PROFESSIONAL DOCTORATES

Transfer of self-instructional & metacognitive training of communication skills for people who have learning difficulties

Williams, W. Huw

Award date:
1991

Awarding institution:
University College of North Wales, Bangor

University of Wales/
Prifysgol Cymru

Title:

Transfer of Self-instructional and Metacognitive training of communication skills for people who have learning difficulties

Name:

W. Huw Williams

Ph.D

1991

Acknowledgements

Many people have given their time, thought and patience to help me in this work.

First I am indebted to Dr. Nick Ellis for the dialogues that shaped the study - and for the boot to keep it going.

For her attempt at educating me in the structure and use of English, and for just being there, I thank my wife Jane. Also, throughout the thesis years, our families have provided me with encouragement and respite - thanks.

I am also grateful to Don Osborne, first for helping to make statistics my friends, and then, with Chris Williams, for analysing spools of intervention film.

I am also grateful to students and staff at the Department of Psychology at Bangor for their assistance and company. In particular I gratefully acknowledge the comments and advice of Dr. Robert Jones and Dr. Gordon Brown.

Finally, and most of all, I wish to thank the people who took part in this study.

[This research was funded by the Welsh Office]

Summary

Transfer of Self-instructional and Metacognitive training of communication skills for people with learning difficulties

Two main skills have been identified as limiting the success of individuals with learning difficulty at gaining and maintaining employment, (i) they do not tend to work adaptively, that is, to transfer skills between similar tasks (ii) and they do not demonstrate the ability to communicate difficulties when working. Both factors limit their probability of successful normalisation. Traditional (didactic) programs have had limited transfer effects. Our goal was to design training devices for aiding clients to make strategies learnt in previous situations meet the demands of new situations, independently.

One factor in the lack of transfer may be the underdevelopment of self-regulation. For Vygotsky the development of self-regulation relies on a person receiving communicative experiences by which she/he could 'internalise' other's social speech to act as a tool to organise her/his own thought. Procedures for training self-regulation include Self-instruction and Metacognition. To self-instruct is to control one's own behaviour by talking to oneself. Metacognition is to know that by talking to oneself that one is controlling one's own behaviour. We developed both methods for training speaker skills for communicating the identity of target referents on maps. 45 people with learning difficulties were assigned, as matched triplets (on the basis of their psychometric, linguistic and communicative abilities) to one of three training conditions, Metacognitive (MT), Self-instructional (SIT) and Practice.

After training each group was tested for maintenance of skill on tasks similar to those trained and for mid- to far transfer of strategies to tasks that involved the same role (speaker) but with a different kind of (i) map, (ii) a different task, object assembly, and then (iii) tasks for which they had to be the listener with maps.

Significant positive changes in performance occured for the speaker role of both training conditions. Far Transfer was evident in significant increases in speaker role scores with object assembly tasks and with listener role tasks for the MT group but not for the SIT group. Successful learning was correlated with abstract reasoning ability in the MT group and language comprehension in the SIT group. Metacognitive training, by accessing people's abstract reasoning ability, made learners aware of the process of generating cognitive strategies and therefore provided furthest transfer.

Contents

Summary

Transfer of Self-instructional and Metacognitive training of communication skills for people with learning difficulties

Two main skills have been identified as limiting the success of individuals with learning difficulty at gaining and maintaining employment, (i) they do not tend to work adaptively, that is, to transfer skills between similar tasks (ii) and they do not demonstrate the ability to communicate difficulties when working. Both factors limit their probability of successful normalisation. Traditional (didactic) programs have had limited transfer effects. Our goal was to design training devices for aiding clients to make strategies learnt in previous situations meet the demands of new situations, independently.

One factor in the lack of transfer may be the underdevelopment of self-regulation. For Vygotsky the development of self-regulation relies on a person receiving communicative experiences by which she/he could 'internalise' other's social speech to act as a tool to organise her/his own thought. Procedures for training self-regulation include Self-instruction and Metacognition. To self-instruct is to control one's own behaviour by talking to oneself. Metacognition is to know that by talking to oneself that one is controlling one's own behaviour. We developed both methods for training speaker skills for communicating the identity of target referents on maps. 45 people with learning difficulties were assigned, as matched triplets (on the basis of their psychometric, linguistic and communicative abilities) to one of three training conditions, Metacognitive (MT), Self-instructional (SIT) and Practice.

After training each group was tested for maintenance of skill on tasks similar to those trained and for mid- to far transfer of strategies to tasks that involved the same role (speaker) but with a different kind of (i) map, (ii) a different task, object assembly, and then (iii) tasks for which they had to be the listener with maps.

Significant positive changes in performance occured for the speaker role of both training conditions. Far Transfer was evident in significant increases in speaker role scores with object assembly tasks and with listener role tasks for the MT group but not for the SIT group. Successful learning was correlated with abstract reasoning ability in the MT group and language comprehension in the SIT group. Metacognitive training, by accessing people's abstract reasoning ability, made learners aware of the process of generating cognitive strategies and thus therefore provided furthest transfer.

Chapter 1: General introduction to the thesis

"'You in this city are all brothers' so we shall tell our tale to them, 'but God as he was fashioning you, put gold in those of you capable of ruling; hence they are deserving of most reverence. He put silver in the auxiliaries, and iron and copper in the farmers and craftsmen... and then we shall make an oracle that the city shall perish when it is guarded by iron or copper'. Can you suggest any contrivance by which they may be made to believe this story?"

Socrates, in Plato's Republic (Lindsay, 1932, p. 114)

"Such a cognizing of cognition itself was already announced by Plato. Aristotle likewise posited a separate power whereby, over an above actually seeing and hearing, the psyche becomes aware of doing so. Late authors, as Strato and Galen, Alexander of Aphrodisias, and in particular Plotinus, amplified the doctrine, designating the processes of cognizing one's own cognition by several specific names. Much later, especial stress was laid on this power of reflection, as it was now called by Locke."

Spearman (1932 in Brown, Campione, Reeve, Ferrara & Palinscar, Personal communication).

"Most of the change we think we see in life
Is due to truths being in and out of favour".
R. Frost, The Black Cottage (1971)

Historical background:

Historically, in the West, varying level of analyses have been applied to distinguish between people who are "normal" and those who require social provision. The first analyses in Britain, under Edward I (1272-1307), made a legal distinction of two groups that required provision, those who were "born fools" and those who had "intervals of lunacy and lucidity". Provision entailed the seizure of their land, either forever, or for the duration of their "interval" (Clark & Clark, 1978). Mill warned in 1859 that being different could still incur penalties of the Confessor's age so many centuries later - "...they are in peril of a commission de lunatico, and of having their property taken from them and given to their relatives" (Mill, 1982, p. 198).

A more functional distinction between "insanity" and "subnormality" was provided by Locke in the late seventeenth century (in Clarke & Clarke, 1978, p. 20): "Madmen put wrong ideas together, and so make wrong propositions but argue and reason right from them; but idiots make very few or no propositions, and reasons scarce at all".

A third type of analysis investigated causality. One view held was that a person's potential to learn was thwarted by environmental constraints. Esquirol (1772-1840) (in Clarke & Clarke, 1978, p. 20, emphasis mine) for example maintained that "idiocy is not a disease, but a condition in which the intellectual faculties are never manifested; or have never been developed sufficiently to enable the idiot to acquire an amount of knowledge as persons of his own age, and placed in similar circumstances as himself, are capable of receiving". A second view, the Eugenic, Social Darwinist perspective, owed more to Plato's myth. "This discredited theory (Social Darwinist) ranked human groups and cultures according to their assumed level of evolutionary attainment, with (not surprisingly) white Europeans at the top and the people dwelling in their conquered colonies at the bottom" (Gould, 1977, pp. 37-38). The property that distinguished each group was intelligence, which was assumed to be a single, innate, heritable and measurable thing (Gould, 1981).

Eugenists saw the environment as merely a trigger for an "idiot's" genetically determined anti-social tendencies to be freed. One proponent, Fernauld (in Clark & Clark, 1978, p. 22, emphasis mine), for example, saw - "The feeble minded [as a] parasitic, predatory class, never capable of self-support or of managing their own affairs...and a danger to the community... Every [one of them] is a potential criminal, needing only the proper environment for the...expression of his criminal tendencies. The un-recognised imbecile is the most dangerous element in society".

At a time when societies became immensely urbanised those who needed care became more numerous, and, more importantly, obvious. Social and political philosophies were sought to provide means for identifying and "treating" those who were in need of "care". In-between such views as held by Esquirol and Fernauld social policy was shaped. Parliament in Britain established an act in 1886 that distinguishing between lunacy and idiocy. Further, idiocy was distinguished from imbecility - the latter being less "defective". Prescription for these idiots and imbeciles was "placement" in any registered hospital or institution "for the care and training of such individuals". In 1890 an Act distinguished between the "educable imbecile and the feeble-minded". In 1897, a Departmental committee was set up to investigate the most practicable means for distinguishing between the educable and non-educable children, which led to the Elementary Education Act of 1899. This act made the distinction between those who could, or could not, be partially self-supporting. Classification continued, with the Act of 1913 whereby idiots, imbeciles and moral imbeciles were distinguished. This was then appended in 1927, and the word idiot was replaced by "profound retardation" (Clark & Clark, 1978).

Although these Acts signal an attitude in keeping with Esquirol, that some people with learning difficulty may be aided to reach a higher potential, they mostly served to protect society since Eugenic "truths", in the United States and Europe, were in favour.

This policy is typified by Goddard in the US after the first World War. Goddard envisaged "colonies" of "idiots", such as his own, Vineland, New Jersey. There he directed his "carers" to treat "idiots" - "as children according to their mental age, constantly encourage and praise, never discourage or scold; and *keep them happy*"(Goddard, in Gould, 1984, p. 164). This can be seen as a consolidation of the view of people with learning difficulty as overgrown children.

"Until fairly recently (the 1950's) such an analysis as by Fernauld, albeit in an attenuated form, underlay much thinking about sub-normality" (Clark & Clark, 1978, p. 22). Definitions of sub-normality have therefore rested on notions of fixed inherited conditions. The environmental influences were overlooked, not only on causation, but importantly of amelioration. The restrictive environment allowed to such people as labelled amplified their plight. The naive Social Darwinist philosophy had realised Darwin's greatest fear for he wrote - "If the misery of our poor be caused not by the laws of nature, but by our institutions, great is our sin" (Darwin, in preface to Gould, 1981).

Introduction to the present thesis:

Normalisation: Fortunately in more recent times in the US and the UK normalisation has become the core principle for the treatment of people with learning difficulty. Normalisation is characterised as an attempt to provide devalued, segregated, people with means which are as "culturally normative as possible, in order to establish and/or maintain personal behaviors and characteristics which are culturally normative as possible" (Wolfsenberger, 1972, p.28). "The ultimate aim [therefore], and it is a difficult one, is valued social participation" (Race, 1987, p. 75). This philosophy is somewhat evident in policies being adopted in the UK for ensuring people with learning difficulty with care within their wider community as opposed to within the isolated world of institutions (see House of Commons Second Report from the Social Services Committee Session, 1984- 1985, and Malin, 1987). With such policies becoming forged the need arises to habilitate and/or resettle people according to their particular needs and skills.

As people are "transferred" in-between care, education, sheltered employment and the wider community, it would be hoped that they also transfer what they learn. Unfortunately people with learning difficulty have not been enabled to show much evidence of the ability to transfer learning, indeed "there is not an instructional technology that has produced reliable generalized skills" (Rusch, Schutz & Heal, 1983, p. 463) for this population. This thesis was primarily an attempt to investigate training procedures that could be provided for people with learning difficulties for enhancing transfer. Over the last twenty years the social developmental theory of L.S. Vygotsky has become a source of ideas for training (see Whitman, 1990).

A note on client description: The people that took part in this study are becoming referred to, in the UK, as people with learning difficulty. Until very recently they would have been described as people with mental handicaps. This thesis reviews work conducted over time in different societies. Where relevant, for the sake of precision in subject comparison, we have used the descriptions of subjects given by the authors of studies discussed. One potential source of confusion, however, is in the terms used in the UK and US for children who are considered "normal" but have a educational disability, such as "hyperactivity". In the UK "normal" children with educational problems would be described as having "learning disabilities". However the same term is now substituting "mental retardation" in the US for people with learning difficulty. We have therefore used "learning disability" in the British sense throughout this thesis, even in discussing studies from America.

In the remainder of this chapter we will therefore (i) first introduce Vygotsky's social developmental theory, particularly (ii) as regards people with learning difficulty. We will then briefly introduce two areas of research which have utilised Vygotskian ideas for promoting cognitive development, (iii) verbal self-instruction and (iv) Metacognitive training.

(i) Social Developmental Theory;

Vygotsky saw the "psychological evolution" of a child as having roots in both the biology of an individual and in its society. "*Within* a general process of development, two qualitatively different lines of development, differing in origin, can be distinguished: the elementary processes, which are of biological origin...and the higher psychological functions, of socio-cultural origin...*The history of the child behavior is born from the interweaving of these two lines* " (Vygotsky, 1978, p. 46).

He believed that the main aspect of the social-cultural environment for cognitive growth to be language. "Outside the individual human organism in objective social history..[the] ..the formation of language during the process of social development provided (mankind with) ...not only a new ...method of communication but also with a new tool for ordering his mental processes" (Luria, in Vocate, 1987, p. 2).

Vygotsky held that thought, although not dependent on language, comes to be influenced by social speech of others. This external speech may then become internalised for the child to organise her/his own thinking. In fact - "*the most significant moment in the course of intellectual development, which gives birth to the purely human forms of* *practical and abstract intelligence, occurs when speech and practical activity, two previously completely independent lines of development converge*" (Vygotsky, 1978, p. 24). Vygotsky's notion is illustrated in Dylan Thomas poem From love's first fever to her plague (1979, p. 11) - "I learnt man's tongue, to twist the shape of thoughts".

Vygotsky outlines developmental stages for this internalisation of speech. First there is the external speech of principal others that control the child's behaviour. Then the child begins to imitate such speech outloud to prompt its own behaviour, and finally the child uses speech covertly as "inner speech" (Sokolov, 1972). Social, interpersonal, speech may therefore be internalised to take on an intrapersonal function. Through such stages persons acquire the ability to mediate between the external world and their behaviour. When a child is faced with failure at a task, for example, it contacts an adult to intervene. The adult brings about another strategy for the task. If there was no adult, the child may begin to 'imitate' what an adult may have said and done before. The child thus learns to appeal to itself for a solution strategy. Social speech is therefore turned inward, and language takes on an intrapersonal function in addition to its interpersonal function.

The convergence between language and thought thus brings about a host of new psychological functions for a developing child, particularly as regards memory. "Natural" memory Vygotsky characterised as having the quality of "immediacy". Such as the young child (4 - 6) is said to have a very concrete representation of the world. They do not, he said, possess the character of abstraction, for example, "if you asked him to tell you what a grandmother is, he is likely to reply "she has a soft lap"...This is the immediate impression that the 'object' has had on the child...[thus]...The content of the thinking act in the child, when defining such concepts, is determined not so much by the logical structure of the concept itself as by the child's concrete recollections" (Vygotsky, 1978, p. 50). The older child, with more internalised language, will, he argued, develop a more logical memory (become "logicalized") and will realize that remembering is reduced to establishing and finding logical relations. "For the young child [therefore], to think means to recall; but for the adolescent, to recall means to think" (Vygotsky, 1978, p. 51).

(ii) Social Developmental Theory and learning difficulty;

Vygotsky's theory of "normal" development emphasised the importance of communicative experiences for fostering cognitive growth. Social intercourse enabled a person to regulate his or her behaviour by internalising the social speech used by others who initially controlled his/her behaviour. Therefore, as for amelioration - "in the tradition of Marx and Engels, the mechanism of individual developmental change is [also] rooted in society and culture" (Cole & Scribner in Vygotsky, 1978, p. 7).

In general, Vygotsky held that the labelling of a person as "mentally retarded" led that individual to lose these fundamental communicative experiences of cognitive growth since they were isolated from mainstream society (Vygotsky, cited by Gindis, 1988). Specifically, he criticised contemporary assessment and ameliorative practices in the USSR for compounding both learning disability in "normal" children and "retardation" in those with learning difficulties.

Assessment, he argued (in the context learning disability) always dealt with what a child could already do and not what that child's capacity to develop was -- that which has happened and not what could happen. He suggested that a child's potential for a task could be gauged more accurately by monitoring how she/he performed with guidance (Vygotsky, 1978). The difference between what people could do with help as against without help he called the zone of proximal development which he defined as the - "*...distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined by problem solving under adult guidance or in collaboration with more capable peers*" (Vygotsky, 1978, p. 86).

The provision of guidance from an expert to a learner, in certain skills on certain tasks, therefore provides a means for measuring how much help people need to learn skills to become efficient problem solvers.

Vygotsky also argued that the ameliorative practices provided for children who had learning difficulties ("mentally retarded") were wholly inadequate. Training was conducted on concrete thinking problems, the so-called "look and do methods" (Vygotsky, 1978, p. 89). Such training, he believed, compounded the results of social deprivation by denying "retarded" children the opportunity to develop "reflective awareness and deliberate control" (Vygotsky, 1962) which could enhance their functioning.

He noted that it was understandable that educationalists settled for educating by "look and do methods" since it even seemed that children with learning difficulty were "not very capable of abstract thinking" (Vygotsky, 1978, p. 89). However such methods, he argued, not only failed to help such children to overcome, but reinforced their handicaps by accustoming them exclusively to concrete thinking, which "suppress(es) the rudiments of any abstract thought that such children still have" (Vygotsky, 1978, p. 89). Therefore, "Precisely because retarded children, when left to themselves, will never achieve well-elaborated forms of abstract thought, the school should make every effort to push them in that direction and to develop in them what is intrinsically lacking in their own development" (Vygotsky, 1978, p. 89).

Vygotsky underlined the importance of education in reflective thinking by linking such processes to motivational states. He believed that "mental retardation", as a condition, was not primarily characterised by intellectual factors but by the interaction between intellectual and affectual processes. He argued that "Thought can be the slave of passions or their servant" but fortunately "it can also be their master" (Vygotsky, 1987, p. 85). Since people with learning difficulty had been generally deprived by society, specifically of experiences for gaining reflective thought, they may develop negative affective states but have no means of reflecting on and manipulating such thoughts. They could therefore be left as servants but not masters of emotion.

(iii)Verbal self-instruction:

Luria whose work has been usually seen as drawing a direct line form Vygotsky (Zivin, 1979), believed that "...the speech system, which is formed in the process of the child's social intercourse with the adult, is a powerful means of systematic organization of our mental processes, and that the precise study of this will help us solve the highly important task of modifing and perfecting the higher nervous activity of man" (Luria, 1961, p. 97, emphasis mine). Luria thus attempted to demonstrate how the speech of adults and, later, a child's own speech, comes to regulate that child's own behavior (Zivin, 1979). He then attempted to apply this knowledge to clinical cases.

In a series of experiments Luria asked children to press a rubber bulb in accordance with certain verbal instructions, such as when to "start" or "stop", and also the much more complex conditional request e.g. "when the light flashes you will press the bulb". He found that children of around three years of age could initiate bulb pressing in response to a verbal instruction before they were able to inhibit ongoing bulb pressing. Further, they were able to follow instructions spoken by an adult before they were able to obey their own verbalizations. He suggested that the full regulating function of speech did not occur before a child reaches around four and a half years of age.

He related the development of such self-regulatory skill to social interaction - "as L.S.Vygotskij has already shown, the function which at first is distributed between two people can easily turn into an internal psychological system, and what the child does today with help, he will tomorrow be able to do on his own" (Luria, 1959, p. 349).

He outlined general stages to the shift in the locus of the behavioural control between a caregiver and a child, of that child. First the control of a child's behaviour is held in the speech of others (to initiate or inhibit behaviour). Then the child progresses to regulate some aspects of its behavior (to initiate behaviour). Finally the child develops more control (both to initiate and inhibit behaviour).

Communicative interactions could therefore be arranged so that a person could be aided to develop skills for regulating their own behaviour. Training procedures were derived from this model by Meichenbaum and Goodman (1971) for their Self-instructional training (SIT) device. SIT was principally designed to help hyperactive children gain greater self-control.

The training procedure followed the stage development as described by Luria. First a learner observes an instructor perform a task whilst the instructor "talks aloud". Then the learner performs the same task whilst the instructor provides instructions. The learner then performs the task whilst instructing herself/himself aloud. Finally the learner whispers the instructions during task performance. The instructions are primarily learnt by rehearsal and successive approximations to the modelled instructions were reinforced. Also correspondence between verbal behaviour and task performance is reinforced.

Meichenbaum and Goodman found that the device - "... which trains impulsive children to talk to themselves is effective in modifying their behaviour...[and moreover] self-instructional training...significantly alters the attentional strategies of the impulsive children and facilitates behavioral change" (Meichenbaum & Goodman, 1971, p. 124). Although developed for hyperactive children SIT has become utilised for the training of people with learning difficulties. In this chapter we will provide a brief overview of such developments. In chapter 3 we will provide a more detailed analyses of SIT.

Burgio, Whitman and Johnson (1980) used an SIT package to aid "highly distractable retarded children" to increase their attending behaviour for learning skills for mathematics and printing. The package included coping self-statements for the tasks, for example - "What does.. [the teacher].. want me to do?" and "She wants me to draw this word". Near transfer was assessed by testing the children on the same tasks as trained but in the ordinary classroom. Farther transfer was tested with a new phonic task. Both trained children learned to verbalise each of the self-instructions. There was, however, only increases in the accuracy of performance on the maths task.

Agran, Fodor-Davis and Moore (1986) investigated if SIT could be used to encourage adults with learning difficulties to learn skills for housekeeping in a hospital. The subjects were taught to say self-instructions for what they had just finished doing, what they needed to do next, and what they were going to do. Following training all participants increased their percentage of job-sequencing. They also maintained the use of their skills up to 3 months after training.

Agran, Salzberg and Stowitstchek (1987) attempted to use similar techniques with severely "mentally retarded" individuals for training them to initiate social interactions with co-workers. The subjects failed to learn the self-instructions. Hughes and Rusch (1989), however, found that people with severe learning difficulties could be encouraged to learn through SIT. Their subjects were reported as not solving work-related problems independently. Both of their subjects learnt to use self-instructions on over 80% of the training tasks and began to learn to respond correctly to increasingly more tasks . Both subjects also maintained their higher performance six months later.

SIT has therefore led to learning and maintenance of skills for a wide range of people with learning difficulty, but of far transfer there was little consistent evidence (Gow & Ward, 1985; Whitman, 1990). It would therefore seem that SIT needs to be further investigated for factors that lead to, or diminish, transfer.

(iv) *Metacognition:*

The abstract thinking that Vygotsky notes as "reflective awareness and deliberate control" (Vygotsky, 1962) has become equated with what Western Cognitive Psychologists have come to call metacognitive activity (Stone, 1985). Furthermore Vygotskian ideas have become utilised for designing ameliorative techniques by cognitive theorists. We will therefore first provide a brief introduction to metacognitive theory, and then an overview to metacognitive training approaches, particularly as related to Vygotskian theory.

Wellman (1983) considered that metacognition was not a precise psychological construct but a fuzzy concept. Discussion of metacognition has therefore involved a general statement as to what is meant by the concept, and then a consideration of what kinds of cognitive acts are characteristically metacognitive.

The anchor distinction of metacognition given by Wellman (1983, pp. 33 - 36, also see Flavell, 1971 and 1979) is that - "it is the difference between engaging in some form of cognition versus knowledge of that cognition itself....it is no different from any other knowledge one possesses [Flavell, 1979]. What distinguishes it is its referent - it is knowledge about the human information processing system. Otherwise it has no special status. It is stored in long term memory like any other knowledge...".

Flavell and Wellman (1977) explained metacognition by detailing what aspects of cognition are characteristic of metacognitive activity. These were of two classes, "sensitivity" and "variables". Sensitivity relates to the notion that some situations require that planful memory-related exertions are needed and some are not. Variables signify a number of factors that may influence performance of a person's memory in a given situation. A level of awareness of these factors in a person would therefore be indicative of metacognitive activity.

Sensitivity focuses on the development in the individual of an ability to realise that they need to call on their memory activities, or strategies, in order to deal with information. They outlined two main forms for this process, either a person's memory capabilities are elicited by others, or they may be spontaneous.

Children of varying ages may be more or less sensitive to the need to call on strategies. For example in a memory experiment when a child is requested to remember, such a request "should" lead to some sort of memory relevant behaviour - that is there "should" be the implicit understanding of the "request" to use strategies. Young children might not understand this invitation to "engage a strategy" - the child would indeed not 'read' the implicit instruction. Appel, Cooper, McCarel, Sims-Knight, Yussen and Flavell (1972) found that when younger children were asked to "remember" certain items they did not demonstrate any difference to those in a condition to just "look at items", and remembered just as little. Eleven year olds, however, were able to instantiate a strategy for remembering when only given a general instruction. The idea that younger children lacked spontaneity was evolved into the notion of production deficiency by Flavell. This means that the children may be able to use strategies but do not see the need to use them. "Part of metamemory development, then, may consist of coming to know when and why one should intentionally store and retrieve information" (Flavell & Wellman, 1977, p. 10).

Sensitivity of the need to use a strategy is, therefore, to varying degrees, and consequently varying effectiveness, dependant on the experience of the thinker. Two stages seem prominent, one where a person knows a strategy, but does not know to "call it up" (although they might with an implicit request to do so by another person) and secondly, a stage when they know such strategies and when to "call" on them independently of any other person.

Variables are those factors that, as they interact, influence the probability of a person engaging in metacognitive and strategic activity. These influences have been categorised as person, task and strategic variables.

Person Variables are attitudes people have about themselves in terms of their general, historical, cognitive skills that indicates to them how they will perform in the "here and now". This "mnemonic self-concept" tells them, for example, if they are "good" or "bad" at remembering names or faces. Flavell, Freidricks and Hoyt (1970) asked children to predict how many depicted objects they would be able to recall in the correct serial order; if they were good or bad memorists; and if they were better or worse than their friends. They then tested the children's actual recall for those objects. Over one-half of the younger children (4-6 years) predicted un-realistically that they could remember many more items than they could whereas the older children (7-10 years) were more realistic. Younger children also seemed more confident than the older children and they tend to see themselves as better than their friends.

There are two main types of task variables which a person may be aware of as affecting memory. These are the types of information in the task, and the task's malleability to processes involved in storage and retrieval. An example of "informational characteristics" is the ability to recognise that, for example, 16 words could be much easier to remember than 10, provided that the latter are randomly selected and the former are of a set, such as colours. The former would, of course, have processing advantages in that such conceptual relations between informational units would aid memory. To illustrate, Kreutzer, Leonard and Flavell (1975) gave children two types of word pairs, one of opposites (black/white; stop/go etc) and another of people and actions (Anne/walk; Joe/climb etc) and asked if one type was easier than the other to learn. Nine to eleven year olds successfully recognised that opposites would be easier to learn, whilst the 6-7 year olds failed.

Strategy variables can be viewed in terms of preparation for, and retrieval from, storage. There is huge scope available in a mature thinker's memory repertoire for preparing for future recall, both inside their heads and outside, as noted by Flavell &Wellman (1977, p. 19) - "He may mentally rehearse, cluster, or elaborate on the material to be retrieved, but may also store it by making notes, photocopies, photographs, or tape recordings. He may try to assimilate an item into several different semantic networks in hopes of increasing its retrieveablity, but he may also sow his life space with written reminders, nonverbal prompts, and other external retrieval cues". Kreutzer et al. (1975) found that children of different ages remembered to take their skates to go ice skating with more "in the world" devices (such as putting the skates next to the bedroom door) were mentioned more often than "in the head" (such as thinking about the skates the night before). The older the children were, however, the more mnemonic devices they could enumerate.

Metacognitive activity is thus recognisable in a person's synthesis of all sorts of knowledge, about the type of information, characteristics of the tasks, and what they themselves can and cannot do, into a general theory of what they are probably capable of doing in a given situation. A person would therefore demonstrate metacognitive insightfulness if they knew, for example, "that difficult items offset easy demands, that efficient strategies offset poor memory attributes, and that high ability is needed to ensure adequate performance on difficult tasks" (Flavell & Wellman, 1977, p. 22).

Schneider and Pressley (1990) argue that what could be entailed by metacognition by Flavell and Wellman was limited by their research methods. Flavell and Wellman based their theory of metacognition on questionnaire methods; children responded to questions about what they knew about their memory. The idea of what metacognition was, therefore, that which was produced by children as a response to questions of the kind "are you a good rememberer ?". The meaning of the concept of metacognition was therefore emphasised as knowledge about cognition.

Campione Brown and Ferrara (1982) approached metacognition with different methodology. The type of research Campione et al. conducted investigated the - "self-regulatory mechanisms used by an active learner during an ongoing attempt to solve problems. These indexes of metacognition include *checking* the outcome of any attempt to solve the problem, *planning* one's next move, *monitoring* the effectiveness of any attempted action, and *testing*, *revising*, and *evaluating* one's strategies for learning" (Campione et al., 1982, p. 434).

Metacognition for Campione et al. therefore involved "executive" decisions about what is to be done during cognition. As Schneider and Pressley (1990, p. 91) observe - "The executive can analyze new problems and select appropriate strategies and attempt solutions... *the executive monitors* the success or failure of ongoing performance, deciding which strategies to continue with and which to replace with potentially more effective and appropriate procedures...[it] knows when one knows and when one does not know...".

Areas of cognition studied by Campione et al. were those involved with orchestrating cognition towards problem solving, such as for text comprehension and memory retrieval. The main problem for a person not aware of their current comprehension of a text is that they might not spontaneously deploy strategies to counter their problems. That is they would not know their limits and not take account of those limits - "If the child is aware of what is needed to perform effectively, then that child, can take steps to meet the demands of a learning situation more adequately. If, however, the child is not aware of his or her own limitations as a learner or of the complexity of the task at hand, then he or she can hardly be expected to take preventative actions in order to anticipate or recover from problems" (Campione et al., 1982, p. 433). In chapter 3 we will provide a detailed account of Metacognitively oriented training programs, first, however we shall provide an introduction and overview to such approaches here.

Brown and Barclay (1976) taught two groups of children with learning difficulties ("mental ages" of 6 and 8) strategies for remembering pictures that inherently required the production of executive decisions. These were anticipation (guessing which picture would come up next), and cumulative rehearsal. Anticipation and rehearsal were seen as self-testing strategies since the subjects were asked to make executive decisions, either in checking if they predicted the material correctly or if they had learnt the material correctly.

On post- tests both the children in the younger and older groups improved their recall scores significantly when prompted to use the strategies. On unprompted tests, however, the younger children's performance was not significantly different to baseline, whereas the older group had made substantial gains.

A follow up study by Brown, Campione and Barclay (1979) monitored the effect of training a year later. On unprompted trials the younger group showed no evidence of maintenance, with performance at pre-training level. The older children, however, continued to perform at higher rates. The older children and a new group of matched naive children were then tested for ability at prose recall. The subjects in the self-testing strategy group out-performed the control group.

Metacognition may therefore be seen, as it is by Campione et al., as an executive regulatory mechanism that monitors on-going cognition. Its function is to find the solution to such a question as "how do I think about this problem?" and "what am I doing?". The result of such self-interrogation is to find any other best means, such as others strategies, for problem solving and then for monitoring their effectiveness.

Campione and Brown have found Vygotsky's concepts of internalisation and the zone of proximal development as means for educating children with learning disability in metacognition. "Consistent with the views of Luria (1976) and Vygotsky (1978), we argue that awareness of self-regulatory activity has its roots in social interactions with others. Others, in the developing child's world, initially take responsibility for articulating metacognitive processes. With time, this responsibility is ceded to the child, who is required to take charge of her or his own thinking behaviors" (Reeve & Brown, 1985, p. 347).

Campione and Brown first developed Vygotsky's suggestions for education in their dynamic assessment approach, and then in Reciprocal Teaching.

Campione, Brown, Ferrara, Jones and Steinberg (1985) used Vygotsky's concept of the zone of proximal development as a framework for investigating the degree of help children with learning difficulties and normal children require for learning and transferring reasoning skills for Ravens Progressive Matrices. There were no differences between the normal and "retarded" groups in terms of hints required for learning. However on transfer tasks the normal group made significantly fewer errors and required fewer hints than the retarded group.

Reciprocal Teaching (RT) was principally designed for aiding children who experienced educational problems to attain greater success at reading comprehension and mathematics. In a similar manner to SIT it functioned as a systematised social interaction for children in groups to learn skills. The emphasis was, however, on aiding learners to become metacognitively aware rather than on the learning of verbal instructions for correspondence with behaviour.

Brown, Campione and Webber (Personal communication) summarised the approach as follows: "The goal is joint construction of meaning: the [metacognitive] strategies provide concrete heuristics for getting the procedure going; the reciprocal nature of the procedure [dialogue] forces student engagement; and teacher modeling provides examples of expert performance."

The instructor therefore "models mature comprehension-promoting strategies, thus making overt, explicit, and concrete thinking activities that are usually not open to inspection. Instead of being told to "monitor your comprehension", the students see how the teacher does this" (Brown et al., personal communication).

Brown and colleagues have extensively researched this approach. In a study concerned with reading comprehension involving over 650 high school children with learning disability, 80% of subjects gained scores of between 75% to 80% on independent tests of comprehension on five days after training. They also maintained such "mastery" for six months to a year after instruction, and - "they generalize(d) to other classroom activities, notably science and social studies; and they improve(d) approximately two years on standardized tests of reading comprehension" (Brown et al., personal communication).

Metacognitive training, with its emphasis on generative aspects of cognition (how to find and monitor solutions and how to make predictions of performance etc) seems to take account of factors that may be important in the transfer of skills. The most important of these is self-interrogation for attempting to utilise existing skill for new tasks.

Overview of the thesis:

In the following chapter we will first expand upon the notion of transfer as conceptualised by Cognitive theorists. We will then investigate an area of skill which seems highly relevant to the process of normalisation, communication. In our analysis we hope to uncover which communication skills may be relevant for training purposes and which might be most malleable for transfer. We will also discuss methods of assessing communication skills for establishing if people possess, but show little general use of, certain skills. Such analyses might indicate not only what skills could be taught, but what skills need to be built upon.

We have introduced, above, existing and potential training approaches for people with learning difficulty that have utilised Vygotskian concepts. In chapter 3 we shall first discuss these approaches in greater detail and then introduce the intervention techniques developed for this thesis. In chapter 4 the specific methodology utilised for assessment and training of communication skill will be described. The results of these attempts will be presented in chapter 5. In chapter 6 we will discuss these results in the context of theory and practice presented in chapters 2 and 3.

Chapter 2: The representation of communication skills for transfer

General Introduction:

We had two principal aims in this present research. The first was to establish methods of training that enhances transfer for people with learning difficulties. The second was to train skills that may have benefits for them in their adjustment to new environments.

Beveridge and Conti-Ramsden (1987) found that caregivers inadvertently diminish the social control of children with learning difficulties by assuming a more dominant control over them than their normal children. Vygotsky (in Gindis, 1988) suggested that as societies deprive children with learning difficulties adequate communicative experiences they deny such persons experiences to fully develop "reasoning" and "verbal memory".

Such social submissiveness extends into the adult lives of people with learning difficulties. Bedrosian and Prutting (1978) investigated the control of conversations of four adults with learning difficulties with each other, with parents, co-workers, clinicians and normal children. They analysed the style of interactions among their subjects along dominant and submissive dimensions and specifically checked for ways in which people expressed control or authority in these interactions. For example control could be expressed by a speaker if a respondant to a message accepted the "bid" (the request) of that message. A listener's control could be manifest in that listener being allowed to respond. Results indicated that none of the "retarded" subjects held a dominant position in any conversational settings, except for one, when she with her peers, and when she was with a child (Bedrosian & Prutting, 1978). This suggested to Bedrosian and Prutting that there is a much greater need for a consideration of the functional use of language for communication in the education of people with learning difficulties and they recommend that practitioners -"...could begin to teach specific types of questions and responses to those individuals who need strategies for expressing the variety of control methods available to a speaker" (Bedrosian et al..,1990, p. 94).

This need is amplified since communicative problems block the successful integration of people with learning difficulties into community settings, especially into and of maintaining of employment. McConaughy, Stowitstchek, Salzberg and Peatross (1989) surveyed work supervisors from three types of businesses that have "frequently provided entry-level nonskilled jobs" (McConaughy et al., 1989). The ratings taken were irrespective of whether the employees had learning difficulty or not. They found that social skills such as following instructions for tasks, getting necessary information, and providing job-related information for others were the most frequently rated skills in the employability of people.

Unsurprisingly, given their general lack of social equality, people with learning difficulties have been shown to have major problems on social skills. For example Lignugaris/Kraft, Salzberg, Rule and Stowitschek (1988) investigated the social interactions of nineteen workers with "developmental disabilites" and 18 non-disabled adults who were mainly senior citizens. The workers were either in a sheltered workshop or in a "competitive" business where they were liable to lose employment if they did not work satisfactorily. Both work environments included tasks such as cleaning furniture and loading/unloading vans etc. The "disabled" workers interacted most often with each other than with the "non-disabled" co-workers. They were also given more commands than their non-disabled counterparts. Moreover the workers without "disabilities" made many more requests for work-related information than the "disabled" workers.

Social interaction at work (in particular being able to follow instructions, clarify ambiguous instructions and to request information for performing a task) is therefore a principal variable for job success (Lignugaris/Kraft, Salzberg, Stowitschek & McConaughy, 1986; Lignugaris/Kraft et al., 1988).

On the basis of such communicative problems of people with learning difficulties, several researchers recommend that the training of conversational skills for their employment is paramount, particularly of the skills of asking for critical information and for clarifying instructions (Lignugaris/Kraft et al., 1988; Schloss & Wood, 1990; Abbeduto, Davies, Solesby & Furman, 1991).

Training mechanisms for conversational skills, as of any skills to people with learning difficulty, has to confront the "thorny" problem of transfer. For a clinical or educational intervention to be successful it usually needs to promote transfer - "A therapeutic behavioral change, to be effective, often (not always) must occur over time, persons, and settings, and the effects of the change sometimes should spread to a wide variety of related behaviors." (Stokes & Baer, 1977, p. 350). Training in communication skills would seem particularly fruitless if the skills were not used in further settings than those taught. In fact the ability to work adaptively, that is, to transfer and perform skills across a wide range of situations is seen as a second major factor in a persons employability (Agran, Fodor-Davis & Moore, 1986).

These two skills, of working competently alone, and communicating the progress of work, are bound to each other. Such as if a person monitors and communicates the progress of a problem solving attempt then they could recruit help from others when required. If they do not then they may give up, or if they continue, their problem solving attempt could be futile. Moreover such behaviour might be useful in eliciting reinforcers in themselves. For example, let us consider a situation where an inexpert person directs another according to a map. The road that needed to be followed might turn left next to one of two churches (one with a spire, the other with a tower), and branch off to go up one of two hills (one bald, and the other forested), and so on.

The in-expert speaker might only say "turn at the church, then up the hill". The in-expert listener might not think to ask which of the two was meant, wait a while and guess that the speaker meant the first church she/he came to. The speaker could have asked "did you get it?", to which the listener may have responded that they weren't sure. The speaker could then add that they meant the second, spired church. Eventually a speaker might become more expert and put both parts of the message into one "the hill, with the forest on it". Such skills, of monitoring the accuracy of messages and making comparisons, might not be in the repertoire of most people with learning difficulty. We therefore attempted to teach them these crucial skills.

Before we set out to train communication for transfer, for its own sake and as a self-supporting transfer mechanisms, we need to build a framework for understanding the cognitive processing that may underlie such skills as communication and transfer. This is particularly important since failure to get transfer has been seen as due to a lack of analyses of the processing that underlies it - "...too few distinctions have been drawn among kinds of transfer...(and the) problems studied have been too incompletely analysed for investigators to understand the relations between their training and transfer tasks, or the problems have been too simple to reveal anything about practically important problems..." (Butterfield, personal communication).

In the remainder of this chapter we will first provide a conceptualisation of transfer from a Cognitive perspective, in particular what kinds of relationships between tasks that lead to transfer. That is we'll look at the routes that transfer takes. We will then look at transfer processes themselves. The vehicles that travel the transfer routes. These processes have been explicated within cognitive theories of how information is held, changed and used. Communication skills will then be analysed for routes and vehicles. To do this we break the act of communication down into its component parts. These components would then be analysed to see if there are skills that, as vehicles, would give most transfer distance, such as to other components, and between communication situations.

Transfer: How it is conceptualised from a Cognitive perspective

Transfer is the phenomena at work when any learning or performance of new tasks is affected by existing knowledge, abilities or skills (Cormier & Hagman, 1987).

It has two major characteristics. The first is 'extent', such that the more different the new affected task's environment is to the learning environment (in which the behaviours were originally learnt) then the further transfer has occured. The second is direction. Transfer is positive when previous experience helps the performance of new tasks, and negative when it hinders.

Cognitive theorists have concentrated on understanding the relationships between tasks along which transfer could occur. There were two main relations, vertical, learning a 'sub-skill' that helps the performance of a general task, and lateral, learning both general and sub-skills helping the performance of tasks for which both those skills are appropriate (Gagne, 1970). For instance a person learning to buy a ticket to ride a bus as transportation to work would be learning a vertical sub-skill for that more general skill (getting to work). If that person was then to buy a ticket for another means of transport for work, e.g. a train, then they would have laterally transfered their "getting to work" skills from bus-riding to train-riding.

A major determinant of transfer occuring is the similarity between situations. A persons transfer performance rests on their perception of similarity between tasks. This can be a highly subjective process in which any salient similarity of two situations will influence their overall perceived similarity. Perceived similarity between training and transfer tasks, if it occurs, will then affect the retrieval of the representation of the training situation during the transfer task - the greater the perceived similarity of the two situations the more likely it is that transfer will be attempted (Gick & Holyoak, 1987).

Similarities between tasks may lie in their surface features or, deeper, within their structures - "Components of a situation that are causally or functionally related in outcomes or goal attainment will be termed structural, and those not so related will be termed surface" (Gick & Holyoak, 1987, p. 16).

The less expert would probably rely on the task's surface features, whilst the expert may be looking for deeper, structural similarities. For training for transfer we therefore need to understand how tasks could be related by surface and/or structural factors.

An indication of what is meant by structural factors is provided by Gentner (1979). She outlined a methodology -- structure mapping -- to discover the validity of scientific metaphors, such as the atom/solar system metaphor. In this metaphor the solar system is used to describe the structure and actions of atoms -- that is knowledge on solar systems is transfered to a new knowledge area for creating knowledge on atoms. For example the sun is more 'massive', and 'attracts' the planets which 'revolve' around it, and the same is 'true' of the atom, which is more 'massive', and 'attracts' the electrons that 'revolve' around it.

According to this the validity of a metaphor (as a transfer vehicle) depends on its structural attributes the most important of which are high level relations (or predicates) shared by objects, for example the relations between objects in the solar system (attracts, orbits around) form a system from which other lower order relations can be predicted ("massness" etc). Thus the high level predicates are shared then lower order relations could be predicted. Transfer success therefore relies on the structural qualities of tasks being shared.

Gick and Holyoak's (1980) "radiation problem" provides an example of similar structural similarities between tasks leading to positive transfer. They gave two groups of subjects the following problem -

"...a patient with a malignant tumor in his stomach...it is impossible to operate on the patient, but if the tumor isn't removed the patient would die. There is a kind of ray that at a sufficiently high intensity can destroy the tumor. Unfortunately, at this intensity the healthy tissue that the rays pass through on he way to the tumor would be destroyed. At lower intensities the rays are harmless to healthy tissue but will not affect the tumor. How can the rays be used to destroy the tumor without injuring the healthy tissue?" (adapted from Gick & Holyoak, 1980, p. 283).

Before they were given the radiation problem, however, each group was given another story. One group was given a story ("attack") about a General who wished to capture a fortress in the middle of a country, which read -

"Many roads radiated outwards from the fortress..which were mined...so that only small groups could pass over them safely...yet the general needed to get his entire army to the fortress...he solved this problem by dividing the men into small groups and dispatching them simultaneously down multiple roads to converge on the fortress" (adapted from Gick & Holyoak, 1980, p. 283).

The second group was given a similar story ("parade") in which a General had to parade his troops to meet the demands of a dictator that the parade should be seen and heard throughout the country. The dictator is in a fortress in the middle of the country.

"Dictator in fortress in centre of country, surrounded by villages...roads radiate from the fortress...[General has to] produce a parade that can be seen and heard throughout the entire country...Sending entire army down one road fails to produce impressive parade...if parade fails to impress dictator, general would lose his rank...[General's solution is to] Divide up parade...many groups...from different directions...simultaneously" (adapted from Gick & Holyoak, 1980, p. 298).

There were two main structural similarities common to some but not all these stories. First the convergence solution applied to all three stories. In the radiation story the healthy tissue could be saved if rays were directed from different angles to converge on the unhealthy tissue. Secondly in the attack and radiation stories there was a "foe" to be dealt with. No such foe existed in the parade story. The radiation and attack stories therefore had the same goal of destroying an enemy. Of the first group of subjects (those given the "attack" story), 76% attempted to use the convergence solution on the radiation problem, whilst 49% of the subjects given the "parade" story transfered the solution.

This exemplifies two aspects of successful transfer. First that transfer between tasks is increased when there similar structural qualities such as processing (as between both the "attack" and "parade" stories and the radiation problem in searching for convergence solution) and if there are similar goals (such as the goal of applying most pressure in the "attack" story and the radiation problem) - "...similar goals and processing increase perceived similarity, which facilitates retrieval of appropriate solution to apply to the transfer task" (Gick & Holyoak., 1987, p. 34).

Clearly we will only be able to understand transfer, and have a coherent methodology for attempting to train it, if we are able to analyse tasks for their surface and structural similarities. For this we would have to have a model of the knowledge required for tasks to work from.

Cognitive models of transfer processes:

As has been emphasised above there needs to be an understanding of the processes and mechanisms that may underlie transfer. Cognitive models aim to describe how knowledge is represented and manipulated -- stored and accessed -- for tackling a variety of situations. The suggestion is that if we had an idea of how information is stored and accessed we might have clues as to how information is accessed in novel situations - an underlying necessity for transfer. Furthermore we want to demonstrate how different degrees of transfer have been modelled to indicate how we might conceptualise training and transfer tasks for encouraging a broad sweep of transfer effects.

The first aspect of a model would be the storage of knowledge. The second aspect is how that knowledge is processed. Most forms of knowledge can be synthesised into categories such as declarative 'concepts' (Mammals) and procedures which define them (furry, warm blooded, females lactate). Such knowledge as these concepts and procedures could be encoded in rules, with conditions and actions e.g.

"If" (condition) mammal - "then" (action) has fur

As each condition is met with an action, new conditions needing new actions are set up. Accessing these rules is allowed by proceeding from conditions to actions -

forward chaining. When a number of such rules are connected up we may call it a 'production system'. 'Robbie the robot' - a hypothetical system for identifying animals at a zoo is such a mechanism (Winston & Brown, 1979). It may have such rules as -

If (animal has hair) then (animal is a mammal)
If (animal is mammal) and If (animal has pointy teeth) then (animal is a carnivore)
If (animal is a carnivore) and If (animal has roar) then (animal is a Lion)

Robbie could deduce the animal it is seeing by processing forwards from general rules to more specific rules-

If (animal has hair) then (animal is a mammal)
If (animal is mammal) and If (animal has no pointy teeth) then (animal is a herbivore)
If (animal is a herbivore) and If (animal has a pouch) then (animal is a Kangaroo)

A more clever Robbie might know that if it were to go to Regents park Zoo it would first meet wolves. It might then not need to deduce the first animal, but guess and verify, e.g.

If (go to Regents Park Zoo) then Could be wolves
and if howls then wolf

Rules, as we see with Robbie's, do not sit independently of each other, but nestle in a network, with each rule holding some amount of information that may characterise a concept or procedure. For Robbie, one rule holds the kind of 'teeth' the concept 'wolf' has another the concept's outer covering (fur), and so on. Therefore - "Both concepts and procedures will therefore often be represented not by some single rule but by interrelated clusters of rules with overlapping conditions or action" (Gick & Holyoak, 1987, p. 14).

These clusters are hierarchically formed within general categories and specific instances. This is termed "concept-relatedness" and makes a production system of some sort a suitable model of the human control over processing (Newell & Simon 1972).

Conceptual categories could be built up from a number of rules, and that each newly encountered real world subject could be processed according to its probable category. For example, a new animal (not registered in a Robbie's knowledge base) could be given a probability of belonging to each concept category, and even each instance of a category. For example a 'wolverine' - a concept with sharp teeth, fur and howls but not represented as an instance of a category by Robbie - would have a slight probability of being a crustacean, but would have a near certain chance of being in the wolf category. In this way a simple system can transfer by making judgements about new instances based on existing knowledge. In other words the system makes a calculated guess.

More sophisticated examples of rule networks driven by probability include "expert systems" - "While conventional systems deal with facts, expert systems handle 'lore', that is, the rule of thumb, the hunches, the intuition which forms the knowledge basis of an expert's skills acquired over a lifetime's experience" (Feignbaum, 1981).

Such systems would have been derived from the knowledge bases and inferred processing strategies of experts, and may cover any subject from gastric ulcers through to oil exploration. Their main feature is the utilisation of prior knowledge to give the probability of one or another state being true given certain conditions. For example if we had a "wheat disorder" diagnostic system it may have rules such as -

"if the crop has yellow leaves " - "then it could be nitrogen deficiency".

Since we find nitrogen deficiency to be true for 90% of diseased cases of wheat, it is give a prior probability of ninety out of a hundred. Other possible causes of disease such as drought may be given a 5% chance, and flood 4%.

Rules can therefore be likened to behavioural responses, each with a probability of being fired in a set environment, hence the transfer of knowledge in the rule network, from one situation to another - "...can vary by degrees as a function of the appropriateness of the applicable rules established and strengthened during prior training." (Gick & Holyoak, 1987, p. 15).

Production rules, can therefore, at a basic level, transfer by finding the most appropriate rule for any new instance - making guesses.

Humans may have similar structures as production rules for representing knowledge, as such they might transfer by guess-work. The development of "concept-clusters" or schema can be seen in the development of expertise in chess players.

In semantically rich domains such as chess playing (problem areas that require substantial amounts of prior information), there have been many studies showing the difference in ability between experts and novices (e.g. de Groot, 1965; Chase and Simon, 1973).

In these studies a comparison would be made between grand masters and more novice chess players. In the first stage both groups of subjects would be exposed to chess boards with typical chess positions (as in the middle of a game). The subjects would then have to recall the positions of each piece. Usually the grand masters recall over 90% of all the pieces and positions, whilst the experts manage around 50%. In the second stage both groups of subjects are presented with randomly placed pieces (not necessarily typical patterns of a game). In the recall phase both groups recall at the 50% level.

The rationale for explaining these results is that the grand masters, when there was some resemblance of typical chess order, could use this order, or pattern, to structure recall whilst the novices, in the "order" condition, may not have been able to make use such patterns. That is the master's processing of chess may not be in terms of individual pieces on the board, but as patterns of pieces whereas the novices had to rely on remembering where individual pieces rested. The patterns that the masters used may have been ones of offence and defence stored in their long term memory. This gives support to the hypothesis that experts have a hierarchy of knowledge about a domain which enables them to organise clusters of information about that domain (Kahney, 1986).

This is what we called 'concept-relatedness' earlier, and it provides a number of benefits for experts. Foremost is more knowledge of the game. This knowledge also becomes more organised and accelerates processing. For example the development of general rules that cover many antecedents allows a player to ignore many of those antecedents based on a skimming through general rules. Once a general rule that seems to fit the situation is found, its subordinate knowledge can be applied. All these things release the expert to consider many more moves at a time than a novice and to predict best moves according to patterns.

Such developments allow a kind of transfer. An expert might see a pattern of pieces as similar to a certain pattern for which a defensive response is suggested. This is similar to the production systems above, since it is finding a nearest match between a pattern of information and a related set of concepts and procedures and applying what is applied under those conditions.

So far we have looked at how production systems represent and manipulate information and how such systems explain some of the differences in ability between novices and experts. We shall now be concerned with how novices become experts according to production system theory. In this we shall illustrate how humans have a more abstract form of transfer than pure guess-work. One production system based account of expertise is Anderson's ACT model (Anderson, 1983).

The ACT model is an attempt to explain how a large domain-specific database and specialised problem solving procedures could be acquired by a system that starts off with only a few facts about that domain and a few general problem solving procedures. Anderson proposes three stages for this. .

The first stage is the accumulation of domain relevant facts for storage in the system's declarative network structure. For example a complete novice in chess would need such knowledge as a bishop moves diagonally. Problem solving speed at this level would be hampered by having to access this type of declarative knowledge consciously (bishops move diagonally) from long term memory.

Secondly, Anderson proposes that this declarative knowledge becomes proceduralised. This means that production rules are gleaned from using the declarative knowledge. For example the learner of chess might know that-

i. Bishop moves diagonally
ii. Offensive player takes defensive player's pieces
iii. Offensive player can take a piece that is in his/her immediate 'movement' field.

Given these facts a system could make the rule that-

IF opponent has piece on bishop's diagonal THEN take piece

Such procedures chunk information -- put information parts together in a cluster-- and thus enhances the amount of information processable at a given time.

The third stage of learning proposed by this model is that these procedures are "tuned". It is in this stage that a person acquires information about when productions should be generalised. There are two processes for this, composition and strengthening.

Composition is the construction of new rules from a pair of old rules which are related to the same goal, and which occur together. This means that the system puts together the "if" parts of two productions, and their relevant "then" parts, to have a new "if - then" rule.

For example a person may have the two rules for moving a King from check-

If king checked	then move king
if move king into check	then illegal move

These rules can be 'composed' into one, such as -

If king checked and move king into check then illegal move.

The second process employed by the ACT model is 'strengthening'. This is a mechanism which ascribes power to the productions. New productions may be given a strength of one, and with each new use it would have its strength incremented by one. When they are not used then their value decreases.

These twin processes organise a system for expert performance. Composition creates new rules that may summarise a number of rules, and strengthening places each rule onto a hierarchy of usefulness. Composition releases more processing space by having these summary rules, whilst strengthening denotes which rule may be most useful based on previous experience.

These processes thus allow the system to transfer in a similar way to the "guesswork" methods discussed earlier since strengthening allows the system to make a judgement about a new environment based on previous experience -- which allows transfer to occur such as the system 'knows' which rule worked best last and could call on it again given a certain environment. Put simply, there may be no definite answers to many questions, and therefore a system needs to be able to deal with the probability of one thing being more appropriate given a set of circumstances rather than another -- in the same way as we saw the production systems operate above.

In ACT there is an even 'higher' level form of transfer. In the above the rule structure is used to cover new instances, in ACT, however, the form of processing itself may be generalised.

This - "Involves making alterations to the conditions of a production so that the same action can be applied in a wide range of new but similar circumstances" (Kahney, 1986, p. 134)
For example (Anderson, 1983) -

P1 IF the goal is to indicate that a coat belongs to me
THEN say "my coat"
P2 IF the goal is to indicate that a ball belongs to me
THEN say "my ball"

So that then, the chess master that we discussed above might transfer by abstraction between chess and rugby, such as -

P1 IF the goal is to take the queen
THEN faint with bishop and charge with knight
P2 IF the goal is to make a try
THEN faint with winger and charge with back row

ACT thus generalises by discovering, first that a pair of productions have a lot in common, and then it creates general rules that may apply to a number of operators. As

Khaney (1986, p.134, emphasis mine) explains "...a more general production (rule) could be created by constructing a rule that contained a variable in place of the specific objects mentioned in the original productions...the generalization process is a mechanism for finding analogies between the present situation and other earlier learnt conditions, and creating a production that captures these similarities".

The capability exemplified by ACT is that of the application of old information for the abstraction of new information for processing further newer tasks. That is, it illustrates how a knowledge based system can abstract the structure of a particular domain of knowledge and apply that to the processing of further knowledge.

Summary of cognitive processes underlying transfer:

A major factor affecting transfer is the perceived similarity of a new situation to the old by the transferee. The more aware a person is of structural similarities between situations the more positive transfer may be. Two major structural factors are the type of processing and overall goals. To train for transfer we have to be aware of the processing requirements and goals of training and transfer tasks.

We attempted to provide an outline of cognitive processes that underlie transfer with reference to production systems. In discussing Robbie and other more advanced expert systems we saw how they held information in hierarchical concept clusters (schemata). They could transfer an understanding of a present situation through guessing what previous situations was most alike a present.

We saw that humans may well exploit such categorical organisation for processing, e.g, chess knowledge. The master abstracted upwards from the basic moves of individual pieces into patterns for sweeping attacks and defences involving all pieces. Individual moves became sub-processes -- on the board and in the mind -- which did not need to be consulted but which was executed automatically from more general commands. With the gaining of expertise chess players become able to process more moves more efficiently than previously. It was then noted that such abstractions might make experts more adept at transfering their skill to other domain than novices. For example a chess expert whilst playing draughts might attempt general, abstract moves of offense and defence rather than only start of with trying to understand how one piece might move.

Anderson's ACT model afforded greater analysis of how expert performance is developed and maintained, with concommitant increase in transfer ability. In ACT experts were seen as becoming so through making more efficient use of memory structures and processes. First they changed the nature of knowledge from declarative into procedural forms, and then contracted related procedures into new procedures. The expert was thus seen as being able to generalise in two ways, by simply attempting to use the rule that had the highest probability of being correct in 'any' environment for the new environment, and by utilising logical relations of old knowledge to the processing of new knowledge. This organisation and elaboration of knowledge and its subsequent application in new situations created new, abstracted, information. Experts are thus especially equipped to attempt novel tasks and get positive transfer since they may have an understanding of the higher level (or structural) components of tasks within their domain.

In summary there are two main types of knowledge transfer. First by guess from the last best guess for a given situation, and secondly by reasoning through the structural similarities of situations

If we want to train people to transfer it would seem that we need a framework to represent the skills required for tasks, and the skills required to generalise across tasks for any specified type of tasks. With such a framework we could provide our learners with a hierarchically organised model of task skills (a schema) that should generalise across tasks.

Componential analysis of communication skills:

Social and interpersonal skills have been identified as a major employment concern for people with learning difficulties (Lignugaris/Kraft, Salzberg, Stowitschek & McConaughy, 1986). In particular, such skills as being able to follow instructions, clarify ambiguous instructions and to request information for performing a task (Lignugaris/Kraft et al., 1988). Several researchers view the training of these conversational skills as critical for people with learning difficulties to adjust to normal lifestyles (Lignugaris/Kraft et al., 1988; Schloss et al., 1990; Addebuto et al., 1991; Bedrosian et al., 1990).

The ability to monitor for, and respond to, ambiguity in one's own and other's messages is known as referential communication - "...to speak so that others will understand and to listen so that you will understand others or know when you have not" (Sonnenschein & Whitehurst, 1984, p. 1936).

A starting point for training is to analyse communication to discover what kind of sub-skills are necessary for effective communicative functioning. Also this analysis should create a number of testable suppositions as to what kind of skills effective communicators have, and those that less well communicators lack. Such analyses are becoming of paramount importance. "To improve the adaptive functioning of persons with mental retardation ...we need data on their ability to meet the requirements of language comprehension in everyday communicative exchanges" (Abbeduto, Davies, Solesby & Furman, 1991, p. 551, emphasis mine).

The methodology for attempting to study referential communication generally involves a speaker who describes a referent object or a picture so that on the basis of that message a listener can attempt to select a target referent from a group of potential referents (Patterson & Roberts, 1982). Through such methods communication has been broken down into its component parts into an "atlas" of communication skills (Sonnenschein & Whitehurst, 1984). The atlas has two spheres of skill, speaker and listener. By looking at the structural similarities between skills within and between these two spheres we may see what skills should be trained and what kinds of transfer to expect. Because of the dearth of data on people with learning difficulties communication skill, and in order to illustrate communication skills and problems we will generally refer to studies that have detailed other in-expert communicators, "normal" children.

Speaker Role:

There are a number of separable skills that come together to fulfil an effective speaker's repertoire of skill. A primary speaker skill is that the speaker must know that while she or he knows the identity of the target referent the listener does not. That is the speaker must have the capacity to take on the perspective of the listener to realise that it is different to their own (Patterson & Roberts, 1982). Patterson and Roberts gave 42 four to six year old children a perspective taking task in which they had to say if the listener knew the identity of the target referent of two potential referents before any messages were communicated. Of the 42 children tested, 86% evidenced this kind of understanding - some young children therefore failed to grasp the basic premise of communication, although most succeed.

Once a speaker has understood that the listener is ignorant of a target referent's identity she or he must decide on what information needs to be communicated to inform the listener of the target's identity. Underlying this ability is the ability to selectively compare differences between objects that share some other common features.

The success of people of different levels of comparison skills can be gauged against the complexity - or grain - of the comparisons necessary to isolate one referent from a number of potential referents. Glucksberg, Krauss and Weisberg (1966) showed that children as young as five years old could provide adequate comparisons between referents if the subjects were pictures of different animals - that is they could provide a name that distinguished between two or more animals. When the potential referents become more similar to the target referent the "grain" of comparison becomes more difficult. Vurpillot (1968) showed that four year old children, when asked to say if two pictured houses were identical, tended not to make the relevant comparisons that nine year olds would. The more complex the comparisons become, the less likely children were to complete the comparisons (Sonnenschein & Whitehurst, 1978). Therefore quite young children may, depending on the complexity of comparisons needed, be able to isolate attributes of referents. They may therefore have an underlying skill of referential communication.

Explanations for such children's difficulties as speakers have been generally attributed to ineffective perspective taking or inadequate skill at making comparisons. Empirical support for either hypothesis is, however, elusive. It may be that even if people can isolate differences between referents they might not necessarily do so in their messages for listeners (Sonnenschein et al., 1984). So whilst comparison skills are important for communicative success they might not be the only factor causing ineffective communication (Roberts & Patterson, 1983).

It may be the case that each skill in isolation, when requested by another person, may be well developed, but they may not have come to work together in a communicative context. That is there may be a more advanced perspective taking skill which involves the speaker understanding that when the listener is ignorant of the referent's identity then they, as a speaker, must decide on what information the listener needs.

Roberts and Patterson (1983) attempted to measure such advanced "perspective" skill along with a basic form of perspective taking and selective comparative and referential communicative abilities. Their subjects (42 children, mean Chronological Age (CA) 5 years) were asked on the referential communication task to communicate to a listener (a stooge) the identity of one of two referents (such as a triangle from a circle). Advanced perspective taking was assessed by the subject evaluating the listener's (stooge) perspective after the experimenter had given the listener messages that either described the target uniquely or only described the attributes shared by both. Selective comparison was assessed by the experimenter asking the children to say how one referent was different to another. Most of the children were able to asses the listener's initial knowledge base -- that is they could make basic perspective decisions. They were also capable of making comparisons between referents. However children varied "considerably" in their ability to assess the listener's perspective after the listener had received messages (the advanced perspective taking test). They were also poor on the referential communication task, with 21 of the 32 subjects producing redundant or un-informative messages. Furthermore performance on the referential communication task was strongly correlated with that on the perspective taking task.

Thus before comparison skills become useful to a speaker for constructing referentially appropriate messages for communicating the identity of a target from potential referents she/he <u>must become aware of the need to selectively compare</u>. They *need not only be aware of a listener's perspective at the start of a communicative exchange but the effect of the provision of messages on the listener's knowledge base. It seems to be the case that younger children do not have this knowledge - "The young child does not seem to know that to communicate referentially is to describe differences" (Whitehurst and Sonnenschein, 1981, p. 139).*

That is young children may have learnt the basic skills in isolation, but they have not as yet spontaneously transfered such skills "vertically" into a more complex, general task.

If we were to train people to be more effective speakers then there are three speaker skill components to be accounted for, (i) Basic perspective taking (iii) selective comparison and (iii) advanced perspective taking, or monitoring. These can be seen as hierarchically linked. That is basic perspective taking and selective comparison are subordinate skills to the advanced perspective taking in the context of a referential communication task. Some proficiency at the two basic skills could exist but would not be executed unless directed by the higher perspective skill.

Listener Role:

The listener role is that of a respondant. It is in how a listener responds to a speaker that listener abilities can be determined. The main skills that we will be interested in within the listener role is therefore the ability to assess the quality of messages produced by the speaker so as to first use the message (if the message is appropriate) or, secondly, if the message is inadequate, to produce further messages from the speaker.

A basic listener skill is therefore to actually make use of an informative message. When messages are informative (that is when they refer uniquely to one target referent) children as young as four have no difficulty in choosing target referents (Cosgrove & Patterson, 1977).

Sometimes, however, listeners have to respond to messages which are not informative. Patterson and Roberts (1982) distinguish two types of uninformative message: first ambiguous messages which refer to more than one referent, secondly inappropriate messages that do not refer to any potential referents.

Listeners have to understand that uninformative messages lead to communicative failure unless they respond appropriately to such messages. It seems that children find ambiguous messages more difficult to respond to than un-informative messages. Robinson and Robinson (1977) asked six year old children to assign blame to the listener or the speaker when either ambiguous or inappropriate messages broke communication down. They had the children sit next to a doll which attempted to "communicate" the identity of a target referent for another doll. The children could see which of the set was the target that the "doll" was supposed to "communicate". Ten of the children assigned blame to the listener when communication broke down when the speaker's message was ambiguous. However they were able to find blame with the speaker when messages failed to apply to either potential targets and were thus inappropriate. Therefore younger children may fail to blame the speaker for communicative failures when messages are ambiguous because they respond to the performative rather than propositional aspects of communication (Ackerman, 1981). That is the children may believe that if a person is made capable of targeting a referent then that message is appropriate. In other words if the message allows the person to "perform" the act of choosing a referent then that message is good, irrespective of that message's inadequate propositional contents. Children may therefore not respond to ambiguous messages by requesting more information from the speaker because they become enabled to perform.

Another reason for children's reticence at requesting more information when given ambiguous messages may be due to assumptions they might make about the speaker.

Bredart (1983) gave 68 children (aged between 7 and 12) tasks in which they had to listen to instructions for choosing one of three potential referents. The referents were typically three pictures of doll-type characters. Each doll "held" one or more object, such as one held an oar and an axe, another an axe, and the other a lamp. The instructions for choosing the target were either informative (such as "the one with the lamp") or ambiguous (such as "the one with the axe"). When confronted with an ambiguous message which refered to two dolls the subjects nearly always (94% of the time) chose the doll that had the item specified but not an extra item, e.g. when told to choose the doll with an axe, the children prefered to choose the doll with only an axe and not the doll with an axe plus an oar. The children may thus respond according to an assumption that the speaker would be cooperative enough to refer to the extra features of the second potential referent if they meant that one to be chosen. This assumption, known as Grice's quantity maxim, instructs a listener to assume that the speaker will be informative enough, but not more informative than, "necessary" (Bredart, 1983). Children might therefore not ask for more information because they believe that "enough" has been provided within the context of the message.

Abbeduto, Davies, Solesby and Furman (1991) investigated further contextual factors which determine the communicative success of children with learning difficulties. Abbeduto et al. (1991) had one group of 10 subjects with mild to moderate mental retardation (mean CA 9.5 mean IQ given as 57) and another group 10 non-retarded subjects (mean CA 7). Each group was matched for "mental ages".

The children had to "role-play" as shop-keepers and serve a researcher who played a customer. The trials consisted of a "customer" asking the "shop-keeper" to pick up one of three objects on a counter so that they could "look more closely at" those items. On half of all the trials (the "ambiguous" trials) the target referent object came from the same category as another potential referent (such as there were two jigsaw puzzles). On half of these "ambiguous" trials, the "customer" provided a context for the "shop-keeper" to assume which one was a target before they asked the "shop-keeper" to pick up the referent object. For example when there were two jigsaw puzzles, one a complicated (adult) type and another basic (child) type, the customer said "I want to buy a gift for a child" before they said "show me the puzzle". On the other half of the "ambiguous" trials no contextual clues were provided, and an appropriate response by a listener to such messages would be to ask "which one?".

It was found that both groups of children turned to the context of a message when confronted with ambiguous messages. That is they used the contextual clues to choose the referents for the customer. For example when "cued" by the customer with the statement that they need a gift for a child, and then asked to show "the puzzle", when there were two, the "shop-keepers" responded by showing the more basic puzzle. Children with learning difficulties could therefore be equally strategic as their matched "mental age" peers in responding to ambiguous messages when a context provided clues. Unfortunately such strategies block requests for more precise information. On the trials for which there was no context provided (that is no suggestion given of which referent was a target) and the message was ambiguous, normal children were able to ask "which one?" of the customer. The children with learning difficulty failed to make such requests for more information.

The quality of requests for more information was investigated by Brown, Sharkey and Brown (1987). They had forty six children (of 13 years of age) grouped as either academically high or low achieving. As in the Bredart et al. study the children were given three characters (here clowns) as potential referents. Each clown had certain characteristics, such as one "smiled" and/or held a bucket and so on. In contrast to the children in the Bredart et al.study (1983) the subject in the study by Brown et al.were told explicitly that they were going to be given ambiguous messages and that they had to ask questions to find out more information about the target referent.

Nearly all the subjects (97%) discovered which messages were ambiguous. However the two groups differed in the type of requests they made for further information. The "high achievers" asked specific questions, such as "do you mean the one with the bucket or the one with the bucket and is smiling". The "low achievers" failed to request for such specific additions to the speaker's message.

Considering these studies (above) the development of effective listener ability that is indicated by the referential communication seems to take the following stages. First children acquire the skill of knowing how to use a message that is informative for selecting referents. As by-standers they can even start to blame a speaker for producing inappropriate messages. At the same time they might see ambiguous messages as appropriate because such messages enable them to choose a referent. This would block them from requesting any more information. They might then develop skills for reading into the context of an ambiguous messages for identifying referents, which would also block their realisation that they could request more information. Later on they might begin to realise that ambiguous messages are inappropriate and that a request for more information might be useful for choosing the correct referent.

There are therefore three aspects of listener skill to be accounted for (i) if people make appropriate use of an informative message; (ii) if a person can make use of contextual cues for choosing a referent when messages are ambiguous; (iii) can they request more information when given in-appropriate messages?

One major caveat is in order here though. It may be that people make strategic choices rather than request more information when the speaker is a person that they see as having authority. In Brown et al. (1987) subjects were told to ask questions because messages were ambiguous. However the "low achieving" subjects did not succeed in asking appropriate questions even when instructed. It could therefore be argued (as do Brown et al., 1987) that such authority effects might not be overwhelmingly influential. However it may be the case that the "high achievers" transfer their positive responding to authoritative people such as their ordinary teachers into the experimental conditions, whilst the "low achievers" had no such responses to transfer. They might even have had negative responses to authority figures which they transferred.

Structural comparisons between skills and roles:

As we argued above, there needs to be an analysis of communication skills for detailing how roles and skills are structurally related in order to identify the skills that would yield the greatest amount of transfer. Thus we would know where to concentrate training for transfer effects.

Sonnenschein and Whitehurst (1983, 1984 a,b) investigated the commonality between speaker and listener roles. They make a similar distinction to Gick and Holyoak (1987) between situations that share surface similarity and structural similarity. Surface similarity between situations is gauged in terms of the distance between such situations on a horizontal axis. That is tasks that are seen as functionally distinct according to surface features by children of a certain level of ability lie on different locations along a horizontal axis (Sonnenschein & Whitehurst, 1984). So the less tasks resemble each other, superficially, the further away from each other they are. Tasks that seem to share components are also seen as similar along a vertical axis, with tasks involving common, but more skill, being higher up, and those with common but less skills being lower. Sonnenschein and Whitehurst (1983) proposed that relations between tasks and roles for children at various stages of development could be mapped by training certain skills on certain tasks and testing for their transfer to other tasks. If younger children were capable of transfering between superficially similar tasks, then a "surface" relation would be confirmed. If more older children were able to transfer across superficially different, yet structurally similar tasks then such a relation would be confirmed.

Sonnenschein and Whitehurst (1983) trained 4-5 year old children to learn to describe differences between a referent and a non-referent as speakers or listeners. The children were able to maintain their new skills within the same role as which they were taught but did not transfer across roles. The children thus saw speaking and listening tasks as quite separate, even when they required the same materials, therefore the roles are "horizontally" distinct domains for those children.

Sonnenschein and Whitehurst (1984, b) attempted to train the awareness that the two roles may share common components -- and thus test if the roles may be vertically arrayed. They trained 5 year olds to describe differences in either the listener role or the speaker role. They also allowed the children to sample the opposite role to that explicitly taught during training. Transfer occured from the training roles to the transfer roles. That is, those subjects taught as speakers became better listeners, and those tested as listeners became better speakers. The children had therefore abstracted an awareness of the the similar components of each role during training. They had therefore become somewhat meta-communicative.

The children were given a further transfer test - social evaluation. In this the children were asked to observe a communicative exchange and to assign blame either to the speaker or the listener when communication broke down. Children who knew to describe differences between referents for a listener and to request differences between potential referents and a target when they were listeners failed to say who was at fault when other speakers and listeners experienced failure. It may be that they fail to evaluate another person's performance because it requires them to be able to consider communication as a less immediate (to their own informational needs) and abstract cognitive entity. Such cognition enters further into meta-communicative domains of knowledge than which they had previously developed.

Given the transfer failure between roles and social evaluation skills Sonnenschein and Whitehurst (1984, a) trained 5 year olds the importance of making distinctions between target and potential referents within a social evaluation context. The children were shown a "Bugs Bunny" character tell a "Daffy Duck" character which of two referents to choose. Some messages were ambiguous. Experimental subjects were asked to say if the characters had done what they were supposed to do. If they did not mention that the referents had to be made distinct, then they were told so. Control subject only "passively observed" the communication exchanges. After training all the children were tested on social evaluation, speaker and listener skills. The children given feedback out-performed their passive counterparts on all three tests.

The pattern that emerges from the studies by Sonnenschein and Whitehurst is that (i) "normal" children can learn to transfer skills between communication tasks and roles, and (ii) if skills are trained within a contexts which are higher up a vertical axis, such as evaluative skills in the speaker role or in an indirect social interaction, then the greater is the transfer that may be had. That is with an increase in metacognitive ("top-down") knowledge transfer becomes more broad.

Communication skills to test and train:

The analyses that provide us with the atlas of skills allow us to witness the interweaving cognitive mechanisms required for effective communication. Within such an atlas we were able to trace relationships between hierarchically 'superior' and 'inferior' skills - those that are meta-communicative (the evaluation of messages) and subordinate (basic perspective taking and selective comparison).

We suggest that that higher level evaluative skills be targeted in the training for transfer of communication skills. There are two main reasons for this.

The first reason concerns the greater generality of more abstracted evaluative skills. A listener's assessment of message adequacy would be at a lower awareness level than a speaker's monitoring of the effect of messages. This is because the listener responds from an immediate environmental need as 'a listener' rather than plans for those needs as a 'speaker'. That is, in the speaker role a person deploys a listener skill out of the context of being a listener by taking on the perspective of the listener. Developmentally, then, a person might glean an insight in the listener role about the effect of messages and transfer that into the speaker role so as to check on the adequacy of messages that they transmit as speakers. Further up the vertical axis may then be the ability to socially evaluate messages and listener responses up and out of the immediate personal context of communicating. This developmental trend could be inverted in training. If we were to train 'developmentally late' higher order skills then such skills might seep downwards into other contexts more readily than they might 'upwards' from more basic tasks. That is people who learn the higher skills might transfer vertically 'down' into sub-ordinate contexts.

Secondly, these skills may not be developed by a majority of people with learning difficulties. We have seen that such meta-communicative knowledge is possibly underdeveloped in people with learning difficulties (Lignugaris/Kraft et al., 1986; Schloss et al., 1990; Bedrosian et al., 1990) however little data on specific skills exists (Abbeduto et al., 1991). Data that exists for other in-expert communicators, children, indicates that they may well have gained specific skills such as basic perspective taking and selective comparison, but they might not have well developed notions of the need to assess messages for referential precision. It may therefore also be that people with learning difficulties have some sub-skills of communication but have yet to develop meta-communicative knowledge for organising and orchestrating these skills in a communication setting. If such meta-communicative skill is absent, then it may be the case that the training of such skill would promote the transfer of skill across communication tasks and roles.

A starting point for training would be to measure the skill of people with learning difficulties in both communication spheres. We would then be in a position to know which skills might need to be trained, and which might already exist.

A problem with measuring skills in isolation, as we suggest above, is that there might not be a correlation between what people do in constrained testing environments and what they do in more naturalistic settings: as Brown et al. maintain - "An inability to perform a narrowly defined experimental task cannot necessarily be taken as indicative of a lack of a particular communicative sub-skill" (Brown, Sharkey and Brown, 1987, p. 538). This 'narrow' context may inhibit the 'normal' listening or speaking behaviours.

In a similar vein Vygotsky criticised the assessment practices of his time because they almost always dealt with the actual developmental level and not what the child's capacity to develop is -- that which has happened and not what could happen. He suggested that a person's potential for a tasks could be gauged by - "offering leading questions [to the child], or show [to the child] how the problem is to be solved and the child solves it...or if the teacher initiates the solution and the child completes it, or solves it in collaboration with other children...[that is] what children do with assistance of others might be in some sense even more indicative of their mental development than what they can do alone" (Vygotsky, 1978, p. 85, emphasis mine).

The difference between what people could do with help as against without help he called the zone of proximal development which he defined as the - "*...distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined by problem solving under adult guidance or in collaboration with more capable peers*"" (Vygotsky, 1978, p. 86).

The provision of guidance from an expert to an in-expert in certain skills therefore provides a means for measuring how much help people need to become efficient problem solvers on certain tasks. A number of approaches have attempted to assess what people can do with help against what they could alone (see Budoff, 1973, and Feuerstein, 1979). One such approach, based on Vygotsky's construct of the zone of proximal development is Dynamic Assessment developed by Campione, Brown, Ferrara, Jones and Steinberg (1985). They tested children's potential for learning to transfer reasoning skill through counting the amount and type of help that the children required for solving reasoning problems. The problems were "abstract reasoning" tasks in that they involve making decisions regarding which of a number of sample pieces might be a missing piece from an array. Decisions on the identity of the best fit rests on rules that can be abstracted from the organisation of the stimulus array. The rules taught were those of rotation, subtraction and imposition. These rules were arrayed in a hierarchy from the most general problem solving actions to one's specific to the task at hand. The initial hints were therefore very general, and succeeding hints became more specific, with the last "hint" providing a detailed blueprint for generating the correct response (Campione & Brown, 1987).

For example to help a subject rotate a sample picture to look like an array picture, some of the following hints for using a rotation solution might be given -

Hint 1: "This problem is called a turning problem, think about why it might be called that...Do you know how to solve the problem or do you want another hint?"

Hint 2: "This is row 1, put picture 1 in the practice box...now try to make the picture look like the second picture...

Hint 3: "Watch how it turns, now you do it"

(Sequence adapted from Campione et al., 1985).

Therefore, initially, a more expert person might take responsibility for articulating metacognitive processes. With time, this responsibility is ceded to the in-expert who is required to take charge of her or his own cognition and behaviour (Reeve & Brown, 1985).

We suggest that these two assessment problems, lack of naturality and ineffective measurement of potential, can be overcome somewhat by providing subjects with, first, a more general task, and secondly, help for completing that task, if and when they require it. That is it may be possible to test the componential skills of communication within a "broader - natural" context by constructing a hinting hierarchy. One such setting may be the giving and receiving of directions based on a map. Essentially map usage is an extension of one person providing another person with information about the properties and relations of a real, or imagined, area.

A person's ability to do this depends on the quality of their map-referencing 'schema' (Gilhooley, Wood, Kinnear & Green, 1988). This schema includes such knowledge as -

1. The labelling of features by general/specific names (e.g, "the mountain, Moel Y Ci").

2. Description of features by characteristics (e.g, "the round mountain").
3. Relational encoding (how things may be next, or near to other things, e.g, "the round mountain next to the little village").
4. Directional encoding (in what direction things are from each other e.g, "the round mountain that's to the left and up from the quarry").

This hierarchical production system will, then, be an integrated collection of questions and statements -- general and specific production rules -- which represent what we see as relevant task behaviours for the speaker role in such a setting, such as making comparisons between features, monitoring the listener's understanding and requesting feedback form the listener, as can be seen below -

Example of hierarchical production system for a speaker to communicate the identity of a target icon on a map (such as an icon of a large forest) when there are two icons similar in name (such as two forests):

Perspective monitoring (a)
If there's two [target and potential referents] how do you make sure the listener chooses the right one?

> *Basic perspective taking*
> *Does the listener know what you know ?*
> *What doesn't the listener know ?*
>
> > *The listener doesn't know which is the right one to choose [is the target].*
> > *The listener doesn't know that the large forest is the one [target].*
>
> *Selective comparison*
> *Are the forests [target referent and potential referents] different?*
> *How are the forests different?*
>
> > *One forest is large and the other is small*
> > *Which one of the forests should the listener choose?*
> > *The large forest [target referent].*

Perspective monitoring (b)
How do you know that the listener chose the right one?
Can you ask her/him?
What could you ask?

Could you ask "did you choose the large forest?"?

Skills involved in being a listener (such requesting for more information when messages are inappropriate) could also be represented in a hierarchy, as shown below -

Example of hierarchical production system for a listener to receive the identity of a target icon on a map (such as an icon of a large forest) when there are two icons similar in name (such as two forests):

Requesting information:

Can you tell if you're in the right place ?

What do you do if what the speaker says doesn't make sense ?

If there are more than one forest?

Could you ask something ?

Can you ask her/him to tell you how the forests are different ?

Could you ask which forest to go to ?

The crucial aspect of this approach is that it allows us to observe general and sub-skills as interactive components on a near natural task. If a subject was not demonstrating a component we may prompt them to do so with that skill that we see as superior to it. For example if a subject was not selectively comparing when in the speaker role we may first give them a general perspective taking hint, such as -

"If there's two [target and potential] referents how do you make sure the listener chooses the right one?"

If that fails to promote their use of comparison skills we could then check their basic level of perspective taking, and thereafter we could then begin to provide them with more detail on how and why to selectively compare, such as -

"Are the forests [target referent and potential referents] different?
How are the forests different?" etc

Within such a perspective we can view under-development of task skill in a subject when they require help to be more efficient speakers. The type of hint they required would point towards their particular area of difficulty.

In short then, the hierarchical production system that we construct from the components outlined in the atlas of skills gives us a model of adequate task behaviour and we may attempt to gauge which aspects of the model a person has difficulty with by prompting them from the model.

It is suspected that people with learning difficulties will have more need of the 'higher' executive hints that organise the more specific task behaviours (that is more in need of metacognitive support) for deploying specific skills they may have already. That is they may have developed some of the pre-requisite skill of effective communication (perspective taking and selective comparison) but they might not, as yet, use these skills in more complex situations, such as in being a speaker. Moreover such procedures allow some assessment of each individual's potential to gain from training for both the speaker and listener roles.

Research questions and directions for the present thesis:

We had two principal aims in our present research. To establish methods of training that enhances transfer for people with learning difficulties, and to train skills that may have benefits for them in their adjustment to new environments. We echo previous researchers in suggesting that education in communication skills is of paramount importance for this population. It seems that people with learning difficulty, in particular, are not able to follow instructions, clarify ambiguous instructions and to request information for performing a task.

A starting point for training would be to map out communication skills in both communication spheres. We would then know which skills that need training, and which might already exist.

Within the speaker sphere we hypothesise that a majority of people with learning difficulty already have some proficiency at certain skills, such as taking another person's perspective and selective comparison. We need to know the spread of ability that people with learning difficulties have in making comparisons, from naming general to specific differences between objects. People even at higher levels of such skill might not, however, organise and orchestrate these skills effectively within communication settings. The skill that seems to conduct these sub-skills is perspective monitoring. This is the ability to assess the adequacy of messages that oneself gives to a listener. We therefore believe that such a skill is most likely to be least developed by people with learning difficulty. We therefore need to measure such an ability.

In the listener sphere it is suggested that people with learning difficulties do not easily make requests for more information when they are given inappropriate messages. This might depend on the authority they invest in that particular speaker. Furthermore it may be that, in the case of ambiguous messages, a lack of responsiveness is due to a strategy based on the context of the message. It might however be due to a lack of knowledge about effective responses for clarifying the speaker's messages. We therefore need to test for each of these factors to know which are more or less dominant in the listener repertoires of individuals with learning difficulty.

Once established in isolation the sub-skills of both spheres of communicative skills could then be assessed within more naturalistic contexts like the giving and receiving of map directions. Moreover such tasks may provide us with an opportunity to dynamically assess communicative skills. We may thus be able to show how near such persons are to becoming effective speakers and listeners when given guidance with certain skills. We predict that such persons might have a greater potential for becoming effective listeners since such listener skills as assessing message adequacy pre-exist those of a speaker's.

Extra and severely needed analysis to be conducted in this research will pin-point the developmental characteristics of persons who have, or have not, certain communicative abilities. Training could then, in future, be predicted by such correlates.

Chapter 3: Training cognitive self-regulation for the transfer of communication skills

General introduction:

Transfer, the ability to use what has been learnt in one situation in later environments, has been generally found to be a problem for people with learning difficulties (Campione, Brown, & Ferrara, 1982). Vygotsky (Gindis, 1988) suggested that societies may respond to children who have organically traceable learning difficulties by depriving them of adequate communicative experiences which delay their development still further. One major reason thus given for such persons limited transfer is their isolation from "normal" lifestyles in which they would have fostered some independent decision making skills (Shapiro, 1981). Moreover caregivers of children with learning difficulties tend to be less responsive and give less feedback to their "handicapped" children than to normal children and caregivers assume a dominant control over their interactions with the children whose own control is diminished (Beveridge & Conti-Ramsden, 1987). Such isolation and loss of control is seen as compounding their dependency on other people's decision making abilities.

People with learning difficulties therefore seem not only to be largely characterised by an apparent inability to generalise but also concommitant dependence on external control. They therefore fail to transfer because they do not have a general notion that they could regulate their own behaviour enough to decide that they could use skills in situations other than those the skills were taught in. However, although such symptoms and causes have been identified - "there is minimal evidence that effective dynamic self-regulatory training programs have been developed for this population" (Whitman, 1990).

The main question of this chapter is therefore could effective programs be developed for teaching self-regulatory mechanisms to people with learning difficulties for facilitating transfer?

The kinds of methods that we shall discuss have been developed against a backdrop of Vygotskian and Cognitive-Behavioural theory and concern clients' regulation of cognitive events.

The general suggestion is that "normal" human development could be exploited as a vehicle for designing intervention programs to enhance transfer by making people aware of processes for cognitive regulation. This has been attempted by Cognitive-Behaviourists for people with learning difficulties and for children with learning disabilities. There has been varying degrees of success, particularly as regards transfer.

We will argue that the inconsistent findings of Vygotskian based interventions may be due to the different emphases given to, or even inclusion of, some core Vygotskian concepts by practitioners in their training approaches.

Our review will consist of three sections. In the first section we will be concerned with the problem that whilst people with learning difficulties have been categorised as such since they do not possess cognitive skills, then it would appear that the notion training of such skills for complex mediation would be supported if there were more basic precedents. We will show that people with learning difficulties may have some capacities (such as of ordering items into categories that aid memorisation (Bender & Johnson, 1979)) for cognitive economy which pre-exists explicit training. We will also show that if such skills have not been mastered by some individuals then they can be prompted to use them (Spitz, 1966). Moreover they may also learn to use more sophisticated mnemonic skills such as imaginal mediators (Wambold & Hayden, 1975), rehearsal (Belmont & Butterfield, 1971; Brown, Campione, Bray & Wilcox, 1973) and for executive decision making (Brown, Campione & Barclay, 1979).

In the second section we will look at Self-Instructional training, a Vygotskian based intervention for the development of "inner"-regulation. The main Vygotskian notion employed by SIT is that the learner internalises the verbal guidance given to her/him by a more expert person so as to regulate their own behaviour i.e. they learn to say to themselves what others said in order to control their behaviour. We will see that it is a successful training mechanism for people with learning difficulties for decreasing distractability (Burgio, Whitman & Johnson, 1980), academic skills (Whitman & Johnson, 1983) and improving job sequencing (Agran & Martin, 1986; Hughes & Rusch, 1989).

However in all these studies transfer was very limited. This may be because SIT may not provide enough "inner" control to effect transfer because the control over a learner's behaviour tends to remain with the instructor who has to tell learners to use self-commands (e.g. Keogh, Whitman & Maxwell, 1988; Guevremont, Osnes & Stokes, 1988). Also, the instructions used were taught as a list and the process of their creation, and of their necessity for guidance, may not have become evident to the learner, i.e. they learners do not necessarily become metacognitively aware of the abstract "theorising" skills which created the concrete "action" instructions. However it may also be that the inconsistent transfer shown by SIT may be due to further factors, for example it is likely that individuals who do not benefit from SIT have not been partialled out from those who do and therefore confound the results (Meichenbaum & Asarnow's, 1979; Bornstein, 1985).

In the third section we will outline a second approach based on Vygotsky's social developmental theory and on metacognitive theory, Reciprocal Teaching (RT), developed by Campione, Brown and colleagues for children who have learning disabilities. RT makes use of two aspects of Vygotskian theory. Firstly it holds that abstract thinking skills rather than concrete actions should be main focus of the education of people with educational difficulties. Secondly it assumes that these could be introduced to a learner within a dialogue which clearly makes the thinking involved on some problems a shared, social activity. Therefore, rather than encouraging the inexpert to copy the physical and verbal behaviour of the expert, RT attempts to be provide a dialogue from which a learner could view the metacognitive processing involved in problem solving. RT may provide a model for intervention programs for the education of people with learning difficulties.

We will then provide a summary of the material presented here and an introduction to the procedures that we developed from Self-instructional and Metacognitive approaches for training people with learning difficulties to communicate more effectively.

Since this review is international, and historical, descriptions used in each study of their subject populations will be provided.

SECTION ONE: Strategic processing and people with learning difficulties:

Introduction:

Campione, Brown and Ferrara (1982) claim that a major indicator of a person having learning difficulties was the seeming inability to transfer. The general causes underlying such transfer problems are linked to their lack of regulation of their own cognitive abilities, that is of metacognition.

The purpose of this section is therefore to review the relevant cognitive literature concerning people with learning difficulties. There are two main points to be made. First, if people with learning difficulty can learn cognitive strategies or demonstrate the use of some means of cognitive economy, then they are potentially capable of learning cognitive strategies for transfer. Secondly, if their cognitive development can be shown to mirror the cognitive development of "normal" people, then theories of normal development may be utilised to provide a framework for engineering intervention programs.

In this section we will detail strategic deficiencies in the cognitive repertoire of people with learning difficulties, strategies that have been effectively taught, and the effect of teaching both strategies and metacognitive processes in combination.

Studies on strategic processing of people with learning difficulty:

Spitz (1966) working on the assumption that - "...organization will be preferred when certain material is in such a state that either organization or disorganization can occur..." (Spitz, 1966, p. 30) investigated "mentally retarded" people's use of mechanisms for creating organisation of dis-organised material. Spitz had twenty "high grade" and twenty "low grade" "mentally retarded" males split into two groups. One group (of each "grade") were first given a task in which they had to rearrange randomised pictures into clusters of which ones go together. Two weeks later they were given the names for each of the previous pictures by an experimenter and then asked to recall as many as possible. The second group were given the same tasks in reverse order.

Of the 20 high grade "retardates" 14 presented with pictures, grouped them into the four categories of food, clothing, animal and body parts. Of the 20 low grade "retardates", only 2 succeeded in these four groupings. However, in the recall task there there was no significant differences between the high and low grade groups. Spitz (1966) therefore assumed that there was no relationship between amount recalled and clustering.

Since clustering might aid recall then it was thought that imposing such a strategy would aid the recall of "mentally retarded" adolescents (Intelligence Quotient given as (IQ) 64, Chronological Age of (CA) 15). This was done in two ways. First in a "presented cluster" method half the subjects were given 20 words that were clustered into 5 categories, by category. In the second method "requested cluster" the other subjects were given the same words but randomised, but were asked in recall to "tell me all the animals you remember" etc.

Both methods significantly increased recall over the regular "random" procedure, and neither method differed from the other. Spitz concluded that - "normals frequently act on the incoming information in ways which aid their learning and memory; retardates frequently do not act on the incoming material, or act in ways that hinder learning and memory...material to be presented to the retardates should, for optimal learning, be presented in a well organised state. By his own ingenuity the experimenter, or teacher, must devise ways of presenting material in an efficiently organized manner in the hopes of bringing retardates closer to their potential level of functioning" (Spitz, 1966, p. 53).

A later study by Bender and Johnson (1979) found evidence of the use of untrained organisational strategies by children with learning difficulties. They investigated if retarded people could make use of hierarchical systems for organising and remembering pictures. Having class-based clusters is an example of a hierarchical system. The class name, such as "animals" acts as a "trunk" onto which "boughs" of instance types, such as "pets" and "wild" may be placed. Then there would be further differentiation with 'branches' for "pets" having "twigs" for "cats" and "dogs". Being presented with any of the nouns in this particular tree might remind a person of one of the others, and each to a certain degree.

Bender et al. had 54 children (CA 13, Mental Age (MA) given as 8) as subjects. The subjects were given two blocks of 5 pictures. Once the subject had seen a block the experimenter would give them a retrieval cue - a word taken from a hierarchy of related words. For example one of the pictures may have been a "dog", and the retrieval cues may have been a close cohyponym "cat", a remote cohyponym "hippopotamus", a close superordinate "pet" or a remote superordinate "animals".

The most effective retrieval cue were the close superordinates. The remote superordinates (e.g. animals to dog) and the close cohyponyms (e.g. cat to dog) were equally effective whilst the least effective were the remote cohyponym (e.g. hippopotamus to dog).

The results therefore suggest that children with learning difficulties have some hierarchical semantic systems for remembering. That is they may use hierarchical categories for organising material-without such categories being imposed by the experimenter.

This study shows that, to some extent, people with learning difficulties may not only have a capacity to categorise, or even use categorisation when it is imposed by an experimenter for memorisation, but moreover they may also have well evolved knowledge bases organised in normal hierarchical fashions to provide structures and routes for effective memorisation.

When information does not easily fall into categories, but still has to be remembered, mnemonic strategies may need to be employed. Wambold and Hayden (1975) investigated the use of verbal and imaginal mediators for memorisation in adolescents with learning difficulties. Such mediators may act as mnemonic devices for remembering paired associates. For example a person wishing to remember "pumpkin" and "bus" may create a sentence that links them, such as "the pumpkin sat on the bus".

They had 24 mildly "mentally retarded" children (mean CA 13, mean IQ 72). First each subject was given a paired associate task. In the task they were first shown 6 pairs of pictures, one on each side of a card (outside and inside), and then they were given the picture on the outside of each card and asked to say what picture went with it. They were then split into four groups for training on paired associate tasks. One group received no training. The second group (verbal) received sentences from the experimenter that linked the paired associates. The third group (imaginal) were given a selection of paired associates on the same page (that is two pictures on the outside of a card). Afterwards they were given one of each pair of pictures (that were previously shown together) on the outside of a card and asked what went with it and would therefore be on the inside. The fourth group received a combination of the verbal and imaginal procedures.

Results indicated that the subjects' performance was substantially improved by the inclusion of verbal or imaginal mediation. That is they could learn strategies. However there were no maintenance of such learning three weeks later.

Belmont and Butterfield (1971) compared the use of rehearsal strategies for keeping letters in short term memory in a group of 30 normals (high school students) and 30 "mentally retarded" subjects (teenagers). It was believed that the longer a person's pauses became between presentations of letters, over the duration of the task, then the use of a rehearsal strategy would be indicated. A further indication of rehearsal is a primacy effect, that the first few presentations would be remembered better than those in the middle.

Subjects were presented with six letters for half a second in a sequence. Pauses between the presentations lasted as long as the subjects desired. At the end of the presentation the subject was given another letter, a probe, and had to recall the position of the probe letter in the sequence.

The mildly retarded subjects tended to have short, or negligible, pauses between each letter presentation, whilst the normal subjects had much longer pauses. On actual recall the normal subjects had much greater accuracy. The suggestion was that the normals were using some form of strategy, such as rehearsal, to keep the letters in short term memory for their comparison against the probe.

Belmont and Butterfield (1971) then attempted to reverse this pattern by denying the normals the opportunity to rehearse (through speeding up the presentation) and imposing a rehearsal strategy on the retarded (by getting them to pause after the third letter and rehearse each letter, and then do the same for the next three). The performance of the retarded was improved, particularly for the first three items. That is they demonstrated a primacy effect consistent with rehearsal. The performance of the normals dropped, and they failed to show the primacy effect - which meant that they were not able to use the rehearsal strategy and they barely remembered items. People with learning difficulties could therefore learn to use strategies, and these strategies represented the most significant difference between their, and normal people's, cognitive activities.

These findings were confirmed by Brown, Campione, Bray and Wilcox (1973). They compared the use of the rehearsal strategies in two groups of adolescents, normal and mildly learning disabled, on a keeping track task. A keeping track task is a continuous short-term memory problem which requires that the subject keep track of the present state of a number of variables or categories (Brown et al., 1973). Subjects were presented with sequences of pictures representing different categories, such as a number of animals, or vehicles. They were then asked to recall an instance of one of the categories such as "which animal did you see last?" The number of instances per set increased over the duration of the task. To remember a category member efficiently, particularly when there was an increase in the number of instances, the subject would have had to rehearse each instances as a list.

The retarded adolescents were split into two groups. One had training, on the keeping track task, in rehearsal, and the other were left naive. The performance of the "rehearsal" group was better than the "non-rehearsal" group, with the "non-rehearsal" group's performance dropping when there was an increase in instances. The "rehearsal" group's performance was at its greatest for the early serial positions. That is they showed a primacy effect consistent with rehearsal.

The normal adolescents were also split into two groups and taken through the same procedure. However one group was given freedom to use whatever strategy they chose (the "free" group), whilst the other (the "repetition" group) were blocked from using the rehearsal strategy by the experimenter instructing them to repeat the last instance each time (rather than all the previous and present instance cumulatively) and were asked to count backwards before the probe category was given. The "repetition" group showed decreasing accuracy when instances were increased - as had the "mentally retarded" subjects who did not rehearse.

Lack of strategic processes were thus thought to underly differences between normals and people with learning difficulties -"...by both training a strategy in "retardates" and simulating the absence of that strategy in normals, we can confirm that it is the presence or absence of this mnemonic that governs performance in both groups" (Brown et al., 1973, p. 130).

Although rehearsal deficits were reasonably characteristic of people with learning difficulties they could learn such strategies. However, as Brown et al. pointed out, one limitation of the literature thus far was that there was no knowledge of the long term effects of such training - "Immature subjects may abandon their newly acquired strategy when the task demands change, or even within the same situation, unless they are specifically prompted to continue..." (Brown et al., 1973, p. 130).

Campione an Brown (1974) therefore attempted to chart the use of trained strategies on the same type of task long after training had ceased (maintenance) and on other types of task (transfer). They trained "mentally retarded" children to remember pictures by naming the pictures and 'rehearsing' those names. The children accomplished these naming and rehearsal skills -- that is they learnt to use a strategy. Furthermore they maintained these skills up to six months after the intervention.

A transfer test was presented to the children with the six month maintenance tests. In these tests the children were given tasks in which one of the skills, rehearsal was equally valid as in the learning situations. For example they were asked to try to remember just words. Results showed that the subjects failed to transfer. Performance was as low on the transfer test as it was on the initial learning tasks. That is even when they had learnt to rehearse the names of pictures, they would not generalise that to only rehearse words.

The logic of training a strategy and hoping for transfer was therefore questioned. A new direction was sought to promote transfer since there was no strong evidence for transfer to new tasks. Generalised effects of training had therefore to be programmed, rather than simply hoped for (Campione, Brown & Ferrara, 1982).

Interim summary of strategic processing of people with learning difficulties.

Subjects with mild learning difficulties are not only capable of using organisational strategies when they are imposed (Spitz, 1966) but can impose their own organisational systems on material to be remembered (Bender et al., 1979). They are also capable of learning both visual and verbal mnemonic systems (Wambold et al., 1975) and rehearsal strategies for enhancing memory (Belmont & Butterfield, 1971; Brown et al., 1973). Furthermore when normal subjects are blocked from using rehearsal strategies when those with learning difficulties had them imposed then response patterns reversed. As for transfer effects, subjects with learning difficulties are able to maintain the use of such strategies for the tasks they were trained on, but fail to transfer the strategies to other tasks (Brown et al., 1977). People with learning difficulty are thus described as being able to learn cognitive strategies, but not to use such skills independently other than when the "remembering" (transfer) situations duplicated the learning situations.

SECTION TWO: Self-instructional training of self regulation

Introduction:

During the same period as the strategic thinking skills were being investigated within the memory literature, self-regulation of cognitive activities was becoming an aim of training attempts of those engaged in behaviour modification (Brown et al., 1979).

Behavioural approaches had traditionally held that - "a person does not act on the world, the world acts upon him" Skinner (1971, p. 211).

Self control for Skinner was explained in terms of how people controlled themselves through managing the contingencies that operated on them as they would of others - "He [the self] controls himself precisely as he would control the behavior of anyone else - through the manipulation of variables of which behavior is a function" (Skinner, 1953, p. 228), or as Goldiamond (1965, quoted by Meichenbaum, 1977) summarised - "If you want a specific behavior from yourself, set up the conditions which you know will control it".

Self-control of some form was therefore a valid target behaviour of operant interventions. However generalisation itself remained - "a passive concept almost devoid of technology" (Stokes & Baer, 1977 p. 349).

This passive generalisation stemmed from the assumption that many theorists held of it being a natural outcome of any behavioural change. That is since teaching involves a number of different stimuli then it inevitably involves varying samples of stimuli, which would therefore inevitably evoke and reinforce varying samples of behaviour (Stokes & Baer, 1977). As Stokes et al. noted - "Newly taught responses could therefore be controlled not only by the stimuli of the teaching program but by others somewhat resembling those stimuli...Thus, generalisation was something that happened, not something produced by procedures specific to it" (Stokes & Baer, 1977, p. 349).

The importance of generalisation to clinical and educational interventions was, however becoming recognised as immense since - "A therapeutic behavioral change, to be effective, often (not always) must occur over time, persons, and settings, and the effects of the change sometimes should spread to a wide variety of related behaviors" (Stokes & Baer, 1977, p. 350).

Stokes and Baer (1977) summarised procedures that could be included to program actively for transfer -- the "unfinished business" of the operant analysis. They made two main points for transfer. First there should be a 'fit' between the learning and transfer situation. Such as training should be over a number of exemplars that share common components, as should the transfer situation. Secondly contingencies should be managed to maximise the potentiality of the emition of learnt responses in transfer situations. Stokes and Baer l. (1977, p. 369) emphasised that - "The most commonly used mediator is language, apparently. However the deliberate application of language to accomplish generalization is rare in the literature reviewed, and correspondingly little is known about what aspects of a language response make for best mediation" (Stokes & Baer, 1977, p. 361).

The potential of the use of language as a vehicle for transfer seemed obvious but under-researched according to Stokes and Bear (1977, pp. 361-362) - "Language is a response, of course; it is also, equally obviously, a stimulus to the speaker as well as to the listener. Thus, it meets perfectly the logic of a salient common stimulus, to be carried from any training setting to any generalization setting that the child [or any population group it may be supposed] may ever enter. It also exemplifies the essence of the active generalization approach..." (Stokes & Baer, 1977, pp. 361-362).

Such active approaches had to be encouraged, Stokes et al. (1977) argued, since they may allow subjects to become more prominent agents of their own behaviour change, rather than being hapless pawns of more-or-less random environmental contingencies.

Self-activation was becoming the overall goal of the burgeoning cognitive behavioural approach. A principal proponent, Bandura, argued the need to make individuals the principal agents of their own behavioural change (Bandura, 1977). A major example of such an approach is Meichenbaum's Self-instructional training (SIT) (see Meichenbaum, 1977). SIT was an attempt to provide a framework for understanding and modifying human behaviour by combining operant theory and the Vygotskian language based social-developmental models of cognitive regulation. "Whereas the operant approach focuses attention on the rearrangement of the external environment to help establish self-control, the more cognitive conceptualization of self-control...supplements the operant approach by helping individuals to alter their internal environments" (Meichenbaum, 1979, p. 11, emphasis mine).

"Inner" self regulation in SIT is achieved by providing client's with training in giving instructions to themselves. SIT was modelled on Luria's experimental proceduralisation of Vygotsky's Social Developmental theory.

Vygotsky (1978) had argued that speech was both a communicative and cognitive tool which provided human-kind with means to control both their environments and themselves. He argued that the phylogenical development of self-regulatory speech was evident in the ontogenic development of children's use of language to control themselves. Vygotsky outlined three stages for this ontogenic phenomenon.

First there is the external speech of principal others that control the child's behaviour. Then the child begins to imitate such speech outloud to prompt its own behaviour ("egocentric speech") - and finally the child uses speech covertly to direct its own behaviour ("internal speech") - "The greatest change in children's capacity to use language as a problem solving tool takes place...when socialized speech (which has been earlier been used to address an adult) *is turned inward*, Instead of appealing o the adult, children appeal to themselves; language thus takes on an *intrapersonal function* in addition to its *interpersonal use*." (Vygotsky, 1978, p. 27).

In general the internalisation of language allows a shift in the control of a child's behaviour, from care-giving adults to the child itself.

As such processes develop, so do the abilities of persons not to be driven by environmental contingencies but to behave voluntarilly. Luria (1959) attempted to demonstrate this developement under experimental conditions with children between one and five years of age. Zivin (1979, p. 29-30) gives the following overview to Luria's work - "Luria's...empirical work...usually draw a direct line of development from Vygotsky...concerning work on one form of accomunicative speech...and he proceeds to introduce his experiments demonstrating how the speech of adults and, later, the child's own speech regulate the child's behavior".

Luria's "classic" experiment traced the regulatory function of speech through developmental stages (Vocate, 1987). He asked children to press a rubber bulb in accordance with certain verbal instructions, such as when to "start" or "stop", and also the much more complex conditional request e.g. "when the light flashes you will press the bulb".

He found that children could initiate bulb pressing in response to a verbal instruction before they were able to inhibit ongoing bulb pressing. Further, they were able to follow instructions spoken by an adult before they were able to obey their own verbalizations. In short he found the following developmental sequence;

a. Adult can initiate a child's behaviour by a verbal signal.

b. Adult can inhibit a child's behaviour by a verbal signal.

c. A child can initiate her/his own behaviour by producing their own verbal signal.

d. A child can inhibit her/his own behaviour by producing their own verbal signal.

In general he found that by the age of between three and four years children could initiate and inhibit their behaviour according to another's instruction, but only initiate according to its own. He suggested that the full regulating function of speech did not occur before a child reaches around four and a half years of age.

He related the development of such self-regulatory skill to the interaction children would have with caregivers - "as L.S.Vygotskij has already shown, the function which at first is distributed between two people can easily turn into an internal psychological system, and what the child does today with help, he will tomorrow be able to do on his own" (Luria, 1959, p. 349). He therefore outlined general stages to the shift in the locus of the behavioural control between a caregiver and a child, of that child.

a. The control of a child's behaviour is held in the speech of others (to initiate or inhibit)

b. The child progresses to regulate some aspects of its behavior (first to initiate).

c. The child develops more control (to initiate and inhibit).

He saw that such a model of self-regulation had a potential for clinical utility - "There is every reason to believe that the speech system, which is formed in the process of the child's social intercourse with the adult, is a powerful means of systematic organization of our mental processes, and that the precise study of this will help us solve the highly important task of modifing and perfecting the higher nervous activity of man" (Luria, 1961, p. 97).

Meichenbaum adapted this model of development for training. The main idea was to use the model to develop self-verbalisations in clients which would direct, or prompt, their behaviour (Gow & Ward, 1985). They worked with hyperactive children. Luria and Homskaya (in Luria, 1959) had reported that 'hyper-kinetic' children lacked proficiency in verbal control tasks, and this, they assumed, was due to the inadequate functioning of their 'inner speech'.

Meichenbaum and Goodman (1971) therefore attempted to train 8 year old hyperactive children to learn self instructions for gaining greater self-control. The children were in remedial education at a normal school.

The self-instructions were supposed to direct the children to do academic work and to lessen their hyperactive behaviour. Therefore self-instructions such as the following were used -

i. To ask relevant questions about the nature of the task -
(e.g. "What is it I'm supposed to do?").
ii. To answer such questions in the form of rehearsal and planning -
(e.g. "You want me to copy the picture with the different lines").
iii. To self instruct themselves to control specific problem behaviours -
(e.g. "I have to go slow and careful").

iv. And to monitor performance -
(e.g. "Good, I'm doing fine so far")
[Adapted from Meichenbaum and Goodman, 1971].

The training procedure followed the stage development as described by Luria -
i. The child observed the experimenter perform the task whilst the experimenter "talks aloud" to herself/himself (that is the instructor say the instructions out-loud).
ii. The child performed the same task, as the experimenter provided the instructions for completing the task.
iii. The child performed the task whilst instructing itself aloud (overt guidance-- saying the same instructions as which the instructor used).
iv. The child whispered the instructions during task performance (faded overt self-guidance).
v. The child performed the task using only covert self-instructions (covert self-guidance).

It was found that - "...a cognitive self-guidance program which trains impulsive children to talk to themselves is effective in modifying their behaviour...[and moreover] self-instructional training...significantly alters the attentional strategies of the impulsive children and facilitates behavioral change" (Meichenbaum & Goodman, 1971, p. 124).

In SIT the premise is therefore that what individuals say to themselves will have a subsequent effect on their behaviour, i.e. antecedents of behaviour are altered through verbally mediated self-commands (Gow &Ward, 1985). Behaviours to be learnt, as well as the directions for that behaviour held in instructions, could therefore be modelled by a teacher for a learner to imitate and the imitations that successivley approximate the target behaviour could then be reinforced.

In this section then we will assess SIT's strengths and weaknesses as it evolved as a teaching device. Of particular importance for us is the way in which SIT advanced to compensate for transfer failures. SIT has been developed for two main population groups, children and adults with learning difficulties, and "normal" children who have learning disabilities that militate against their learning in mainstream education. We will therefore draw on studies undertaken with both types of groups to illustrate SIT and to explore factors in SIT which influence its success.

Self-instructional training with people who have learning difficulties

Since Meichenbaum's seminal work a plethora of studies have demonstrated the value of SIT with a number of child and adolescent populations both for gaining self-control over maladaptive behaviours, such as hyperactivity and aggression, and in the learning or "unlearning" of skills, such as increasing performance on porteous mazes and reducing cheating (Bornstein, 1985). However, despite the promise of self-control techniques for enhancing the independence of people with learning difficulties, such methods have only scarcely been employed and have only a brief history with this population (Shapiro, 1981; Lennox, 1984). Shapiro noted two points that may explain this under-use. First people with learning difficulties are assumed to have limitations in ability, and self-control may seem to imply abilities beyond them. Secondly they may have limited opportunities to demonstrate self-control due to the expectations of society.

Lennox and Polling (1984), on reviewing the literature in 1984, found that - "to date, research concerning SI [SIT] training with this population has principally demonstrated that behavior can be altered through such training; clinical applications of SI procedures, wherein clients derive obvious therapeutic benefits from their application, are limited to a single study (Burgio et al., 1980)." (Lennox & Polling, 1984, p. 31).

Burgio, Whitman and Johnson (1980) attempted to use an SIT package to aid highly distractable retarded children to increase their attending behaviour for learning skills for mathematics (addition and subtraction problems) and printing (copying words) in an experimental room for transfer to the ordinary classroom. The experimental children were 9 and 11 years old and had IQ's of 70 and 46 respectively who were gauged as being "off-task" for more than 50% of the time. There were 3 control children.

The package included coping self-statements for the tasks, for example -

1. "What does.. [the teacher].. want me to do?"
2. "She wants me to draw this word".
3. "I did a good job".

These self-instructions were taught by procedures similar to those developed by Meichenbaum above. However the children were also given extra training to increase the likelihood of generalised effects. First they were given "story-like" instances of distractable events of the ordinary classroom. Secondly they were presented with stimuli similar to the distractable stimuli of the ordinary classroom in the experimental room (such as recorded voices of other children) for which further self-instruction were taught, such as -

4. "I'm not gonna look, I'm gonna keep doing my work".

Learning was gauged on the same tasks on which they were trained (maths and printing) in the experimental room. Near transfer was assessed by testing the children on the same tasks but in the ordinary classroom. Farther transfer was tested with a new phonic task (which involved various problems focusing of word sounds) in the classroom. Performance on each was measured on the quality of work, distractability and the use of self-instructions.

Both trained children learned to verbalise each of the self-instructions. Both also showed some use of the self-instructions in the near (but not the further) transfer conditions. They also showed marked decreases in distractability after training on all three tasks. There were, however, no systematic changes in the rate or accuracy of performance on the printing or phonic tasks -- only in maths.

This study showed that SIT could affect behaviour in the actual training environments, and that it could lead to some transfer effects over into subjects' every day situations. However transfer effects were limited in that their work-rate success did not generally appreciate. That is they might have become less distractable, but only gained minimal improvements in scores in maths. Burgio et al. (1980, p. 457) note that the subjects may have not gained more generalised competence since the self instructions may not have contained enough task appropriate information and add - "...it might be beneficial to design self-instructional programs incorporating components that not only help the individual deal with distractions but also cope quite specifically with the academic task demands".

The specificity of instructions for tasks was thus signalled as a factor that may affect transfer. More generally, this study demonstrated that children with learning difficulties could be taught to learn self-instructions even though they may be language deficient and commonly thought unable to gain control over their own behaviour.

Whitman and Johnson (1983) examined the effectiveness of training task specific self-instructions for mathematics (adding and subtracting) and printing (copying words) with a group of "mentally retarded" children (mean CA 11 and mean IQ 65).

The self-instructions they employed were highly task specific such as on the maths task -

1. "It's an add problem. I can tell by the sign".
2. "I start with the top number in the ones' column and I add. Seven add 5...etc".

The training procedure was similar to that developed by Meichenbaum and Goodman (1971) other than the children were taught in groups of three. The teacher first solved a problem by verbalising the self-instructions and performed the corresponding behaviour whilst the three children observed. Then the teacher verbalised aloud whilst the children also performed the behaviour. The three children then verbalised together and performed the tasks. Increasingly accurate approximations to the self-instruction monologue were reinforced by the teacher.

All nine subjects learned the self-instructions, and there were significant increases in performance on both the maths- grouping and words- copying tasks. Six of the subjects were completing addition with grouping problems at educationally acceptable levels of 80% greater than baseline after training. The children were then also tested for performance on maths tasks that did not require re-grouping, and performance was significantly improved. That is the children had succeeded in some near transfer across examples of maths tasks.

Whitman supposed that teaching specific verbalisations - one, and only one, approach to the problems - may have given a consistency and specificity that contributed to the transfer effects.

Overall this study demonstrated that self-instructional programs could be used with people with learning difficulties for their learning of skills (Whitman & Johnson 1983). However only very limited transfer effects were shown .

Skills training for the integration of people with learning difficulties into normal communities have further shown the utility of self-instructional approaches.

Success, in terms of keeping employment, for individuals with learning difficulties, depends upon their ability to work adaptively. That is to perform skills across a wide range of environmental contexts autonomously (Agran, Fodor-Davis & Moore, 1986) and lack of independent action has been identified as a factor contributing to job termination of supported employees (Kregel, Wehman, Revell & Hill, in press, cited by Hughes & Rusch, 1989).

Traditional techniques for teaching work-skills have depended on external management procedures, such as direct supervision by teachers (Agran et al., 1986). Such didactic training involved a teacher providing instructions for a learner to carry out procedures. The trainees are then expected to perform their learnt skills in different settings -- settings which have dynamic changes in tasks, co-workers, supervisors and operating procedures. Moreover the use of external teaching methods have been criticised for increasing the likelihood that that work behaviour would only be performed in the presence of the trainer (Agran & Martin, 1987) confounding transfer.

Agran et al. (1986) investigated if SIT could be used to encourage people with learning difficulties to direct their own behaviour in the ever-changing environments of the work-place. Their subjects were 4 "mentally retarded" women, aged 18,19, 18 and 20 with IQ's given as 64,60,45 and 65 respectively. They worked in a hospital as housekeeping and kitchen staff. They were reported as having difficulties in sequencing tasks.

The subjects were taught to say self-instructions for what they had just finished doing, what they needed to do next, and what they were going to do. For example -

1. "I've just brought the bucket into the room."
2. "I need to fill the bucket."
3. "I'm going to fill the bucket now."

They were taught these self-instructions through a typical SIT procedure which included modelling, behaviour and verbal rehearsal, corrective feedback and reinforcement. One subject (who had the lower IQ score of 45) required the modification of the self-instructions into one word self-labels.

Following training all participants markedly increased their percentage of job-sequencing. Maintenance data indicated that three of the subjects (those with IQ scores of over 60) sequenced tasks for up to 3 months. Training also resulted in increased productivity.

SIT may therefore enhance the vocational competence of adults with learning difficulties (Agran et al. , 1986) as compared to traditional techniques. This study does, however, highlight an individual differences problem for SIT. That is it appeared that some individuals with higher IQ scores were able to make more use of SIT than others, especially with regards maintenance effects. This suggestion was reinforced by Agran Salzberg and Stowitstchek (1987). They attempted to train severely "mentally retarded" individuals to verbalize self-instructions for initiating social interactions with co-workers for requesting assistance when they had ran out of work materials. The subjects failed to learn the self-instructions. Such training problems were in mark contrast to their earlier success with people with mild to moderate "mental retardation" (Agran et al, 1986). In contrast however Hughes and Rusch (1989) found that people with severe learning difficulties could be encouraged to learn through SIT. They had two subjects with severe "mental retardation". Myra aged 37 and with an IQ estimated at 27, and Les aged 57 with an IQ estimated at 33. They were were reported as not solving work-related problems independently and typically spoke in two to three word sentences. The female subject also exhibited self-injurious behaviour more frequently when she was not working. Job tasks were related to packaging soap. They were taught self-instructions such that -

1. Stated the problem (e.g, "Tape empty")
2. Stated the correct response (e.g, "need more tape")
3. Gave a self report (e.g, "fixed it")
4. Provided a self-reinforcement (e.g, "good")

Training followed the procedures outlined by Meichenbaum and Goodman (1971) over many examples of work problems such as turning on a radio or getting more chip-boards. After training they were given trained examples, and further problem solving situations which had not been trained, such as to get a hair net or put a tray on a table. These comprised the learning and transfer tests. Before training the subjects work performance showed that they were hardly able to respond to any problem situations correctly. Over training both managed to use self-instructions on over 80% of the training tasks. Also over the training sessions Myra began to learn to respond correctly to increasingly more tasks which she continued after training was ceased. Les similarly learnt correct responses to problem situations. Both subjects also responded correctly to untrained situations at a "much higher level" after the intervention. Data from six months later showed that both subjects maintained their higher performance. Hughes et al. (1989) therefore suggested that certain persons with severe learning difficulties could learn such self-instructions if such instructions were tailored to a comprehendable size for them, and that these instructions could aid their solution of problems, even of some not trained with.

Interim summary: SIT and people with learning difficulties

Therapeutic success depends on clients being able to use learnt skills in situations beyond those in which they were taught and this primarily rests on their ability to use their self-control mechanisms to transfer such skills. From our brief review of the literature of the use of SIT with people with learning difficulties it can be seen to provide clients with <u>some</u> control over their own behaviour - "it gave responsibility to individuals for their own behaviour, and it freed them from external prompts and support: an important point, particularly in terms of the cost effectiveness and, indeed, ethicality of the method" (Thorbecke & Jackson, 1979, p. 17, cited by Gow &Ward, 1985, p. 158).

However there remained inconsistencies and unanswered questions. First there is the issue if SIT is better than external teaching methods for promoting learning and transfer. There was only a suggestion that SIT provides greater educational advantages than the "external" methods because previous training attempts with external methods had not been successful. There was therefore no attempt to compare each approach experimentally.

Secondly there is the issue of how far the transfer of training occured. In the study by Hughes and Rusch (1989) the training and transfer tasks were motor-directed tasks and thus they shared both surface and structural features, such as of selecting an object and manipulating it, e.g. picking up an object and placing it down on a table. Such transfer as there was would therefore be between "near" situations.

Moreover it seems difficult to distinguish what factors yielded such transfer. For example training specific self-instructions led to better transfer of skills that led to academic improvements (Whitman and Johnson, 1983) than training general self-instructions (Burgio et al., 1980). However such transfer as found in the Whitman et al. study was between quite similar maths tasks - for which the self-instructions were well suited. The transfer tasks in the Burgio et al. study were quite dissimilar to the training tasks, moreover, the training tasks were much more difficult than the transfer tasks. Most of the subjects showed a high level of competence at those transfer tasks which may have only indicated that they were already capable of these tasks before any training. The main point is that the studies had too little in common for a fair comparison of what type of instructions lead to greatest transfer.

There was also little comparison of who profits most from SIT. The earlier studies by Agran et al. (1986/1987) had indicated that people with IQ's of over 60 may benefit more than those of less. Yet with some modification to the complexity of self-instructions used in training Hughes et al. (1989) showed that people with IQ's estimated at around 27 and 33 could learn and transfer skills by SIT. There therefore remains the need for proper investigation of which individual characteristics make people predisposed to benefit from SIT, as Whitman (1987, p. 213 emphasis mine) states - "...in evaluating self-instructional programs, more attention must be given to the developmental characteristics of the persons to be trained...". This emphasises Meichenbaum and Asarnow's (1979) claim that the equivocal results yielded by SIT were a function of individual differences rather than weaknesses in the design.

In conclusion, however, it is clear that SIT can help people with learning difficulties to learn skills that were of worth to their everyday life, even if consistent transfer has proved elusive.

Self-instructional training with "normal" children who have learning disabilities (over)

The use of SIT with "normal" children with learning disabilities and other educational difficulties has led to a number of components to be refined or added to SIT for increasing transfer effects. These developments relate to the problems we have outlined above of the use of SIT with people with learning difficulties. The first problem was that there was no direct comparison between didactic and self-instructional training. Also it may be the case that different individuals would have different outcomes from each.

Meichenbaum (1975) hypothesized that children would benefit more from SIT as opposed to didactic training (external, traditional teaching styles) when they are confronted with new, more complex and challenging tasks. This hypothesis was tested by Evenglesti, Whitman, and Johnston (1986) . They attempted to test if normal children taught either through self-instruction or didactic instruction would gain most on visual classification problems. Self-instructions used were, for example, -

1. "What am I supposed to do with this problem?"
2. "I have to find which of the two pictures on bottom card is most like the picture on the top card".

These instructions were taught by similar procedures as developed by Meichenbaum. Didactic training involved the instructor giving instructions such as -

The object of this game is to figure out which of the two pictures on this bottom card is most like the the picture on the top card.

The subjects were tested on simple or complex tasks immediately after training, and then a week later.

Results indicated that SIT was significantly more effective than the didactic training for the 'complex' tasks conditions. Evenglesti et al. therefore proposed that SIT is more effective than didactic training, in helping a person to respond successfully to complicated versions of training tasks in later environments.

This study is of particular interest since it shows how SIT (as opposed to traditional training methods) promotes some strategic thinking. It suggests that the more complex a task is for a learner, the more effective SIT is over didactic training and when learners are at their most naive in their understanding of a problem solving area SIT provides them with more help than didactic instruction.

If it is the case that the more naive subjects are about a task area, the more they gain form SIT than didactic training, then it should follow that children of different developmental levels would have different outcomes from SIT and didactic training attempts. Thus Keogh, Whitman, Maxwell (1988) proposed that SIT would be particularly effective with children with learning disabilities since they are less proficient than normals in terms of language development, have perceptions of external control, have a lower knowledge base, and lack attention and self-control skills.

They compared the effectiveness of SIT and didactic training with both learning disabled and normal children. The normal children's mean age was 7 years and the learning disabled 10 years. However the learning disabled had a mean score of 6 and a half years on the Peabody picture vocabulary test and were therefore closely matched to the normal group.

Tasks for training and transfer tests were mathematical addition-regrouping problems. The transfer tasks differed to the training tasks in that they either required a discrimination by the subject as to which problems required regrouping, or, that some tasks required the subject to use the regroup strategy twice, instead of just once as in training.

The SIT procedure was similar to that used by Meichenbaum and Goodman (1971). Self-instructional such as "What do I add?" and "I start at the top". In the external instruction the instructions remained the same, but the pronoun "I" (such as "I start at the top...") was changed to "You" (such as "You start at the top..."). Moreover in the external instruction the children were never required to verbalise the instructions.

The learning disabled children were found to perform more accurately after the self-instruction than the didactic instruction. This contrasted with the normal children, who performed similarly after both instructional conditions.

Keogh et al. (1988) suggest three explanations for these divergent training effects, especially since language levels had been matched. The first is that the learning disabled are not as attentive as those of normal ability and that SIT helped them focus their attention. Secondly learning disabled children may have had difficulty in spontaneously producing mediational strategies and therefore might have need for more explicit training than normal children in the use of strategies. Such explicitness may have been more evident in SIT in that it makes a person actually verbalise a strategy rather than just hear it being explained, as under didactic instruction. The third point was that SIT might have made a subject more active and autonomous in their problem solving. SIT therefore provided a level of independence for the subject by teaching them to say what they had to do and then do what they said, whereas in the external condition subjects had to do what the instructor said and - "as a consequence were less directly prepared to utilize independently the trained strategy in the assessment situation" (Keogh et al., 1988).

SIT may therefore have been effective because it provides a person with some measure of control, and knowledge, of strategies which make them more attentive and more purposeful in task-settings. Through its explicit training in the use of strategies, and its encouragement of an individual's independent control, it may be particularly useful for people who have self-control problems.

However these conclusions may not be taken too strongly as recommendations for using SIT. Not only did self-instructionally trained children not show superior performance on generalisation tasks as compared to those didactically trained, but there was, even then, only some "slight improvement" (Keogh et al. , 1988) in both groups. SIT may therefore be limited in exploiting the learner's greater potential. Reasons for this may lie in the nature of the control that the learners develop.

The notion of independent control over problem-solving assumes control to have been with principal others. In fact such 'other' control is crucial for learning appropriate self-control (through the more expert allowing the less expert to learn from them to control themselves). The locating of such control over to a person has been argued as a fundamental variable in effecting transfer since the more a person's behaviour is under their own control the less they have to rely on external cues for behaviour.

The learning disabled children that received SIT may have experienced some movement of power along the 'control continua' (from the instructor's regulation of the child towards the child's own self-regulation), but the extent of such movement may be limited by self-instructional procedures.

The form of movement along the control continuum that promotes transfer may be affected by the type of instructions a subject learns to use. As we have discussed above, these may depend on the specificity or generality of instructions: *the more specific they are, the more might readily be learnt, and the more general they are, the more generalisable they may be.*

According to Thackwray Meyers and Schleser (1985) general instructions seemed the most promising for transfer since it required subjects to abstract task information from the general instructions and adapt the self instructional strategies for the demands of the training tasks, and that this practice of adapting may facilitate later performance on novel generalisation tasks.Thackwray et al. (1985) thus investigated differences between general versus specific instructions anent transfer. They investigated whether general or specific instructions would be most effective in promoting transfer of mathematic skills for "academically deficient" children (mean CA of 8). The training tasks were 80 two-, three-, and four-place addition problems, with level of difficulty increasing over training conditions. Maintenance tests involved maths, and transfer tasks were performances on general academic tests such as Peabody Individual Achievement Test (PIAT) and the Academic Skill Rating Scale (ASRS).

Training followed the procedures of Meichenbaum (1975). One group were given specific self instructions such as -

"This is addition, I know because of the sign..."

A second group were only given general instructions such as -

"I have to answer a problem...so I better think up a good plan"

Only children receiving general self-instruction training were found to have improved significantly on the PIAT spelling and general information sub-tests. Thackwray et al. (1985, p. 307) concluded that - "This research generally support...assertions that the child's active cognitive involvement is a crucial component for fostering generalization of self-instructional training...practice in generating and applying problem-solving strategies may be central for facilitating generalization of behavior change".

However it was also found that the specific instructionalists out-performed the general instructionalists on the immediate task to be learnt, a finding supported by Gow and Ward (1985).

Similar findings on the effect of general and specific instructions were reported by Schleser, Meyers and Cohen (1981). They trained 140 children (normal 1st and 2nd grade) either didactically or by SIT with general or specific instructions on matching familiar figures tasks (MFFT). Transfer was tested for on perspective taking tasks. The specific instructions were such as "I have to pick one of the pictures" and the general instructions were such as "I'm going to answer a question". The general instructions were therefore not "anchored to any specific task" (Schleser et al., 1981). The didactic conditions utilised the same commands but they were given in the second person, and they were not rehearsed.

Only children given self-instruction with the specific instructions made significant gains on the MFFT tasks. However only children given self-instruction with general instructions made significant gains on the transfer tests.

The transfer utility of general instructions has also been found with normal children by Miller (1985) on comprehension monitoring problems. Miller provided 44 fourth grade children with either didactic training or self-instruction with either general or specific instructions for detecting ambiguities in text. Both self-instruction procedures were more effective than didactic training in enhancing the children's abilities in detecting errors. Moreover the general self-instructional package led to an increase in the subjects' tendency to monitor a wider range of conceptual information than the task-specific self-instruction (Miller, 1985).

A major component of successful transfer by SIT is therefore the provision of general instructions that might make a learner become practised at engaging in, and adapting a learnt strategy in a novel situation. The notion that it is the process of adapting strategies to meet the demands of situations that leads to such transfer effects for general self-instructional packages has been further supported by Goodnight, Cohen and Meyers (1984).

Goodnight et al. (1984) gave 48 first and second grade children either self-instruction, or no training, on MFFT tasks. In subsequent perspective taking tasks half of those given self-instruction were given either specific or general instruction on how to adapt the strategies learnt earlier on MFFT. For example they were told in the specific condition -

"For this game I have to pick one of these again but this time it has to look just like what she sees from over there".

In the general condition they were told -

"To do a good job I have to check my answer".

Both groups of self-instructed children showed improvements from baseline. They were then tested with a further task, the Tower of Hanoi. Only children described as concrete operational in the specific adaptation group showed significant gains from baseline on the Tower of Hanoi task.

Whilst positive transfer effects have led to an identification of factors that make SIT a vehicle for learning and transfering skills, negative findings have served to warn that such effects may not be guaranteed, and that SIT may need to be improved upon.

Guevremont, Osnes, and Stokes (1988) developed an SIT program specifically designed for transfer. They attempted to improve children's performance at 'pre-reading' activities -- the identification of letter sequences that most often occur in written language. Their transfer environment were children's 'on task' performance levels after they left their training environment and were back in their regular classroom. That is near transfer.

The subjects were 4 children, of 4 and 5 years of age. They had low rates of 'on-task' behaviour in the classroom, and they generally had deficient independent work-skills. Training followed the stages set by Meichenbaum. The self instructions included -

1. Problem orientation e.g. "what do I have to do first ?"
2. Task statement e.g. "I have to circle words that have same letters".
3. Guiding Self-Verbalisations e.g. "not this one so I won't circle it".
4. Self Acknowledgement e.g. "good job"

The self-instructions were trained as by Meichenbaum et al. (1971). Generalisation was specifically trained with two components. An extra third component was added if the child failed to generalise spontaneously.

1. Towards the end of training in the experimental room the experimenter stood behind the subject -- as if in the regular classroom -- and the children were only praised for on-task behaviour.
2. At the end of every training session the children were instructed to "use the instructions you learnt today to help you on your worksheets during work time.
3.The children, when back in the classroom, were given a prompt - "I want you to say the instruction you learnt...while you do your work" from their teacher.

The children only used the trained instructions back in the classroom after prompting by the teacher. Spontaneous transfer, therefore, had not occured. Once prompted, however, the children exhibited a high rate of self-instruction use and increases in correct responding (Guevremont et al., 1988). Thus self-instructions improved performance on a task in a given environment, and even afforded a means for a child to self-regulate in another environment, but they were not enough to bridge similar training and transfer situations. The children in the Guevremont et al. study, when in their regular classroom, remained under the executive problem solving control of the teacher.

Further studies have blunted the perceived clinical utility of SIT. In particular there have been failures to replicate an early and much referenced study by Bornstein and Quevillion (1976) with "overactive" children .

Bornstein and Quevillion (1976) attempted to explore the utility of an SIT program for preschool impulsive children, and to transfer effects from a training environment into their ordinary classroom. They had three 4 year old subjects who had been reported as being "out of control" in the classroom. Measures were taken of their on-task behaviour, e.g. in drawing pictures. They were then taught self-instructions such as -

1. "What does the teacher want me to do?"
2. "Oh, that's right, I'm supposed to copy the picture".

The training was similar to that in Meichenbaum and Goodman (1971). The subjects were also asked to imagine that the instructors were their regular teachers.

From pre-treatment scores of under 20% of on-task behaviour when in the classroom, the subjects' performance rose to around 70% in the experimental room. Performance in the ordinary classroom maintained at around the same high level.

Friedling and O'leary (1979) attempted to replicate the Bornstein et al. study with eight hyperactive children (mean CA of 7). Four of the children received the same procedures as those in the study by Bornstein et al. another four received behavioural modelling but were not taught self-instructions. They also received instructions to pretend that the instructor was their ordinary teacher. Dependent measures were once more the children's on-task behaviour. There were no general changes in behaviour in either group for neither on-task or academic performance. Reasons suggested for such discrepant findings to Bornstein et al. centred on the age differences of the subjects. In particular the older children may have had a long history of non-compliance with instructions which may have been further exacerbated in training with the command to "imagine" the instructor to be their teacher and they may have transfered their "non-compliance" from their regular classroom into the training situation.

A second attempt to replicate the Bornstein study by Billings and Wasik (1985) was more systematic. They had 4 subjects who were between 4 and 5 years old and off-task 25% of the time. They were therefore closely matched to Bornstein's subjects. Three were trained, the other remained as a control. Procedures used were the same as those in the Bornstein study. However socially significant durable increases in appropriate classroom behavior were not obtained.

Explanations of these contrary findings were related to the behaviour of the teachers. Billings and Wasik following a suggestion in the Bornstein and Quevillion study discussion of their study, noted that in the earlier study the teachers had become more positive towards the subjects over the study -- thus encouraging more positive behaviour. Two of the teachers in the Billings and Wasik study had been noted as giving little or no positive attention to the children during the data gathering points of the study. This suggested that off-task behaviour was maintained since the teachers failed to reinforce any positive changes in the children's behaviour.

Bornstein's response to the Billings and Wasik's study, and in a short review of SIT was to note that - "Quite simply, it appears that self-instructional programs can be effective, although obviously they are not always effective" (Bornstein, 1985, p. 70).

Interim summary of Self-instructional Training for people who have learning difficulties and for "normal" children who have learning disabilities:

Failures of the transfer of training for people with learning difficulties has been viewed as a result of the inadequate self-regulatory functions (Whitman, 1987). A program for developing self-regulation was developed by Meichenbaum & Goodman SIT, which alluded to Vygotsky's Social-Developmental theory. SIT was supposed to promote such phenomena as transfer because it provided an "intrinsic" control and such "intrinsic control" of behaviours is more likely to result in generalisation of those behaviours to other situations (Gow and Ward, 1985).

SIT was proposed as a particularly better vehicle for developing intrinsic control than other more traditional "external" teaching methods. This was shown because people with learning difficulties who had failed to make appreciable learning gains by traditional didactic approaches made performance improvements through SIT, for example in decreasing distractability (Burgio et al., 1980), and in learning mathematical and writing skills (Whitman et al. , 1983) and in job sequencing (Agran et al., 1986; Hughes et al., 1989). Moreover in some cases there was transfer of these newly learnt behaviours (Whitman et al,, 1983; Hughes et al., 1989). However such transfer as shown was typically confined to similar tasks and situations -- as such is was near transfer.

The utility of SIT over didactic training in promoting intrinsic control was shown more experimentally with children. First normal children gained greater competence through SIT than didactic training on visual classification problems (Evenglesti et al., 1986), MFFT tasks (Schleser et al., 1981), and comprehension monitoring (Miller, 1985) as did learning disabled children on mathematical tasks (Keogh et al., 1988).

Although greater transfer was suggested for self-instructionally trained children than those didactically trained, differences were marginal and therefore inconclusive. In general, therefore, Meichenbaum's comment (in Gow & Ward, 1985) that successful transfer had eluded SIT still seemed true.

The major reason for this may be that SIT might not promote enough so called "intrinsic control" and may leave a learner somewhat dependent on external conditioning variables. As we explained whilst discussing the study by Keogh et al. (1988), SIT might not allow enough control over an individual's behaviour to pass along the "control continuum" from principal others to that learner. That is the fundamental control over the learner's problem solving rested with the teachers and did not get sufficiently developed by the learners.

A hint at what factors within SIT may confine it to a mere "stepping stone" to a more sophisticated covert strategy rather than a fully evolved program in its own right (Guevremont et al., 1988) may be evident in the observation that it is not directly what the learners say to themselves that is expected to lead to generalisation, but the external controlling variables (situations being similar, instructors and teachers telling the learner's to use their instructions etc).

For example in the study by Guevremont et al. (1988) the teacher was modeled by the trainer in the training situation to make that situation more like the ordinary classroom, also the trainer "didactically" told subjects "use these instructions tomorrow/today". Such emphasis on external-environmental factors within SIT may limits its access to what learners actually say to themselves for self-regulation, and leave the learner's behaviour in the control of 'others'.

What SIT provides as a medium of self-control may also limit transfer. Intrinsic control by a subject through language internalisation in SIT is to expected after the subject learns a verbalisation and a corresponding behaviour -- saying what to do and then doing it. These verbalisations were provided in monologue form (as explicitly mentioned in Whitman & Johnson, 1983). So in SIT a subject is essentially reinforced to learn a menu of instructions, and then reinforced to learn behaviours when emitting the instructions. It may be that the subject learns both the instructions and the behaviour without much awareness of the significance of creating such instructions, only using them. *That is they can follow a set of instructions as given by the instructor, and then even internalise those instructions, but they might not be able to generalise the instructions since they are not aware of the process of generating such instructions in the first place. Being aware of such processes would require metacognitive insights.*

The kind of instructional content was a variable manipulated within SIT, and the results provide an idea of where the stepping stones lead. Thackwray et al. (1985) proposed that learners with general self-instructions would have to abstract task information from such general instructions, and adapt these instructions for each training task. This was seen as making the learner more cognitively active and involved in the tasks. That is, it had the effect of making the learner pay attention to a task and make the demands of tasks explicit to themselves, and then they had to generate the answer. They therefore did not follow some specific instructions to arrive at an answer, but were made privy to some extent to the creative process that leads to self-commands. They were therefore becoming more aware of executive functions of cognition for problem solving -- i.e. more metacognitively aware. Such general instructions did yield greater far transfer than specific instructions.

However there was also the general conclusion that specific instructions led to greater performance success on tasks similar to those trained on - that is in maintenance. For best results, therefore, a training method must be able to employ both types of instructions incorporating the strengths of each.

Echoing Meichenbaum, Bornstein (1985) suggests that SIT's inconsistent success reflects a lack of specificity as to who benefits most from it. Negative results due to people who might have individual differences from those who experience positive results may disguise SIT's positive effects for some people. As we have seen above the parameters of subjects' abilities against outcomes have only been barely established. If there were recognisable characteristics of people who benefit from SIT rather than other treatments then it may be more possible to asses the negative results and also give direction for future uses of such training. Such needs drive calls for greater subject numbers for allowing individual and group comparisons (see Whitman, 1990; Bornstein, 1985).

Keogh et al. (1988) showed that subjects demonstrating the usual characteristics of a lack of self-regulation could benefit more from SIT than didactic training. The normal children who benefited equally by didactic as well as SIT would therefore presumably do so because (for the given task environment) they would have a sufficiently evolved self-regulatory device, and therefore not need this extra component in training. Evenglesti et al. showed that "normal" subjects confronted with complex tasks (that is when they are essentially naive) were enabled by SIT to learn and utilise problem solving strategies more effectively than a didactic program. That is, when a person is least organised in their problem solving (when in-expert), SIT more than didactic programs provide most cognitive self-regulation. As we have mentioned problems of self-regulation are endemic to the mentally handicapped population through social deprivations. More precise cataloguing of individual factors that affect training outcomes are needed. Therefore, at the moment, little is known about who gains most from SIT. As far as people with learning difficulties are concerned, potential, both of subjects and training mechanism, is probably greater than what's realised.

Due to the dearth of studies of SIT and people with learning difficulties we have attempted to broaden the discussion through including work done with children with learning disabilities. Such generalisations across subject groups has been criticised, however. Pressley (1990) argued that there should be caution in accepting work undertaken with learning disabled children (those who are considered of "normal" intelligence but with educational problems) should qualify SIT for people with learning difficulties ("mentally retarded") because of the latter's "big difference in language capabilities" (Pressley, 1990). Similar caution has been voiced by Kendall (1990), who argues that the effectiveness of self-instructional training for "lower functioning individuals seems questionable" due to their insufficient cognitive and linguistic development for understanding and appropriately applying the subtleties of the self-instructional approach. It may well be that, overall, the recipients of SIT may require certain pre-requisite skills due to the inherent complexity of such cognitive interventions (Kendall, 1990) but since there has been some preliminary vindication of SIT with those who have a wide range learning difficulties (as by Hughes et al., 1989) such caution serves to underline the need for greater understanding of individual differences rather than their prima facie exclusion from cognitive training. This is a particularly pertinent for a population group who have a wide range of inter-personal differences. It has to be remembered that - "heterogeneity is the single most outstanding characteristic of retarded groups no matter how constituted" (Baumeister, paraphrased by Muma, unpublished, in Bedrosian & Prutting (1978, p. 94)).

Interactions between person-treatment and task has also not been adequately addressed. We noted above how transfer might not have occured in some situations simply through a mis-match of tasks. Moreover it may be that negative results are due to choices of tasks that were not amenable to SIT. A suggestion by Bornstein et al. (1976) that "further research is needed of the classes of behavior most amendable to modification through self-instruction" therefore remains current.

Replication failures of a study by Borstein et al. (1976) showed further potential problems for SIT anent long term clinical/educational success. Billings and Wasik (1976) showed that the ecologies of the client's lives, in particular the behaviour of significant other's, has to be examined for investigating what the conditioning variables are for behaviour, otherwise they may mitigate against training. Friedling et al. (1979) showed training has to account for potentially negative transfer factors from client's past experiences that might mitigate against training.

To emphasise the point at which SIT may lie on the evolutionary curve towards efficacious training methods we may look to Meichenbaum's (conference paper, 1980;

refered to by Gow et al., 1985) suggestion that SIT may only prompt a child's fluency at problem solving skill and not actually provide them with those actual skills. This limitation taken with SIT's intermittent success signals that the direction identified and taken by self-instructional training in terms of what to effect (self regulation) and methods for doing this (affecting cognition through internalising social processes) may be valid, but in itself SIT may not be sufficiently evolved as a training mechanism.

In general therefore training approaches need to improve on SIT's balance between controlling variables 'outside' the subject and those 'inside'.

SIT can therefore be said to lead to people with learning difficulties becoming able to gain skills for tasks. Self-instruction with general task instructions have been shown to provide a greater distance of transfer. However "the evidence for treatment generalization...across response modes and settings is [still]...often equivocal" (Meichenbaum & Asarnow, 1979, p.15) which indicates that SIT might not be sufficiently advanced to provide enough people with enough cognitive regulation for transfering skills.

SECTION THREE: Metacognitive training methods

Introduction:

SIT was envisaged as providing "intrinsic" control over behaviour which would promote transfer. Transfer effects were inconsistent, possibly because SIT might not have promoted enough so called "intrinsic control" since it depended on external contingencies and a limited form of self-mediation. SIT therefore did not seem to fully promote metacognitive awareness. Providing subjects with general self-instructions did allow learners to abstract task information and adapt these instructions to allow greater transfer. The general instructions prompted subjects to make their own executive decisions regarding tasks, i.e. triggered metacognitive processes.

In general SIT may only prompt a learner's problem solving skills and not actually provide them with those skills. SIT may not therefore be a sufficiently evolved as a training mechanism. SIT's reliance on prompting a subject's existing abilities required an element of spontaneity in those learners to learn and utilise skills, particularly in new situations where no external prompts may be strong enough to elicit learnt responses.

Metacognitive models have become increasingly used to conceptualise the development of strategy use rather than leave such apparently crucial behaviours to "spontaneity". "Strategy use is *never spontaneous* but rather the result of continuous, long-term developmental process that reflects the maturation of the metacognitive system...[moreover]...*Spontaneity* is the result of a complex interaction involving children's knowledge of strategies, knowledge about higher level coordinating strategies, and motivational beliefs" (Borkowski, Carr, & Pressley, 1987, pp. 62 - 63, emphasis theirs).

The model proposed by Borkowski et al. (1987) emphasises an instructional deficiency in the educational programs assigned to individuals who experience educational problems and not to some production deficiency in those persons. Training may therefore need to re-create aspects of normal development for those who have not shown such development. This trend of reasoning is in accord with self-instructional developments of social developmental theory in that normal development may be a guide for training.

However if to self-instruct is to control one's own behaviour by talking to oneself, then to be metacognitive would be to know that by talking to oneself that one is controlling one's own behaviour. SIT relied on learners to learn sentences that controlled them, whereas metacognitive training attempts to involve a person becoming active in generating such self-regulatory speech. Promoting this greater "meta" level of cognition in training might promote greater transfer of skills.

Metacognitive interventions were a natural development of the cognitive strategy interventions discussed above. Those studies showed that people with learning difficulty could make use of strategies (Spitz, 1966; Bender & Johnson, 1979) and learn new strategies (Wambold & Hayden, 1975; Belmont and Butterfield, 1971; Brown et al., 1973) for cognitive economy.

They were also able to maintain the use of such strategies, but failed their transfer to other tasks (Brown, Campione & Murphy, 1977). They did not, therefore, spontaneously use strategies in situations that differed to those in which they were taught. Therefore "If it is true that young children in general, and slow learning children in particular, experience major problems when required to orchestrate and regulate their own attempts at strategic intervention, then it follows that an alternative approach to training specific mnemonics would be to train the metacognitive skills that provide the most pronounced difficulties for the immature learner." (Brown, Campione and Barclay, 1979, p. 502, emphasis mine).

Brown (in Palinscar 1987) suggested that there were two important components to metacognition, the statable and stable knowledge of one's cognitive processes and the regulation of such activity through executive decisions. This conceptualisation of metacognition and its desirability for training is in accord with Vygotsky's theory of learning difficulty.

Vygotsky believed that "mental retardation" (a term confined in the Soviet Union to persons with "organic brain impairment" (Gindis, 1988)) is compounded by a social deprivation which denies such persons communicative experiences to fully develop higher psychological functions such as "reasoning" and "verbal memory" (Vygotsky, cited by Gindis, 1988). He even concluded that - "mentally retarded children are not very capable of abstract thinking" (Vygotsky, 1978, p. 89).

Given such problems he noted that it was understandable that educationalists at his time settled for educating such children on concrete thinking problems or "look and do methods". However such methods, he said, failed to help them overcome their handicaps and, moreover, reinforce their handicaps by accustoming children exclusively to concrete thinking, which - "suppress the rudiments of any abstract thought that such children still have" (Vygotsky, 1978, p. 89). Therefore, he claimed, - "Precisely because retarded children, when left to themselves, will never achieve well-elaborated forms of abstract thought, the school should make every effort to push them in that direction and to develop in them what is intrinsically lacking in their own development" (Vygotsky, 1978, p. 89).

Metacognitive training for children with learning difficulties and for children with learning disabilities:

Due to the lack of studies on the training of metacognition with adults who have learning difficulties we shall discuss research from two areas, the training of children with learning difficulty and those who are considered "normal" but have certain learning disabilities.

Brown et al. (1977) investigated children with learning difficulties for the first component of metacognition, the awareness of cognitive processing. They had 68 "educable mentally retarded" children which were split into two groups, one younger (mean CA 9 years 3 months, mean MA 6 years 5 months) and one older (mean CA 11 years 1 months, mean MA 8 years). The children were given two memory tasks. In the first they were given a series of picture sets which increased the number of items they contained (which we will call the item-incremented series). The second was a number of sets of 10 pictures (the ten-set category) -- some sets had pictures from 2 categories, some from 10 different categories. They first had to predict their memory span for the first set, and then the second. They were then tested for their actual memory span on each task. Subjects of both age groups were then split into 2 groups, realistic and nonrealistic predictors. A realistic predictor was one who predicted within +/- 2 of his or her actual performance. Only 21% of the younger and 31% of the older subjects were judged as realistic.

All subjects were then given training on the 10 item sets, but not on the item-incremented series. Half the realistic and of the unrealistic subjects received explicit training, the remainder did not. Training concentrated on feedback to the subjects on how many pictures they were actually able to recall on the sets with 10 pictures. The subjects were then tested for their prediction of, and real, memory spans on the two types of tasks the day after training, 2 weeks later, and a year on. Performance on the item-incremented series was used as a transfer test since there was no direct training on that task.

The older subjects were able to improve their estimation of their memory spans irrespective of the group they were in. However only the younger children in the explicit training condition were able to become more realistic estimators of their own memory. The older children's ability to predict maintained at 2 weeks, with some drop (but not complete) in performance a year later. The younger children failed to maintain performance at two weeks. There was no transfer of the accuracy of prediction for the subjects who became realistic from the 10 item sets to the item-incremented sets.

Since the subjects in this study had "mental ages" of either around six years and eight years Brown et al. matched their subjects against subjects in studies with normal children (kindergarten and second grade) of the same MA. Flavell et al. (1970 reported by Brown et al., 1977) had reported that 64% of kindergarten and 25% of second grade children were unrealistic "guessers". Yussen and Levy (1975, reported by Brown et al., 1977) reported that 58% of their nursery school population were guessers. Of the younger children in the Brown study 62% were guessers, whilst of the older children 31 % were "guessers". Thus the educable retarded subjects are at approximately the same level of development as their MA-matched peers (Brown et al., 1977).

Children of different "mental ages" also have different outcomes from training. The older seem able to make use of exposure to trials to extract an awareness of their own capacity. The younger children fail to demonstrate the ability to make a metacognitive realisation for themselves, but they were able to make use of explicit instruction to become metacognitively aware. However even when helped they had difficulty in maintaining such awareness. For neither group of learners, however, was there transfer - metacognitive knowledge per se could be learnt but did not transfer. However Brown et al. point out that - "the children received no instructions concerning the desirability of transferring the information across tasks. Indeed we know of no study where, far from attempting to train generalization, the experimenter has even hinted that this is the name of the game..." (Brown et al., 1977, p. 209).

Brown, Campione and Barclay (1979) investigated the second component of metacognition, which includes checking the outcome of attempts to solve a problem, planning one's next move, monitoring the effectiveness of any attempted action, and testing, revising, and evaluating one's strategies for learning (Campione, Brown and Ferrara, 1982). They taught children with learning difficulties strategies that inherently required the production of executive decisions. This followed up to an earlier study by Brown and Barclay (1976). In the initial study they had two groups of educable "mentally retarded" children with MA's of 6 years and 8 years. The subjects were given a series of trials in which the task was to memorise in order a set of 'n' items ('n' was calculated for each subject as one and a half times their maximum short term memory span). Only 4% of the younger MA and 12% of the older MA were able to provide one perfect recall.

Both sets of children were then split into three groups for training in the use of one of three strategies. These were anticipation (guessing which picture would come up next), cumulative rehearsal, and just labeling each picture as they came up. Anticipation and rehearsal were seen as self-testing strategies since the subjects were asked to make executive decisions, either in checking if they predicted the material correctly or if they had learnt the material correctly.

The subjects were then given three post-tests of short term memory. First the day after training ceased they were given a "prompted" test on which they were asked to use the strategy that they were taught. Secondly on the next day, and two weeks later, they were given the same tests but without prompts.

Both the children in the younger and older groups in the anticipation and rehearsal groups improved their recall scores significantly when prompted to use the strategies, with 72% of the younger and 92% of the older children giving at least one perfect recall. On the unprompted tests however the younger children's performance was not significantly different to baseline, whereas the older group had made substantial gains.

The second study attempted to check on the effect of training a year later, again under prompted and unprompted conditions.

On the unprompted trials the younger group showed no evidence of maintenance, with performance at pre-training level. The older children who had been taught in the self-testing conditions continued to out-perform the subjects in the labelling condition. When prompted the younger children who had been taught the self-testing strategies had significant increases in performance, but they failed to maintain when tested unprompted later. When the older group were prompted their performance rose still further, and maintained at those higher level when tested unprompted later.

The three groups of older children and a new group of naive children (a second control group) were then tested for ability at prose recall. The prose used were a number of stories which had between 10 and 19 idea units each. The anticipation group had a mean recall score of 50%, the rehearsal group 49%, the label group 35% and the naive group 37%. The subjects in the self-testing strategy groups had therefore recalled significantly more than the two control groups.

Again we see that children of different "mental ages" have different outcomes. The younger children were not able to spontaneously use their trained metacognitive strategies, although the older children were capable of not only spontaneous usage but the far transfer of the strategy to other tasks.

In summary, due to the lack of spontaneity in their strategy use, children with learning difficulties were taught metacognitive processes. A most basic type of metacognition is such knowledge as that of one's own short term memory capacity (Brown et al., 1977). Training such knowledge per se did not result in transfer. However when training emphasised the executive function of metacognition in making decisions regarding the utility of deploying strategies in a given environment then those strategies transfered across quite different tasks (albeit inconsistently)(Brown et al., 1979). Children with learning difficulties of different "mental ages" had different outcomes from training which, to some extent, reflected their normally developing counterparts success on similar tasks. The suggestion is therefore that children with learning difficulties develop in a similar fashion to normal children (Brown, Campione & Murphy, 1977; Brown & Barclay, 1977) but at a delayed rate and, moreover, can make use of metacognitive strategies for transfering skills.

As with SIT, the literature on cognitive regulation with people who have learning difficulties is limited. We will therefore consider studies conducted with another population group characterised as having difficulties with cognitive regulation and transfer, "normal" children with learning disabilities.

Gelzheiser (1984) attempted to use elaborative processes for engendering the transfer of training of strategies. She trained children with learning disabilities strategies for remembering pictures words and two word phrases for transfer to prose passages.

She had two groups of learning disabled children who received training, and a further group of learning disabled and a group of non-disabled as controls. Training was over three stages. In the first stage both training groups ("recall groups") were given pictures, words and two-word phrases, which they had to categorise. One of the two groups, however, received extra two-word prose examples -- becoming the "recall plus" group. In the next stage both groups were given training in studying the items by group, naming the groups and clustering for recall followed by a quiz on the objectives of using such strategies. In the third stage of training the "recall" groups were given test items once more but were also given feedback on the amount they got correct, their degree of clustering and comments such as "using the study rules helped you remember".

Results showed that a majority of the learning disabled subjects in both training conditions learnt strategies for recalling pictures, words and two-word phrases -- evidenced in approximately 25% gains. Both groups also transfered their use of strategies over into the prose passage tasks, with again about 25% increases in scores. The control groups showed no significant gains.

Wong and Jones (1982) investigated if insufficient metacomprehension was a possible cause of learning disabled adolescents problems at prose comprehension. They had 120 subjects. Half were learning disabled (in grades 8 and 9) and half were non-disabled (from the 6th grade). All the subjects were split into two groups, one for training in comprehension skills and the other for just practice - as controls. There were two stages in training. First the subjects were trained in finding the main idea of prose, and then they were taught to use self-questioning strategies for enhancing metacomprehension. For example they were asked "What are you studying this passage for?" and told "Find the main idea and underline it" and "think about a question about the main idea?"

All the subjects (both trained and untrained) were post-tested in one of two conditions, "prediction" and "no-prediction". The prediction group were asked to predict which of the main ideas would appear later in comprehension tests.

Dependent measures included the amount of predictions made, questions created and actual comprehension. Both groups of learning disabled subjects who had been trained predicted ideas that appeared for comprehension more often than the control group of learning disabled. The trained groups also created more questions, and scored significantly more points on the comprehension tests than the learning disabled control. There were no significant differences between the learning disabled that were given prediction prompts in post-testing and those that weren't. Self questioning, and such strategies as predicting the comprehension questions were therefore enough in themselves to inculcate metacomprehensive processes for the learning disabled. There were no differences between the trained and control groups of non-disabled subjects. Normally achieving students may very well spontaneously monitor their own understanding (Wong & Jones, 1982) - that is they have the metacognitions for dealing with such academic tasks as prose comprehension. However adolescents with learning disabilities do not readily demonstrate such skills, but they can gain levels of skill approximating their non-disabled peers through instruction in such metacognitive strategies as predicting future informational needs.

Such positive effects have not, however, been consistently found. Kramer and Engle (1981) examined the effect of combining strategy training and increased awareness of strategy use on the ability to generalise. The training tasks were picture recall, whilst the transfer tasks were serial position and picture recognition tasks. Picture recall tasks required the subjects to remember a set of items for recall, whilst the subjects in the serial position task had to indicate where in a previously seen list a probe picture was located. In the recognition task the subjects were shown a series of pictures and then afterwards shown a number of probe pictures and asked to say if they'd seen them on the previous list. Their subjects were 80 children with MA's of 8 years, half of which had learning disabilities, the rest were without. The two sets of subjects were split into 4 treatment groups.

The first treatment group ("rehearsal") were taught a rehearsal strategy through the experimenter modelling its use and the subjects repeating everything that the experimenter did. There was no attempt in this condition to make the subject aware of the utility of the strategy only its most basic use. The second group ("rehearsal and awareness") were given rehearsal training (as above) and were told that they were learning a strategy that was useful for learning long lists of information since it broke them down into smaller bits and allowed them to practise the names of items until they knew them. They were also given an "awareness" prompt of "What two things are you going to do to help you remember the list?". A third group ("awareness") were not explicitly taught the rehearsal strategy, but they were told about the utility of using two staged strategies such as breaking down lists and then repeating the names of items. They were also given the "awareness" prompt. A fourth group ("no training") did not receive training in either rehearsal or strategy awareness.

After training the subjects received picture recall, serial position and recognition tests - both the day after training and two weeks later. There were reliably positive effects of training for both "rehearsal" groups on the recall task, but there was no significant impact of training on the performance of the "awareness" and "no training" groups. There were, however, no training effects carried over into the serial position task i.e. there was no transfer. All groups had near perfect scores on the recognition tasks -- although the rehearsal groups and the non-disabled controls had longer inter-item pauses and slightly higher scores than the learning disabled in the "awareness" and "no training" conditions.

Conclusions from this study were somewhat ambiguous as to the usefulness of strategy awareness for transfer. First transfer had not occured in the serial recall task. Secondly there was an obvious ceiling effect on the recognition test (Kramer & Engle, 1981).

Metacognitive training with children who have learning disabilities therefore provide some support for training executive processes for attaining strategy transfer (Brown et al., 1979; Gelzheiser, 1984; Wong et al., 1982), however universal success has not been attained (Kramer & Engle 1981).

In summary, metacognition seems a viable target for training since it is - "The ability to stop and think before a problem, to ask questions of oneself, and of others, to determine if one recognises the problem. To check solutions...to monitor attempts to learn to see if they are working or worth the effort" (Campione & Brown, 1977, p. 3, in Meichenbaum & Asarnow, 1979). Furthermore these functions are routinely used by effective learners and play a major role in strategy choice and execution, that is, in transfer performance (Campione et al.,1982).

Social developmental approaches to metacognitive training:

In the above studies there was little provision for allowing a learner to glimpse the cognition of effective learners, they were only told what to do. What was needed was a way of systematically allowing an inexpert person to learn the expertise of others, in particular the way that experts use old information in new ways for solving new problems.

Campione, Brown and their colleagues have been highly influential in the development of metacognitive forms of training. Reeve and Brown (1985) considered there have been a lack of coherent conceptualisation of the development of metacognition and propose that Vygotsky's social developmental theory holds the key to further developments. A major criticism made by Vygotsky of educational practice at his time was directed at the methods of testing children's competence. He argued that cognitive tests "almost always deal with the actual developmental level" (Vygotsky, 1978) and not what the child's capacity to develop is. In other words cognitive tests assess that which has happened and not what could happen. He suggested that this important aspect of intelligence could be gauged by - "offering leading questions [to the child], or show [to the child] how the problem is to be solved and the child solves it...or if the teacher initiates the solution and the child completes it, or solves it in collaboration with other children...[that is] <u>what children do with assistance of others might be in some sense</u>

even more indicative of their mental development than what they can do alone" (Vygotsky, 1978, p. 85, emphasis mine).

The difference between what people do with and without help he called the zone of proximal development which he defined thus [as the] - "...*distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined by problem solving under adult guidance or in collaboration with more capable peers"* (Vygotsky, 1978, p. 86). That is an inexpert person's potential for a task could be gauged against how much guidance they require.

The provision of guidance from an expert to an in-expert on certain skills provides a microcosmic stage for the internalisation processes which Vygotsky held as leading to the development of higher psychological functions. It illustrates thinking as a social activity which is initially shared between people (e.g. between an expert and a novice), but gradually internalised into the cognitive repertoire of the novice to reappear again for solving future problems (Brown, Campione, Reeve, Ferrara, & Palinscar, Personal communication). "The fundamental process of [such] development is the gradual internalization and personalization of what was originally a social activity" (Brown et al., personal communication). Vygotsky (1978) thus held that thinking appears twice: first on the social level between people (interpsychologically), and later, on the individual level, inside the person (intrapsychologically).

Western Psychologists, such as Campione and Brown have found Vygotsky's concepts of internalisation and the zone of proximal development to lie at the heart of means for educating children with learning disability in metacognition, "...theorists of cognitive development from different cultures have long believed that individual thought processes may have their genesis in social interactions...Consistent with the views of Luria (1976) and Vygotsky (1978), we argue that awareness of self-regulatory activity has its roots in social interactions with others. Others, in the developing child's world, initially take responsibility for articulating metacognitive processes. With time, this responsibility is ceded to the child, who is required to take charge of her or his own thinking behaviors" (Reeve and Brown, 1985, p. 347). As we have seen such processes may well be denied to a majority of people with learning difficulties.

Campione and Brown first developed Vygotsky's suggestions for education in their dynamic assessment approach, and then in Reciprocal Teaching.

Campione, Brown, Ferrara, Jones and Steinberg (1985) used Vygotsky's concept of the zone of proximal development as a framework for investigating differences between children with learning difficulties normal propensity to learn and transfer reasoning skills.

They had two groups of 25 subjects. One group had a mean age 14 years, and a mean IQ score of 72 and a "mental age" of 10 years -- they were labelled mildly "mentally retarded". The second group were 9 years old on average, had a mean IQ of 118 and also had a "mental age" of 10 years.

Campione et al. attempted to estimate the amount of help needed by each child to attain a criterion level of learning, and then to estimate the amount of help they needed to transfer that learning. The problems used were similar to those in Ravens Progressive Matrices. These are "abstract reasoning" tasks in that they involve making decisions regarding which of a number of sample pieces might be a missing piece from an array. Decisions on the identity of the best fit rests on rules that can be abstracted from the organisation of the stimulus array. The rules taught were those of rotation, subtraction and imposition.

During learning children were given a computer display of the samples and arrays and were asked to solve these problems. If they did not choose the correct sample they would be given a hint by the computer (called PLATO) as to how to solve the problem (according to one of the rules). PLATO therefore acted as a device for measuring individual potential by the amount of help each person required. To estimate the minimum amount of help required by the learner to solve the problem, hints were given in a series form general to specific. For example, for helping a subject rotate a sample picture to look like an array picture, some of the following hints for a rotation might be given -
Hint 1: "This problem is called a turning problem, think about why it might be called that...Do you know how to solve the problem or do you want another hint?"
Hint 2: "This is row 1, put picture 1 in the practice box...now try to make the picture look like the second picture...
Hint 3: "Watch how it turns, now you do it". (Sequence adapted from Campione et al., 1985).
Transfer was tested on problems that required the simultaneous application of two previously learnt rules. They took the errors made and hints given as dependent measures.

There were no differences between the normal and "retarded" groups in terms of hints required for learning. However on transfer tasks the normal group made significantly less errors and required less hints than the retarded group.

This study confirmed the suggestion that children with learning difficulties may not be able to transfer learnt information as readily as normal children -- even when they are of the same "mental age". However it also indicated that they could learn skills through a hinting procedure. They therefore had the potential to transfer, albeit to a lesser extent than their normal counterparts. Campione and his colleagues developed Reciprocal Teaching (RT) device from these dynamic assessment methods. RT was principally designed for aiding children who experienced educational problems to attain greater success at reading comprehension and mathematics. It functioned as a systematised social interaction for children to learn skills in groups.

Reciprocal teaching addresses aspects of the strategies taught, the learning environment, and the role of the instructor.

Taught strategies are usually metacognitive in nature, involving for example, questioning, summarizing and predicting etc. These "self-testing mechanisms" allow the learner to monitor their current understanding. For example, if a learner could not summarize text then it is signalled that comprehension is not proceeding smoothly and therefore some action might need to be taken.

The general feature of the learning environment, for encouraging strategy up-take, is similar to dynamic assessment in that - "Reciprocal teaching was designed to provoke a zone of proximal development within which novices could gradually take on greater responsibility for learning" (Brown et al. personal communication). The meta-strategies structured the dialogues. The dialogues (initially modelled by the instructor) externalises the use of the these strategies, which the learner is then encouraged to internalise.

At the start of training the student is encouraged to complete a whole task with much support being given by the instructor. The teacher models and provides metacognitive skills and sub-skills of a task. Those skills that do not possess, or are not competent with, are provided by the instructor. Gradually, as the learner becomes more proficient with these new skills, the control of the task is ceded to her/him. That is they begin to take over control of the metacognitive processes. As Brown explains - "the novice's role is made easier by the provision of a supportive social context that does a great deal of the cognitive work until the novice can take over a greater degree of responsibility." (Brown et al., personal communication). Over time, then, the learner takes over more responsibility for getting the job done.

The instructor's role is to work as a group leader, and she/he deliberately "scaffolds" the cognitive activities of the group through asking questions, monitoring understanding, clarifying problems etc. The discussion is then given over to children who in turn provide models for the other children. The general idea being that the teacher takes control only when needed and hands over responsibility to the students whenever they are ready -- the instructors thus act as "sympathetic coaches" (Binet, 1909, in Brown et al, personal communication). Through their interactions with the teacher the students are guided to perform at increasingly more challenging levels.

The instructor also provides the learner with a model of expert behaviour - "She models mature comprehension-promoting strategies, thus making overt, explicit, and concrete thinking activities that are usually not open to inspection. Instead of being told to "monitor your comprehension", the students see how the teacher does this; by retelling content in her own words, by asking what something means, and by posing questions about main points." (Brown et al., personal communication).

Brown and colleagues (personal communication) summarised the approach as follows: "The goal is joint construction of meaning: the strategies provide concrete heuristics for getting the procedure going; the reciprocal nature of the procedure forces student engagement; and teacher modeling provides examples of expert performance."

Brown and colleagues have extensively researched this approach. Their first study concerned reading comprehension and involved over 650 junior high school and first to third grade children --who were at least two years behind on standardized tests of reading comprehension (and this considered as having some learning disability). The instructors were regular classroom teachers, who worked with small groups of these students.

On entering the study children scored about 30% on independent comprehension tests. Intervention consisted of the elements discussed above. An instructor led (and modeled) discussions and then released "discussion control" over to the learners, with the aim of the children gaining metacognitive activities such as summarizing and questioning, for them to gain independent control over tasks. Tasks were the reading of passages. Passages followed each other without coherent thematic links, such as a story about volcanoes followed by one on dinosaurs, and then aquanauts.

The following sequence provides an example of an intermediary level of comprehension skill being developed by children in a reciprocal training environment. After reading a story on aquanauts a discussion was started by a question -

Student 1: "My question is, what does the aquanaut need when he goes under water?"
Student 2: "A watch"
Student 3: "Flippers"...
Student 1: "For my summary now: This paragraph was about what aquanauts need to take when they go under the water"
Student 5: "And why they need those things".
Student 3: "I think we need to clarify gear".

Student 6: "That's the special things they need".

Student 1: "I don't have a prediction to make.

Teacher: "Well in the story they tell us there are "many strange and wonderful creatures" that the aquanauts see as they do their work. My prediction is that they'll describe some of these creatures..." (Extract taken from Palinscar & Brown, 1986, in Brown et al., personal communication, emphasis mine).

As can be seen the dialogue the children have accomplished a number of metacognitive processes (asking a question, making summaries, clarifications and predictions about the text) which have helped them to comprehend the text more fully than they had others previously. Overall - "The students clearly internalized the types of interactions they had experienced, improving not only their ability to paraphrase and ask questions of clarification, interpretations and prediction, but also in their ability to assume the role of teacher producing their own questions and summaries, and evaluating those of others" (Reeve & Brown, 1985, p. 350).

Over 80% of children gained scores of between 75% to 80% on independent tests of comprehension on five days after training. They also maintained such "mastery" for six months to a year after instruction, and - "they generalize to other classroom activities, notably science and social studies; and they improve approximately two years on standardized tests of reading comprehension" (Brown et al., personal communication).

Brown and her colleagues then extended their work with text comprehension to the comprehension of mathematics for "normal" children. Campione, Brown and Connell (1989) maintained that there is considerable agreement that the way in which mathematics it taught in schools lead to students' failure to understand what they are being taught. They argue that in traditional mathematic teaching there is little reflection on the meaning of what is being done. They therefore proposed that reciprocal teaching might provide a procedure for ensuring discussions about the conceptual nature of mathematical problems. Again they used comprehension monitoring activities (questioning, summarizing, clarifying and predicting) to scaffold discussions between teachers and students (junior high school) so as to engender reflection - "The four activities became rituals that made sure that a discussion took place and forced comprehension monitoring of oneself and others" (Brown, Campione, Reeve, Ferrara & Palinscar, Personal communication).

An additional step with mathematic instruction was the inclusion of a "reflection board" onto which the group as a whole externalised the state of play of their attempts in terms of goals, plans and solutions.

Campione et al. (1989) therefore had high school teachers train children metacognitive strategies for attempting mathematical problems such as single variable linear equations. The children were then tested for transfer of skill into further mathematical problems such as monomial by binomial equations. A control group were taught mathematical skills by traditional didactic means. Initially the students were given expert modelling by the teacher, their activities would then be scaffolded through reflective processes, and towards the end of training they would receive "coaching" by the teacher. Another extra component, towards the end of training, was "problem extension". In this they were posed with a variety of related problems, which were designed to accentuate the need for understanding the problem in the context of its set, and thus make a student aware of the general use of their strategies -- that is transfer. It was found that a "reciprocally taught" group outperformed the control group on both training and transfer tasks (Campione et al., 1989). On the linear equations over 60% of the RT subjects were correct, against only just over 20% of the traditionally trained group. On the transfer tests (binomial equations) over 30% of the RT group were correct whilst there were none of traditionally trained subjects correct.

In summary Campione and Brown and colleagues viewed metacognition as a level of cognition arrived at by a child after they have internalised the social interaction of others -- that which earlier controlled their behaviour. Thus metacognition serves to organise and direct thinking activities. Internalisation processes, they argue, can be engineered around specific task areas, such as comprehension monitoring. In this a dialogue is constructed in which a task expert (such as teacher) reveal their strategic, and meta-strategic, processes for dealing with such tasks. From this dialogue a learner could be encouraged to internalise strategies to monitor and direct their thinking. The internalisation of metacognitive strategies in Brown and colleagues subjects promoted transfer.

The dialogue engendered within Campione and Brown's Reciprocal teaching is a major point of divergence from SIT methodology. RT dispenses with such processes as directed verbal rehearsal. Subjects in RT do not get provided with a specific menu of verbalisations -- as in a monologue -- which they have to rehearse, they are taught strategic thinking in the context of a metacognitively driven dialogue. The dialogue is seen as responsive to each subject's zone of proximal development, through which they are guided to fulfil their potential. Intrinsic control through reflective awareness -- or metacognition -- may therefore be achieved for transfer effects through such interventions as RT.

A study by Schleser Cohen, Meyers and Rodick (1984) emphasises the need for including metacognitive processes in training for promoting transfer. They directly compared a metacognitively enriched intervention against a traditional self-instructional intervention. Furthermore they illustrated how aspects of metacognitive and self-instructional training may be blended.

They proposed that SIT with faded rehearsal makes relatively simple cognitive demands on a learner - "It requires the child to engage in memorial processes to reproduce the self-instructional statement, but does not require the child to draw on or integrate existing knowledge" (Schleser et al., 1984, pp. 188-189). They argued that training should require the use of self-generated search routines in which the learner actively scans and adapts their extant strategic repertoire to meet the demands of novel tasks and therefore promote generalisation (Schleser et al., 1984).

They compared such a metacognitive technique "directed discovery training procedure" against traditional SIT procedures. In the directed discovery training the "child was led to "discover" the strategy statement by interacting with an adult experimenter in a "Socratic" dialogue (Schleser et al., 1984).

Their subjects were 110 pre-operational and concrete- operational children (mean age 7 years 7 months; range 6-8 years 9 months). They were trained on a matching to familiar figures task (MFFT), and transfer was tested for on perspective taking tasks.

The children were assigned to one of four conditions. The first was a traditional SIT approach in which subjects learnt statements such as -

1. "What do I have to do here ?"
2. "I have to look real closely at the pictures..."

In the second condition, directed self discovery (Socratic) condition, the same statements as above were taught, but they were embedded in extra questions (underlined below) such as

<u>1. "What was the first thing I had to do ?"</u>

to which answer the Instructor replied for example -

<u>2. "Oh, I get it. You mean I asked myself,</u> What do I have to do here ? I have to look more closely at the pictures"

Clearly the children were being made privy to the knowledge that they are learning to talk to themselves. In the third condition the children were didactically trained, and in the fourth they were not given training.

Pre-operational and concrete-operational children who received strategy training through either SIT or directed discovery were the only ones to demonstrate significant improvements on the training task. Only the concrete operational in the directed discovery condition improved significantly on the generalization task.

Schleser et al. concluded that, first, simply listening to strategies for problem solving appears insufficient for their meaningful acquisition and application. Secondly, even if self-instructionally trained children learnt to use a strategy well on the training task (MFFT), they gained little to help them in general strategy construction or modification. Directed discovery thus led to transfer because - "although the self-instruction statements were geared specifically for the training task, the procedure for generating and applying the strategy was general to a variety of problem solving situations" (Schleser et al., 1984, p. 197). Here we see how metacognitive activities such as questioning and monitoring take control more fully over to the learner, and impact on their cognition in such a way as to make them aware of the generalisability of strategies. *That is they had been taught how to think over what to think* (Brown et al. personal communication).

Summary and research questions:

Belmont, Butterfield and Borkowski (1978) suggested that if we were to effect generalisation we have to ask how people with learning difficulty could be trained to invent for themselves programs for new situations. The goal being to make clients capable of making strategies learnt in previous situations meet the demands of new situations, independently (Williams & Ellis, 1991).

The cognitive literature indicated that such processes could be taught, but no systematic means existed. Since there have been fundamental developmental processes denied to a majority of people with learning difficulty, and that they are capable of developmental progress along normal pathways, developmental theories of self-regulation seemed reasonable blueprints for training attempts. Such a theory was that of Vygotsky's, which holds that what is external to children and controls them may become internalised for them to control their own behaviour. This aspect of Vygotskian theory was developed into SIT. Through SIT learners learnt instructions to control their behaviour. First the instructions are modelled by a trainer. Then the trainer controls their behaviour through the instructions, and then they being to rehearse the instructions to go with behaviour.

SIT had some success in generating self-control. However the degree of intrinsic control developed by SIT generally appears to have been too limited to sustain consistent transfer. Thus SIT was seen as failing to fully impact on the cognition of the learner for enabling them to generate and apply strategies other than in the training environment. It tended towards relying on generalisation "controllers" outside the person rather than inside and thus it failed to achieve "reflective awareness" in learners.

Vygotsky's theory was re-interpreted to form Brown and Campione's Reciprocal Teaching. In RT Brown and colleagues attempted to teach specifically metacognitive skills through a dialogue. The dialogue was structured according to Vygotsky's zone of proximal development within which problem solving behaviour was orchestrated by metacognitive strategies. This dialogue is a major point of comparison between SIT and RT. In RT subjects are not given an explicit list of instruction to be learn by rehearsal to go with a behaviour, rather they are taught internalisable verbalisations in the context of a "naturalistic" dialogue scaffolded around metacognitions. RT promoted metacognitive behaviour in children which transfered across situations. Transfer effects of such "sophisticated covert strategies" have not, however, been universal across subjects (Campione et al., 1985; Schleser et al., 1984).

Many questions remain. First and foremost, can effective self-regulatory programs be developed for people with learning difficulty? One, SIT had some hope of promoting cognitive regulation however it lacked consistent transfer effects. Was SIT lacking in cognitive impact and thus lacked transfer, or was it hamstrung by a lack of knowledge regarding individual differences which led to such variant outcome effects? In any case can systematic means be found to teach higher level cognitive skills than attained by SIT which would bring client's own control over cognition into focus for effecting transfer? Would such attempts be doomed to failure through the complexity of such approaches being beyond the capacities of such persons?

Implications for the present research:

The present thesis therefore had two principal aims regarding training approaches (i) to establish methods of training that enhance the transfer of learning for people with learning difficulties, and (ii) to develop methods of training for skills that may have benefits for them in their adjustment to new environments. It seems that many people with learning difficulty may not be very able at following instructions, clarifying ambiguous instructions, requesting information for performing tasks or at providing information for others. We therefore decided to test and train such communication skills.

We attempted to replicate normalised situations under experimental conditions in the giving and receiving of map directions. Direction giving tasks provide a context for a person to readily demonstrate communicative skills, such as (in the speaker role) for providing detailed information for others to follow or for (in the listener role) clearing up message ambiguity by requesting more information.

On the tasks we designed, one person, with icons connected up in a certain order, had to give directions for another person (who also has the same, but un-connected icons) for her/him to link up their icons in the same order. One of the skills required by a speaker on these tasks is that of making comparisons between referent objects that share the same categorical name. For example one of the maps had a target referent (that which needs to be selected) such as a car, but there was also a second car (different in colour). A speaker would thus have to give a message that distinguishes between each car (e.g. "The white car and not the grey one"). A listener, when given inadequate comparisons between referents (e.g. told to "go to the car"), might either make a guess as to which referent to choose or, with more effect, make some form of request for a more informative message (e.g. to ask "which one?").

Traditional techniques for teaching skills to people with learning difficulties have depended on didactic procedures, such as direct supervision by teachers (Agran et al., 1986). After training clients are expected to transfer skills to other settings -- settings which have dynamic changes in tasks, co-workers, supervisors and operating procedures (Agran et al. 1986). The use of such external teaching methods have been criticised for increasing the likelihood that work behaviour would only be performed in the presence of the trainer (Agran & Martin, 1987). As we have detailed above recent approaches have attempted to make more use of the fact that the constant variable between the training and transfer environments is the learner her/himself. Therefore the ability to transfer learning between situations has become linked to the learner's capacity for controlling their own behaviour (Gow & Ward, 1985). Teaching programs that effectively exploit such self-regulation have therefore been seen as more likely to promote transfer than training relying on external control.

We therefore designed two intervention approaches for training communicative and self-regulatory skill, both descended from Vygotsky's Social-developmental theory, (i) first a typical Self-instructional approach, and secondly (ii) a Metacognitive approach. We also include a third training condition, non-guided practice, as a control.

Vygotsky (1978) had argued that speech was both a communicative and cognitive tool which provided human-kind with means to control both their environments and themselves. Furthermore the phylogenical development of self-regulatory speech was evident in the ontogenic development of children's use of language for their own control. In general Vygotsky proposed that a child learnt to control themselves by internalising the language which caregivers had earlier control their behaviour by. The stages of this self-regulatory inner speech's development has been taken as a structure for representing and guiding training. SIT and Metacognitive training differ in their methods of achieving 'internalisation'.

The general goal of SIT is to access what individuals say to themselves to affect behaviour by allowing an individual some control over the antecedents of behaviour through verbally mediated self-commands (Gow & Ward,1985). For this SIT involves verbal and behavioural modelling of the desired behaviours by a trainer for a learner to copy. The main component of the model provided for a learner are self-instruction's. These are statements for guiding task behaviour. For example, for monitoring a persons perspective and for the making comparisons between referents, we will use a variation of the following self-instructions -

Self Instruction of a speaker for task skills of monitoring the effect of a message and comparing referents:

1. The Line goes from the tree to the house.
2. I'm to ask if you got there.
3. Did you get there ?
4. Oh, if there's two houses, which one?
5. The large house or the small one - the large one
6. I'm to ask if you got there.
7. Did you get there ?

These self-instructions were modelled by the trainer for the trainee, who would be asked to learn and apply them by rehearsal.

Campione and Brown and colleagues viewed metacognition as a level of cognition arrived at by a child after they have internalised the social interaction of others -- that which earlier controlled their behaviour. They constructed a metacognitive training program, Reciprocal Teaching (see Campione & Brown, 1987). For Campione, Brown and colleagues, however, training need not rely on the direct rehearsal of a set of self-instruction's through rehearsal. For them internalisation could occur in the context of a more conversational dialogue. Such a dialogue was led by a task expert (such as a teacher) and through it they reveal their strategic and meta-strategic processes for dealing with certain tasks for the learner. From such a dialogue, then, a learner was encouraged to internalise strategies to monitor and direct their thinking.

Our metacognitive training methodology, developed from RT, combined metacognitive strategies such as questioning, predicting, summarizing and clarifying with internalising processes such as modelling and guided practice. As in RT these strategies provided a framework for organising and orchestrating task appropriate behaviour, and when used by the trainer they provided an example of expert performance for the trainee to imitate. The dialogue nature of the training also forces the learner's engagement in solving the problem at hand, a section of the instructor's part in this dialogue is shown below-

Example of metacognitions for a speaker of task skills for monitoring the effect of a message and comparing referents:

[Selective comparison questions when the target referent is one of two houses]

1 Monitor summary

So what should we do ?

I'm going to check if you're doing it o.k. by asking you if you made a line from the tree to the house (SUMMARY)

did you get it ?

2. If there's two houses how do I make sure you pick the right one?
3. Is one different to the other?
4. Is one a large house and one a small house?
5. The big house.

Metacognitive training therefore attempted to access the memory processes of individuals through a dialogue. As in SIT, Metacognitive training attempted to provide a context for a learner for setting and meeting the demands of tasks as modelled by the trainer. In metacognitive training the trainee was made conspiratorial with the trainer in delineating what was to be done through the dialogue. This was encouraged because the dialogue was woven around a number of critical, metacognitive, questions. The hypothesis was that these questions are crucial in building up and organising a schema for the task and may lead to an abstraction by the trainee of general problem solving skills for a particular domain of tasks. It should be noted that in Metacognitive training there was no explicit attempt made to learn task-statements by rehearsal. Vygotsky observed that these abstract reasoning skills of "reflective awareness and deliberate control"

(Vygotsky, 1978) were the least developed by people with learning difficulties and should therefore be focused on in training.

After training on maps in the speaker role the effects of training were measured in performance on a number of communication tasks - in both communication roles. After such testing the subjects were profiled through correlating performance changes from baseline to performance at baseline on a variety of psychometric tests. Not only did we hope to show what personal characteristics make some people more able to profit from each type of training, but to monitor what cognitive and/or linguistic skills each program was capable of accessing.

Training tasks that involve communication skills, and intervention programs that utilise conversational modelling based on Vygotskian principles seemed a perfect marriage.

Our overall aim in this research was to provide clients with means to assess the similarities of conversational situations, trained and un-trained, for they themselves to choose to use referential communication skills.

Chapter 4: Methodology for training communication skills

General introduction:

This study was designed to investigate a number of issues regarding the communication skills of people with learning difficulties.

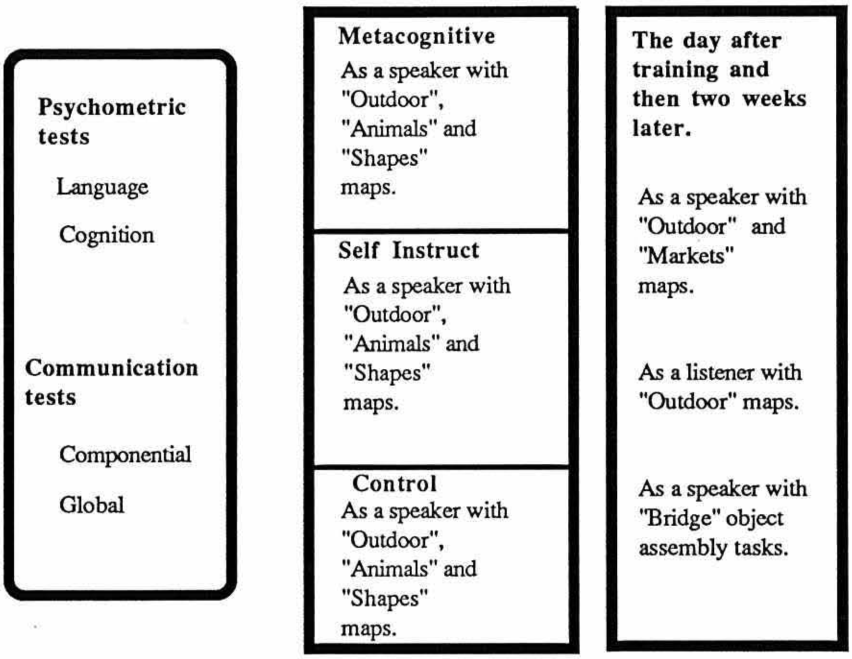
First we wanted to discover if our subjects had measurable difficulties in communication. Secondly, if there were such problems, we wanted to provide different kinds of training to establish if communication skills could be trained, and what kind of training would be most effective. Third, we wanted to ascertain if any specifiable difference between individuals in the study could have led to different outcomes from training.

The study was therefore designed as a general vehicle for three different, but related, experimental questions. Questions that could only be answered with a large number of subjects. The study was therefore required to be general enough in terms of abilities required for it for the inclusion of as many people as was possible, and then it had to be sensitive to the individual needs of each subject for them to demonstrate their abilities to their maximum.

The general method developed had three main stages. First there was the testing of linguistic, cognitive and communicative abilities. The communication tests isolated a number of key communication skills, and then those skills as orchestrated in more global context s, such as the in the giving and receiving of directions for completing maps and building objects. The second stage involved the training of subjects in the skills necessary for being effective speakers on map-based tasks. There were three conditions for training, Self-instructional, Metacognitive and Practice (Control). The third stage of the study was the testing of performance change in the speaker role on map-based tasks, and then the testing of the transfer of communication skill from the speaker role to the listener role (which was not taught) and to the speaker role with object assembly tasks. This general structure is summarised in Figure 1 below.

Figure 1: Overview of our study on the training of communication skills for people with learning difficulties.

Baseline Tests---->---Training---->----Transfer Tests



Each of these stages, with their component tests and conditions, will be described in turn. First of all though, we shall present the design of the study, and the subjects who took part in it.

Design:

The independent variable was the type of training in communication skills given to each subject, and the dependent variable was the subject's later performance on tasks both similar to those on which they had been trained (maintenance) and on tasks that were somewhat different (transfer). There were three types of training, Metacognitive, Self-instructional and practice (Control). Subjects were allocated into one of each of these interventions by a matching procedure. This procedure matched subjects in terms of cognitive, linguistic and communicative abilities.

This matched groups design allowed a comparison of each group's performance both before and after intervention.

Subjects:

There were 45 subjects aged between 21 and 60 years, with an average age of 38 (SD 9.88). Seventeen were females and there were twenty eight males. Fifteen were allocated to each training condition.

The subjects were adults with learning difficulties. They were all in either full, or part-time, attendance at one of three adult training centre's (ATC's) or one "Mental Handicap" hospital. Sixteen were in part-time employment or education at normalised centres. Selection of subjects for entry into the study involved two main stages. First the training staff at each centre received guide-lines from the experimenter as to what characteristics would make a person suitable for the study. These characteristics were, for example, that they had have some degree of language use, and that they had have no major sensory handicaps. Staff would then short-list a number of people who would be introduced, individually, to the experimenter. Following this the experimenter gave each prospective subject a general description of the study and asked for their help to conduct it. Those who volunteered were taken into the next selection stage.

In the second stage of selection the subject undertook a number of Cognitive and Linguistic tests. Their remaining in the study required them to understand and comply with the basic requests of these tests. The subject population may be described by their performance on these tests. These are, in the main, standardised tests of development. Some of the scores yielded could be given in terms of years and percentage of years (the results of these tests are given more fully in the Chapter 6). On the *British Peabody's Picture Vocabulary Scale* the mean age equivalent score was *5.46* years (SD, 1.91). On the *Test for the Reception of Grammar* the mean age equivalent score was *4.60* years (SD, 0.52). On the *verbal comprehension* test of the Reynell's Developmental language Scales (RDLS) the subjects' mean age equivalent score was *4 years* (SD, 1.19). On the RDLS *expressive language* scales they scored *3.81* years (SD, 0.84).

Their *average sentence length* was *4.27* words (SD, 1.98) and their *short term memory* for digits was *2.9* (SD 1.28), which may be extrapolated to give an age equivalent score of 2.8 years. Finally on *Ravens Progressive Matrices* the subject's scored a mean of *32.93%* (SD, 13.55) which is below the median score of 46% for 5.5 year old normal children.

We will now present the methodology that was utilised for the first stage of the research, the baseline measurement of linguistic, cognitive and communicative abilities. We will then present the methodology of the second stage of the research, that of the training and the testing of transfer of, communication skills.

RESEARCH STAGE ONE:
Baseline tests of Psychometric and communicative abilities:

There were two sets of baseline measures. Firstly, (A) Psychometric tests of linguistic and cognitive skills. Secondly (B) there were tests of communication, in terms of the individual components of communication, and of those components in interaction on global tasks.

A: Psychometric tests.

The language tests (a) were of vocabulary (Peabody), comprehension of grammatical structures (TROG), and on general receptive and expressive abilities (Reynell and Sentence Length). The Cognitive (b) tests were on abstract reasoning (Raven's), memory capacity (Short Term Memory Tests) and locus of control (Connel).

a. Language Tests.

i. British Picture Vocabulary (BPVS) (Dunn, Dunn, Whetton and Pintilie, 1982).

This is a test of the achievement of receptive vocabulary, that is, it shows approximately how much understanding of spoken English words a person has acquired.

Results derived by this test, when compared to standardised scores of "normal" children between 2.5 and 10 years, give an age equivalent score of vocabulary development for each subject.

ii. The Test of the Reception of Grammar (TROG) (Bishop, 1982)

This tests the comprehension of grammatical structures, from nouns and verbs through to reversible passives. It has been standardised on "normal" children from 4 to 11 years.

From this test we derived -

a. An age equivalent score.

b. An indication of where a person begins to fail on the test, which suggests which types of grammatical structures a person can understand, and those that she/he specifically cannot.

iii. Reynell Developmental Language Scales (RDLS) (Reynell & Huntley, 1985)

This is a general test to check on the comparative development of both receptive and expressive language abilities, as compared to standardised scores of "normals" from 6 months to 6 years.

iv. Sentence length test (Reynell & Huntley, 1985)

This component of the language tests provided a measure of the subjects' length of sentences. This is based on a 10 - 15 minute conversation between the subject and the experimenter from which between twenty and forty sentences per subject were analysed. The total number of sentences produced by each subject were then divided by the total number of words. Words were defined as by the Reynells expressive language test (1985).

b. Cognitive

i. Ravens - Coloured Progressive Matrices (Raven, 1947)

Ravens coloured progressive matrices attempts to test the ability to perceive and think clearly irrespective of verbal comprehension. The test items have been developed for the very young, those with learning difficulties and the elderly.

There are three sets of matrices corresponding to three sub-tests (A, Ab and B). Each set requires the filling in of a "missing" segment of a matrice from an array of possibilities. Set A requires the ability to complete continuous patterns which, toward the end of the test, change in one and then in two directions as spatially related wholes. Test Ab requires the ability to see discrete figures as spatially related wholes, and test B, the ability to think abstractly through analogies, such that the missing piece is the same to one element as another is to another.

The Coloured Matrices have been standardised with children from 5.5 through to 11.5 years of age. Of the 5.5 year olds half scored 42% or less. Of the 11.5 year olds half scored 88% or less.

ii. Short Memory Test (STM).

This was a test developed from Campione, Brown and Ferrara (1982). It measures the number of digits a person can retain and recall under two conditions. In the first condition (A) digits are presented singularly in sets for the subject to then recall, such as "5, 7, 8". In the second condition (B) the digits are presented again in sets but are also paired such as "68, 42, 23".

Age differences in retention of digits have been found to range from 2.3 for 2 year olds up to 4.3 for 5 year olds (Dempster, in Schneider & Pressley, 1989). Spitz (1966/1971) found that MR subjects' (chronological age of 14 years) recalled 3-4 digits as opposed to normal adults span of 5-7.

Materials:

There were two series of digits required for this test. Both series had sets of digits that increase in the number of digits that were to be recalled. The first series had digits that were given individually, such as "six, seven, seven, two" whilst the second series had numbers that were given in meaningful clusters, such as "sixty seven, seventy two". The series started off with a set of five trials of one digit each, then the next set or five trials had 2 digits each, and so on. Both series are shown in the appendix 1.

Procedure:

Subjects are first told that they are going to be tested for "how good their memory is for numbers". They are then given the first test (test A). In test A the experimenter reads each digit of the first series for the subject. The subject is allowed time in-between the presentation of each digit to reply with the digit they were given. The experimenter then goes through the next set which has two digits. The subject is asked to wait until she/he has heard both digits of each trial before replying. The procedure is the same for the rest of the trials. If the subject produces the same digits as she/he was given, in the same order, on a trial, then that trial is scored as correct. Once the subject has been unsuccessful five times the test is completed. The same procedure is used for the second series. On the second series, however, there are clustered numbers, and care is taken to announce the digits as slowly as was the case for the digits presented individually.

The scoring system gave a set as passed if either all the digits were recalled on that set or if any trial was passed on the next set. A subject's total of passes on a set in which they did not pass on all the items can be used to give a score to one decimal place. For example a subject who successfully recalled all the two digit items, and then only one of the three digit items (and none thereafter) would be given the score of 2.2.

iii. Locus of control (adapted from Connel, 1985).

This test attempts to measure where, and to what degree, a person perceives control over their outcomes in social academic settings. There are three dimensions extracted for analyses, with the self, with principal others, or in the unknown. Within these dimensions there are divisions for assessing control on or in physical, cognitive, social and general tasks or events.

Our test was based on Connel's multi-dimensional measure of children's perceptions of control. It contained statements about the self for a subject to agree or disagree with to varying strengths. Connel (1985) had found that this measure of control correlated with other measures of perceived and actual competence with children between 8 and 14 years of age. Connel's statements were redesigned for application with adults with learning difficulty (see appendix 2).

B: Baseline tests of communication.

There were two types of communication tests. First (A) those that isolated component skills of being a speaker or listener, and secondly (B), those that combined these skills in a more global context, that of giving and receiving instructions both the use of maps and on object assembly tasks. The order of presentation shown here reflects the order in which the communication tests were given to the subjects.

a. Communication component tests.

The first four tests described below are tests of the components of the speaker role, and the last test (the fifth) of the components of the listener role. These tests comprise an 'atlas' of communication skills. These tests are -

i. Basic Perspective Taking.

ii. Perspective Monitoring.

iii. Selective Comparison.

iv. Referential Communication.

v. Message Adequacy.

i. Basic Perspective Taking

Introduction:

This was a test of how well subjects' could gauge that a person with a different vantage point to themselves, and therefore a different knowledge base, might not be able to see the same objects as they could, and thus know what they know. The test is based on Patterson and Roberts (1982) Basic Perspective Test which showed that 86% of their 42 child subjects (aged 4-6 years) were able to realise, before any messages were created, that they could identify a target whilst a listener may not.

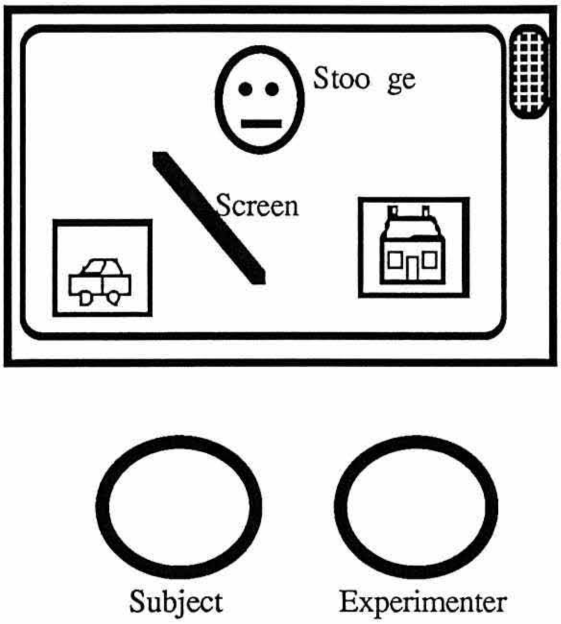
Materials:

Stimuli consisted of stimuli cards which were presented on a pre-recorded video- film in which a stooge was represented in an interaction with the subject.

The stimuli cards were 10 black and white pictorial representations of objects and structures of everyday environment such as a large house, a small house and a car (as can be seen in figure 2 below).

The "interactive" film had a stooge sat facing a camera from behind a desk (also see figure 2 below). To one side of the desk there was a small screen (black, 6" square) placed between the stooge and camera. The screen blocks the stooge's vision to one quarter of the desk near the camera. Next to the screen - visible to both the camera and to the stooge - a pictured referent is placed. Another pictured referent is placed on the desk, but to the camera's side of the black screen, and therefore not visible to the stooge.

Figure 2: The materials, apparatus and set up for running the Basic Perspective Taking test. The subject is shown a film in which a stooge is shown being able to view one picture (such as the house) but not another (such as the car), because of a screen.



The experimenter had a sheet for checking responses that also contained instructions.

Apparatus:

For preparing the stimuli cards the we used Snodgrass and Vanderwart's (1980) standardised pictures, Macintosh Hypercard and Macintosh Image Processors.

In preparing the video film experimenter we used a video camera and recorder.

For presentation of the stimuli a video-recorder and television was used.

Procedure:

The subject is asked to sit next to experimenter to view the television. She/he is then given instructions, for the first trial, which asks them to -

"Watch Jane [the stooge] on the television. There are pictures on desk -- which is in front of her".

Then they are asked -

"which picture can she see, and which one can't she see ?"

That question is then asked over the next 4 trials. The subject is also told that they can indicate their choice by pointing.

On each trial the experimenter may prompt an answer from the subject by pointing at both of the pictures on the screen, in turn, and ask "can she see this one?"

The experimenter notes each of the subjects' choices on a scoresheet.

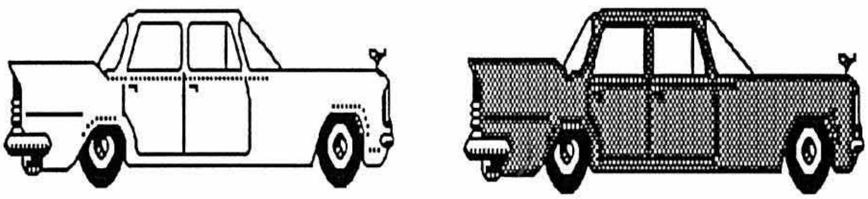
At the end of the session the experimenter counts the number of correct responses out of ten possibilities.

ii. Perspective Monitoring

Introduction:

This tests a person's ability to take the listener's perspective when the listener is given ambiguous messages to choose referents. Effective speakers appreciate that when a listener has to choose one of two similar referents (such as one of two cars, one being white and the other black, as can be seen in figure 3 below) then they have to be given a message that makes distinctions between the referents. For example, if a listener was presented with the referents in figure 3 below and told to choose "the car", then that message would be inadequate, whilst the message to choose "the white car" would be effective.

Figure 3: An example set of two referents. The referents have the same name, "car", but are distinguishable by other features, such as colour.



Listener have therefore to be given messages that include differences between referents. A speaker therefore needs to evaluate messages, before or after they are given, to monitor if they apply to one or more referents (such as that saying "car" would apply to both referents).

Markman (1977) showed that young children (first graders - 4-5 year olds) were very poor at detecting blatant ambiguities in instructional messages prior to actually trying to carry them out.

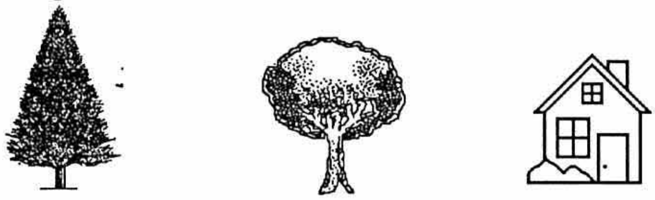
In this test subjects watch a stooge that acts as a listener on a television. The "Speaker" is then heard giving messages to the "listener" that either distinguish a referent from other referents for making a choice, or messages that fail to make a distinction possible. Immediately prior to the televised interchange the subjects were presented with a card with the target referent pictured. The subjects were then asked to tell the experimenter which messages made the referent objects distinguishable.

Materials:

This test required a video film for presenting the subjects with a situation in which a listener is given the task of selecting a referent from a number of referents based on the messages of a speaker. The speaker, however, provides messages that are often ambiguous, and the subject has to tell the experimenter if each message given to the listener is going to be enough for them to make a positive selection -- before the listener actually responds.

The first materials we required were sets of pictured referents. There were 30 picture sets in total. Each picture set consisted of potential and target referents. An example is given below in figure 4 (given in full in the appendix 3).

Figure 4: An example set of three referents for the Perspective Monitoring test. Two referents have the same general name "tree", but are distinguishable in terms of secondary characteristics, such as one is evergreen and the other is deciduous.



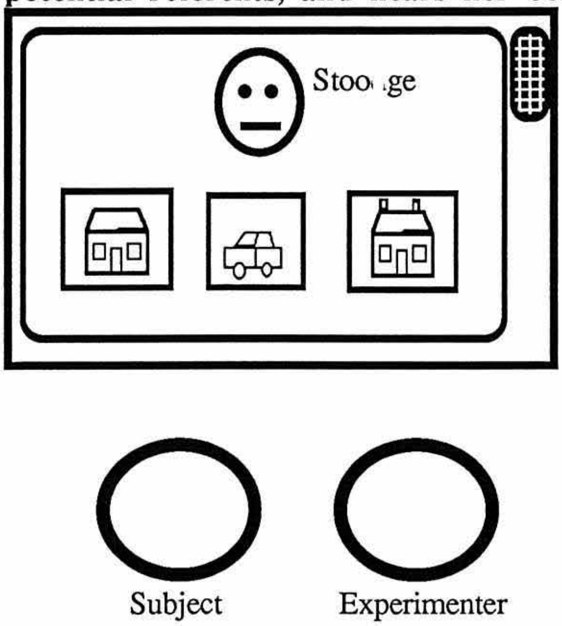
There was one target per set over the series, from 1-30. Over the trials there was a blockwise increase in the number of differences - and in the fineness of differences - that were necessary for describing the target referent of each set uniquely.

The first set had primarily object names as the difference (such as there was one tree and one house), then some additions and subtractions (one house with a chimney and one without), an eventually there were rotations (a tree with a bird sitting on the top branches, and another tree with a bird sitting the quarter of the way down).

The picture sets were used in creating an "interactive" video-film.

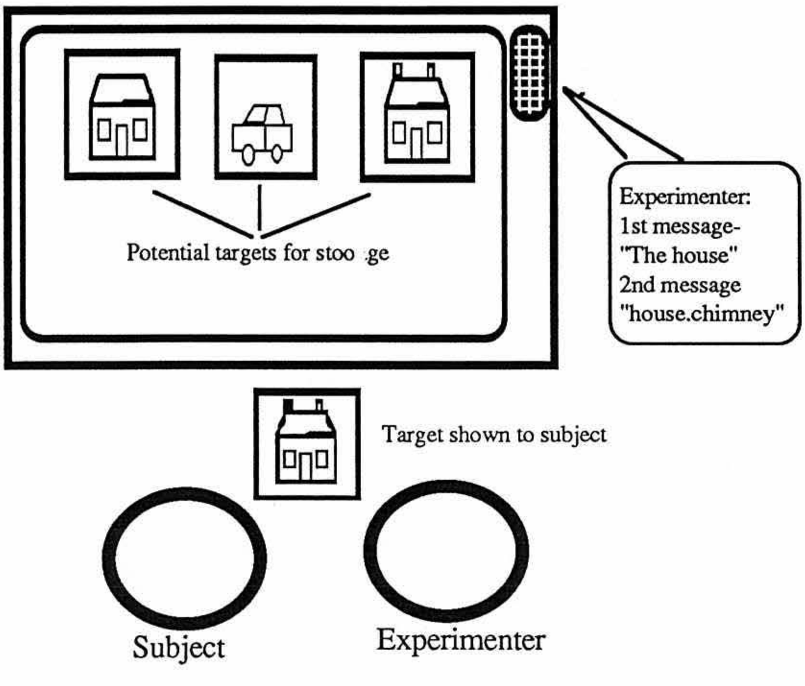
There were two scenes to the film. In scene one (as shown below in figure 5) a stooge sat at desk on which picture sets was placed. The stooge was then shown being "given instructions" for completing the task.

Figure 5: The first scene of the film for the Perspective Monitoring test. In this scene the subject sees the stooge sit in front of a number of potential referents, and hears her being given instructions for the test.



In scene two the top of the desk is shown. The Television screen shows clearly the picture set that is on the stooge's desk (see below in Figure 6).

Figure 6: Scene two of the Perspective Monitoring tests in which the stooge is given messages of varying accuracy for selecting a target referent.



Scene two unfolds to show each of the thirty picture sets of referents for the thirty trials. For a third of all trials the first and only message given to the stooge describes the target referent uniquely. In another third, the identity of the target becomes clear on the second message, and in another third, on the third message. (The messages used are shown in appendix 4). The number of messages required per set increases over the duration of the test. For example none of the sets requiring three messages occur in the first third of the trials, 3 in the second and 7 in the last.

Over the trials if the stooge does not choose by pointing at a referent, another message is given, and if that does not provide enough description, yet another. The stooge when she "knows which one to choose" indicates her choice (which is always correct) by pointing at the target referent.

The experimenter had a dialogue scripted for his interaction with the stooge on the film. The script had up to 3 sentences per picture set for describing the target referent. There was a gap of about 3 seconds between each message to allow the experimenter to stop the tape for the interaction with the subject.

For the actual interaction with the subject we required a further series of 30 cards. These pictured the target referents of the picture sets.

The experimenter's script was also used to record the subject's responses.

Apparatus:

For preparing the stimuli cards we used Snodgrass and Vanderwart's(1980) standardised pictures, Macintosh Hypercard and Macintosh Image Processors.

In preparing the video film experimenter required a video camera and recorder.

For presenting the stimuli a video-recorder and television was used.

Procedure:

The subject is asked to sit facing a television (as shown above in Figure 5) and she/he's given the following instructions for the task -

"If we wanted a person to choose something we have to be very careful about what we tell them. Here you're going to see and hear me tell Jane [the stooge] to pick one of a number of pictures. She might not get it the first time because what I say might not be good enough. If you think she could definitely pick the one I mean tell me. She is not supposed to guess -- she has to be sure which one I mean".

The film is then presented to the subject. The first scene shows the stooge being given instructions, which emphasise that she is not allowed to guess which pictured referent the target is, but has to wait and be sure. Then Scene two is presented (as shown in figure 6), in which the picture sets are presented.

At the beginning of each trial the subject also given a card (which is placed on the desk in front of subject between her/him and the television) on which there is the target referent for that trial. For example a conifer tree may be a target for a set containing both conifer and deciduous trees and a house. For each trial the experimenter (on the film) gives the stooge a message, or sometimes a number of messages, to identify the target. After each message the experimenter pauses the film (freezing the trial stimuli on screen) before the stooge makes (or does not make) her choice. The subject is then asked to indicate if the Stooge -

"knows which one to pick?"

The subject may also be prompted with -

"is she going to point to one right now?"

If their response is correct then the film is continued and the subject sees the stooge point to a picture (and sometimes she also says "this one"). If the subjects' response was incorrect (saying that the Stooge 'knows' when she could not) then the film is continued and they hear the stooge being given another message from the experimenter. If the subject indicates that the stooge does not know which the target referent is, after she has been given an unambiguous description of the referent, then the subject is shown the stooge make her choice (without, of course, no need of a further message).

The subject's responses are recorded by the experimenter.

iii. Selective comparison

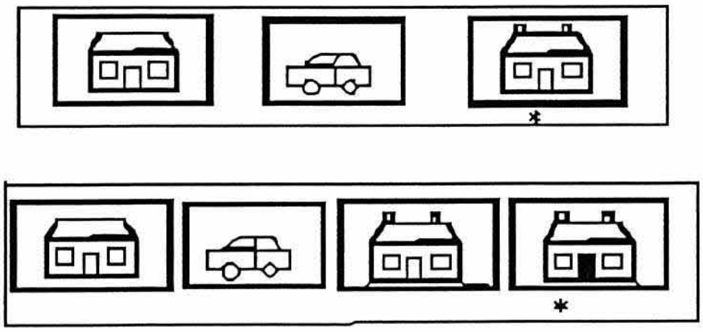
Introduction:

The Selective Comparison test assesses a person's ability to describe differences between objects that share some other common features (such as houses that may be large or small, with chimney stacks or not). Vurpillot (1968) showed that 4 year old children, when asked to say if two pictured houses were identical, tended not to make the relevant comparisons that 9 year olds would. In this test subjects were prompted by the experimenter to describe differences between up to 5 referents over 30 trials.

Materials:

Thirty picture sets were constructed which were similar to those outlined above for the Perspective Monitoring test. That is, objects (such as houses, cars, trees etc) were arranged on cards in an increasingly more complex combinations. However on each set one referent was asterixed. A sample is shown below in figure 7 (they are given in full in the appendix 5)-

Figure 7: Examples of referent sets in the Selective Comparison test.



The sets varied over a number of blocks in the number of objects (target and potential referents) pictured and in the amount and type of differences that existed between them (similarly to the Perspective Monitoring sets above) -- which are summarised in table 1 below.

Basic differences were of name, colour, size and shape. Fine grain differences were, for example; 'addition', the inclusion of a secondary characteristic such as an aerial on a car, the 'rotation' of such an aerial, the 'direction' such an addition might point in compared with another (one aerial straight up and another at an 45 degree angle). There were also 'position', which is where the secondary object might be placed, such as an aerial on the boot rather than the bonnet of the car and subtraction, this is "taking away" a secondary object generally shared by the group of objects, e.g. a roof of a car. These differences between objects would therefore become more numerous and more fine grained over the duration of the session. The first block contained 4 trials of 2 referents. These referents needed only one selective comparison for their identification, and these comparisons would be "basic" - name, colour etc. The next block contained 8 trials of three referents. At least two selective comparisons were needed for the identification of the referents. The next block (number 3) contained 13 trials of four referents. Selective comparison here were more difficult since, first, in the case of one major distinguishing feature (e.g. "largeness") a referent still needed to be compared to another three referents, and secondly there were not only more referents to be compared to, but there was the inclusion of even more distinguishing features for comparison. The last block (number 4) had five trials of five referents, again giving more referents for comparisons and necessitating even more comparisons.

Table 1: Level of difficulty of each of the referent sets that correspond to the 30 trials of the Selective Comparison test.

Trial	No of Objects	Type of Differences
1	2	Name
2	2	Addition
3	2	Colour
4	2	Name or Shape
5	3	Name & Size
6	3	Name & Size
7	3	Name & Size
8	3	Name & Colour
9	3	Size & Colour
10	3	Shape & colour
11	3	Size & Shape
12	3	Size & Shape
13	4	Size & Shape
14	4	Size & Colour
15	4	Size
16	4	Size & Shape
17	4	Size
18	4	Size
19	4	Size & Addition
20	4	Shape & Addition
21	4	Size & Rotation
22	4	Size, Colour & Position
23	4	Addition, Position & Rotation
24	4	Size, Shape & Position
25	4	Addition & Rotation
26	5	Size & Addition
27	5	Size, Addition & Rotation
28	5	Colour, Position & Rotation
29	5	Addition & Rotation
30	5	Addition & Rotation

The experimenter had a response sheet which had potential distinguishing attributes for each set outlined (again names, additions, rotations etc), and a space to score the subject's responses.

Apparatus:

For preparing the stimuli cards the we used Snodgrass and Vanderwarts'(1980) standardised pictures, Macintosh Hypercard and Macintosh Image Processors.

Procedure:

The experimenter asks the subject to sit alongside him, and then gives the subject instructions for the task. In these the subject is asked to tell the experimenter how one referent (the target which is asterixed) is different to the other referents. This instruction is given in the first trial whilst the experimenter points to the one referent that has an asterix below it (putting his finger on the asterix) on the first picture set. The experimenter may then ask the subject to name the target referent and also asks her/him to say how its different to the other, potential, referent.

In the next nine trials there are three extra prompts to -

"name them, [the referents] and tell me how they are different"
and also -
"how is this one [the experimenter points to the asterixed referent] different to this one and that one ? [experimenter points to the potential referents]".

Over the last twenty trials the subject is only given the prompt -
"how is this one [point] different ?"

After such prompts the subject is allowed time to make a response, after which (or after a pause of ten seconds) the experimenter asks "have you finished", if the subject answers "yes", or there is another ten second pause, the trial ends, and next one begins.

The experimenter recorded the subject's responses onto the scoresheet.

iv. Referential communication.

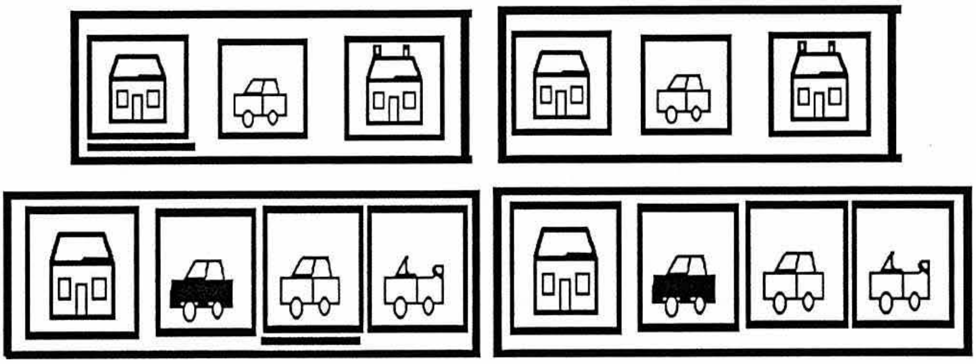
Introduction:

This was a test of speaker ability which attempted to combine both selective comparison and perspective monitoring skills within a similarly constrained context -- with the same type of materials and task structure. It also only required the locating of one target referent and was therefore not considered a global task. In this test the experimenter acted as a listener and the subject as a speaker, over thirty trials. The subject was given cards with target referents underlined which they had to communicate the identity of for the experimenter (acting as the listener).

Materials:

For this test thirty picture sets were constructed which were similar to those outlined above for perspective monitoring and selective comparison. Here, however, two duplicate series were made, with one series having one referent per picture set underlined -"targeted" - for the speaker, and the other series with none underlined - "un-targeted" - for the listener - as can be seen in the sample below in figure 8.

Figure 8: Examples of referent sets in the Referential Communication test. In the referent set on the left a referent has been underlined (targeted) for a speaker to differentiate for the listener who has the referent set on the right, who then has to underline the corresponding referent if it is made distinct.



Each of the thirty picture sets had up to four potential referents and one target. These target referents shared common properties with a majority of the other, potential, referents, such as they were houses. The picture referent sets are detailed below in table 2, and are given in full in appendix 6.

Table 2: Level of Level of difficulty of each of the referent sets that correspond to the 30 trials of the Referential Communication test.

Trial	No of Objects	Type of Differences
1	2	Name
2	2	Addition
3	2	Colour
4	2	Name or Shape
5	3	Name & Size
6	3	Name & Size
7	3	Name & Size
8	3	Name & Colour
9	3	Size & Colour
10	3	Shape & colour
11	3	Size & Shape
12	3	Size & Shape
13	4	Size & Shape
14	4	Colour & Size
15	4	Size
16	4	Size & Shape
17	4	Size & subtraction
18	4	Size
19	4	Size & Subtraction
20	4	Shape & Addition
21	4	Size & Rotation
22	4	Size & Colour
23	4	Addition, Position & Rotation
24	4	Size, Shape & Position
25	4	Addition & Rotation
26	5	Size & Addition
27	5	Size, Addition & Rotation
28	5	Colour, Position & Rotation
29	5	Addition & Rotation
30	5	Addition & Rotation

Apparatus :

For preparing the stimuli cards we used Snodgrass and Vanderwarts (1980) standardised pictures, Macintosh Hypercard and Macintosh Image Processors.

A screen was required for the interaction.

Procedure:

The subject is asked to sit alongside the experimenter at a desk. A series of thirty picture sets, and their duplicate series, are put face down on the desk.

The experimenter takes the first pair of picture sets (with the "targeted" referent), one from the first series and its corresponding duplicate from the duplicate series (the "un-targeted" referents). He then lays the set with a referent underlined in front of subject, on their side of the desk, and the other set (with no referents underlined) on his side of the desk.

Whilst doing this the experimenter says, "this one is yours, and it has a [for example the house] underlined. Mine hasn't any underlined".

The experimenter then picks up a pencil, and looks at his set, and asks the subject to tell him which picture-referent in their set is underlined so that he (the experimenter) could underline the same one on his set. At which point the experimenter also puts up a small screen between each persons' side of the desk, obscuring the view of each others' picture sets.

If the subject distinguishes a referent (from the others in the set), the experimenter says "thank you" and shows the subject the duplicate which would then have the corresponding, underlined, referent. The experimenter then asks the subject to see that both sets now have one referent underlined.

If the subject does not provide a distinguishing message, then she/he is given another prompt, "tell me which one of yours is underlined". If no distinguishing message is given by the subject, or no other response is made, the experimenter shows the subject his un-modified set. The experimenter would then point at the target referent, on the subjects' set, and say "it was that one". This counts as the first trial.

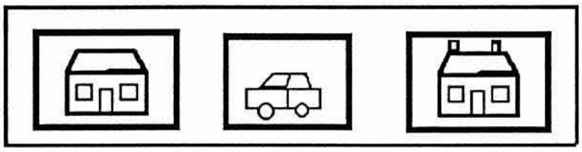
The experimenter then proceeds to present the subject with succeeding trials by placing duplicate sets ("targeted" for the subject and "un-targeted" for the experimenter) on each's respective side of the screen -- being careful not to turn the subjects' card face upwards until on the subjects' side of the screen. Over the next nine trials the subject may be given the prompt - "tell me which one of yours is underlined" on three of those trials. They are also given the prompt "remember I cannot see your card" on two trials before they are given time to attempt a response. On the last twenty trials there are no extra prompts. Over all trials (apart from the first one) the subject is not given feedback as to their message being effective, unless they ask. Trials are completed when the subjects have provided a targeting message, or when they have paused, after being requested to say if they have finished, for over ten seconds. The experimenter records the subject's responses onto a response sheet.

v. Message adequacy

Introduction:

This is a test of a subject's ability to respond appropriately to messages that are ambiguous. For example if a listener was shown the picture set in figure 9 below and given the message "the house" for choosing a house an appropriate response would be to ask "which one?". An alternate response in this context is to choose the referent that has the least extra features. For example, to the request to choose the "house" from the set in figure 9 a person might choose the house that has no chimney. This is a strategy based on the belief that the speaker would have mentioned the extra feature (the chimney) if house with the chimney was the target.

Figure 9: An example of a referent set in the message adequacy tests.



Abbeduto, Davies, Solesby and Furman, (1991) showed that nine year old children with learning difficulties (TROG age equivalent mean score of 5.16 years) were capable of making strategic responses to ambiguous messages when the context of the message 'suggested' a certain referent. However when compared to normal children (chronological age of 6.8 years and TROG age equivalent mean score of 7.9) under conditions that did not suggest a strategic response was possible to an ambiguous message, they were much less likely to respond with a request for more information and almost always made a selection.

In our tests ambiguous messages were provided for the subjects on half of forty communication trials. The most appropriate response to these messages would be to request more information, however subjects were also always given a context for making a strategic response -- such as by including objects with extra features.

Each subject was given two presentations of twenty trials. Ten from each series had an ambiguous message describing which referent to choose. In the first series, 'A', they were reminded that what a person, such as the experimenter, says to them might be inadequate. In the second series 'B', they were given a stronger indication of a speaker's liability to give inadequate messages.

Materials:

Three picture set series were required for this test. There was also a sheet containing messages corresponding to each picture set, for all three series, for the experimenter. There was one short practice series of four such picture sets. One experimental series of twenty picture sets (set A), and a second experimental series of twenty which also included a large circle (diameter of which was 4 cm) drawn above the picture referents (set B). All three series were represented in a booklet style, with a picture set per page.

Each set had three potential picture-referents (the subject of which were cars, houses, trees etc) such as in figure 9 above. (The three series of picture sets for this test are shown in appendix 7).

The experimenter had a sheet on which he had "descriptive sentences" -- one sentence for each picture set. For the first, series (practice), the experimenter had a sentence that uniquely described the target referent (for example "the house with chimney's" in figure 9 above). For the next two series (the first and second experimental conditions) ten messages isolated one target referent (again, for example "the house with a chimney" in figure 9 above), and ten could be applicable to two of the picture-referents (such as "the house" in figure 9 above (the messages created for each trial are given in appendix 8)).

Over both experimental conditions there were therefore -

i. Twenty descriptive sentences that unambiguously described the target. For example for a set consisting of a house that had a chimney, a house with no chimney and a car, the sentence "house with a chimney" would unambiguous target that referent.

ii. Twenty descriptive sentences that described, to some extent, two of the three picture-referents per set. For example for the same set as above in (i) the sentence "house" would ambiguously describe two potential referents.

The experimenter also had a response sheet containing boxes representing all the potential response outcomes of the subject to ambiguous messages, such as to

i. Make a strategic choice (choosing the pictured referent that has the least extra features).

ii. Make a non-strategic choice (choosing the pictured referent that has extra features).

iii. Make a wrong choice (selecting a pictured referent that was not named).

iv. Request more information (such as asking "which one?")

Procedure:

The picture sets series described above correspond to three consecutive interactions. The general procedure remains the same over each interaction.

Initially a subject sits alongside the experimenter at a desk. They are both placed to view the first page of picture-referents set from the practice series. The subject is then given instructions for practice series :-

"I [the experimenter] am going to try and tell you which one of these pictures [experimenter points at the set] I'm thinking of, and you have to point to the one that you think I'm thinking of. Sometimes what I say might not be very useful (or very good), so you have to think of something to do or say to help".

The subject is then given the four practice trials, on each of which there is a message that isolates the target referent.

They are then given the first twenty experimental trials, ten sets of which have a target isolated in the message and ten not.

The second experimental series is then given. The subject is also given another instruction, corresponding to the extra feature, the circle, that appears on each trial's page :-

"I [the experimenter] am going to try and tell you which one I'm thinking of, and you have to point to the one that I'm thinking of. Sometimes what I say might not be very useful (or good), and it may be difficult for you to pick one out. You have think of something to do or say to help. If you can't maybe you could tick this circle at the top of the page [experimenter hands the subject a pencil and points to the circle on the page]".

The subject is the given the remaining 20 trials on each page of which there are large circles.

In general, for each trial, the experimenter turns to that trial's page, and says the "message" for that set (it would either be an ambiguous or unambiguous message). The subject is then allowed time to make her/his response, which the experimenter records. If there is no response within ten seconds, the experimenter goes on to the next trial.
If the subject requests more information to an ambiguous message, a descriptive second message is given.

b. General message giving and taking tests -- components in interaction.

General Introduction:

Our second method of assessing our subjects' communicative abilities was based on more global situations than in the component tests. First there were tasks in which subjects had to give and receive map directions, and then tasks in which they had to give instructions for the experimenter to assemble models of bridges from wooden bricks.

Maps are representations of the properties and relations of real or imagined spatial locations. For these tests we created two types of maps. One in which referents (such as trees, houses, cars etc) were connected with a line, and another that had the same referents, in the same order, but did not have a 'connecting' line.

The "connected" map would be given to a speaker, the "un-connected" to a listener. The speaker would have to inform the listener which referents the line linked, whilst the listener had to use the speaker's messages, or request supplemental information for linking up her or his referents. One set of maps had target referents (those linked by the line) that were always nominally different to the other referents on that map, such as the one car, one house etc. Another set had targets that shared their name with other, 'potential', targets, such as there were two houses, the target house having a chimney. Simplified versions of these maps are shown below in figures 10 and 11. Figure 10 has referents that are nominally distinct. Figure 11, below, has referents that are nominally similar.

Figure 10: Simplified speaker and listener maps that have nominally distinct referents, that is all the referents are different in name

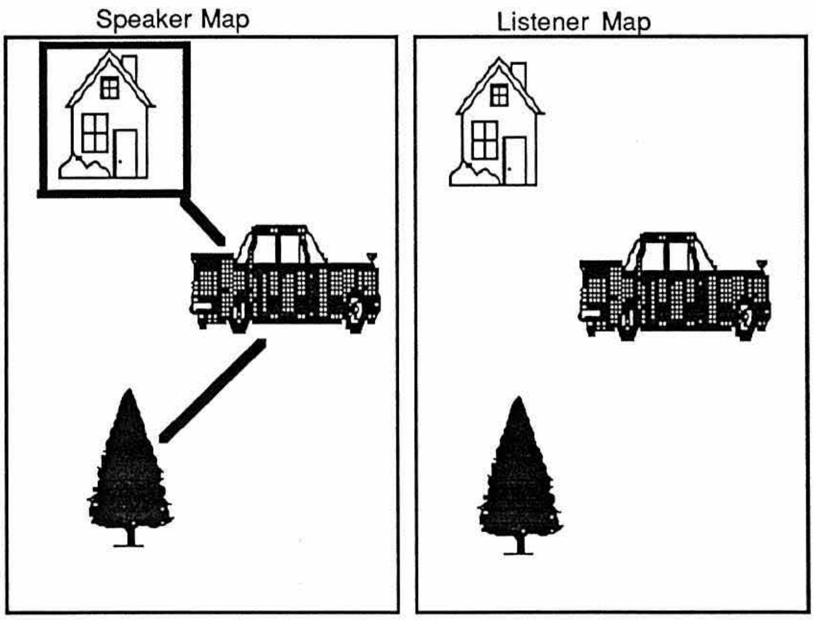
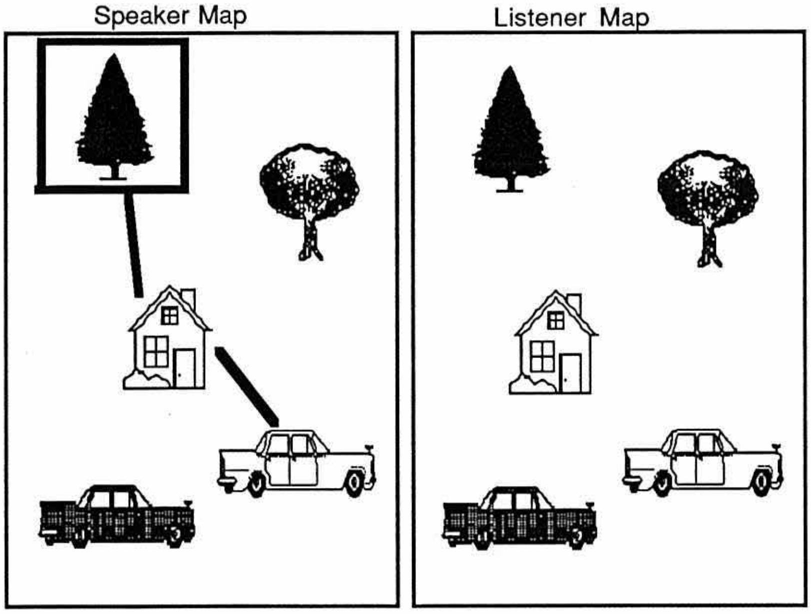


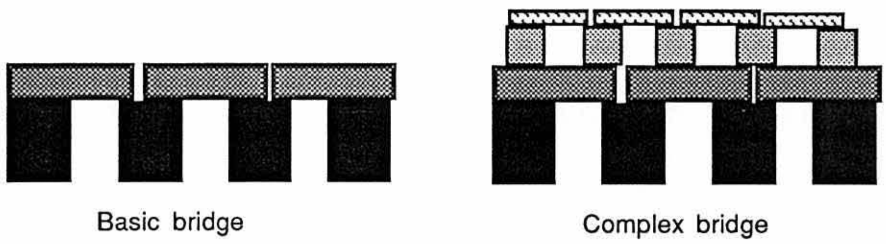
Figure 11: Simplified speaker and listener maps that have nominally similar referents, that is some referents have the same name (such as are cars) but are different in some subordinate characteristic (such as colour).



Using such maps the subjects were tested as both speakers and listeners with maps of nominally distinct and nominally similar referents. Moreover after the subjects were given 'nominally distinct' and 'nominally similar' maps they were given a further example of each map, on which they received help in the form of hints from the experimenter. This was to test both how near the subjects were to being fully competent on the task, and to provide a second measure of task ability.

The object assembly tasks tested the subject s' abilities in giving instructions for the experimenter to construct models of bridges. There were two bridges corresponding to two tasks, one of a 'basic' model, made of 7 bricks, and another 'complex' model made of 16 bricks. Before the actual communication tasks themselves each subject was given the task of making actual duplicates of each model. Figure 12 below gives a schematic representation of the models of bridges used.

Figure 12: Schematised examples of the models of bridges used for the object assemble tasks (the number, location and variance in colour of blocks correspond to the actual models used).



Below we will describe each class of task, first the speaker role as tested with maps, then the listener role (again as tested with maps), and finally the object assembly tasks.

Summary of tests:
i. Speaker role by diagrammatic maps.
ii. Listener role by diagrammatic maps.
iii. Speaker role by object assembly models.

i. Subject tested as a speaker with maps.

Introduction:

These tests measured subjects' abilities as map readers and direction givers - that is message construction and provision. The general procedure required each subject to tell the experimenter how a line connected up a number of referents. Speaker skills were tested under two main conditions, un-guided and guided. In the guided conditions the experimenter presented the subjects with hints that "guided" them towards appropriate task behaviour. These hints were organised in a hinting hierarchy. The top of the hierarchy contained general hints about problem solving, with the hints getting progressively more specific about task behaviour down the hierarchy. The experimenter acted as a "passive" listener on the tasks that he did not guide the subject. That is he did not request more information when given ambiguous messages, and he only targeted those referents that the subject unequivocally distinguished. He did, however, respond appropriately to requests from the speaker that checked if he had targeted a particular referent.

There was also two sub-conditions, diagrammatic maps which had all the referents distinctive by name ("nominally distinct"), and diagrammatic maps which had some referents similar in name but distinguishable in some sub-ordinate feature ("nominally similar" but of different sizes, colours etc).

There were, therefore, two main conditions, and two sub-conditions. Overall there were therefore four tests -

Summary of subject as speaker tests :-

1. Subject as a speaker with nominally distinct referents (SpND).
2. Subject as a speaker with nominally similar referents (SpNS).
3. Subject as a speaker with nominally distinct referents, and guidance from experimenter (SpNDG).
4. Subject as a speaker with nominally similar referents, and guidance from experimenter (SpNSG).

The test trials were preceded by a practice trial.

Materials:

Diagrammatic maps were required as stimuli. They also served as response sheets. The experimenter also required a further sheet of instructions.

According to the four conditions listed above the subject required, in two conditions, maps with ten referents distinguishable by name, and in another two conditions maps which had a number of nominally similar referents distinguished by attributes other than name.

Maps were further needed to be paired for each trial, so that both the speaker's and the listener's corresponded. The speaker and listener maps only differed in that the speaker map had a "road" connecting up referent objects and the listener map lacked such "road".

The maps, which had nominally similar referents, used by the experimenter when acting as a "speaker" required a note next to each nominally similar referent that stated whether it was to be mentioned ambiguously or unambiguously. Each of these maps will be described in relation to their respective tests below .

Practice:

The speaker map (the subject's) had five, connected, target referents. The first of which was 'boxed'. The listener's (the experimenter) maps had the same targets, but they were un-connected (for both see appendix 9).

Tests:

<u>1. Subject as a speaker with nominally distinct referents (SpND)</u>

A pair of maps in which each has ten potential referents which are all target referents. Each referent is distinguishable on the level of name, that is one is a house, another a car, a tree etc.

The subject's map also contains a line which is interpretable as a road which connects each referent together, starting from one referent that is boxed and progressing along the page, generally downwards (for both see appendix 9).

2. Subject as a speaker with nominally similar referents (SpNS).
A pair of maps in which each map has sixteen potential referents of which twelve are targets. Four targets are distinguishable at the name level, (car or seesaw etc) others eight have a potential referent of the same name but vary in some other dimension such as a big house and a small house etc. A "road" connects the twelve referents, from a "boxed referent" and downwards (for both see appendix 9).

3. Subject as a speaker with nominally distinct referents, and guidance from experimenter (SpNDG).
Maps here are similar to "1" above but stimuli pictures are either different, or in different positions.

For the experimenter there were hierarchically arranged hints for guiding the subjects' on-task behaviour. The hierarchy consisted of general and specific hints containing information about task demands, such as seriation (that the line goes from one referent to another), and perspective monitoring (that the listener's perspective was different to the speaker's) (for both maps see appendix 9, and for hierarchy see appendix 11, note that selective comparison hints were not required for this map).

4. Subject as a speaker with nominally similar referents, and guidance from experimenter (SpNSG).
Maps here are similar to "2" above but stimuli pictures are either different, or in different positions, and there are eleven targets of fifteen potential referents (three nominally different, and eight with a similarly named potential referent).

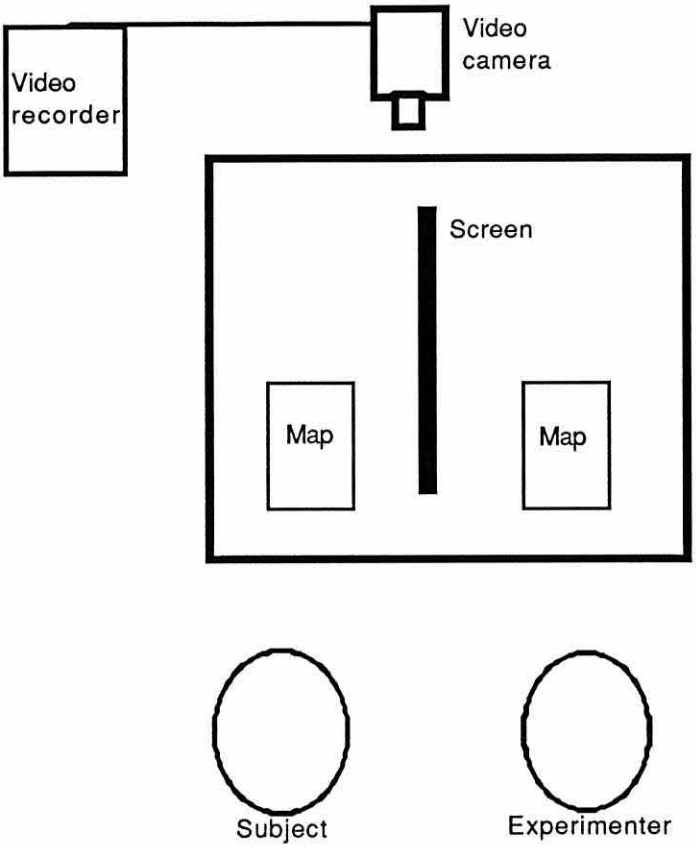
For the experimenter again there were hierarchically arranged hints for guiding the subjects. The hierarchy here consisted of general and specific hints containing information about task demands and perspective monitoring and selective comparison (that referents that share the same name should be distinguished by some other, sub-ordinate, feature) (for both maps see appendix 9, and for hierarchy see appendix 11).

Apparatus

In the preparation of materials for these tests we used Snodgrass and Vandervilt's (1980), Macintosh Hypercard and Macintosh Image Processors.

Interactions between speaker and listener required a screen so as to disallow each to see the other's maps. An audio tape recorder and a video camera were required for recording interactions. The listener required a thick line marker pen which made their drawing work visible for an overhead video camera, as can be seen below in figure 13.

Figure 13: The set up for running and recording communication on the speaker map-tasks.



Procedure:

First the subject is shown the "practice", pair of maps. On these maps the subject is introduced to the task of being a "speaker" -

"your map shows how some things are joined up by a line or road [experimenter point to the subject's map], and the things on my map aren't joined up [experimenter point his own map]. I want you to tell me how those things on your map are joined up-- if you do that I can join these things [experimenter point his own map] up on my map. So you have to tell me how the line or road goes so that I can fill one in on my map"

The practice map is then presented to the subject. The subject is then shown by experimenter how the line -

"starts off at the box which has the house (for example), and goes to the tree (for example), etc...".

In doing this the experimenter physically moves his own finger along the line from the start to the finish naming each referent. The subject is then encouraged to move her/his finger along the line starting with the house in the box and so on.

If the subject did not demonstrate that she/he has become aware of the seriation aspect of the map (that the line goes from one thing to another in a progressive order) then she/he is taken through the map up to two more times.

The subject is then asked to tell the experimenter where line starts (at the box) and "goes to next". After two referents have been communicated, a screen is placed up between experimenter and the subject (and thus respective maps are hidden from each others view).

The practice trial is terminated when one of three criteria have been met -

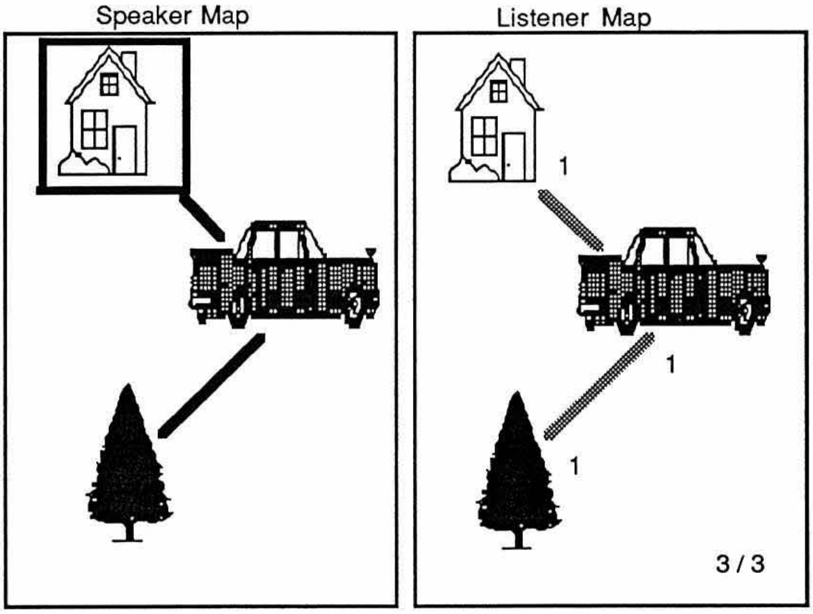
- the subject has communicated all the referents
- there has been a positive answer to the experimenter's question of "have you finished"
- or there has been a ten second gaps after such a question.

After the practice trial has been completed the speaker tests are administered.

Subject's performance on the map-tests is scored according to the number of correct responses made by the listener. The "correctness" of responses is gauged according to three criteria - (this is illustrated below in figures 14 - 16).

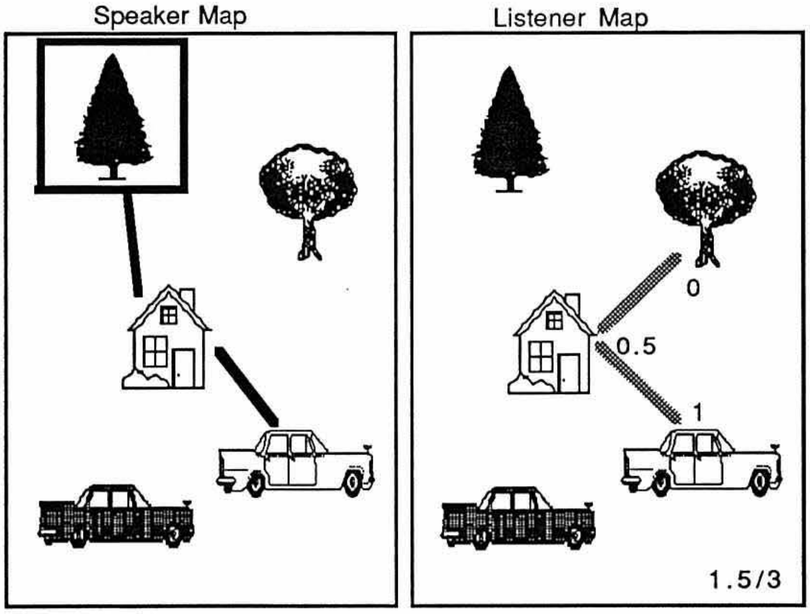
1. If the subject enables the experimenter to locate the "previous" referent to, and the "present" target (and therefore a line between them is correct) then she/he gets one point (this is illustrated below in figure 14). In figure 14 the listener has located the target of the house, (one point) which is "previous" to the car which she/he also targets (one point) which itself is previous to the tree which she/he also targets (one point).

Figure 14: Method of scoring the map task no.1. When the listener has located all the referents in the correct serial order then a full score is given.



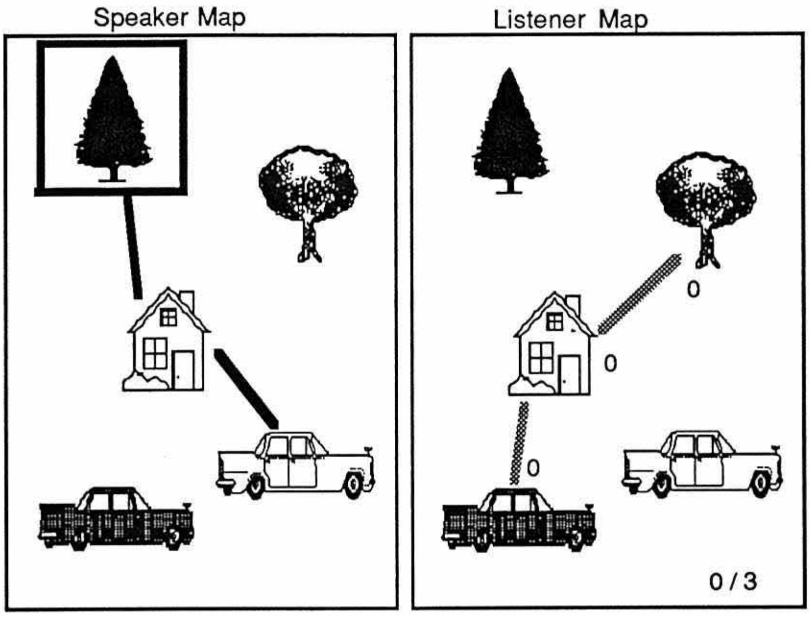
2. If the subject enables the experimenter to get a "present" and "future" correct but not a previous then the "present" scores a half point and the future scores a full point (as shown below in figure 15). In figure 15 below the listener has not targeted the correct tree (no point) but has located the house. Since the tree, being "previous" to the house, was incorrect she/he scores half a point. The last target, the car, is correct and the "previous" target was correct, and therefore a full point is awarded.

Figure 15: Method for scoring the map task No.2. When the listener has not located the previous referent to a correctly located referent (as the deciduous tree is to the house) only a half point is given.



3. If the experimenter neither gets a "previous" nor a "future" correct then a "present" is not counted as correct either (this is illustrated below in figure 16). The listener is figure 16 failed to locate the correct referent previous to or after the house and therefore no point is awarded.

Figure 16: Method for scoring the map task No.3. When the listener has not located a referent previous to, nor next from, a "correctly" located target, such as the house, then no score is given.



Trial 1: Subject as a speaker with nominally distinct referents (SpND)

The experimenter gives the subject the first test map (SpND), the speaker map to the subject on one side of a screen, and a listener map to experimenter on the other side of the screen.

The experimenter then instructs the subject to tell him -

"how the line goes starting with what is in the box ".

If no initial response is made the experimenter moves the screen and points to the box and says -

"start here"

He then replaces the screen back in-between the subject and himself.

The subject may then assume the speaker role. When the subject does not provide a message for up to ten seconds, (or there are no more referents on map left un-connected) the experimenter asks the subject -

"have you finished?"

If the subject responds yes, or there's another pause of ten seconds, then that map-trial is completed.

During the interaction the experimenter, acting as a passive listener, attempts to link up as much of the map as is possible according to the subject's messages.

Trial 2: Subject as a speaker with nominally similar referents (SpNS)

Again the experimenter instructs the subject to tell him how the line goes. Again the experimenter assumes the role of a passive listener, especially in that he does not request more information when given an ambiguous message (such as the message "tree" for a set containing a evergreen tree and an apple tree). If the subject requests of the experimenter if he located a particular referent, such as "the tree" the experimenter responds yes or no accordingly. If he's asked a second time if he's got the same referent again (and he's not in receipt of a further contrastive message, such as "the evergreen tree") the experimenter says "I'm not sure". The third time this happens for the same referent he responds with "carry on".

Trial 3: Subject as a speaker with nominally distinct referents, and guidance from experimenter (SpNDG)

For this trial the same general procedure as in trial one is used, but that the subject is given hints as to what to do for being an effective speaker.

First they are given the extra instruction -

"I'll try and help by talking about what you, the speaker, could do".

Then the experimenter utilises a "hinting hierarchy" to help the subject in solving the problem (the hinting hierarchy is shown in appendix 11, note that selective comparison hints were not required for this map).

The hints are given in such a way as to go from general questions to specific routines about the nature of the task and what, specifically, to do. So if a subject did not request if the experimenter (as a listener) had targeted a referent then the "Monitoring" part of the hinting hierarchy would be given particular emphasis.

Trial 4: Subject as a speaker with nominally similar referents, and guidance from experimenter (SpNSG)

For this trial the same general procedure as in trial two is used, but that the subject is given hints as to what to do for being an effective speaker. (The hinting hierarchy is shown in appendix 11).

First they are given the extra instruction:-

"I'll try and help by talking about what you, the speaker, could do".

Then the experimenter utilises a "hinting hierarchy" to help the subject in solving the problem. Perspective monitoring and selective comparison would be particularly emphasised on this trial.

ii. Subject as listener tests with maps.

In the Listener role Map trials subjects were tested for their ability to respond appropriately to messages that were unambiguous or ambiguous. Each subject was required to listen to messages from the experimenter so that they could make paths to connect up referents. Some messages described a referent uniquely, others may have applied to two or more potential referents.

There were two main conditions, un-guided and guided, and there were two sub-conditions, diagrammatic maps which all the referents distinctive by name ("nominally distinct"), and diagrammatic maps which had some referents similar in name but distinguishable by some sub-ordinate feature ("nominally similar").

There were, therefore, two main conditions, and two sub-conditions within each -- that is, as for the speaker maps, four tests .

Summary of listener tests:-

1. Subject as listener with nominally distinct referents (LiND).
2. Subject as listener with nominally similar referents (LiNS).
3. Subject as listener with nominally distinct referents and guidance from experimenter (LiNDG).
4. Subject as listener with nominally similar referents and guidance from experimenter (LiNSG).

Before the test trials there was a practice session. The experimenter, when in the Speaker role, acted as a "passive" speaker. That is he failed to consistently provide unambiguous messages when there were referent's that shared the same names, and he did not request of the listener if she/he had targeted a referent.

Materials:

Again diagrammatic maps were required, as described above for the Speaker trials, as was a hinting hierarchy. The hinting hierarchy concentrated on aspects of the listener role such as for monitoring one's understanding and requesting more information when given ambiguous messages.

Practice:

The speaker map had five, connected, target referents, the first of which was 'boxed'. The listener had the same targets, but they were un-connected.

Tests:

<u>1. Subject as listener with nominally distinct referents (LiND)</u>

The maps for this test was generally similar to that in speaker test (a), SpND, above but the picture-referents were either different, or in different positions (for both maps see appendix 10).

2. Subject as listener with nominally similar referents (LiNS).

The maps for this test was generally similar to speaker test (b), SpNS, above but the picture-referents were either different, or in different positions. Here there were twelve targets out of nineteen potential referents. Four were distinguished at the "name level" and eight had a potential referent of the same name but varied in some other dimension. Furthermore, the experimenter's map (speaker role) had a message to correspond with each target referent on the map (for both maps see appendix 10).

3.Subject as listener with nominally distinct referents and guidance from experimenter (LiNDG).

The maps for this test was generally similar to speaker test (b), SpNDG, above but picture-referents were either different, or in different positions.

For the experimenter there were hierarchically arranged hints for guiding the subjects' on-task behaviour. The hierarchy consisted of general and specific hints containing information about task demands such as monitoring current understanding (for both maps see appendix 10, and for hierarchy see appendix 11. Note that speaker inadequacy hints were not required for this map).

4. Subject as listener with nominally similar referents and guidance from experimenter (LiNSG).

The maps for this test was generally similar to speaker test (b), SpNSG, but picture-referents were either different, or in different positions, and there are eleven targets of fifteen potential referents (three nominally different, and eight with a similarly named potential referent).

For the experimenter again there were hierarchically arranged hints for guiding the subjects. The hierarchy consisted of general and specific hints containing information about task demands such as self-monitoring, checking the adequacy of messages and requesting selective comparisons (for both maps see appendix 10, and for hierarchy see appendix 11).

Apparatus:

The apparatus was the same on the listener maps as on the speaker maps above.

Procedure:

First the subject is shown the "practice", pair of maps. On these maps the subject is introduced to the task of being a "Listener" -

"My map [experimenter points to his map] shows how some things are joined up by a line or road, the things on your map aren't joined up [experimenter points to the subject's map]. I'm going to tell you how the things on my map are joined up. If I do that then you can join those things up on your map [experimenter points to the subject's map]. So, I have to tell you how the line goes so that you can fill one in on your map".

The experimenter then begins to tell the subject directions beginning with the boxed picture-referent, and after two referents are communicated, and connected by the subject, a screen is placed between experimenter and subject. If the subject did not connect the first two targets, then the experimenter repeats the message -- up to two times. If the subject was still un-successful then the experimenter helped the subject draw a line from the first target referent to the second.

The practice trial is terminated when the experimenter has described all the referents, with a 3-4 second gap between each (which was thought to be enough time for the subject to draw their "connecting" line). The speaker only communicated the referents, and did not request the listener's comprehension.

After the practice trial was completed the listener tests were administered.

The subjects' performance as a listener is scored according to the same criteria as was applied to the speaker role above.

Trial 1 Subject as listener with nominally distinct referents (LiND)

The subject is given the first listener test map, which is placed behind the screen in front of subject and out of the experimenter's field of vision.

The subject is then given instructions for the task, as in the practice trial -
"My map [experimenter points to his map] shows how some things are joined up by a line or road, the things on your map aren't joined up [the experimenter then pointed to the subject's map]. I'm going to tell you how the things on my map are joined up. If I do that then you can join those things up on your map [the experimenter then pointed to the subject's map]. So, I have to tell you how the line goes so that you can fill one in on your map".

They are then given actual "directions" by the experimenter.

The trial is completed when the experimenter has given directions in-between all the referents on his map with appropriate time (three to four seconds) for the subject to make a response.

The experimenter, as the speaker, only communicated the referents, and did not request the listener's comprehension.

Test 2: Subject as listener with nominally similar referents (LiNS)

The subject is given the second listener map, which contains referents that share the same name (e.g. two cars).

The experimenter then gives directions to the subject, according to the map, and according to the descriptors written in on the map. Some of the messages acted as selective comparisons -- others were ambiguous.

The experimenter did not monitor the subject, and only communicated the referents (as directed). He did not therefore request the listener's comprehension, but he was allowed to respond appropriately with unambiguous messages if the subject monitored the interaction and requested such messages.

3.Subject as listener with nominally distinct referents and guidance from experimenter (LiNDG).

The same general procedure was used on this trial as in trial 1, but that the subject was given hints as to what to do for being an effective listener.

First they are given the extra instruction -

"I'll try and help by talking about what you, the listener, could do".

Then the experimenter utilises a "hinting hierarchy" to help the subject in solving the problem. Particular emphasis is given to the monitoring of current understanding.

4. Subject as listener with nominally similar referents and guidance from experimenter (LiNSG).

The same general procedure was used on this trial as in trial 2, but that the subject was given hints as to what to do for being an effective listener.

First they are given the extra instruction:-

"I'll try and help by talking about what you, the speaker, could do".

Then the experimenter utilises a "hinting hierarchy" to help the subject in solving the problem. Particular emphasis was given to self-monitoring, checking message adequacy and the requesting of selective comparisons.

iii. Subject as speaker on "bridge-assembly" test.

General introduction:

We provided our subjects with a third type of global task to test their communication skills, but only in the speaker role. This test involved the production of messages for directing a listener to construct a three dimensional model.

Each subject was given two model bridges, one of seven wooden blocks (basic level) and another of sixteen blocks (complex level). The subject then viewed each "bridge", and was then asked to direct the experimenter in building replicas of each. Not only would the subjects be required to describe differences between bricks, but also very fine grain descriptions of their positions and orientations.

Before the subjects were asked to instruct the experimenter, she/he was requested to view both models and assemble replicas of each themselves. This acted as a check in case our subjects could not actually cognitively represent and duplicate the models for themselves.

There were therefore four tests. The subject had to assemble a basic, and a complex bridge, from models, and then direct the experimenter to build both a basic and a complex model.

Summary of tests:

1. Object assembly 'basic' level (Assembly-basic).
2. Object assembly 'complex' level (Assembly-complex).
3. Object assembly instruction 'basic' level (Instruction-basic).
4. Object assembly instruction 'complex' level (Instruction-complex).

General Methodology

Materials:

The demands of this test required two sets of object assembly materials. These were a model of a basic bridge constructed of wooden blocks, and a number of loose blocks that could be assembled to duplicate the model, and a model of a complex bridge with a corresponding array of loose blocks for it's duplication.

The first model was built from seven wooden blocks, and the second model was made of sixteen blocks, all of which were either yellow, red or blue.

The two sets of blocks corresponded to the two "bridges", therefore there was one set of seven blocks, and another of 16 blocks. (The bridges are as shown in figure 12 above).

The experimenter had an instruction and score sheet for conducting the tests.

Apparatus

Interaction s between speaker and listener required a screen so as to disallow each to see the others bridge.

Audio tape recorder and a video camera were required for recording interactions. The set up was therefore similar to that used for the map-based interactions above.

Procedure

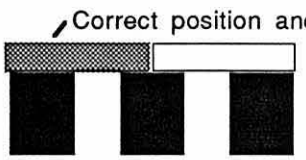
There are two stages to the bridge test -

- the subjects building a bridge according to models (tests 1 and 2) which was scored on the basis of the subjects' actual placing of items
- the subjects instructing the experimenter on how to build bridges according to models that only they could see (tests 3 and 4), which was scored on the basis of the understanding the experimenter could establish from the subject's messages.

Scoring of performance was conducted according to the following criteria -

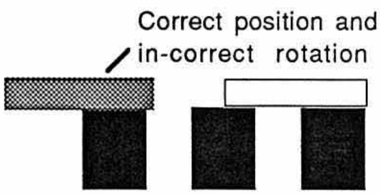
1. If a block is placed in it's correct position and orientation in respect of other blocks then a full point is given (as illustrated below in figure 17).

Figure 17: Method for scoring the bridge tests No.1. A full score is given when a brick is in correctly located (here the grey brick is on the top left corner) and oriented (here the grey brick is extended towards the middle of the bridge).



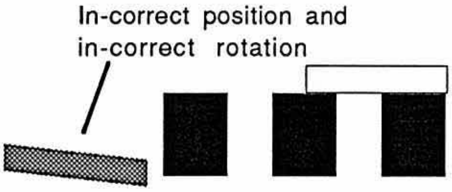
2. If a block is placed in the right position but wrong orientation (again in respect of other blocks) a half point is given (as illustrated below in figure 18).

Figure 18: Method for scoring the bridge tests No.2. A half score is given if a brick is correctly located (here the grey brick is on the top left corner) but in-correctly oriented (here the grey brick is extended away from the bridge).



3. If a block is not placed either in correct position nor orientation no point is given (as illustrated below in figure 19).

Figure 19: Method for scoring the bridge tests No.3. No score is given if a brick is not correctly located.



Specific methodology:

<u>Test 1, Subject assembles a basic bridge</u>

The subject is presented with a model of a bridge (made of seven blocks) and is given a further seven loose blocks. The subject is then asked to -

"build a bridge exactly like this one [the experimenter then pointed to a model]".

After the subject has completed the bridge (or there is a pause of 10 seconds) the subject was asked if she/he has finished, if she/he said "yes" (or if there is no response and another ten seconds pause) then the trial is completed.

<u>Test 2, Subject assembles a complex bridge</u>

The subject is presented with a second bridge (made of sixteen blocks) and a further sixteen loose blocks. The subject is then asked to build a duplicate of the model.

The trial is completed when conditions are as above in Test 1.

<u>Test 3, Subject instructs the experimenter to assembles a basic bridge</u>

The experimenter places a model bridge in front of the subject, and behind a screen so that experimenter cannot see it, and comments -

"there's a bridge for you".

The experimenter, while commenting -

"and these are my blocks",

shows loose blocks to the subject, which are then pushed out of subject's view behind the experimenter's side of the screen.

The subject is then instructed that -

"You have a model of a bridge, and I have a few bricks. Could you tell me how I could build one exactly like yours ? Remember I can't see your model. You have to be careful how you tell me."

If the subject completed the task, or there was a pause of ten seconds, then the experimenter asked "are you finished?". If the subject said "yes", or there is no response and another pause, the trial was completed.

During the trial the experimenter attempted to construct the bridge as he is instructed by the subject. Also the experimenter assumed the role of a passive listener in that he did not request more information if he was given ambiguous messages. However if the subject requested of the experimenter if he located a particular referent the experimenter responds yes or no accordingly. If he's asked a second time if he's got the same referent again (and not in receipt of a contrastive distinguishing message for distinguishing it from other potential referents) the experimenter then said he was "not sure", and the third time he responded with "carry on".

Test 4. Subject instructs the experimenter to assembles a complex bridge

In this trial the same procedure as in test 3 (above) is used with a bridge of sixteen blocks.

Summary of Baseline Measures -

There were two sets of baseline measures (1) Psychometric tests of linguistic and cognitive skills and *(2) tests of communication.*

The language tests were of receptive vocabulary (Peabody) and grammatical structures (TROG) and general receptive and expressive abilities (Reynell and Sentence Length). Cognitive tests were of abstract reasoning (Raven's) and of memory capacity (Short Term Memory Tests).

There were two types of communication tests, (1) those that isolated component skills of being speaker's and listener's, and (2) those that combined these skills in more global contexts, that of giving and receiving instructions.

Componential tests isolated a number of skills. The Basic Perspective Taking test measured how well subjects could gauge that a person with a different vantage point to themselves, and therefore a different knowledge base. Perspective Monitoring tested subjects' abilities to take the listener's perspective when the listener has to choose referents when confronted with ambiguous messages. Selective Comparison tested subjects' abilities to describe differences between objects that share the same name. Referential Communication tested subjects' speaker abilities of selective comparison and perspective monitoring within a similarly constrained context -- with the same type of materials and task structure. Message Adequacy tested subjects' ability to respond appropriately to messages that are ambiguous, either by asking "which one" or making a strategic guess.

The global tests were of three forms. Two forms, those for being speakers and listeners required maps. There were two types of maps, those that had all their referents distinctive by name, and maps which had some referents similar in name but distinguishable in some sub-ordinate feature. Being an effective speaker on the second type of map required the creation of selective comparisons. Being an effective listener on the maps with nominally similar referents required responses that demand selective comparisons. Object Assembly Tests of the speaker role provided a further naturalistic context for the subjects' construction and provision of messages. There were two such tests, both of which required selective comparisons for effective communication.

The baseline tests are summarised below in table 3.

Table 3: Summary of all baseline tests, with developmental years on which the tests were originated and/or standardised with in decimals.

Test	Measure	Developmental Range
Peabody Picture Vocabulary	Receptive vocabulary	2.5 - 10 years
Test of the Reception of Grammar	Receptive grammar	4 - 11 years
Reynells Developmental Language scales	Receptive & expressive language	6 months - 6 years
Sentence Length	Average length of sentence	-
Ravens Progressive Matrices (Coloured)	Pattern completion, spatial relations and abstract reasoning	5.5 - 11.5 years
Short Term Memory	Recall of digits from Short term storage	-
Basic Perspective Taking	Different vantage points lead to different knowledge base	4 - 6 years
Perspective Monitoring	Ability to check messages as a speaker	4 - 6 years
Selective Comparison	Ability to describe differences	4 - 9 years
Referential Communication	Ability to describe differences for a listener	-
Message Adequacy	Ability to respond appropriately to ambiguous messages	5.16 - 7.9 years
Speaker, Nominally Distinct Maps	Object identification and seriation for a listener	-
Speaker, Nominally Similar Maps	Object identification, seriation, and selective comparison for a listener	-
Speaker, Nominally Distinct Maps and Guidance	Object identification and seriation for a listener	-

Table 3: continued

Speaker, Nominally Similar Maps and Guidance	Object identification, seriation, and selective comparison for a listener	-
Listener, Nominally Distinct Maps	Object identification and seriation based on messages	-
Listener, Nominally Similar Maps	Object identification, seriation and appropriate responses to ambiguous messages	-
Listener, Nominally Distinct Maps and Guidance	Object identification and seriation based on messages	-
Listener, Nominally Similar Maps and Guidance	Object identification, seriation and appropriate responses to ambiguous messages	-
Bridge 1	Object assembly with a basic model	-
Bridge 2	Object assembly with a complex model	-
Bridge 3	Instructing another to assemble a basic model	-
Bridge 4	Instructing another to assemble a basic model	-

RESEARCH STAGE TWO

(A) Training, and (B) testing the transfer of, communication skills:

In the second section of this chapter we'll first (A) detail the methodology of the training of communication skills and then (B) the methods for testing for performance change, and transfer of, speaker skills after training.

A : Training of communication skills:

General Introduction:

Training was provided in communication skills. There were three training conditions, Self instructional (SIT), Metacognitive (Meta) and practice (Control). The two explicit training conditions are based, in part, on Vygotskian notions of the learning of self-control through the internalisation of social speech. In general the theory holds that speech, for the developing child, stops being a vehicle for others to control them, and it internalises to lead to the child's self control. The stages of this self-regulatory inner speech's development is taken as a structure for representing and guiding training. SIT and Metacognitive training differ in their methods of achieving 'internalisation'.

The general goal of SIT is to access what individuals say to themselves so as to affect their behaviour -- that is, to allow individual some control over the antecedents of behaviour through verbally mediated self-commands (Gow & Ward, 1985). To do this it relies on verbal and behavioural modelling of the desired behaviours by a trainer. These models are rehearsed by the trainer for the learner to copy.

The main aspect of the verbal model provided for a learner are self-instruction s. These are statements for guiding task behaviour and for controlling extraneous influences over behaviour. For example, in the case of hyperactive children attempting a word categorisation task there may be the following self instructions -

Self Instruction for task skill:

"I have to circle the words that have the same letters".

Self Instruction to control extraneous variables :

"I have to do this slowly".

Meichenbaum and Goodman (1971) developed the following structure for training self instructions -

i. The subject observes the experimenter perform a task whilst the experimenter "talks aloud" to himself/herself (that is, the experimenter says the instructions out-loud whilst doing the task).

ii. The subject performs the same task as the experimenter provides the instructions for completing the task.

iii. The subject then performs the task whilst instructing itself aloud (overt guidance--saying the same instructions as which the instructor used).

iv. The subject whispers the instructions during task performance (faded overt self-guidance).

v. The child performs the task using only covert self-instruction s (covert self-guidance).

Later additions by Guevremont, Osnes and Stokes (1988) to the SIT procedures attempted to improve generalisation effects. These additions include -

i. Towards the end of training in the SIT environment, the trainer attempts to make that situation more similar to the "to be transfered to" environment. Such as standing behind the child in a special classroom as if in the regular classroom.

ii. At the end of every training session the subjects may be instructed to "use the instructions you learnt today to help you on your work during work time".

iii. In the everyday environment, a prompt such as - "I want you to say the instruction you learnt [in training] while you do your work" may be given by the teacher if there was a failure to generalise spontaneously.

Metacognitive activity involves stopping to think before a problem solving attempt by asking questions of oneself, and of others, to determine if one recognises the problem and then to check solutions as they are applied and to monitor attempts to learn to see if they are working or worth the effort (Campione & Brown , 1979).

Metacognitive levels of cognition are arrived at by a child after they have internalised the social interaction of others -- that which earlier controlled their behaviour. Moreover this internalisation process could be engineered around specific tasks areas, such as communication. This, so far, is similar to the SIT approach. For Campione and colleagues, however, training does not rely on the direct rehearsal of a limited set of self-instruction s through rehearsal. For them internalisation could occur in the context of a more conversational dialogue. Such a dialogue is led by a task expert (such as a teacher) to reveal to a learner their strategic and meta-strategic processes for dealing with certain tasks. From such a dialogue, then, a learner could be encouraged to internalise strategies to monitor and direct their thinking.

The dialogue combines metacognitive strategies such as questioning, predicting, summarizing and clarifying with internalising processes such as modelling and guided practice. The strategies provide concrete heuristics for getting the procedure for the task going and then the dialogue forces the learner's engagement in solving the problem of the task; the trainer modeling provides examples of expert performance (Brown, Campione, Reeve, Ferrara, & Palinscar, Personal communication).

Procedures based on Metacognitive principles have been developed by Schleser Cohen, Meyers and Rodick (1984) and Campione and Brown (1987), and include three key stages -

i. The trainer models the metacognitive and task specific strategies for the trainee and at the same time engages the learner to find the solution strategy. For example, on word categorisation tasks the trainer models questions such as -

Metacognitive probe:

"What was the first thing I had to do ?"

Task Strategy:

"Oh, I get it. You mean I have to circle the letters that have the same name".

ii. The learner is then encouraged to complete a whole task with a lot of support being given by the instructor. The sub-skills of a task that they can use, they execute for themselves, but those skills that they are not aware of, or are not competent with, are cared for by the instructor. Such as in communication training, if the subject was able to make messages that delineated referents by name, but did not make selective comparisons based on other features, then those skills would be focused on.

iii. The trainer, over time, fades out their cognitive input from the interaction allowing the learner to assume control.

Metacognitive training thus attempts to access the cognitive processes of individuals through a dialogue. As in SIT, Metacognitive training attempts to provide a context for a learner for setting and meeting the demands of tasks as modelled by a trainer. In metacognitive training however the trainee is made conspiratorial with the trainer in delineating what is to be done through the dialogue. This is encouraged because the dialogue is woven around metacognitive questions. These questions are crucial in building up and organising a schema for the task and may lead to an abstraction by the trainee of general problem solving skills for a particular domain of tasks. In Metacognitive training there is no explicit attempt made to learn task-statements by rehearsal.

Subjects in the Control condition were not given explicit training in communication, but were taken through the "training" tasks as in the unguided conditions in baseline.

Each training condition shared certain characteristics, such as stimulus material, general task instructions and the order of task presentation. We will therefore first describe the variables general to all three conditions. Then we shall describe each training condition.

General Methodology

Materials:

There were three sessions of six trials each in which the experimenter and the subject took turns in being the speaker and the listener. The actual tasks used for training were very similar to the map-based tasks used for testing the subjects at baseline. There were therefore eighteen map pairs required. One of each pair (the speaker's map) had a line connecting each target referent, starting at a boxed example and moving progressively across and down a page. The listener's map of each pair had the same referents in the same positions but did not have a line connecting them up.

Half of the map pairs had nominally distinct referents and the other half had a number of nominally similar referents.

There were three types of referents used to construct the maps (one type per map pair)-

"Outdoors" - referents taken from everyday outside world (houses, cars, slides, trees etc),

"Animals" - referents made of pictures of animals (elephants, bears, foxes, kangaroos etc),

"Shapes"- referents that were abstract shapes (circles, squares, clouds, triangles etc).

There were therefore eighteen map pairs constructed - which alternately had either nominally distinct or nominally similar referents. Each sessions maps were arranged into booklets, one for the speaker role and the other for the listener. Booklets were arranged so that for the first two training sessions the 'Outdoors' would come first, then 'Animals' and then lastly 'Shapes'. For the third training session, however, the 'Animals' came first, then 'Shapes' second and 'Outdoors' last. (Maps used in training are shown in appendix 12).

There was also a general instruction sheets for the experimenter.

Apparatus

In the preparation of materials for these tasks we used Snodgrass and Vanderwart's (1980) standardised pictures, Macintosh Hypercard and Macintosh Image Processors.

Interactions between the speaker and listener required a screen so as to disallow each to see the other's maps.

Audio tape recorder and a video camera were required for recording interactions. The listener required a thick line marker pen which made their drawing work visible for an overhead video camera.

Procedure

There was a procedure general to all three conditions, and there were also factors that remained constant for both explicit training conditions.

The procedure that was common to all three training conditions included the (1) instructions given to each subject, (2) the positioning of the subject, the experimenter, and of a screen for disallowing each to see the other's maps, (3) the allocation of communication roles to the subject, (4) the experimenter's performance in each communication role, (5) the completion of trials, and finally (6), the changing of maps.

In the Self Instructional and the Metacognitive conditions the (1) cognitive-behaviour to be shaped was the same, also (2) the reinforcers for that behaviour were similar, and finally (3) there was an attempt to tailor training for the individual needs of each person.

Procedures for all three conditions -

1.Introductory instructions

Subjects were asked to sit next to the experimenter at a desk. The first map pair would then be presented. The subject would have the "speaker" map placed before her/him, whilst the experimenter would have the corresponding "listener" map.

The screen would not, as yet, be put up between experimenter and subject's sides of the desk.

The subject is then given an instruction for the task -

"We've both got something in front of us, they're like maps. Yours show how some things are joined up by a line, and the things on mine aren't joined up. I want you to tell me how those things on your map are joined up -- if you do that I can join these things up on my map. So you have to tell me how the line/road goes so that I can fill one in on my map".

The subject may then be given more instructions depending on her/his training condition.

2. Experimenter and subject's positions.

On trial 1, the experimenter sits parallel to the subject with both maps parallel, and there is no screen between each's sides of the desk. On trial 2 the experimenter sits with his map at a right angle to subject's. On the remaining trials, from 3-18 the experimenter and subject's halves of the desk are divided by a screen, so that they cannot see the other's map.

3. Communication Roles.

In the first session, over the first 4 trials the experimenter is the speaker and the subject is the listener, and over last 2 trials the subject is the speaker and the experimenter is the listener.

In the second and third training sessions the first two trials has the experimenter as the speaker and the subject as the listener, and in the last four trials the subject as the speaker and the experimenter as the listener.

4. Experimenter's performance at communication roles.

The experimenter, other than as directed by specific instructional conditions acted inactively in both communication roles (as in the baseline tests). That is he did not, as a speaker, monitor the subject's understanding. He was, however, allowed to respond appropriately if the subject monitored the interaction and made requests, for example, for a selective-comparison. As a listener the experimenter also acted in an inactive role, such as he did not request more information when given ambiguous messages. However if the subject requested of the experimenter if he located a certain referent the experimenter responded yes or no accordingly. If the experimenter was asked a second time if he had located the same referent again, but he is not in receipt of a contrastive message, then the experimenter says "I'm not sure". The third time he responds to such a request (again if a contrastive message is not forthcoming) with "carry on".

During the interaction the experimenter attempts to link up as much of the map as is possible from the subject's messages.

5. Completion of trials.

When the subject, as a speaker, does not provide a message for ten seconds, (or there aren't any more referents on the map that are un-connected) the experimenter asks the subject "have you finished?". If the subject responds "yes" or there is another pause then that map-trial is completed.

When the subject is a listener a trial is completed when the experimenter has given directions in-between all target referents on the map with appropriate time (two to four seconds) for the subject to make a response.

6. Changing maps.

The experimenter turns over both his and the subject's page to make sure the map-pairs are correct.

We've summarised aspects of the general procedure below (Figure 4).

Table 4: Summary of the location of maps, communication roles and type of maps used throughout training for all subjects

Trial	Map position	Subject's role	Type of map
1	Parallel	Listener	Outdoors.nominally distinct
2	Right angle	Listener	Outdoors.nominally similar
3	Hidden	Listener	Animals.nominally distinct
4	Hidden	Listener	Animals.nominally similar
5	Hidden	Speaker	Shapes.nominally distinct
6	Hidden	Speaker	Shapes.nominally similar
7	Hidden	Listener	Outdoors.nominally distinct
8	Hidden	Listener	Outdoors.nominally similar
9	Hidden	Speaker	Animals.nominally distinct
10	Hidden	Speaker	Animals.nominally similar
11	Hidden	Speaker	Shapes.nominally distinct
12	Hidden	Speaker	Shapes.nominally similar
13	Hidden	Listener	Animals.nominally distinct
14	Hidden	Listener	Animals.nominally similar
15	Hidden	Speaker	Shapes.nominally distinct
16	Hidden	Speaker	Shapes.nominally similar
17	Hidden	Speaker	Outdoors.nominally distinct
18	Hidden	Speaker	Outdoors.nominally similar

Specific procedures of the two explicit training conditions -

1. The cognitive-behaviour to be shaped;

At the end of training, for the ideal subject, the behaviours being exhibited would be those of an effective speaker. That is the taking of the listener's perspective when there are nominally similar object-referents and the creation of selective comparisons. To arrive at this juncture the subject would have behaviours that most strongly approximate this target behaviour reinforced throughout the training -- that is the cognitive-behavioural goal is shaped by successive approximations towards it. At each stage of training, then, the most advanced cognitive-behaviours towards the target behaviour would be reinforced.

It was hypothesized that for most subjects that the first approximations to the target behaviour would be their verbalisation of a self-instruction, or metacognition, that holds information for a communicative action. The next form of responses would be that same verbalisation at the same time as behaving in correspondence with the instruction, or metacognition.

2. The reinforcement of behaviour;

The behavioural chain, in the subject, described above, was reinforced by varying amounts of supportive sentences from the experimenter.

When a behaviour that most resembled the target behaviour emerged in the subject's repertoire that behaviour was selected for reinforcement.

At the start of training, every "correct" (or approximately correct) response by the subject would be reinforced with social praise. There were 3 types of social reinforcement, for example "good", "very good" and "that's wonderful, very good". There was also corrective feedback statements such as "no, that's not right".

Towards the end of training the subject would have evolved their closest approximation to the desired cognitive-behaviour, and that would be reinforced. When the subject reached this criteria the amount of "correct" responses needed to be emitted for reinforcement was increased. Training may therefore be generally characterised as a shaping procedure employing a variable ratio schedule of reinforcement.

3. "Tailoring" of training;

Depending on how much the subject was demonstrating learning, the experimenter would "tailor" the procedure for that individual subject's competence. This would be done by giving more modelled examples of the use of self-instruction's or metacognition's, or the prompting of their use for some people. This would become more important in later training trials where some subjects would demonstrate, by a comparative lack of learning to their peers, a need for greater support than others.

Specific methodology of each training condition

Self-instructional training sessions

Introduction:

SIT aims to give individuals control over behaviour through verbally mediated self-commands. It accesses a person's self-mediated repertoire through the provision of verbal and behavioural models.

The materials, apparatus and procedures for the Self-instructional sessions were the same as mentioned in general, above, other than as specified below.

Materials:

The self-instruction s included general problem solving information and also specific information on the skills required for map based communication tasks.

The self instructions used were:-

i. What do I do first ?

ii. I have to tell you how the line goes.

iii. Line goes from 'x [such as a tree]' to 'y [such as a house]'.

iv. Oh if there's 'two y's [two houses, for example]' which one.

v. The 'yi [descriptor then included, such as large house as opposed to a small one] one'

vi. I'm to ask if you got there.

vii. Did you get there ?

viii. We're doing O.K.

Procedure:

In the following we will detail the procedure used for all the trials of the three training sessions. The type of map used for each trial is shown in brackets next to the trial number.

Session One (see Maps 1-6 in appendix 12).

After the general instruction is given, the subject is taken through six trials. At the end of each trial the subject is given a general impression of their performance such as -"we didn't do so good" or "we did O.K." or " we did well/very well".

Trial 1.(Outdoors.Nominally Distinct)

The experimenter models the speaker role for the subject. The subject is told that -

"I'll [the experimenter] try and help you by saying outloud what I say to myself when I have to tell someone where things are".

The experimenter then takes the speaker map-booklet and gives the subject the listener map-booklet (opening them to "outdoor.distinct") and proceeds to say outloud the self-instruction s (apart from numbers iv. and v. - since selective comparison is not needed for this map), and then the experimenter assumes the role of speaker. Maps are placed in parallel with each other.

The experimenter then says the self-instruction's from (apart from i., iv., and v.) for each consecutive referent.

At end of the trial the subject is given a general impression of their performance such as -"we didn't do so good" or "we did O.K." or " we did well/very well".

Trial 2.(Outdoors.Nominally Similar)

The maps on this trial are presented at right angles to each other to make it difficult for each person to view the other's map.

The experimenter again models the speaker role for the subject, and gives the same instructions. He models all the self-instruction s, that is, he includes self-instruction s (numbers iv. and v.) for the selective comparison of referents. When there are two referents similar in name (such as two houses), therefore, the experimenter says, for example -

iv. "Oh if there's two houses which one."
v. "The large house."

After making the selective comparison the experimenter waits for 3-4 seconds and proceeds to the next referent.

Trial 3.(Animals.Nominally Distinct)

The procedure for trial 3 is the same as for trial 1, other than a screen is placed in-between the experimenter and subjects' maps to make it very difficult for each person to view the other's map.

Trial 4.(Animals.Nominally Similar)

The procedure for trial 4 is the same as for trial 2, but that a screen is placed in-between the experimenter's and subject's maps.

Trial 5.(Shapes.Nominally Distinct)

On this trial the subject becomes the speaker. The experimenter gives the subject the speaker booklet and takes the listener booklet, turning both to the maps "Shapes.Distinct".

The experimenter points at examples of the shapes and asks the subject to name them, and if they cannot name them correctly, (or according to a systematic manner) the experimenter provides names for each object. The screen is then placed in-between the experimenter's and subject's maps.

The subject is then given the role of the speaker, and the experimenter prompts the subject to use the self-instructions outloud before she/he starts the task (apart from numbers iv and v which are for selective comparison).

Then the experimenter asks the subject to -

"Try to say outloud to yourself what I said to myself when you try to do this".

Before the subject begins to give the experimenter (who is now the listener) directions the experimenter requests the subject to say the self-instructions such as-

"before we start could you say "what do I do first""

then the experimenter says-

"can you say "I'm to tell you how the line goes""...

""line goes from" (what's in the box?) "to the" (what's next ?)"

The experimenter then says can you say,

"I'm to ask if you got there"

and then-

"now say "did you get there?""

The subjects' verbalisation of each Self-instruction is reinforced with such comments as "good".

For the rest of the referents on that map the experimenter prompts, and reinforces the subject to attempt to use each self-instruction (apart from numbers iv and v which are for selective comparison) in the same order.

If the subject does not respond appropriately with a Self-instruction, or a recognisable portion of one, on any of the first three referents, the experimenter attempts (up to 3 times) to get subject to repeat each Self-instruction for one of the referents.

At the end of the trial the experimenter invites the subject to look at both maps, and the experimenter points out examples of where communication broke down (as above).

If the subject said the instructions correctly, but had not given the right directions then the subject is informed that-

"you said the right instructions to yourself, but you didn't tell me the right directions".

Correct use of the instructions is reinforced with verbal praise, such as "well done".

Trial 6 (Shapes.Nominally Similar)

The procedure is the same as for Trial 5 above, but since this map includes referents that are similar in name it requires the making of selective comparison, as in self-instruction's numbers iv and v.

Therefore when the subject has named a referent that has a nominally similar equivalent (such as two houses) then the experimenter says-

iv. "Can you say e.g. "If there's two circles, which one?"

v. "The what ? e.g. the large or the small one"

The subject's verbalisation and use of such self-instruction s is reinforced, with particular praise such as "that's very good" for an actual selective comparison.

During this trial a screen is placed in-between the experimenter's and subject's maps.

At the end of trial 6 in Session 1 the experimenter gives the subject a prompt for them to generalise the use of Self-instruction to the next meeting -

"I'd like you to use the instructions you learnt today when we do this again tomorrow"

The subject is then thanked for coming to the session.

Session Two (see Maps 7-12 in appendix 12)-

Session two starts with the experimenter placing both map booklets on a desk, the speaker maps for subject and the listener maps for the experimenter. Before the six trials are begun the subject is given the general instruction (as above) and the generalisation prompt -

"I'd like you to use the instructions you learnt yesterday when we do 'our work' again today".

Trial 7 (Outdoors.Nominally Distinct)

Same as trial 1, session 1, other than that a screen is placed between the experimenter and the subject's maps.

Trial 8 (Outdoors.Nominally Similar)

Same as Trial 2, session 1, but that a screen is used.

Trial 9 (Animals.Nominally Distinct)

The subject is given the role of the speaker, and the experimenter prompts the subject to use the self-instruction s.

First, the experimenter gives the subject the speaker booklet and takes the listener booklet, turning both to "Animals.distinct".
The subject is then asked to-

"Try to say outloud to yourself what I said to myself when you try to do this".

If the subject fails to reproduce the self-instruction s or the correct behaviour, then the procedure of Trial 5 is adopted. That is when the subject requires greater support the procedure of earlier, more supportive trials, are reverted to.

Trial 10 (Animals.Nominally Similar)
If the subject does not reproduce the self-instruction s or the correct behaviour of, such as making selective comparisons, then the procedure of trial 6 is adopted.

Trial 11 (Shapes.Nominally Distinct)
The procedure for this trial is the same as for trial 9.

Trial 12 (Shapes.Nominally Similar)
The procedure for this trial is the same as for trial 10.

At the end of this session, if subject is not saying Self-instruction s, she/he is asked to repeat them after the experimenter. Then the subject is given the generalisation prompt-
"I'd like you to use the instructions you learnt today when we do this again tomorrow"
The subject is then thanked for coming to the session.

Session three (see Maps 13-18 in appendix 12)

This session follows the same procedure as session two. However the order of the map types is changed.

Trial 13 (Shapes.Nominally Distinct)

The procedure for this trial is the same as for trial 7.

Trial 14 (Shapes.Nominally Similar)

The procedure for this trial is the same as for 8.

Trial 15 (Animals.Nominally Distinct)

The procedure for this trial is the same as for trial 9, but if subject does not use the self-instruction s (or demonstrates the related sub-skill) then the experimenter reverts to procedure in trial 5 within which more support was given.

Trial 16 (Animals.Nominally Similar)

Same procedure as in trial 10, but reverting to trial 6's procedure when appropriate (that is when subject requires more support).

Trial 17 (Outdoors.Nominally Distinct)

The procedure for this trial is the same as for 15.

Trial 18 (Outdoors.Nominally Similar)

The procedure for this trial is the same as for 16.

At end of the session, if the subject was still not demonstrating the use of the self-instruction's, she/he is asked to repeat them after the experimenter. At the very end of the session the generalisation prompt is given once more -

"I'd like you to use the instructions you learnt today when we do this again tomorrow"

The subject is then thanked for coming to the session.

(An example segment of the interaction between the experimenter and a subject in SIT is shown in appendix 13).

Metacognitive training sessions

Introduction:

Metacognitive training aims to access a person's memory processes through a dialogue. The dialogue is woven around a number of questions that attempt to prompt awareness of cognitive processes. The hypothesis is that these questions are crucial in building up and organising a schema for problem solving. The ensuing dialogue therefore provides a context for information about the demands of tasks to be modelled for the trainee by the trainer. Moreover the trainee is made conspiratorial with the trainer in delineating what is to be done through the dialogue.

The materials, apparatus and procedures for the Metacognitive sessions were the same as mentioned in general, above, other than as specified below.

Materials:

The metacognitive sessions required a hierarchy of general and specific information for communication-problem solving. The hierarchy needed to closely resemble a conversation that would follow the act of communication from beginning to end and therefore detail what the aims and methods of a conversation could be. At the upper level of the hierarchy are a number of metacognitive prompts, these call up subsidiary information that is arranged in clusters. Each cluster gives a step by step analysis for on-task behaviour. The clusters include information on the general task demands, why and how to monitor the listener's perspective, and why and how to make selective comparisons and finally a cluster of questions for raising metacognitive awareness. These clusters are shown below.

Hierarchy of Hints -

I. Task analysis clusters

i. Task orienting questions;

[This generalisation prompt is available on all but the first trial :

Maybe what we learnt on the last one would help us here ?]

What could I do ?

Ask a question about this ?

What is it ?

Its a Map-like Thing !

Right

ii. Task function question;

I've another question !

What has it got ?

Mine's got things joined up by a road!

The next question is, has yours ?

No!

iii. Task clarification;

I've a question, what have we got then?

Ok I've got a map with a road, and you haven't !

iv. Task prediction;

What do I predict/think we could do?

What If I told you how the road went ?

I think/predict that you could fill in a road.

v. Task summary;

What should we do then?

Well I'm going to tell you how the road on your map goes so that you could join those things up.

II. Monitor cluster;

i. General monitor question ;

I've a question, how do I know that you're doing all-right ?

ii. Monitor clarification

That is , that you're joining up the things up on your map O.k.-- like mine.

iii. Monitor function question ;

My next question, is then - how do I find out if you're joining them up O.k?

Could I ask you something ?

What could I ask you ?

Could I ask you if you made a line from X [e.g. tree] to Y [e.g. house] ?

iv. Monitor function prediction

Ok What would happen if I asked you if you made a line from X [e.g. tree] to Y [e.g. house]?

I think/predict I could tell if you got it right !

v. Monitor summary;

So what should we do ?

I'm going to check if you're doing it o.k. by asking you if you made a line from X [e.g. tree] to Y [e.g. house].

III. Selective comparison cluster;

i. Monitoring for selective comparison question.

How do I make sure you get the right one ?

If theres two how do I make sure you pick the right one ?

ii. Selective comparison question

Is one different to the other ?

Is Ya [e.g. a large house] different to Yb [e.g. a small house] ?

How is Ya different to Yb ? Ya [e.g. is a big house] and Y is [e.g. is a small house]

iii. Selective comparison perspective question

And you should pick ? The Ya [e.g. the big house]

Did you get it right ?

IV. Awareness check cluster;

i. Performance evaluation;

Do you think we did well ?

That we knew how to get you to fill in your map ?

ii. Performance explication;

What did we do ?

I asked questions and found answers about -

What we got - a map

What we could do - I tell you the way

How should we do that - by me checking if you were getting it right

iii. Performance prediction;

What would happen If we did that on the next one ['today' for the first five trial of each session and 'tomorrow' for the last trial of each session]?

We'd get your map to look like mine.

Shall we do that then ?

Procedure:

In the following we'll detail the procedure used for all three training sessions.

Session One (see maps 1-6 in appendix 12)

After the general instruction (in general procedure above) is given, each subject is taken through the six trials. At the end of each trial the subject is given a general impression of their performance such as - "we didn't do so good" or "we did O.K." or "we did well/very well".

<u>Trial 1. (</u>Outdoors.Nominally Distinct<u>)</u>

On the first trial the experimenter models the speaker role for the subject. The subject is told that:-

"I'll [the experimenter] try and help by talking about what I'd do if I were you, the one who has to "tell" the other -- the speaker".

The experimenter then takes the speaker map-booklet and gives the subject the listener map-booklet. Maps are placed in parallel with each other, and therefore each person can see each other's maps.

The experimenter then proceeds to model the Metacognitions listed above (apart from the Selective comparison cluster, number III).

The task orienting cluster (I) are first modelled, once only. The Monitoring cluster (II) is then modelled for each target referent.

At the end of the trial the experimenter models the "awareness check" cluster (IV). These lead into a general discussion of performance that is illustrated by looking at the maps. The experimenter concludes the appraisal by saying such things as "we didn't do so good" or "we did O.K./well/very well".

Trial 2. (Outdoors.Nominally Similar)

In the second trial the maps are presented at right angles to each other to make it difficult for each person to view the other's map. The experimenter then models the speaker role for the subject, and gives the same instructions, as he did in the first trial. However he also models the Selective comparison cluster (number III) for each selective comparison. When there are two referents similar in name (such as two houses), therefore, the experimenter says -

"How do I make sure you get the right one ?
If theres two how do I make sure you pick the right one ?
Is one different to the other ?
Is Ya [e.g. a large house] different to Yb [e.g. a small house] ?
How is Ya different to Yb ? Ya [e.g. is a big house] and Y is [e.g. is a small house]
And you should pick ? The Ya [e.g. the big house]
Did you get it right ?

After making the selective comparison the experimenter waits for 3-4 seconds and proceeds to the next referent.

Trial 3. (Animals.Nominally Distinct)

The procedure for trial 3 is the same as for trial 1, other than a screen is placed in-between the experimenter's and subject's maps to make it very difficult for each person to view the other's map.

Trial 4 (Animals.Nominally Similar)

The procedure for trial 4 is the same as for trial 2, other than a screen is placed in-between the experimenter's and subject's maps.

Trial 5 (Shapes.Nominally Distinct)

This trial has the subject as the speaker. The experimenter gives the subject the speaker booklet and takes the listener booklet, turning both to the "Shapes.Distinct" maps.

The experimenter points at examples of the shapes and asks the subject to name them, and if they cannot name them correctly, (or according to a systematic manner such that they can label the shapes for themselves) the experimenter provides names for each object.

The subject is then given the role of the speaker, and the experimenter prompts the subject to use the Metacognition s and 'find' the appropriate answers (apart from cluster III).

First the experimenter uses the Metacognition's as a guide to request the subject to outline the goal of the task, such as:-

E:"What could you do ?"

[The experimenter then waits for an answer. If there is none then experimenter says -]

"Ask a question ?"

[The experimenter then waits for an answer, and if there is none he moves down the hierarchy, etc].

After the dyad have debated the task orienting questions the subject is encouraged to give the experimenter directions between the target referent s. The experimenter may prompt with "what's in the box ?" to get the subject started. After the first referent is communicated by the subject, the experimenter uses strategic information in cluster II to guide the subject to monitor his (the experimenter's) understanding, such as:-

"I've a question! How do you know that I'm doing all-right ?"

[wait for answer, if none then ask]

"That is , I'm joining the things up o.k. on my map -- like yours" etc.

Over the next referents the experimenter prompts with the question -

"how do you know I'm doing o.k.?" for each referent. He also, when required, expands on the question as detailed in the Hinting Hierarchy above.

At the end of the trial the experimenter leads the subject through "awareness check" cluster (IV). These lead into a general discussion of performance that is illustrated by looking at the maps. The experimenter concludes the appraisal by saying such things as "we didn't do so good" or "we did O.K./well/very well".

The subject's verbalisation and use of the hints is reinforced. Further if the subject did ask task appropriate questions correctly such as "did you get the, e.g. house?", but had not given the right directions such as "from the tree to the house" the subject is told that -

"you asked the right question, e.g. if I'd got the house, but you didn't tell me the right directions".

Trial 6 (Shapes.Nominally Similar)

Same as Trial 5 above, but includes the use of the Selective comparison cluster (III). During this trial a screen is placed in-between the experimenter's and subject's maps.

When the subject has named a referent that has a nominally similar equivalent (such as two circles) then the experimenter uses the information in the Selective comparison cluster. The experimenter moves from one hint to the next depending on if the subject had not acted or verbalised the action in that hint when prompted by the preceding hint. So for example, if the subject has failed to make a selective comparison the experimenter says -

"How do you make sure I get the right one ?

[If she/he still fails to make a selective comparison then the next hint is given -]

If there's two how do you make sure I pick the right one ?

[If she/he still fails to make a selective comparison then the next hint is given - and so on through the hierarchy -]

Is one different to the other ?

Is Ya [e.g. a large circle] different to Yb [e.g. a small circle] ?

How is Ya different to Yb ? Ya [e.g. is a big circle] and Y is [e.g. is a small circle]

And I should pick ? The Ya [e.g. the big circle]

Did I get it right ?"

The subjects verbalisation and use of the hints is reinforced, with particular praise such as "that's very good" for an actual selective comparison.

At the end of trial 6 the "Awareness" cluster of hints are provided - again given in a stepwise manner and only if the subject fails to provide answers. The subject is thus asked -

"Do you think we did well ?

That we knew how to get me to fill in my map ?"

"What did we do ?

You asked questions and found answers about -

What we got - a map

What we could do - you told me the way

How should we do that - by you checking if I was getting it right"

They are then given the generalisation prompts -

"What would happen If we did that again tomorrow ?

We'd get my map to look like yours.

Shall we do that then ?"

The subject is then thanked for coming to the session.

Session Two (see maps 7-12 in appendix 12) -

Session two starts with the experimenter placing the map booklets on a desk. Before trials begin in session two the subject is given the general question-

"Maybe we could use how we thought on those maps yesterday [or from the last interaction] to help us when we do this today ?"

Trial 7(Outdoors.Nominally Distinct)

Same as trial 1, but a screen is placed between the experimenter and the subject's maps.

Trial 8 (Outdoors.Nominally Similar)

Same as Trial 2, but screen is used.

Trial 9 (Animals.Nominally Distinct)

The subject is given the role of the speaker, and the experimenter prompts the subject to use the hints.

First, the experimenter gives the subject the speaker booklet and takes the listener booklet, turning both to "Animals.distinct".

The experimenter says -

"This is another of those maps. Again you've got a a road, but I haven't. Maybe what we learnt on the last one would help us here."

The procedure is then the same as for Trial 5 above.

Trial 10 (Animals.Nominally Similar)

Same as Trial 9 above, but includes the use of hints for selective comparison (cluster III). When the subject has named a referent that has a nominally similar equivalent (such as two bears) then the experimenter says-

"How do you make sure I get the right one ?
If there's two how do you make sure I pick the right one ?
Is one different to the other ?
Is Ya [e.g. a black bear] different to Yb [e.g. a white bear] ?

How is Ya different to Yb ? Ya [e.g. is a black bear] and Y is [e.g. is a white bear]

And I should pick ? The Ya [e.g. the black bear]

Did I get it right ?

The subjects' verbalisation and use of the hints is reinforced, with particular praise such as "that's very good" for an actual selective comparison.

Trial 11 (Shapes.Nominally Distinct)
The procedure for this trial is the same as for trial 9.

Trial 12 (Shapes.Nominally Similar)
The procedure for this trial is the same as for trial 10.

At the end of trial 12 the "Awareness" cluster of hints are provided, which also contain the generalisation prompt. The subject is then thanked for coming to the session.

Session three (see maps 13-18 in appendix 12)

This session follows the same procedure as session two. However the order of the map types is changed.

Trial 13 (Shapes.Nominally Distinct)

The procedure for this trial is the same as for trial 7.

Trial 14 (Shapes.Nominally Similar)

The procedure for this trial is the same as for 10.

Trial 15 (Animals.Nominally Distinct)

The procedure for this trial is the same as for trial 9, but if subject does not use the metacognition s (or demonstrates the related sub-skill) then the experimenter reverts to procedure in trial 5 within which more support was given.

Trial 16 (Animals.Nominally Similar)

Same procedure as in trial 10, but reverting to trial 6's procedure when appropriate (that is when subject requires more support).

Trial 17 (Outdoors.Nominally Distinct)

The procedure for this trial is the same as for 15.

Trial 18 (Outdoors.Nominally Similar)

The procedure for this trial is the same as for 16.

At the end of trial 18 the "Awareness" cluster of hints are provided, which also contain the generalisation prompt. The subject is then thanked for coming to the session. (An example segment of the interaction between the experimenter and a subject in Metacognitive training is shown in appendix 13).

Control Group (Practice sessions);

Subjects in the practice sessions would not be explicitly trained the skills appropriate to the task. They are given the same maps, in the same procedural manner as above in the self-instructional and metacognitive conditions but the subject -experimenter interaction is limited to the procedure described above for baseline testing. That is, for those trials in which the subject is the listener, then the procedure in baseline tests of listener ability (trial 1 LiND an trial 2 LiNS) were used, and for the trials in which the subject is the speaker the procedures for baseline tests for the subject as speaker (trial 1 SpND and trial 2 SpNS) were used.

Independent Observer ratings:

To monitor that the procedures detailed above were adhered to by the experimenter, two non-Psychology graduates were requested to observe video-taped interactions between the experimenter and three subjects from each condition. The observers were asked to record (i) the amount of specific instructions that each subject was enabled to be exposed to in each condition, (ii) the duration of, and (iii) the type and number of reinforcers given, in each session. They were also asked to note if (iv) the experimenter made mention to any subject of the utility of learning speaker skills for becoming better listeners (a form for detailing their observations of subjects are shown in appendix 14).

B : Testing for learning and transfer of communication skills:

Introduction:

Transfer occurs whenever our existing knowledge, abilities, and skills affect the learning or performance of new tasks (Cormier & Hagman, 1987).

Transfer is characterised by two factors, the extent to which more different tasks (to the training tasks) are affected by training, and the direction of the effect, such that if performance increased on these later, post-training tasks,then transfer would be positive, and negative if performance dropped.

The differences between the original and the later environment may be conceptualised as lying on a continuum of novelty -- the more novel the environment, as compared to the original, that produces the originally learnt responses, the further is the transfer of those responses along that continuum. Transfer extent could therefore be generally measured in terms of the degree of novelty in an affected task when compared to the training task then the further transfer has occured.

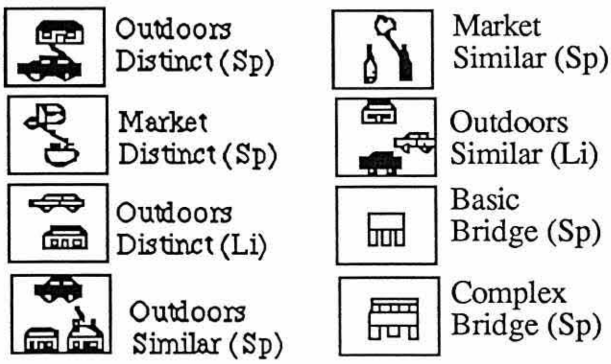
Given such a view of transfer we may map the direction and extent of transfer away from the original training tasks either positively (further and more novel tasks aided) or negatively (further and more novel tasks impeded).

Transfer tests were therefore designed to measure if subjects' who had learnt to communicate more effectively in the speaker role, with maps, also transfered their new skills to situations that differed in various ways from those tasks they were trained on. We took the communication roles, type of maps, and then the actual type of task, and blended them to produce task situations that differed in ever increasing complexity away from the training environment.

Since training had concentrated on the speaker role with outdoors maps we provided the subjects with the same task after training, as a measure of learning. We then presented them with tests of the speaker role with maps that they had not seen before, these were of supermarket layout's. The use of skills learnt during training in this situation would indicate a near transfer of those skill since the training and transfer tests are quite similar. Since we had not trained our subjects explicitly as listeners we then provided them with listener role tests. Increases in performance on the listener role maps with the transfer of speaker skills to the listener roles we considered as "far transfer". Finally we provided our subjects with a different kind of task within the speaker role. These were object assembly tasks. On these the subjects had to instruct the experimenter to construct replica s of model's of bridges. Again since there would be a major difference between these task and the training tasks we considered any transfer to be "far transfer". Performance on all these transfer tests (apart from the supermarket maps) had therefore been measured at baseline for comparison. In the case of the supermarket map we wanted the subject to be completely naive of their existence and therefore performance on the supermarket map was compared against the subjects' baseline score on the outdoors maps. These learning and transfer tests are summarised below in figure 20.

Figure 20: Summary of learning and transfer tests, including the reasons why they measure what they do.

TASKS	Tests for	Reason for this
1 *Outdoors* Speaker Distinct	Learning	Same referents, role and task trained on.
1 Speaker Distinct *Market*	Near transfer	Different referents, but the same role and task type trained in.
2 *Outdoors* Listener Distinct	Far transfer	Same referents and task type, but different role to that trained in.
3 *Outdoors* Speaker Similar	Learning	Same referents, role and task trained on.
3 Speaker Similar *Market*	Near transfer	Different referents, but the same role and task type trained in.
4 *Outdoors* Listener Similar	Far transfer	Same referents and task type, but different role to that trained in.
5 Basic Bridge	Far transfer	Same role, but different referents and task type to that trained with.
6 Complex Bridge	Far transfer	Same role, but different referents and task type to that trained with.



These tests were administered twice, once the day after training had ceased, and then two weeks later. The only differences between the two sets of tests was the time of testing, and the location of, and direction between, some object-referents on the maps used.

The learning and transfer tests can therefore be seen as a series of repeated measures of certain communication skills at two post training intervals, for comparison against pre-training performance.

The methodology of the learning and transfer tests was essentially the same as for the baseline tests that they were a repeated measure of. We will therefore only provide a brief description of the methodology employed.

Method:

General Materials:

There were a number of maps produced for these tests. One set for the first week and another for the second week of testing. These sets were arranged into two booklets corresponding to both test periods. The booklets first had the speaker maps - outdoors maps (nominally distinct then nominally similar) and then the market maps (nominally distinct then nominally similar) - and then the listener maps - outdoors maps (nominally distinct then nominally similar). (Map booklet for the first week is shown in appendix 15, and the second week booklet in appendix 16).

For the "market; nominally distinct" maps there were eleven target-referents, and for the "market; nominally similar" maps there were seven target-referents that had a potential referent of the same name, and a further four that had no nominally similar potential referents. The other maps were variations (in terms of the location of objects) of the baseline maps.

The bridges used for the transfer tests were the same ones as used in baseline. These were, first, a Basic model of a bridge, and secondly a Complex model.

General Apparatus:

For preparation the maps we used Snodgrass and Vanderwart (1980) standardised pictures, Macintosh Hypercard and Macintosh Image Processors.

On all the tests the speaker and listener required a screen so as to disallow each to see the other's maps and bridges. Also an audio tape recorder and a video camera was required for recording interactions. The listener required a thick line marker pen which made their drawing work visible for an overhead video camera.

General Procedure:

The procedures listed above for the map- and bridge- based baseline measures of communication skills also applied here. There was one main difference however, the instructions for the subject was limited to -

"Here is *yours [map or bridge is placed in front of the subject on their side of the screen],* and here is *mine [map or bridge is placed in front of the experimenter on this side of the screen]* , start when you are ready".

Summary of Research Stage Two: Training and Transfer of communication skills

There were three training conditions, Self instructional, Metacognitive and practice. Self-instruction attempts to access what individuals say to themselves so as to affect their behaviour by verbal and behavioural modelling of the desired behaviours by a trainer for the learner to copy.

Metacognitive training did not rely on the direct rehearsal of a limited set of self-instruction s through rehearsal. The major characteristic of a metacognitive approach is a dialogue led by a task expert in which they may reveal to a learner their strategic, and meta-strategic, processes for dealing with certain tasks. Through this dialogue the trainee is made conspiratorial with the trainer in delineating what is to be done.

Subjects in the Control condition were not given explicit training but were taken through the "training" tasks as in the unguided conditions in baseline.

The following table (table 5) makes clearer the distinctions between Self Instructional and Metacognitive training.

Table 5: Distinctions between Self-instructional and Metacognitive training approaches.

A: Content

Self-instructional	Metacognitive
i. Preview	i. Preview
"What do I do first?"	"What could I do? What is it?"
ii. Task information	ii. Task information
"Line goes from [e.g. Tree] to the [e.g. House]"	"I'll tell you how the road goes"
If theres two which one?	iii. Prediction
iii. Monitor	"What would happen if I asked
I'm to ask if you got there	you if you've made a road? I could
Did you get there	tell if you'd got it right"
iv. Reinforcement	iv. Summary/ monitor
"We're doing o.k."	"I'm going to check if you're doing it o.k
v. Rehearsal	by asking..."
Can you say....	v. Reinforcement
	"We did o.k."

Table 5: continued

B: Teaching style

Modeling of self-instruction's by the experimenter. Rehearsal of the self-instruction's by the subject.	Modeling of metacognition's by the experimenter. Subject prompted to come up with strategies for the task by the experimenter.
A monologue modeled by the experimenter, and rehearsed by the subject.	A dialogue engineered by the experimenter based on metacognitive prompts.

C: Sessions end with

An instruction for using the self-instructions again	A dialogue to prompt task awareness, such as "How did we do?", "What would happen if we did that again?"

If training is successful then a learner may be able to transfer their skills learnt in those training environments to other, more different, situations. The greater the difference between the training environment and the situations affected by such training, then the further the extent of transfer is. Transfer of the skills learnt in training on the speaker role maps were therefore tested on maps that they had not seen before, in the listener roles and on tasks in which the subjects instructed the experimenter to construct replicas of model's of bridges.

Summary of Method chapter:

This study (as represented in figure 22 below) was designed to investigate issues regarding the communication skills of people with learning difficulties. First to discover if our subjects had measurable difficulties in communication. Secondly to provide different kinds of training to ameliorate any such communication problems. The effects of training were then measured in situations similar to those trained in and in situations that differed from the training environments.

Figure 22: Detailed overview of our study on the training of communication skills for people with learning difficulties.

Baseline Tests------->---Training-->---Transfer Tests

Linguistic/ Cognitive	**Communicative**	**Self-instruction**	**The day after training and two weeks later**
BPVS (Vocabulary) TROG (Grammar) RDLS (Expressive) RDLS (Receptive) Sentence length Locus of control STM (Digit-span) Raven's [Abstract reasoning]	A: Components of Communication Basic Perspective Perspective monitor Selective comparison Referential communication Message Adequacy B: Global Tasks of Communication Maps/Speaker Maps/Listener Bridge/Build Bridge/Instruct	Speaker Self-instructions internalised by subject **Metacognition** Speaker Metacognitions internalsied by subject **Control** Practice at speaker role, no guidance.	As a speaker with "Outdoor" and "Markets" maps. As a listener with "Outdoor" maps. As a speaker with "Bridge" object assembly tasks.

Chapter 5: Results of the study

General introduction:

This chapter has been organised into three sections. In section one we present the results of various types of baseline tests. These tests provided information for matching and for the delineation of communicative difficulties. In section two we present results regarding the effect of our intervention programs. These results show if any learning occured to any lesser or greater degree in any group. In the third section there is a integration of both results in an analysis of the individual differences that may have influenced the effect of training. The following table (table 1) summarises the aims of each section.

Table 1: Summary of the aims of each of the three sections of Chapter 5.

Summary of Results chapter		
Section One	*Section Two*	*Section Three*
Baseline Scores, of - Language Cognition Communication (Components of and Global)	**Intervention Results, on -** Global Communication Tasks	**Performance Correlates** Degree of learning and transfer related to baseline measures
To:- establish the parameters of subject's' abilities, especially as communicators - provide information for matching subjects in ability - make comparisons between tests to check on their validity, and what factors they share	To provide:- Measures of abilities after training as speakers, on tasks - similar to those trained on (Learning and Near Transfer), tasks different to those trained on (Far Transfer) and as Listeners (Far Transfer)	To analyse individual abilities that may predict Learning and Transfer within each training condition

Section One: (Part 1) Baseline results, (Part 2) matching of groups, and (Part 3) correlates between measures

The first part of this section shows the mean score for all subjects on each baseline test. The second part shows how this group of 45 people were separated into three matched groups of 15 on the basis of their baseline scores. The third part examines the relationships between performance scores on each of the baseline tests.

Part 1-

Baseline Results

There were two sets of baseline measures. First (A) a wide range psychometric tests and (B) tests of communication.

A: Baseline Psychometric tests

We employed a variety of linguistic and cognitive tests to provide information about our subjects for matching and for investigating what individual differences factors in intelligence and language skill determine effects of training.

The language tests (a) were of vocabulary (Peabody), comprehension of grammatical structures (TROG) and then general receptive and expressive abilities (Reynell and Sentence Length). These tests differed not only in their linguistic focus but in developmental language age levels. This allowed a range of opportunities for our subjects to demonstrate their verbal capacity. We attempted to account for further individual differences, specifically in cognitive abilities (b), by including tests of abstract reasoning (Raven's) and of memory capacity (Short Term Memory Tests) and of differences in self attributions (Locus of Control test).

a. Language Tests

i. British Picture Vocabulary - Short Form (BPVS) (Dunn, Dunn, Whetton and Pintilie, 1982).

This is a test designed to measure receptive vocabulary, that is, it shows approximately how much understanding of spoken English words a person has acquired.

The test was standardised on normal children between 2.5 and 10 years. Comparison of each subjects' raw score against standardised age equivalent scores therefore give an indication of vocabulary development for each subject.

The overall group's raw score was 12.13 (SD 4.08) giving an age equivalent score of 5.46 (SD 1.9) years.

ii. The Test of the Reception of Grammar (TROG) (Bishop, 1982)

TROG is a test of the comprehension of grammatical structures, from nouns and verbs through to reversible passives. It has been standardised on normal children from 4 to 11 years. An indication of each subject's level of grammatical development could therefore be gleaned by comparing each subject's raw score against standard age equivalent scores.

From this test we derived three measures. First a raw score. Second an age equivalent score and third, we were able to provide an more detailed description of our subjects grammatical ability by pin-pointing on which structures our subjects failed the test. The raw score was 5.69 (SD 2.64).

Of the raw scores that reached criteria for translating into age equivalent scores the overall mean score was 4.59 (SD 0.52) years. Grammatical understanding was therefore further analysed by checking where a person failed the test, which suggest which types of grammatical structures they could not fully understand. For this measure we indexed each grammatical construct tested on a scale from 1 to 20, from the most basic to the most complex structure, and then noted where each subject reached on the test, as shown in Table 2 below.

Table 2:
Level of grammatical understanding reached on the TROG

No of Subjects completing at each level	Cumulative	Rank	Grammatical Structure
0	0	1	Noun
0	0	2	Verb
0	0	3	Adjacent
6	6	4	Two element combination
5	11	5	Negative
3	14	6	Three element combination
11	25	7	Singular/plural personal pronoun
2	27	8	Reversible active
4	31	9	Masculine feminine personal pronoun
5	36	10	Singular/plural noun inflection
4	40	11	Comparative/absolute
0	40	12	Reversible passive
2	42	13	In and on
2	44	14	Postmodified subject
0	44	15	X but not Y
0	44	16	Above and below
0	44	17	Not only X but also Y
0	44	18	Relative clause
0	44	19	Neither X nor Y
0	44	20	Embedded sentences

*one subject did not fail this test

By observing the table above we may suggest that most subjects began to fail the test when confronted with singular/plural personal pronouns (Ranked 7th), and by Postmodified subject (Ranked 14th) nearly all subjects have failed. The median point of failure was between ranks 6 and 7, which were three element combinations and singular/plural personal pronoun.

iii. Reynell Developmental Language Scales (RDLS) (Reynell & Huntley, 1985)
The RDLS comprises of two language ability tests, one of receptive, and another of expressive ability. The raw scores taken may be compared against standardised scores of normal children aged between 6 months to 6 years.

For verbal comprehension the overall mean raw score was 48.31 , which provided an age equivalent score of 4.0 (SD 1.2) years. For expressive language the overall mean raw score was 45.02 , which provided an age equivalent score of 3.8 (SD 0.8) years.

iv. Sentence length (Reynell & Huntley, 1985)

This test provided a measure of the subjects' typical length of sentence, in words. This is based on a 10 - 15 minute conversation from which between twenty and forty sentences per subject were analysed. The analysis is partly based on Flesch's (1960) test of language complexity by which the total number of sentences uttered are divided by the total number of words.

The average length of sentences, overall, was 4.3 words (SD 1.98).

b. Cognition

i. Ravens Coloured Progressive Matrices (RPM) (Raven, 1947)

The Raven's coloured progressive matrices test attempts to measure the ability to perceive and think clearly irrespective of verbal comprehension. The test has been standardised with children from 5.5 through to 11.5 years of age. Half of the 5.5 year olds half scored 42% or less, and half of the 11.5 year olds scored 88% or less.

There are three sets of matrices in the test (sets A,Ab and B). Success on set A depends on the ability to complete continuous patterns which, toward the end of the test, change in one and then in two directions as spatially related wholes. Success on test Ab depends on the ability to see discrete figures as spatially related wholes, and on test B, the ability to think abstractly through analogies, such that the missing piece is the same to one element as another is to another .

The average score on set A was 47% (SD 18), on set Ab 30% (SD 18), and on test B 22% (SD 11). The overall average for the test was 32% (SD 14).

ii. Short Term Memory Test (STM)

This was a test to discover how many digits a person can recall from short term memory under two conditions. First (A) when digits are presented singularly in sets of increasing numbers (e.g. 5, 6; 7, 3, 5) and secondly (B) when the digits were presented in pairs (e.g. 56; 73, 5) -- thus imposing a cluster strategy onto the stimuli data.

Age differences in retention of digits range from 2.3 for 2 year olds up to 4.3 for 5 year olds (Dempster, in Schneider & Pressley, 1989). Spitz (1966/1971) showed that MR subjects (chronological age of 14 years) recalled 3-4 digits as opposed to normal adults span of 5-7.

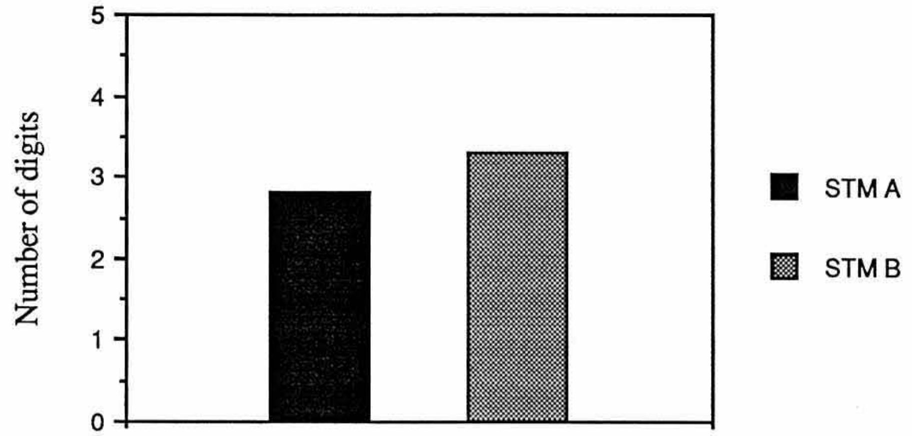
In the first tests (A) when digits were presented singularly in sets an average of 2.9 digits (SD 1.3) were recalled. In the second tests (B) an average of 3.3 digits (SD

1.4). The difference between the first and second test was not significant. The 2.9 score on Test A roughly translates into an overall age equivalent score of 2.8 (extrapolated from Dempster in Schneider & Pressley, 1989).

Overall mean scores on tests A and B are shown below in figure 1.

Figure 1

Overall Mean number of digits recalled under two conditions for all subjects. A, without an imposed strategy, and B, with an imposed 'cluster' strategy



iii. Locus of Control (adapted from Connel, 1985)

With this test we attempted to measure where, and to what degree, a person perceives control over their outcomes in social academic settings. There were three dimensions of control tested, with the self, with principal others, or in the unknown. Our test was based on Connel's multi-dimensional measure of children's perceptions of control. Over the course of the study less subjects were seemingly able to provide responses consistent with the demands of the test. For example we gave statements to subjects over the duration of the test such that externally and internally- locused statements were alternated and many subjects choose to agree strongly with the statement provided. It was therefore noted that a large sample of responses were stereotypic and not considered. We thus failed to show a clear locus of control in either of the three dimensions, as confirmed by an ANOVA (shown below in table 3 where ($F(2,107)=0.31$; n.s.).

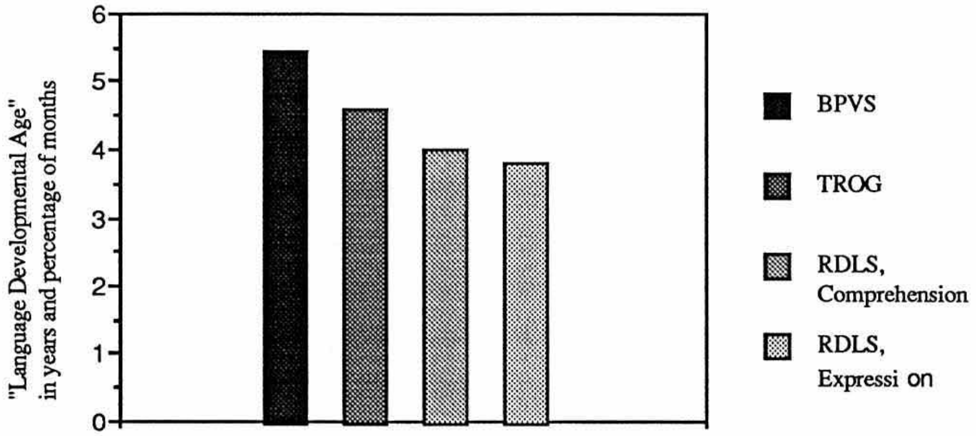
Table 3: ANOVA table comparing the means of the Connel's dimensions for the locus of control (External and Unknown, Other Person and Self - Internal).

Source	d.f.	s.s	m.s.	v.r.	p
Factor	2	387	193	0.31	0.734
Error	105	65428	623		
Total	107	65915			

Summary of Baseline Psychometric tests

Language tests describe our population as having language skills, on average, comparable to the developmental range 3 years 8 months to 5 years 6 months. Overall group mean age equivalent scores on each language measure (apart from sentence length) are shown below in Figure 2.

Figure 2
Mean age equivalent scores on each language measures for all subjects



On Raven's progressive matrices our subjects' scored an overall average of 33%, which is 9 percentage points below the average score for normal children of 5.5 years. Our subjects' average digit span was 2.9, with a slight (but not significant) increase with strategy imposition. This roughly translates to an age equivalent score of 2.8 years. Our measure of people's perceptions of with whom or where control over their lives rested did not produce meaningful results. (The results for each subject on all the psychometric tests in baseline are shown in appendix 17. Also see appendix 20 for details of the abbreviations used).

B: Baseline tests of communication

There were two types of communication tests, first (a) tests that isolated, as far as is possible, component skills of being a speaker or listener, and secondly (b), tests that combined these skills in a more global context, that of giving and receiving instructions both the use of maps and on object assembly tasks.

Again these tests provided information for matching subjects and for investigating individual differences, and moreover, they define the parameters of our subjects' abilities as communicators for assessing if training in communication were desirable. (The results for each subject on all the communication tests in baseline are shown in appendix 18. Also see appendix 20 for details of the abbreviations used).

a. Communication Component tests

The first four tests described below are generally regarded as tests of the components of the speaker role, and the last test one of the components of the listener role. In this chapter we have changed the presentation order of two tests from the order in the Method chapter in that the results of Selective Comparison is given before those from Perspective Monitoring. This is because the order of presentation of tests to subjects is reflected in the method chapter, but the level of complexity of a test is reflected in this chapter (after Patterson & Roberts, 1982).

i. Basic perspective taking.

Basic perspective taking tested how well subjects could gauge that a person with a different vantage point to themselves, and therefore a different knowledge base, might not be able to see the same objects as they could, and thus know what they know. This test was based on a test of a speaker's basic knowledge about the speaker role developed by Patterson and Roberts (1982). Their test checked, for example, if young children realise that while he or she knows the identity of a target referent the listener would not. They found that 86% of the 42 children (aged 4-6 years) they tested were able to realise, before any messages were created, that they could identify a target whilst a listener may not.

Subjects were asked to watch a person on a television and were asked if that person could see various objects. These objects were pictures either placed in front of the stooge or out of their view (although still in the subjects' view) behind a screen. There were ten trials. The overall group mean was 75% (SD 28.9) showing that they could take the perspective of another person, and know that the stooge would not know of the hidden target - allthough they themselves did.

ii. Selective comparison.

Subjects' success at being evaluators of messages may rest on their knowing the basic skill of being able to differentiate between objects. Selective comparison is a test of a person's ability to actually describe differences between objects that share some other common features (such as houses that may be large or small, with chimney stacks or not). Vurpillot (1968) found that 4 year old children, when asked to say if two pictured houses were identical, tended not to make the relevant comparisons that 9 year olds would. The extent to which the younger children failed to make comparisons between stimuli means that they might certainly fail to produce adequate messages for a listener to select pictured objects (Patterson & Roberts, 1982). For this test subjects were prompted by the experimenter to describe differences between up to 5 referents over 30 trials. The overall mean score was 42% (SD 15).

We then attempted to pin-point what kind of comparisons our subject were able to make, and those that were more difficult for them. For this we made an index of the complexity of comparisons (shown in Table 4 below) based on the number of objects (target and potential referents) in a set and the amount and type of differences that exist between them. These were, first, Addition, the inclusion of a secondary characteristic such as an aerial on a car. Rotation is the direction such an addition might point in compared with another (one aerial straight up and another at an 45 degree angle). Position is, for example, where the secondary object might be placed, such as an aerial on the boot rather than the bonnet of the car. Last, subtraction, this is "taking away" a secondary object generally shared by the group of objects, e.g. a roof of a car, which may be removed.

These differences between objects would therefore become more numerous and more fine grained over the duration of the session. Complexity was incremented as blocks. The first block contained 4 trials of 2 referents. These referents needed only one selective comparison for their identification, and these comparisons would be "basic" - name, colour etc. The next block contained 8 trials of three referents. At least two selective comparisons were needed for the identification of the referents. The next block (number 3) contained 13 trials of four referents. Selective comparison here were more difficult since, first, in the case of one major distinguishing feature (e.g. "largeness") a referent still needed to be compared to another three referents, and secondly there were not only more referents to be compared to, but there was the inclusion of even more distinguishing features for comparison. The last block (number 4) had five trials of five referents, again giving more referents for comparisons and necessitating even more comparisons.

A person's ceiling score was assumed to be the first of four consecutive failures to distinguish the target from the potential referents. This is shown in table 4.

Table 4: Level of comparison reached on Selective Comparison by each subject

No of Subjects completing at each level	Cumulative	Rank /trial	No of Objects	Type of Differences
0	0	1	2	Name
1	1	2	2	Addition
0	1	3	2	Colour
2	3	4	2	Name or Shape
0	3	5	3	Name & Size
0	3	6	3	Name & Size
0	3	7	3	Name & Size
1	4	8	3	Name & Colour
2	6	9	3	Size & Colour
2	8	10	3	Shape & colour
1	9	11	3	Size & Shape
1	10	12	3	Size & Shape
1	11	13	4	Size & Shape
1	12	14	4	Size & Colour
0	12	15	4	Size
3	15	16	4	Size & Shape
0	15	17	4	Size
0	15	18	4	Size
13	28	19	4	Size & Addition
3	31	20	4	Shape & Addition
6	37	21	4	Size & Rotation
1	38	22	4	Size, Colour & Position
0	38	23	4	Addition, Position & Rotation
1	39	24	4	Size, Shape & Position
0	39	25	4	Addition & Rotation
0	39	26	5	Size & Addition
2	41	27	5	Size, Addition & Rotation
0	41	28	5	Colour, Position & Rotation
0	41	29	5	Addition & Rotation
0	41	30	5	Addition & Rotation

*Four subjects did not fail the test

Subjects were generally able to make comparisons based on the name of objects, and objects' shape, size, and colour, but ran into difficulties with additions and subtractions, that is when when there was a need for a finer grain of comparison. The median point of ability on this test is indicated as lying between ranks 18 and 19 - making comparisons based on size and additions with 4 referents.

Our subjects were therefore able to make gross comparisons between referents, but did not make fine grain comparisons. They therefore had some mastery of an important sub-skill of communication, the description of differences. However the use of the skill, in this context, was prompted by the experimenter.

iii. Perspective evaluation.

This is a test of a person's ability to take a listener's perspective when the listener is confronted with ambiguous messages for choosing referents. Subjects were co-opted into being conspirators with a speaker who provided messages of varying accuracy for the listener.

For effective communication a speaker must appreciate that a message for a listener, when that listener has to choose one of two similar referents (such as one of two cars, one being white and the other black), has to include differences between the referents (such as to choose the one that is black rather than white). A speaker, in this situation, therefore needs to evaluate messages to monitor if they apply to one or more referents (such as saying "car" would apply to both referents).

Evaluating messages when one is not the listener has become viewed as a hierarchically superior ability to actually being the listener and using the message, it is said to be a more abstract, metacognitive skill (Sonnenschein & Whitehurst, 1984). Markman (1977) found that young children (first graders - 4-5 year olds) were very poor at detecting blatant ambiguities in instructional messages prior to actually trying to carry them out.

In this test subjects watch a listener on a television, and hear them being given messages that either distinguish a referent from other referents for making a choice, or messages that fail to make a distinction possible. In order for subjects to be 'conspiratorial' they had to know which of the pictured referents the target was. They were therefore presented with a card with the target referent pictured. The subjects were then asked to tell the experimenter which messages made the referent objects distinguishable. There were 30 trials with up to 5 referents in each.

The group scored an overall mean of 34% (SD 7.8). However, the design of the test might have led to a number of false positive scores. One third of the first, the second, and of the third messages, were descriptive of the target uniquely. A number of the subjects responded that the first message was descriptive on every occasion -- in effect maintaining that every message was accurate -- and thus scoring 33% without any actual message appraisal. When accounting for this bias by not including such false positive scores the mean score was 21% . It is therefore suggested that subjects largely failed to notice that messages were ambiguous for the listener, hence they lacked metacognitive, role-evaluative, knowledge of the speaker's function.

iv. Referential communication.

This was a test of speaker ability that attempted to combine selective comparison and perspective monitoring skills within a similarly constrained context -- with the same type of materials and task structure. In this test the experimenter acted as a listener and the subject as a speaker. There were thirty trials. On each trial the subject was given a card. Each card had up to four potential referents and one target - which was underlined. These target referents shared common properties with the other potential referents, such as they were houses. The experimenter had a similar set of 30 cards, although none of the referents were underlined on his. The subject had therefore to communicate which referent was underlined on each of his/her card for the experimenter to underline his corresponding referent. The subject therefore had to communicate differences between each target and potential referents.

The overall mean score was 19% (SD 18). That is subjects were able to identify and communicate a target referent on just under one fifth of the trials.

Again we attempted to focus on which referent sets our subject were having most difficulty with. This is shown in table 5.

Table 5: Level of comparison reached on Referential Communication by each subject

No of Subjects completing at each level	Cumulative	Rank /trial	No of Objects	Type of Differences
6	6	1	2	Name
8	14	2	2	Addition
7	21	3	2	Colour
1	22	4	2	Name or Shape
2	24	5	3	Name & Size
1	25	6	3	Name & Size
3	28	7	3	Name & Size
0	28	8	3	Name & Colour
1	29	9	3	Size & Colour
0	29	10	3	Shape & colour
0	29	11	3	Size & Shape
2	31	12	3	Size & Shape
2	33	13	4	Size & Shape
0	33	14	4	Colour & Size
0	33	15	4	Size
2	35	16	4	Size & Shape
0	35	17	4	Size & subtraction
0	35	18	4	Size
4	39	19	4	Size & Subtraction
2	41	20	4	Shape & Addition
2	43	21	4	Size & Rotation
0	43	22	4	Size & Colour
0	43	23	4	Addition, Position & Rotation
0	43	24	4	Size, Shape & Position
0	43	25	4	Addition & Rotation
0	43	26	5	Size & Addition
1	44	27	5	Size, Addition & Rotation
0	44	28	5	Colour, Position & Rotation
0	44	29	5	Addition & Rotation
0	44	30	5	Addition & Rotation

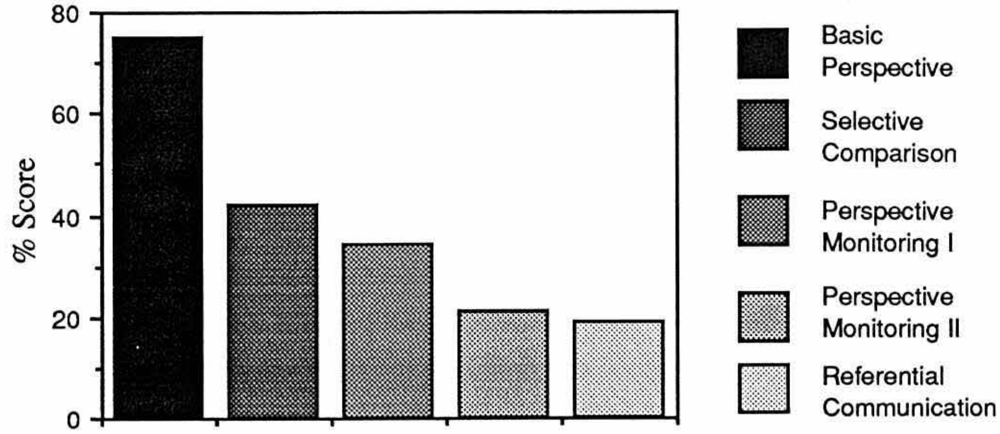
* one subject did not fail the test

As can be seen in the table 4, over half of all subjects had difficulty making comparisons between referents on this task (such as name, colour and addition) which, in the main, they could deal quite effectively with in the Selective Comparison condition task. Moreover the median point of ability on this test is indicated as rank 4, making comparisons based on either name or shape with two referents.

Speaker Component tests, summary:

Overall group means for each of the Speaker component tests are shown below in figure 3.

Figure 3: Summary of Performance scores on Speaker Role Component tests



We analysed differences between the mean scores of our subjects on each test (apart from basic perspective monitoring) with an ANOVA. The following ANOVA table (table 6) was produced.

Table 6: ANOVA table for Speaker role component tests

Source	d.f.	s.s.	m.s.	v.r.	p
Cond	2	2252.1	1126.1	1.85	n.s
Residual	42	25574.2	608.9		
Task	3	161146.3	5382.1	43.31	<0.0011
Cond.Task	6	545.3	90.9	0.73	n.s.
Residual	126	15657.1	124.3		
Total		179	60175.1		

The ANOVA showed that there was a significant difference between subjects' performance on one or more test ($F(3,126)=43.31$; <0.0011).

'A Posteriori' Bonferoni testing, which compared the mean score of each test showed that performance on both Perspective Monitoring Test I (Mean= 34) and Test II (Mean= 20), and on the Referential Communication test (Mean= 19) were significantly lower than on the Selective Comparison test (Mean= 42) - at the 0.05 level. Furthermore performance on Perspective Monitoring II (Mean= 20) was significantly lower than on Perspective Monitoring I (Mean= 34), again at the 0.05 level. There was no significant difference between Perspective Monitoring II (Mean = 20) and Referential Communication (Mean= 19).

In contrast with their performance on the Selective Comparison test, which showed the development of comparison skills, Perspective Monitoring and Referential Communication scores indicate a lack of metacognitive knowledge of those skills, *particularly where and when they should be used. It is therefore concluded that knowing to make comparisons in a communication setting could be a major problem for our population.*

v. Message adequacy.

Message Adequacy tested subjects' ability -- when actually in the listener role -- to respond appropriately to messages that are ambiguous. For example when given the message "the tree" for choosing a tree from a set of two trees and a house (one tree with a swing attached and the other without) an appropriate response would be to ask "which one".

Another type of response, when given such an ambiguous message, is to choose the referent that has the least extra features. For example, to the request to choose the "tree" from the set mentioned above a person might choose the tree that has no swing. This is a strategy based on the belief that the speaker would have mentioned the extra feature (the swing) if that particular referent was the target.

There are two other kinds of responses here also. A person might choose the referent that has the extra feature (considered non-strategic unless it is consistently the case) or just getting the wrong referent entirely, e.g. by choosing the house.

Abbeduto, Davies, Soelsby and Furman (1991) showed that nine year old children with learning difficulties (TROG age equivalent mean score of 5.16 years) were capable of making strategic responses to ambiguous messages when the context of the message 'suggested' a certain referent. However when compared to normal children (chronological age of 6.8 years and TROG age equivalent mean score of 7.9) under conditions that did not suggest a strategic response was possible to an ambiguous message, they were much less likely to respond with a request for more information and almost always made a selection.

In our tests ambiguous messages were provided for the subjects on half of forty communication trials. The most appropriate response to these messages would have been to request more information, however subjects were also always given a context for making a strategic response.

Each subject was given two presentations of twenty trials. Ten from each series had an ambiguous message describing, to an extent, which referent to choose.

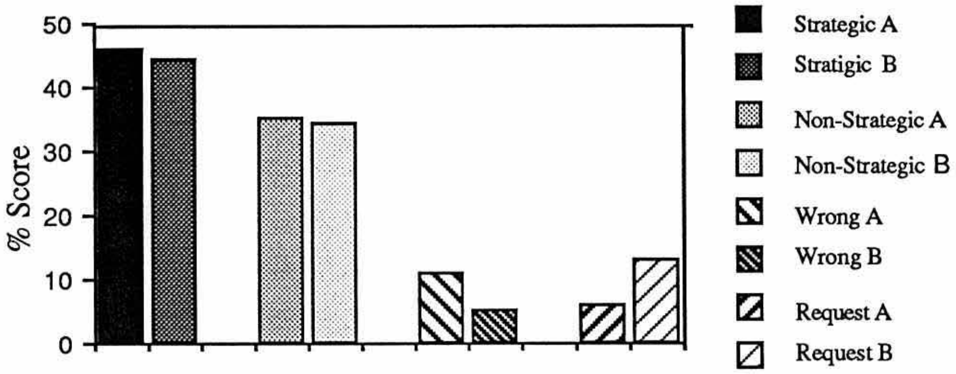
In the first series, 'A', they were reminded that what a person, such as the experimenter, says to them might be inadequate. In the second series 'B', they were given a stronger indication of a speaker liability to give inadequate messages.

Subjects responses were broken down into the percentage of each type of response for each series.

In series (A) 46% (SD 20) of overall responses were strategic, in (B) 44% (SD 20.2). Subjects made non-strategic choice 35% (SD 18.5) in series (A) and 34% (SD 20) in series (B). A Paired sample T-Test showed that there were no significant differences in the amount of strategic responses made between Tests A and B, nor of non-strategic responses. They made wrong choices 11% (SD 14) in series (A) and 5% (SD 8.5) in B. Requests for more information accounted for 6% (SD 13) in series (A) and 13% (SD 27) in (B). A Paired sample T-Test showed that there was a significant difference in the amount of wrong responses made between Tests A and B, at the 0.01 level, and also between the amount of responses to request more information between Tests A and B, at the 0.05 level. These responses are also summarised in figure 4 below.

Figure 4

Percentage of the type of responses emitted by all subjects when given ambiguous messages for choosing referents. Strategic responses are those in which the subject chooses the referent with least extra features, under the impression that the experimenter would have given more information if he'd meant the other referent. Non-strategic responses is choosing a referent with extra features. Choosing a referent of another name than that given by the experimenter would be a wrong response. Confronted with an inadequate message an appropriate response would be to request more information.



To check if subjects, on the whole, were making more strategic responses than non-strategic responses we collapsed their respective scores in both tests A and B for comparison by a Paired Sample T-Test. The overall means of strategic and non-strategic responses were 46% and 35% respectively, which were significantly different at the 0.01 level.

In both tests subjects had a tendency for selecting a referent rather than requesting more information when given ambiguous messages. In such selection there *was a significant bias towards choosing the referent that had the least extra features -- that is towards making a strategic response. There was, however, some requests for more information which increased when the subjects were given stronger indication of speaker inadequacy.*

b. General Communication tests - giving and receiving instructions.

For our second method of assessing our subjects' communicative abilities we created situations that approximated daily life. First in the giving and receiving of map directions, and then in their giving of instructions to the experimenter for him to assemble models of bridges from wooden bricks.

For these tests we created two types of maps. One in which referents (such as trees, houses, cars etc) were connected with a line, and another which had the same referents, in the same order, but without a 'connecting' line. The former map would be given to a speaker, the latter to a listener, and the speaker would have to inform the listener which referents the line linked. The listener had to use the speaker's messages, or request supplemental information for linking up his or her referents. One set of maps had target referents (those linked by the line) that were always nominally different to the other referents on that map, such as the one car, one house etc. Another set had targets that shared their name with 'potential' targets, such as two houses, the target house having a chimney. Using such maps the subjects were tested as both speakers and listeners with maps of nominally distinct and nominally similar referents. Moreover after the subjects were given 'nominally distinct' and 'nominally similar' maps they were given a further example of each map with help, in the form of hints, from the experimenter, as to what they might do. This was to test both how near the subjects were to being fully competent on the task, and to provide a second measure of task ability.

In the object assembly tasks the subjects' ability in giving instructions for the experimenter to construct models of bridges were tested. There were two bridges corresponding to two tasks, one of a 'basic' model made of 7 bricks, and one 'complex' model made of 16. Before the actual communication tasks themselves each subject was given the task of making actual duplicates of each model .

Below we will describe each class of task, first the speaker role as tested with maps, then the listener role (again tested with maps), and finally the object assembly tasks.

i. Subject tested as a speaker with maps

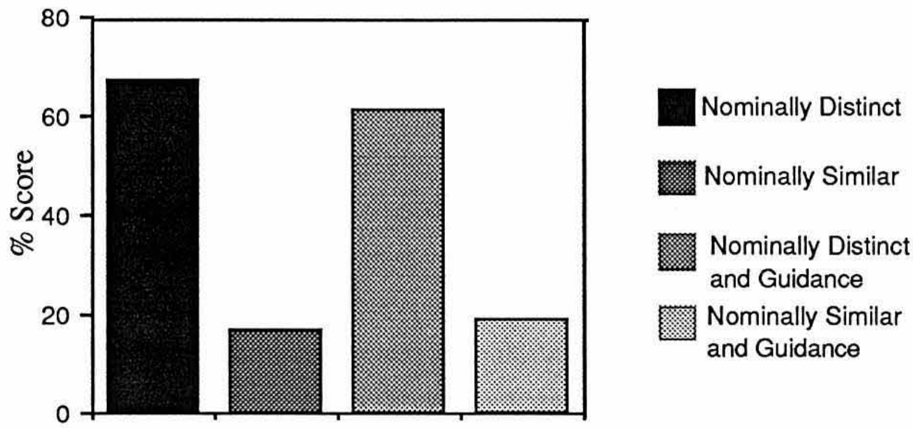
These tests measured subjects' abilities as map readers and direction givers - that is message construction and provision. The general procedure required each subject to tell the experimenter how a line connected up a number of referents. There were two types of tasks of which there were two versions

In the first type of task the subject had only 10 target referents on their map, and each were different in their main characteristic, that of name ("nominally distinct") - such as one house and one car and one tree etc. In the second type we added 6 referents, which shared the same name as a number of the targets ("nominally similar"), but differed in some subordinate characteristic - such as two houses (one big and one small), two cars (one grey the other black) and two trees (one with a nesting bird and the other without).

In one version of the each type of task the subject was provided with hints as to what to do, whilst in the other version they did not receive any help.

With nominally distinct referents and no guidance the overall mean was 67% (SD 30). With nominally similar referents and no guidance the overall mean was 17% (SD 14.56). When there was guidance with nominally distinct referents the overall mean was 61% (SD 33), and with nominally similar referents 19% (SD 17) (the subjects received, on average, 69% of the total of hints available on this task). These means are shown in figure 5 below.

Figure 5: Overall mean scores for Speaker Role Map-Tests



Comparisons were made by ANOVA between the tasks in which the subjects were unguided speakers against those in which they were guided. The following ANOVA table (Table 7) was produced.

Table 7: ANOVA table for Speaker Role as tested with maps

Source	d.f.	s.s	m.s.	v.r.	p
Cond	2	1733.5	866.8	0.5	n.s.
Residual	42	72938.5	1736.6		
Task	1	95925.1	95925.1	361.93	<0.001
HELP	1	48.6	48.6	0.18	n.s.
Cond.Task	2	173.6	86.6	0.33	n.s.
Cond.HELP	2	259	129.5	0.49	n.s.
Cond.Task.HELP	2	109.2	54.6	0.21	n.s.
Residual	126	33394.6	265		

There was no significant difference between the unguided and guided versions of the map tests ($F(2,42)=0.5$,n.s). Therefore the subjects performance as tested by the "unguided" maps can be taken as a consistent indication of the subjects difficulties in the speaker role. However, there was a large effect of whether the maps had referents that were nominally similar or distinct ($F(1,126)=361.9;p<0.0011$).

It is therefore suggested, as it was by the sub-component tests of communication, that our subjects, on the whole, were failing to make comparisons -- other than by name in the "Nominally Distinct" condition -- for the listener when they were in the speaker role. They did not seem to appreciate that to communicate in this context requires the description of differences.

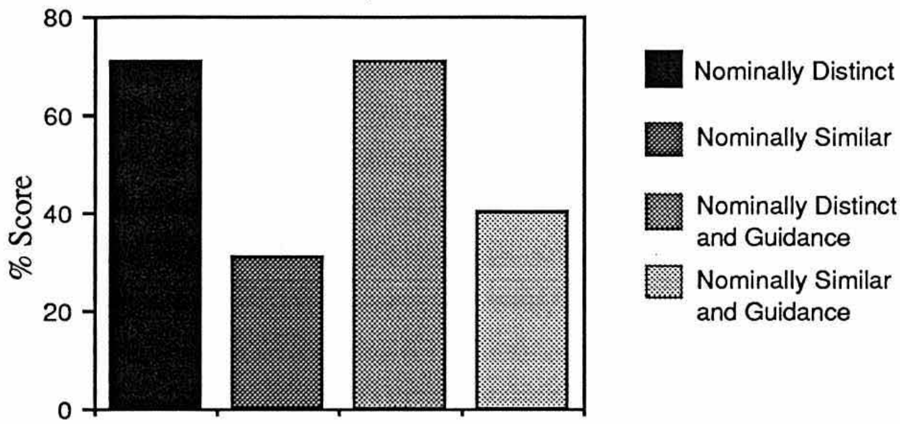
ii. Subjects tested as listeners with maps

These tests measured subjects' abilities to respond appropriately, as listeners, to messages that were unambiguous or ambiguous. Each subject was required to listen to messages from the experimenter that could be used to make paths to connect up referents. Some messages described a referent uniquely, others may have applied to two or more potential referents. As for the speaker role tasks here also there were two versions of two types of tasks.

The tasks were either based on maps that had nominally distinct or nominally similar referents. Help was provided on one version of each type of map.

With nominally distinct referents and no guidance the overall mean was 71% (SD 31) and with nominally similar referents (LS) 31% (SD 25). When there was guidance with nominally distinct referents the overall mean was 71% (SD 29), and with nominally similar referents 40% (SD 29) (the subjects received 63% of all hints available on this task). These means are shown in figure 6 below.

Figure 6: Overall mean scores for Listener Role Map-Tests



Comparisons were made by ANOVA between the tasks in which the subjects were unguided listeners against those in which they were guided, by which the following table (Table 8) was created.

Table 8: ANOVA table for Listener Role as tested by maps

Source	d.f.	s.s	m.s.	v.r.	p
Cond	2	417.6	208.8	0.08	ns
Residual	42	113884.5	2711.5		
Task	1	57865.5	57865.5	242.6	<0.0011
HELP	1	1326.5	1326.5	5.56	0.02
Cond.Task	2	42.2	21.1	0.09	n.s.
Cond.HELP	2	258.7	129.4	0.54	n.s.
Task.Help	1	673.4	673.4	2.82	n.s.
Cond.Task.HELP	2	53	26.5	0.11	n.s.
Residual	126	30056.1	238.5		

Performance scores in the "Nominally Similar" tasks were significantly lower than in "Nominally Distinct" ($F(1,126)=242.6; p<.001$). That is the subjects, confronted with an un-helpful speaker (one that does not make comparisons between nominally similar referents), were not able to make responses to elicit more information, such as asking "which one ?", for selecting one of two potential referents. There was, however a significant improvement in performance with the addition of help from the experimenter in listener skill on the nominally similar maps ($F(1,126)=5.56; p<0.02$).

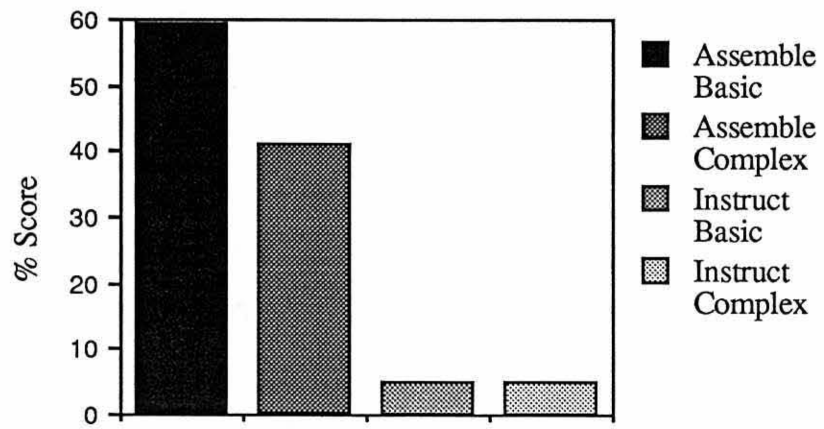
It is therefore suggested, as it was by the sub-component tests of communication, that our subjects were failing to know to evaluate the speaker's role to check if he was making comparisons. They were therefore not demonstrating the meta-cognitive knowledge of communication required for knowing to ask for comparisons. They were *able, however, to ask for comparisons when prompted by the experimenter - that is when the experimenter took on a metacognitive role.*

iii. Subject as speaker on "bridge-assembly" test.

A further situation that requires comparisons between referents is one where a person has to tell another how things "fits together" . This we tested for by assembly tasks. Each subject was given two models of bridges. One of seven wooden blocks (basic level) and another of sixteen blocks (complex level). The subject was then required, when viewing each "bridge", to direct the experimenter in building replicas of each "bridge" . Not only would the subjects be required to describe differences between bricks, but very fine grain descriptions of their positions and rotations.

However before subjects were asked to instruct the experimenter, she/he was requested to view both models and assemble replicas of each. This acted as a pre-check to show if subjects could actually cognitively represent and duplicate the models themselves. To do such require them to be able to differentiate the component parts of the model. The overall mean score for assembling a replica of the basic model was 59% (SD 37), and for the complex model 41% (SD 42). For instructing the experimenter to construct the basic model the overall mean was 5% (SD 18), and for the complex 5% (SD 15). These means are shown below in figure 7.

Figure 7: Group means for object assembly tasks



We compared these means by an ANOVA, producing the following table (table 9).

Table 9: ANOVA table comparing the means of the object assembly tests

Source	d.f.	s.s	m.s.	v.r.	p
Factor	3	90681	30227	32.39	0.000
Error	164	153068	933		
Total	167	243748			

There was a significant diffrence between performances on the bridge- based tests ($F(3,167=32.39$; $p<0.000$). 'Posteriori' Bonferoni testing, which compared each groups' means, showed that performance on the Assembly Basic task was significantly greater than on the Assembly Complex, Instruction Basic and the Instruct Complex tasks. Also performance on the Assembly Complex task was significantly gretaer than on the Instruction Basic and Instruct Complex tasks.

The subjects therefore showed themselves to be somewhat able to actually construct replica s of each bridge -- to differentiate parts of the whole for themselves -- but not to communicate to another person how to. Again this shows some capacity to compare and contrast but not the capacity to do such for another person.

Part 2-
Group matching based on baseline scores

To ensure that the three treatment groups were matched in prior ability on each (and preferably all) of the relevant sub-skills of communication and associated linguistic, communicative and cognitive abilities the subjects' baseline scores on all of these variables were analysed using a principle component analysis to generate a single factor which represented their inter-related effects. This analysis generated a principal component which explained 40% of the overall variance. The loadings of each of the variables on this factor are shown in the left-hand columns of Table 10 (show below), the factor score coefficients which were used to produce each subjects factor score on this component are shown in the right-hand columns. We have ordered the variable list by the magnitude of their factor loading.

It can be seen that this factor most typically represents performance on the map communication tasks themselves, both as speakers and listeners, guided and unguided, with nominally similar referents (LiNS.Map; SpNSG.Map; LiNSG.Map; SpNS.Map), but also that component variables such as the referential communication task (RCom), selective comparison (SCom) and perspective taking (PMon), as well as general language abilities (TROG, BPVS, Reynell) and abstract reasoning (Ravens) all load highly. The factor is thus a complete summary of the relevant factors and is therefore suitable as a criterion variable for group allocation. A full rotated factor matrix is shown in appendix 21.

The subjects were therefore rank ordered for their factor scores on this component and triplets of subjects were successively taken from the top, the members of each triplet being allocated randomly to one of the three treatment groups.

Table 10: Loadings of each baseline tests on the principle component factor (see appendix 20 for names of each abbreviation in full)

VARIABLE	COMMUNALITY COEFFICIENT	FACTOR SCORE
LiNSG.TD	.76	.05
SpNSG.TD	.67	.05
LiNS.Map	.67	.04
LiNDG.TD	.66	.04
SpNDG.MO	.64	.04
SpNSG.Map	.62	.04
LiNSG.Map	.61	.04
SpNDG.TD	.61	.04
TROG.R	.60	.04
RCom	.54	.04
CONNINT	.51	-.04
STM.B	.50	.04
SCom	.49	.04
CONNUNK	.49	-.04
STM.A	.48	.04
BPVS.R	.48	.04
CONNOTH	.48	-.04
LiNSG.MO	.44	.04
RDLS.C/R	.43	.04
SpNDG.Map	.42	.03
PMon	.41	.03
LiND.Map	.39	.03
SpNS.Map	.39	.03
LiNSG.SPI	.38	.03
LiNDG.Map	.36	.03
RDLS.E/R	.34	.03
RPM.A/%	.33	.03
LiNDG.MO	.32	.03
BMon	.32	.03
SpND.Map	.32	.03
SpNSG.CO	.27	.03
SLen	.26	.03
MAA.Str	.25	.03
SpNSG.MO	.24	.02
MAA.Nstr	.18	-.02
MAB.Nstr	.12	-.02
MAA.X	.11	-.02
MAA.Req	.09	.01
MAB.Str	.05	.01
MAB.X	.03	-.01
MAB.Req	.02	.01

To check that this matching procedure did indeed ensure that the groups did not differ on any of the baseline variables, oneway ANOVA were performed assessing potential group differences on each baseline variable in turn. The results of each ANOVA are shown below in table 11.

Table 11: Group differences on each baseline test tested by ANOVA

Test Measure	Section/	Group Means: Control	Self Instruct	Metacognitive	F	P
Peabody	Raw	13.40	12.40	10.60	1.88	n.s.
TROG	Raw	6.06	5.73	5.26	0.33	n.s.
Reynell's						
Comprehend raw		52.60	48.06	44.78	2.04	n.s.
Express raw		48.35	43.80	44.35	1.63	n.s.
Sentence Length		5.04	3.93	3.92	1.45	n.s.
Raven's						
A raw		5.53	5.47	6.13	0.41	n.s.
Ab raw		3.20	3.13	4.53	2.16	n.s
B raw		2.53	3.13	2.33	1.28	n.s.
Short Term Memory	A	3.28	2.45	2.57	1.83	n.s.
	B	3.93	3.31	2.88	2.24	n.s.
Basic Perspective		77	68	80	0.63	n.s.
Perspective Taking		33	32	36	1.01	n.s.
Selective Comparison		42	38	46	1.02	n.s.
Referential Communication		16	17	24	1.04	n.s.
Message Adequacy A	Strategic	51	46	42	0.71	n.s.
	N-strategic	32	39	34	0.62	n.s.
	Wrong	5	10	14	1.60	n.s.
	Request more	10	1	8	1.85	n.s.
Message Adequacy B	Strategic	36	48	47	1.51	n.s.
	N-strategic	37	43	22	5.42	0.008
	Wrong	5	2	6	1.32	n.s.
	Request more	18	0	23	3.30	0.04
Speaker Maps	Nominally Distinct	61	66	72	0.47	n.s.
	Nominally Similar	15	13	22	1.54	n.s.
	Nominally Distinct Guided	61	58	65	0.13	n.s.
	Nominally Similar Guided	20	17	20	0.22	n.s.
Listener Maps	Nominally Distinct	73	67	66	0.19	n.s.
	Nominally Similar	34	29	26	0.33	n.s.
	Nominally Distinct Guided	71	69	70	0.02	n.s.
	Nominally Similar Guided	40	36	41	0.11	n.s.

Table 11: continued

Bridge	Assemble basic	58	52	67	0.52	n.s.
	Assemble complex	35	44	42	0.18	n.s.
	Instruct basic	9	1	5	0.82	n.s.
	Instruct complex	5	4	6	0.09	n.s.

Significant differences only existed between each groups' performance scores on the second message adequacy test (MAB). This second test of listener ability included guidance in making requests for more information. On this item the metacognitive group made significantly less non-strategic responses than the control and the SIT groups, and the SIT group showed significantly lower performance than the control and the metacognitive in requesting more information. On crucial measures of communication performance, the map tasks and the other sub-component tasks there were no significant difference between groups.

The three treatment groups were therefore well matched in prior ability on each relevant sub-skill of communication and associated linguistic, communicative and cognitive abilities.

Part 3-

Correlational analyses of baseline measures

In order to examine the relationships between the sub-skills of communication and linguistic, communicative and cognitive abilities subjects' baseline scores on all of these variables were analysed by Pearson Correlation.

There were three main factors for exploration,

- to test if there was agreement between language measures, in general, as to what they measured
- to determine if our communication tasks had commonality with any of the standardised measures of cognitive and linguistic abilities.
- to ensure that the sub-component tests of communication were related both to each other and to ability on the general, map and bridge -based, communication tasks.

The following tables show the correlations for each variable ranked in order of importance. Only the most significant correlations were selected ($p<.01$).

In table 12 below there are correlations for the Peabody age equivalent score, and for the three Test of the Reception of Grammar scores, Raw, Age equivalent, and Level reached.

Table 12: Summary of correlations for Peabody and TROG
^At less than 0.01 otherwise 0.001

Rank	Peabody Age Equivalent	TROG Raw	TROG Age Equivalent	TROG Level Reached
1	0.69 (TROG.R)	0.79 (RDLS.C/R)	0.62 (RDLS.C/A)	0.77 (RDLS.C/A)
2	0.67 (STM.A)	0.75 (RDLS.C/A)	0.59 (LiNS.Map)	0.76 (RDLS.C/R)
3	0.66 (TROG.L)	0.69 (BPVS.A)	0.56 (BPVS.A)	0.66 (BPVS.A)
4	0.62 (RDLS.C/A)	0.68 (BPVS.R)	0.55 (BPVS.R)	0.66 (PMon.II)
5	0.62 (STM.B)	0.65 (PMon.II)	0.54^ (RDLS.E/R)	0.65 (BPVS.R)
6	0.60 (RDLS.E/A)	0.63 (SCom)	0.52^ (RDLS.E/A)	0.60 (STM.B)
7	0.57 (RDLS.E/R)	0.62 (STM.B)	0.52 (Bri.2)	0.56 (SpNSG.Map)
8	0.55 (TROG.A)	0.62 (LiNS.Map)	0.50^ (RDLS.C/R)	0.55 (STM.A)
9	0.55 (SpNSG.Map)	0.62 (SpNSG.Map)		0.52 (SpNS.Map)
10	0.50 (SpNS.Map)	0.60 (RDLS.E/A)		
11		0.59 (STM.A)		
12		0.59 (RDLS.E/R)		
13		0.58 (LiNSG.Map)		
14		0.53 (BMon)		
15		0.51 (RCom)		
16		0.50 (SpNDG.Map)		
		0.50 (SpNS.Map)		

Age equivalent scores on the Peabody tests correlated significantly with the TROG Raw score (r= 0.69) and with the level attained on TROG (r= 0.66). Peabody also correlated with age equivalent scores on Reynell's receptive (r= 0.62) and expressive (r= 0.60) tests. Further Peabody correlated significantly with both of the short term memory tests (Test A : r= 0.67; Test B: r= 0.62). Peabody scores showed a weaker but significant correlation with ability, when un-guided and guided, in the speaker role with

maps when there are nominally similar referents (r= 0.55 for unguided and r= 0.50 for when guided).
The TROG Raw (TROG.R) score correlated highly with Reynell's comprehension scores (r= 0.75) and Peabody scores (r= 0.68), also it showed a weaker, yet significant, correlation to Reynell's expressive language score (r= 0.60). The TROG Raw score also correlated with the speaker sub-skills of Perspective Monitoring II (r= 0.65) Selective Comparison (r= 0.63), Basic Perspective Taking (r= 0.53) and Referential Communication (r= 0.51). Abilities on maps with nominally similar referents were also significantly correlated with TROG.R. These 'map tests' were the listener role when un-guided with a correlation of r= 0.62, and r= 0.58 when guided, and then in the speaker role when guided there was a correlation of r= 0.62 and r= 0.50 when unguided.
The TROG Age equivalent score (TROG.A) correlated significantly with ability on both Reynell's comprehension test (r= 0.62) and Peabody (r= 0.56) and it showed a weaker, yet significant correlation with the Reynell's expressive language test (r= 0.52). TROG.A was significantly correlated with ability as a listener with nominally similar maps when unguided (r= 0.59) and with ability in object assembly with a complex bridge (r= 0.52). Subjects degree of success on the TROG measured by their level reached (TROG.L) was significantly correlated with both Reynell's comprehension (r= 0.77) and Peabody (r= 0.66) scores. It also correlated significantly with both short term memory ability (Test B: r= 0.60; Test A : r= 0.55) and with performance in the speaker role with nominally similar referents, both guided (r= 0.56) and unguided (r= 0.52). The only communication component tests to be a significant correlate of TROG's age equivalent score was Perspective monitoring II (r= 0.66).

In general both Peabody and TROG measures correlated significantly with each other and with Reynell's Comprehension and Expression scores. TROG Raw scores showed strong correlations with the speaker role sub-component tests, Perspective Monitoring, Referential Communication and Selective Comparison, and to both Listener and Speaker map tests which had nominally similar referents. Therefore baseline language tests were valid and reliable and these language skills are an important part of ability on our referential communication tests.

Table 13 below shows a sample of correlations to Reynell's tests of language Comprehension and Expression, and to Sentence Length.

Table 13: Summary of correlations for Reynell's and Sentence length.

Rank	Reynell's Comprehend Age Equivalent	Reynell's Express Age Equivalent	Sentence Length
1	0.78 (TROG.R)	0.65 (SLen)	0.64 (RDLS.E/A)
2	0.77 (TROG.L)	0.60 (TROG.R)	0.63 (RDLS.E/R)
3	0.73 (STM.B)	0.58 (STM.A)	0.54 (TROG.L)
4	0.70 (STM.A)	0.56 (STM.B)	O.51 (RDLS.C/R)
5	0.63 (TROG.A)	0.54 (TROG.A)	0.50 (LiNSG.Map)
6	0.62 (RDLS.C/R)	0.52 (MAA.Str)	
7	0.51 (RDLS.E/R)		
8	0.50 (SPNSG.MAP)		

Reynell's Comprehension age equivalent scores were substantially correlated with the two TROG measures, Raw (r= 0.78), and Level reached (r= 0.77), and less so, but significantly with TROG Age equivalent (r= 0.63) and with both short term memory tests (Test B: r= 0.73; Test A: r= 0.70). There was also a smaller but significant correlation with ability, when guided, in the speaker role on map tests with nominally similar referents (r= 0.50).

Reynell's Expressive language age equivalent score's highest significant correlate was Sentence Length (r= 0.65). Expressive language was further significantly correlated with both the TROG Raw score (r= 0.60) and Age equivalent scores (r= 0.54), and with both Short Term Memory tests (Test A:r= 0.58; test B: r= 0.56). It also correlated significantly with an ability to make strategic responses to ambiguous messages in the first Message Adequacy test (r= 0.52).

Length of Sentences was significantly correlated with the Reynell expressive language age equivalent scores (r= 0.64), the Level reached on the TROG (r= 0.54) and with ability, when guided, as a listener with nominally similar referents (r= 0.50).

The main results from table 13 therefore show that Reynell's Comprehension scores were significantly correlated with all three TROG measures and STM, and secondly that Expressive language scores on the Reynell's test correlated significantly with Sentence Length, TROG (raw score and Age equivalent) and STM.

In Table 14 , below, there are samples of correlates for the cognitive tests. First the two short term memory tests, A (digits presented singularly in sets) and B (digits presented in meaningful cluster pairs) and then Ravens Progressive Matrices.

Table 14: Summary of correlations for Short Term Memory and Ravens Progressive Matrices.

Rank	STM A	STM B	Ravens Overall
1	0.88 (STM.B)	0.88 (STM.A)	0.72 (R.Com)
2	0.69 (RDLS.C/A)	0.72 (RDLS.C/A)	0.71 (Bri2)
3	0.67 (BPVS.A)	0.67 (RDLS.C/R)	0.67 (Bri1)
4	0.67 (BPVS.R)	0.63 (BPVS.A)	0.65 (PMon.II)
5	0.67 (RDLS.C/R)	0.62 (BPVS.R)	0.61 (SpND.Map)
6	0.61 (RDLS.ER)	0.62 (TROG.R)	0.56 (LiNSG.Map)
7	0.58 (BMon)	0.59 (TROG.L)	0.56 (SCom)
8	0.58 (RDLS.E/A)	0.58 (BMon)	0.52 (LiNS.Map)
9	0.55 (TROG.L)	0.57 (RDLS.E/R)	0.50 (SpNS.Map)
10	0.54 (TROG.R)	0.56 (RDLS.E/A)	0.50 (LiNDG.Map)
11	0.52 (SpNSG.Map)		
12	0.50 (LiNS.Map)		

Both Short Term Memory tests (STM), of capacity for digits presented singularly in sets (STM A) and for capacity for digits when they are presented in clusters (STM B) were substantially correlated with each other (r= 0.88).

STM A was significantly correlated with language measures - Reynell's Comprehension test (r= 0.69), Peabody (r= 0.67), Reynell's Expressive test (r= 0.58) and both TROG Level reached (r= 0.55) and Raw score (r= 0.54). STM A also correlated significantly with the basic perspective taking test of the communication sub-component battery (r= 0.58). Map tests of speaker ability, when guided, with nominally similar referents and listener ability with nominally similar referents were also significant correlates of STM A (r= 0.52) (r= 0.50) respectively.

STM B correlated significantly with language measures, such as Reynell's Comprehension test (r= 0.72), Peabody (r= 0.63), TROG Level reached (r= 0.59) and Reynell's Expressive Language test (r= 0.56). STM B also correlated significantly with Basic Perspective taking (r= 0.58).
Performance on Ravens Progressive matrices was significantly correlated with performance on the communication components tests, Referential Communication (r= 0.72), Perspective Monitoring II (r= 0.65) and Selective Comparison (r= 0.56). It also showed a strong relationship with ability on the object assembly tests (Bri.2: r= 0.71; Bri.1: r= 0.67) and to ability in the speaker role when un-guided, both with nominally distinct (r= 0.61) and similar referents (r= 0.50). Performance on Ravens also correlated strongly with performance in the listener role, both guided and unguided with nominally similar referents (r= 0.56 and r= 0.52 respectively) and when guided with nominally distinct referents (r= 0.50).

STM was therefore generally related to Language measures and with performance on the Perspective taking tests of Speaker ability. Furthermore STM A showed a strong correlation with Speaker and Listener performance, when guided, with nominally similar referents. Ability on *Ravens Progressive matrices were therefore generally related* to performance on the speaker role's communication components tests and object assembly tests, and furthermore to ability in both the speaker and listener roles, when given nominally similar referents.

In Table 15 , below, there are samples of correlates for the tests that isolated component skills of a speaker's role in communication.

Table 15: Summary of correlations for Speaker Component Tests

Rank	Basic Perspective	Selective Comparison	Perspective Monitor (2)	Referential Communication
1	0.58 (STM.B)	0.74 (RCom)	0.72^ (SCom)	0.74 (SCom)
2	0.56 (STM.A)	0.72^ (PMon.II)	0.66^ (Bri.2)	0.73 (RPM.All)
3	0.53 (TROG.R)	0.63 (TROG.R)	0.66^ (TROG.L)	0.65^ (PMon.II)
4	0.52 (SpNSG.Map)	0.61 (LiNSG.Map)	0.65^ (TROG.R)	0.62 (LiNSG.Map)
5		0.58 (Bri.2)	0.65^ (RCom)	0.62 (Bri.2)
6		0.57 (SpNSG.Map)	0.62^ (SpNSG.Map)	0.61 (LiNS.Map)
7		0.56 (SpNS.Map)	0.61^ (MAA.Req)	0.60 (SpNS.Map)
8		0.55 (RPM.All)		0.57 (SpNSG.Map)
9		0.54 (Bri.1)		0.57 (Bri.1)
10		0.52 (RDLS.E/A)		0.53 (Bri.4)
11		0.51 (LiNS.Map)		

Basic Perspective Taking was significantly correlated with both short term memory tests (Test B:r= 0.58; Test A:r= 0.56), and with the TROG Raw score (r= 0.53) and speaker ability with maps, when guided, with nominally similar referents (r= 0.52).

The ability to make Selective Comparisons was substantially correlated with ability on the Referential Communication task (r= 0.74), and less so, but significantly with Perspective Monitoring (r= 0.72). Selective Comparison was also significantly correlated with two language measures, TROG Raw score (r= 0.63) and Reynell's Expressive test score (r= 0.52). Abilities on maps with nominally similar referents was significantly correlated with performance at Selective Comparison. These 'map tests' were the listener role when guided (r= 0.61) and un-guided (r= 0.51), and the speaker role when guided (r= 0.57) and unguided (r= 0.56). Selective comparison was also significantly correlated with object assembly scores (Bridge Two: r= 0.58; Bridge One: r= 0.54) and to ability on Ravens Progressive Matrices (r= 0.55).

Perspective Monitoring (II), was significantly correlated with speaker ability on the sub-component tests Selective Comparison (r= 0.72) Referential Communication (r= 0.65). Perspective Monitoring was also significantly correlated with instructing another person to assemble a complex bridge (r= 0.51), TROG (TROG.L: r= 0.66; TROG.R: r= 0.65), being a speaker when to guided with nominally similar referents (r= 0.62) and to the ability to request more information when given ambiguous messages (r= 0.61).

Performance on the Referential Communication test were substantially correlated with and with Selective Comparison (r= 0.74), Perspective Monitoring (r= 0.65) and ability on Ravens Progressive Matrices. Abilities on maps with nominally similar referents were also significantly correlated with the Referential Communication scores, these were the listener role when guided (r= 0.62) and un-guided (r= 0.61), and the speaker role when unguided (r= 0.60) and guided (r= 0.57). Referential Communication was also significantly correlated with object assembly scores (Bridge Two:r= 0.62; Bridge One: r= 0.57) as well as instructing another to assemble a complex model of a bridge (r= 0.53) and TROG's Raw score (r= 0.50).

Overall performance on the Perspective Monitoring, Selective Comparison and the Referential Communication tests were all significantly correlated to one another. Perspective Monitoring showed a strong correlation with ability in instructing another to assemble objects. Selective Comparison and Referential Communication, however, showed more significant correlations to ability on the map tasks that involved nominally similar referents - that is those tasks that required the actual making of selective comparisons and those that depended on the abstracted knowledge (the meta-knowledge) of the need to make such comparisons. Perspective Monitoring, Selective Comparison and Referential Communication showed strong correlations with the performance on Ravens Progressive Matrices and with object assembly tests.

In table 16 there are samples of correlates for the tests that isolated component skills of a Listener's role in communication.

Table 16: Summary of correlations for Listener Component Tests

Rank	Message Adequacy A Strategy	Message Adequacy A Request	Message Adequacy B Strategy	Message Adequacy B Request
1	0.53 (RDLS.E/A)	0.67 (MAB.Req)	-	0.67 (MAA.Req)
2	0.53 (LiNDG.Map)	0.61^ (PMon.II)		
3	0.52 (LiNS.Map)			
4	0.52 (RDLS.E/R)			
5	0.51 (LiND.Map)			

Subjects ability in making strategic choices when confronted with ambiguous messages in test A was significantly correlated with ability on Reynell's Expressive language test (r= 0.53) and with ability in being listeners with maps with nominally distinct referents

when guided (r= 0.53) and unguided (r= 0.51), and with being unguided listeners with maps that have nominally similar referents (r= 0.52).
Requesting more information, in tests A and B, as a response to ambiguous messages correlated with the same response in either test. Making requests in test A also correlated significantly with Perspective Monitoring (r= 0.61).

The only major correlations to emerge with the Message Adequacy tests were therefore between making strategic choices on Tests A and ability on Reynell's Expressive Language test being Listeners with maps of nominally similar referents.

Our next two tables contain sample correlates of abilities in the speaker and listener roles with maps. These were our main dependent measures. For both the giving (as speakers) and receiving (as listeners) of messages there were two conditions, either with or without help, and two types of maps, those with nominally distinct and those with nominally similar referents. Correlations were computed for ability on each type of map within each condition. The first table (Table 17) below shows sample correlations to performance in the speaker role within each condition.

Table 17: Summary of correlations for Speaker Map Tests

Rank	Speaker Nominally Distinct	Speaker Nominally Similar	Speaker Nominally Distinct Guided	Speaker Nominally Similar Guided
1	0.72 (SpNDG.Map)	0.72 (SpNSG.Map)	0.72 (SpND.Map)	0.72 (SpNS.Map)
2	0.64 (SpNS.Map)	0.66 (SpNDG.Map)	0.71 (SpNSG.Map)	0.72 (LiNSG.Map)
3	0.62 (LiNDG.Map)	0.64 (LiNS.Map)	0.68 (LiNS.Map)	0.71 (SpNDG.Map)
4	0.58 (LiNSG.Map)	0.61 (RPM.All)	0.66 (SpNS.Map)	0.68 (LiNS.Map)
5	0.58 (Bri.2)	0.60 (RCom)	0.61 (LiNSG.Map)	0.62 (PMon.II)
6	0.56 (LiND.Map)	0.56 (SCom)	0.58 (RCom)	0.62 (TROG.R)
7	0.55 (Bri.1)	0.55 (Bri.1)	0.57 (LiND.Map)	0.57 (RCom)
8	0.55 (LiNS.Map)	0.54 (LiNSG.Map)	0.57 (Bri.2)	0.57 (SCom)
9	0.54 (SpNSG.Map)	0.52 (LiND.Map)	0.51 (RPM.All)	0.56 (TROG.L)
10		0.50 (TROG.R)	0.51 (Bri.1)	0.54 (SpND.Map)
11		0.50 (TROG.L)		0.52 (STM.A)
12				0.50 (RDLS.C/A)

Ability in the Speaker role with Nominally Distinct referents (SpND) was significantly correlated with all other speaker-map tests. First with speaker ability when guided with nominally distinct referents (r= 0.72) and then with both unguided and guided tests that have nominally similar referents (r= 0.64 and r= 0.54 respectively). This SpND was also significantly correlated with all listener map tests, most highly with ability, when guided with nominally distinct referents (r= 0.62) and then with ability, when guided, with nominally similar referents (r= 0.58), and, finally, with unguided abilities in each condition (r= 0.56 and r= 0.55 respectively). Further correlations are shown between this SpND and ability to assemble objects - Bridge Two (r= 0.58) and Bridge One (r= 0.55).
Ability in the Speaker role with Nominally Similar referents (SpNS) was significantly correlated with speaker ability when guided with nominally similar referents (r= 0.72) and with nominally distinct referents (r= 0.66). There was also significant correlations to the Listener map tests, when unguided and guided, with nominally similar referents (r= 0.64 and r= 0.54 respectively), and to ability when unguided with nominally distinct referents (r= 0.52). Ability in the sub-component tests of the speaker role of Referential Communication and Selective Comparison were also significantly correlated with SpNS (r= 0.60 and r= 0.56 respectively). Performance on Ravens Progressive Matrices (0.61) and Object assembly ability, at the basic level (Bridge One: r= 0.55), were further correlates to ability in SpNS.
The strongest correlations from SpNS to language measures were to the Raw score of the TROG (0.50) and to the Level reached in the TROG (r= 0.50).
Ability, with Nominally Distinct referents when Guided (SpNDG), was significantly correlated to the same ability when unguided (r= 0.72), and to both other speaker map tests - guided and unguided with similar referents (r= 0.71 and r= 0.66 respectively). It was also significantly correlated with three of the Listener role map tests, when unguided and guided with nominally similar referents (r= 0.68 and r= 0.61 respectively) and when unguided with nominally distinct referents (r= 0.57). Of the sub-component tests Referential Communication showed the strongest significant correlation (r= 0.58) to SpNDG. There were also significantly correlations between SpNDG and object building ability - bridge two (r= 0.57) and bridge one (0.51) and performance on Ravens Progressive Matrices (r= 0.51).
The final speaker test with maps was that of ability, with Nominally Similar referents when Guided (SpNSG). The highest correlate to ability on this test was the same ability when unguided (r= 0.72). It also showed significant correlations to the speaker roles with distinct referents both when guided (r= 0.71) and unguided (r= 0.54). Listener role ability with nominally similar referents, both guided and unguided were also correlated to

SpNSG, (r= 0.72 and r= 0.68 respectively). Two language measures were also significantly correlated to SpNSG. First two TROG scores, raw (r= 0.62) and level reached (r= 0.56), and then Reynell's comprehension test (r= 0.50). Three sub-component tests of the speaker role were further correlates to SpNSG, Perspective Taking (r= 0.62) Referential Communication (r= 0.57) and Selective Comparison (r= 0.57).

In general we were mainly interested in speaker ability with nominally similar referents, which was supposed to involve a number of skills, in particular the ability to make selective comparisons for a listener between target and potential referents based on monitoring a persons perspective. There was a significant correlation between performance on both SpNS and SpNSG map tests, and between each and selective Comparison and Referential Communication. Moreover SpNSG correlated significantly with Perspective Taking. Both also had strong correlations with the Listener map tests where there were nominally similar referents. It could therefore be concluded that tasks that involve the making of comparisons were strongly related, and moreover, the sub-component tests seem to be valid measures of the skills required on the general tasks and vice versa. The main Psychometric tests to correlate to the Speaker Maps were TROG and Ravens Progressive Matrices.

For being listeners, there were also two conditions, either with or without help, and two types of maps, those with nominally distinct and those with nominally similar referents. Correlations for ability on each type of map within each condition, and are shown below in table 18.

Table 18: Summary of correlations for Listener Map Tests

Rank	Listener Nominally Distinct	Listener Nominally Similar	Listener Nominally Distinct Guided	Listener Nominally Similar Guided
1	0.72 (LiNDG.Map)	0.89 (LiNSG.Map)	0.77 (LiNSG.Map)	.89 (LiNS.Map)
2	0.64 (LiNSG.Map)	0.71 (LiNDG.Map)	0.72 (LiND.Map)	0.77 (LiNDG.Map)
3	0.63 (LiNS.Map)	0.69 (SpNSG.Map)	0.72 (LiNS.Map)	0.60 (SpNSG.Map)
4	0.56 (SpNDG.Map)	0.68 (SpNDG.Map)	0.61 (SpND.Map)	0.65 (LiND.Map)
5	0.55 (Bri.1)	0.63 (LiND.Map)	0.60 (Bri.1)	0.64 (Bri.1)
6	0.53 (TROG.A)	0.62 (RCom)	0.55 (TROG.R)	0.62 (RCom)
7	0.51 (MAA.Str)	0.59 (TROG.A)	0.53^ (MAA.STR)	0.61 (SpNDG.Map)
8	0.51 (SpND.Map)	0.57 (Bri.2)	0.50 (RPM.All)	0.61 (SCom)
9		0.57 (TROG.R)	0.50 (RDLS.C/R)	0.58 (SpND.Map)
10		0.55 (Bri.4)		0.57 (RPM.All)
11		0.54 (SpND.Map)		0.56 (TROG.R)
12		0.52 (RPM.All)		0.55 (Bri.2)
13		0.53 (Bri.1)		0.51 (RDLS.C/R)
14		0.52 (MAA.Str)		
15		0.51 (RDLS.C/R)		
16		0.51 (STM.A)		
17		0.51 (BPVS.A)		

Being a Listener with Nominally Distinct Referents (LiND) correlated significantly with all the other Listener map-tests, Nominally Distinct with Guidance (r= 0.72), Nominally Similar with Guidance (r= 0.64) and Nominally Similar without guidance (r= 0.63). LiND was also significantly correlated with speaker ability with nominally distinct referents both with and without guidance (r= 0.56 and r= 0.51 respectively). Other strong correlates were Trog Age equivalent (r= 0.53), object assembly on Bridge One (r= 0.55), and making strategic choices in the first message adequacy test (r= 0.51).

There were a wide range of significant correlates to the Listener role with Nominally Similar referents (LiNS). Most substantially was the ability on the same task with guidance (r= 0.89). The other two listener map-tests, nominally distinct with guidance and without, were also correlates (r= 0.71 and r= 0.63 respectively). Both speaker map-tests in which the subjects were guided, nominally similar and nominally distinct, were strong correlates (r= 0.69 and r= 0.68 respectively), less so, but still significantly was Nominally Distinct without guidance (r= 0.54). Two sub-component tests, one speaker, Referential Communication, and one listener, Message Adequacy A, were correlates (r= 0.62 and r= 0.52 respectively). The highest linguistic correlate was the age equivalent score of the TROG (r= 0.59), followed by TROG raw score (r= 0.57), Reynell's Comprehension test (r= 0.51) and finally Peabody (r= 0.51). Object assembly tasks, Bridge Two (r= 0.57) and Bridge One (r= 0.53) and Ravens Progressive Matrices (r= 0.52) were also significant correlates to this test, as was instructing another person to assemble an object - Bridge Four (r= 0.55), and Short term memory Test A (r= 0.51).

Ability at being a Listener when Guided with Nominally Distinct referents (LiNDG) correlated significantly with all the other Listener map-tests - Nominally Similar with guidance (r= 0.77), Nominally Distinct (r= 0.72) and Nominally Similar without guidance (r= 0.72) - whilst the only strong Speaker map correlate was the Nominally Distinct map with Guidance (r= 0.61). The basic object assembly task - Bridge One - was a further significantly correlate (r= 0.60). The most significant Linguistic measure to correlate was the TROG's raw score (r= 0.55). There was also a smaller, yet significant correlation with Reynell's receptive language score. The Cognitive test, Raven's Progressive Matrices (r= 0.50) was also a significant correlate of Listener task ability. Of the sub-component tests making strategic responses to ambiguous messages on the first Message Adequacy Test (A) was the major correlate (r= 0.53).

Ability when Guided with Nominally Similar referents (LiNSG) correlated highly with all other Listener map tests. These were Nominally Similar (r= 0.89) and Nominally Distinct both with and without Guidance (r= 0.77 and r= 0.65 respectively). It was also significantly correlated with three Speaker Map Tests, Nominally Similar with Guidance (0.60), Nominally Distinct with and without Guidance (r= 0.61 and r= 0.58 respectively). Further significant correlates were abilities on object assembly tasks, Bridge One (r= 0.64) and Bridge Two (r= 0.55). Two Speaker Role sub-component tests correlated with this test, Referential Communication (r= 0.62) and Selective Comparison (r= 0.61).

Of the linguistic measure the strongest correlate was the TROG raw score (r= 0.56), and of the Cognitive Tests, Ravens Progressive Matrices (r= 0.57).

We were mainly interested in Listener ability with nominally similar referents. There was a significant correlation between performance on each test with the other, LiNS and LiNSG. Performance on both were significantly correlated with ability in the speaker role with nominally similar referents - LiNS to the guided and unguided speaker maps, and LiNSG to the guided map test. Two speaker component tests were significant correlates to LiNS and LiNSG, Referential Communication and Selective Comparison. Only one of the Listener component test scores had a strong correlation to these Listener Map tests, Making Strategic Choices in Message Adequacy A to LiNS. Both object assembly scores were significant correlates to listener skill, with the ability to instruct another to assemble an object correlating with LiNS. The language measure, TROG Raw score, and the cognitive measure Ravens Progressive Matrices, correlated with both of these pivotal Listener map tests.

As with the speaker role maps it could concluded that tasks that involve the making, and using, of comparisons were strongly related, and moreover, the speaker and listener role share the common property of creating or using selective comparisons, with high level performance in each requiring an abstracted knowledge of this skill. That is, the communication roles share skills that may transfer between them if learnt in one.

Summary of Correlations -

There was a large degree of agreement between language measures. Peabody and TROG measures correlated significantly with each other. Reynell's Comprehension scores were significantly correlated with all three TROG measures and STM, whilst Reynell's Expressive language scores correlated significantly with Sentence Length, TROG (raw score and Age equivalent). Ability on Ravens Progressive matrices did not show strong correlations with other Psychometric tests.

Communication tasks had commonality with some of the standardised measures of cognitive and linguistic abilities. Selective Comparison, Perspective Monitoring and Referential Communication had strong correlations with the TROG Raw score with Ravens Progressive Matrices.

Being a speaker and a listener with nominally similar referents correlated significantly with TROG -Levels reached and Raw score - and to Ravens.

The sub-component tests of communication were related both to each other and to ability on the general, map and bridge -based, communication tasks.

Perspective Monitoring Selective Comparison and Referential Communication were all significantly correlated to one another. Perspective Monitoring showed a strong correlation with ability in instructing another to assemble objects. Selective Comparison

and Referential Communication, however, showed significant correlations to ability on all map tasks involving nominally similar referents - that is those tasks that required the actual making of selective comparisons and those that depended on the abstracted knowledge (the metacognitive experience) of the need to make such comparisons.
Speaker ability with nominally similar referents correlated significantly with performance on each other and with Selective Comparison and Referential Communication. Ability on the Selective Comparison and Referential Communication tests were also correlated with ability on the Perspective Taking test. Performance on Selective Comparison and Perspective Monitoring also showed strong correlations with the Listener map tests where there were nominally similar referents. It could therefore be concluded that tasks that involved making comparisons were strongly related, and the sub-component tests were valid measures of the skills required on the general speaker tasks and vice versa.

Listener ability with nominally similar referents correlated significantly with ability in the speaker role with nominally similar referents and to two speaker component tests Referential Communication and Selective Comparison. A further speaker task to correlate with Listener skill was the ability to instruct another to assemble an object which correlated with LiNS.

As with the speaker role maps it could be concluded that tasks that involve the making, and using, of comparisons were strongly related to the listener role map-based tests.

Overall then it is suggested that tasks that involve the making, and using, of comparisons were strongly related, such as the component tests of speaker ability and the map-based tests of Speaker and listener ability. Since the communication roles share such skills as making and using selective comparisons transfer of such skills learnt in one role may occur to the other role. It is also worth noting that communication ability in general seems highly related to performance on two major Psychometric tests, TROG and Raven's.

Summary of Section One, baseline results, matching of groups and correlations between measures:

Language tests describe our population as having language skills comparable to the developmental range 3 years 8 months to 5 years 6 months. The cognitive tests puts their abstract reasoning skills as below the normal developmental age of 5.5 years. Their digit span was 2.9 on average, with a slight (but not significant) increase with strategy imposition, which can be extrapolated to give an age equivalent score of 2.8 years.

Of the speaker role component tests Perspective Monitoring and Referential Communication proved more difficult than Selective Comparison - indicating the development of skills for making comparisons but not of metacognitive knowledge of those skills. In the listener role component tests, when faced with an ambiguous message, our subjects had a tendency for making strategic choices over making non-strategic choices. Furthermore subjects did not make many requests for more information when messages were inadequate thus showing a lack of evaluative, metacognitive skills for the communication process - although they did make more requests when given more prompting to do so.

When tested with maps as speakers and listeners, the population produced high scores when given nominally distinct referents, and low scores with nominally similar referents. That is they did not spontaneously supply or request comparisons of referents, more than name, in their communication interchanges

On the object assembly tests subjects demonstrated ability to replicate models themselves. However when instructing another person to build replicas, their scores were very much lower. Again showing adequate immediate skills of discrimination and differentiation between objects but not the ability to describe these differences.

On the basis of these baseline scores all 45 subjects were matched into three treatment groups were by a principle component analysis. Oneway ANOVA's performed on each baseline measure between each group showed that on crucial measures of communication performance, the map tasks and the other sub-component tasks there were no significant difference between groups.

In the analysis of relationships between tests it was shown that, first, the language measures seemed consistent as to what they measured. Secondly our adapted Communication tasks, both sub-componential and general, had commonality with some of the standardised measures of cognitive and linguistic abilities, particularly TROG and Ravens. Third the sub-component tests of communication were both related to each other and to ability on the general communication tasks. In particular speaker and listener tasks that involved making comparisons were strongly related, showing that the communication roles share skills that may transfer.

Section Two: Intervention Results

After the baseline stage we had three groups of fifteen people matched on communicative, linguistic and cognitive abilities - and on communication difficulties. That is we had groups equal in inability to make comparisons in communication roles. Each group was then taken through their respective teaching program, metacognitive, self instructional and control. Training focused on the subjects speaker abilities, and no explicit mention was made of learning for improving listener skill.

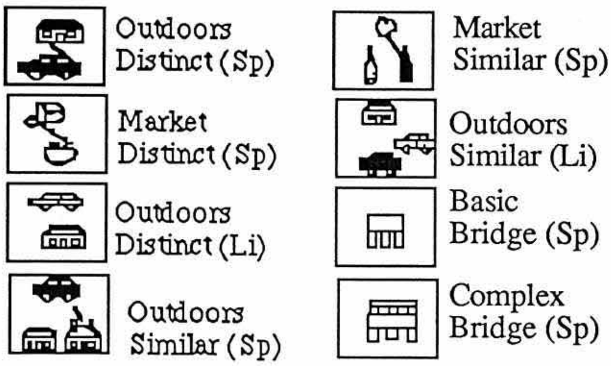
Positive effects of training could have included one or more of the following effects -

- an increase in speaker role test scores on maps similar to those tested on in baseline and trained on (the outdoors map), signifying learning
- a concurrent high score on a speaker map not shown in either baseline or training (a supermarket map), signifying near transfer of learning to tasks similar to those trained on
- increases in performance levels in the listener role (against baseline) indicating far transfer of skills across communication roles
- increases in performance levels in the Object Instruction tasks (against baseline) which would indicate the far transfer of learning to different speaker role tasks.

Possible training effects are shown in figure 8 below.

Figure 8: A representation of the learning and transfer tasks given to subjects and the reason why the tests measure what they do.

TASKS	*Tests for*	*Reason for this*
1 *Outdoors* **Speaker Distinct**	Learning	Same referents, role and task trained on.
1 **Speaker Distinct** *Market*	Near transfer	Different referents, but the same role and task type trained in.
2 *Outdoors* **Listener Distinct**	Far transfer	Same referents and task type, but different role to that trained in.
3 *Outdoors* **Speaker Similar**	Learning	Same referents, role and task trained on.
3 **Speaker Similar** *Market*	Near transfer	Different referents, but the same role and task type trained in.
4 *Outdoors* **Listener Similar**	Far transfer	Same referents and task type, but different role to that trained in.
5 **Basic Bridge**	Far transfer	Same role, but different referents and task type to that trained with.
6 **Complex Bridge**	Far transfer	Same role, but different referents and task type to that trained with.



Such potential developments were tested at the end of training (Week One) and two weeks later (Week Two). The second week measure would provide a record of the maintenance of any transfer effects. There were six such repeated measures -

1. Speaker role with nominally distinct referents (including both "outdoors and "market" maps).
2. Listener role with nominally distinct referents (only "outdoors" map).
3. Speaker role with maps of nominally similar referents (including both "outdoors and "market" maps).
4. Listener role with maps of nominally similar referents (only "outdoors" map).
5. Speaker role with basic assembly task (Bridge One).
6. Speaker role with complex assembly task (Bridge Two).

(The full results for each subject at the transfer tests in both week one and two are given in appendix 19).

For analysis of differences between each group's performance on each repeated measure we used a hierarchy of statistical tests. The first stage therefore required an analysis of each repeated measure for any significant differences between conditions by Analysis of Variance (ANOVA). However, group means in baseline were not matched exactly - even with the extensive matching procedure employed. To take full account of these baseline differences between groups we then used an Analysis of Co-variance (ANCOVA). ANCOVA statistically matched groups on the basis of their baseline scores. The ANCOVA would therefore give us a further indication of any significant differences between the three groups' performance as a result of training. The following section describes the analysis of each repeated measure in turn. We will then present an analyses of each groups' performance before, during and after training in both the speaker and listener role with maps that had nominally similar referents. We will conclude this section with the results of the observer ratings of the experimenter's performance in each condition.

1. Speaker role with nominally distinct referents including both "outdoors and "market" maps (Speaker Distinct).

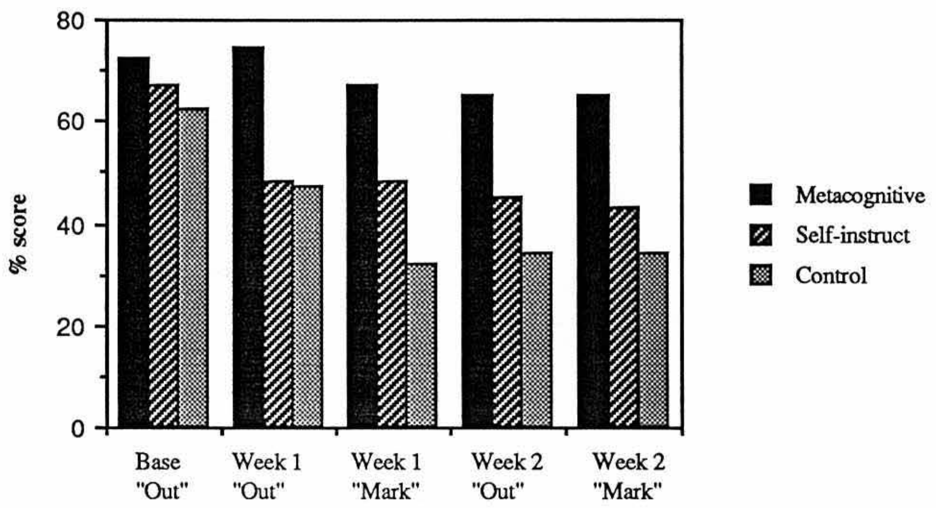
An ANOVA was used to analyse differences in performance within groups over time and between conditions on the Speaker role maps that had nominally distinct referents. The following table (table 19) shows each groups mean scores. Task one is the "outdoors" map and task two is the "market" map.

Table 19. Means for each training group in the speaker role with nominally distinct "outdoors" and "market" maps at Baseline, Week One and Week Two

	Baseline	Week One		Week Two	
Condition	Task 1	Task 1	Task 2	Task 1	Task 2
Meta	72	74	67	65	65
SIT	67	48	48	45	43
Control	62	47	32	34	34

These means are also shown in figure 9.

Figure 9: Means for each training group in the speaker role with nominally distinct "outdoors" and "market" maps at Baseline, Week One and Week Two



From the data for Task 1 ("Outdoors" map) the following ANOVA table was made -

Table 18: ANOVA table for the mean scores of each training group on the "outdoors" map in the speaker role.

Source	d.f.	s.s.	m.s.	v.r.	p
Cond	2	12354.4	6177.2	2.55	n.s.
Residual	42	101818.9	2424.3		
Time	2	8057.8	4028.9	10.73	<0.001
Cond.Time	4	2394.4	598.6	1.59	n.s.
Residual	84	31547.8	375.6		

For the "outdoors" map there was a significant effect of time on performance (F(2,84)=10.73; p<0.001) , but not of condition (F(2,42)=2.55; p= n.s.). That is performance did not depend on which group a person was in, but mainly on time.

From from the data for Task 2 ("Market" map) the following ANOVA table (table 20) was made -

Table 20: ANOVA table for the mean scores of each training group on the "market" map.

Source	d.f.	s.s.	m.s.	v.r.	p.
Cond	2	15339.5	7669.7	2.44	n.s.
Residual	42	131832.5	3138.9		
Time	2	10319.3	5159.7	14.57	<0.001
Cond.Time	4	2859.6	714.9	2.02	n.s.
Residual	84	29754.9	354.2		

For the "market" map there was a significant effect of time on performance (F(2,84)=14.57; p<0.001), but not of condition (F(2,42)=2.44; p= n.s.). Time, and not a persons condition was therefore the major factor affecting change in performance.

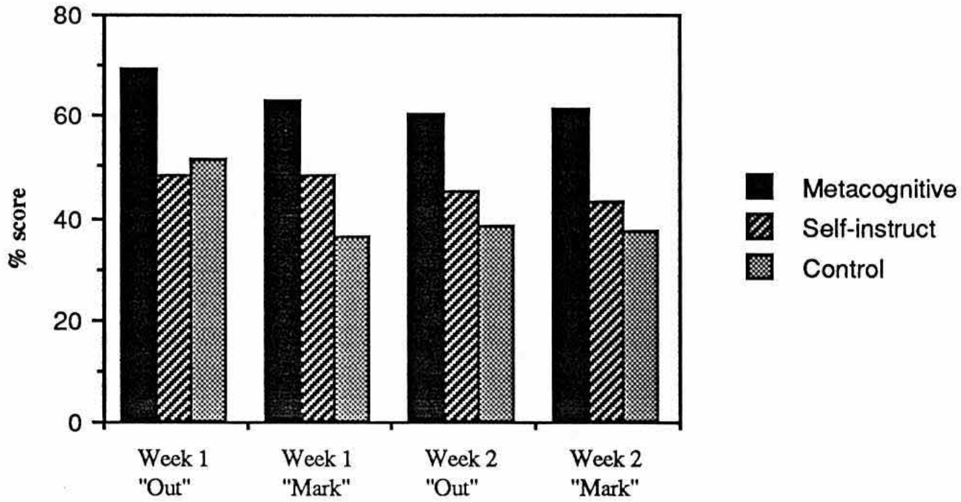
Since there were some differences between the groups' baseline score we made a second check for differences between conditions by ANCOVA. Biased means produced shown in table 21.

Table 21: Adjusted condition mean scores for each training group by task ("outdoors" and "market") and time (weeks one and two) for the Speaker Distinct Maps.

	Week One		Week Two	
Condition	Task 1	Task 2	Task 1	Task 2
Meta	69	63	60	61
SIT	48	48	45	43
Control	51	36	38	37

These means may also be compared in figure 10.

Figure 10: Biased means for each group in the Speaker Role with nominally distinct "outdoors " and "market" maps at Week One and Week Two



From these biased means the following ANCOVA table (table 22) was produced. It contains both task one ("Outdoors") and two ("Market") -

Table 22. ANCOVA table for Speaker Distinct maps

Source	d.f.	s.s	m.s.	v.r.	p
Cond	2	16740.6	8370.3	4.14	<.023
Covariate	1	88031.4	88031.4	43.55	<0.0005
Residual	41	82867.9	2021.2		
Time	1	1158.7	1158.7	3.08	ns
Task	1	657	657	1.75	ns
Cond.Time	2	28.4	14	0.04	ns
Cond.Task	2	375.6	187.8	0.50	ns
Time.Task	1	511.1	511.1	1.36	ns
Cd.Ti.Ta	2	533.6	266.8	0.71	ns
Residual	126	47434.8	376.5		

There was a significant effect of conditions on performance ($F(2,41)=4.14; p<0.023$) but not of time ($F(1,126)=3.08$; n.s.). That is, when we accounted for baseline variance between conditions it is suggested that later performance differences are affected by a persons group allocation rather than the passage of time.

'Posteriori' Bonferoni testing, which compared each group's means, showed that the Metacognitive group (Mean=64) differed significantly from the control group (Mean=41) at the 0.05 level. The SIT group (Mean=46) did not differ significantly to control. The SIT and Metacognitive groups did not differ significantly from each other. When considering the Bonferoni tests in the context of the graph above in figure 11, which shows performance losses for both the Self Instructional and Control groups, it seems that the degree of decrease in performance in the Control group was much greater than in the SIT condition, with the SIT group nearly maintaining baseline performance at the same height as the Metacognitive group. There could therefore be some negative transfer in the Control group.

2. Listener role with maps containing nominally distinct "outdoors" referents (Listener Distinct).

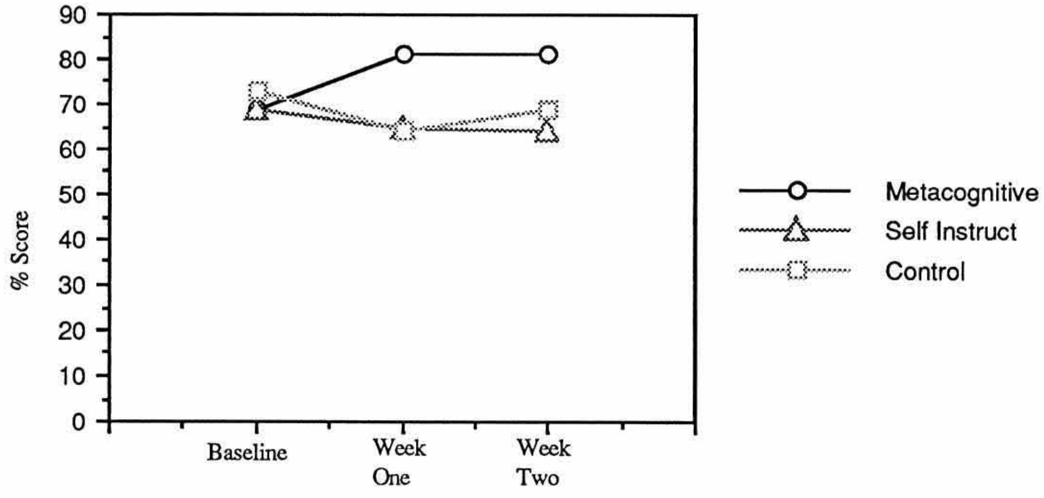
An ANOVA was used to analyse differences in performance within groups over time and between conditions on the listener role maps that had nominally distinct referents. The following table (table 23) shows each groups' mean scores.

Table 23: Means for each training group in the Listener role with nominally distinct "outdoors" maps at Baseline, Week One and Week Two.

Condition	Baseline	Week One	Week Two
Meta	68	81	81
SIT	68	65	64
Control	73	69	68

These means are also shown in figure 11.

Figure 11: Means for each training group in the Listener Role with nominally distinct "outdoors " maps at baseline, Week One and Week Two



From the data the following ANOVA table (24) was produced -

Table 24: ANOVA table for the mean scores of each training group on the "outdoors" map in the listener role.

Source	d.f.	s.s.	m.s.	v.r.	p.
Cond	2	2835.5	1417.7	0.50	n.s
Residual	42	118846.9	2829.7		
Time	2	61.4	30.7	0.06	n.s
Cond.Time	4	1906.8	476.7	0.88	n.s
Residual	84	45343.3	539.8		
Total	134	168993.9			

There was no significant differences in performance scores over time (F(2,84)0.88;n.s.) or between conditions (F(2,42)0.50;n.s.).

3. Speaker role with maps of nominally similar referents including both "outdoors and "market" maps (Speaker Similar).

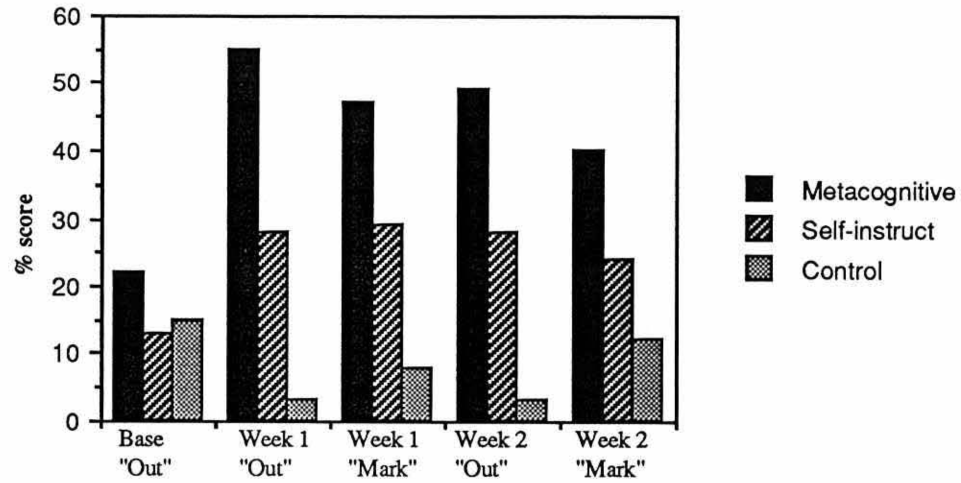
An ANOVA was used to analyse differences in performance within groups over time and between conditions on the Speaker role maps that had nominally similar referents. The following table (table 25) shows each groups mean scores. Task one is the "outdoors" map and task two is the "market" map.

Table 25: Means for each training group in the speaker role with nominally similar “outdoors" and “market” maps at Baseline, Week One and Week Two

	Baseline	Week One		Week Two	
Condition	Task 1	Task 1	Task 2	Task 1	Task 2
Meta	22	55	47	49	40
SIT	13	28	29	28	24
Control	15	3	8	3	12

These means are also shown in figure 12.

Figure 12: Means for each group in the Speaker Role with nominally similar "outdoors " and "market" maps at baseline, Week One and Week Two



From the data for Task 1 ("Outdoors" map) the following ANOVA table (table 26) was made -

Table 26: ANOVA table for the mean scores of each training group on the "outdoors" map in the speaker role.

Source	d.f.	s.s.	m.s.	v.r.	p
Cond	2	27747.3	13873.6	8.91	<0.001
Residual	42	65363.2	1556.3		
Time	2	3644.2	1822.1	7.71	<0.001
Cond.Time	4	9166.7	2291.7	9.70	<0.001
Residual	84	19853.7	236.4		

On the "Outdoors" map there were significant differences in performance over time within groups (F(2,84)7.71;p<0.001) and between conditions (F(2,42)8.91;p<0.001), and there was therefore a significant time/condition interaction (F(2,84)=9.70;p<0.001). That is, one or more group were performing at considerably higher rates after training.

From the data for Task 2 ("Market" map) the following ANOVA table (table 27) was made -

Table 27: ANOVA table for the mean scores of each training group on the "market" map in the speaker role.

Source	d.f.	s.s.	m.s.	v.r.	p.
Cond	2	13887.7	6943.9	4.16	<0.02
Residual	42	70066.6	1668.3		
Time	2	3094.9	1547.5	5.15	<0.001
Cond.Time	4	4155.3	1038.8	3.46	<0.01
Residual	84	25221.7	300.3		

On the "Market" map there were significant differences in performance over time within groups (F(2,84)5.15;p<0.001) and between conditions (F(2,42)4.16;p<0.001), and there was therefore a significant time/condition interaction (F(2,84)=3.46;p<0.01). That is, one or more group were performing at considerably higher rates after training.

For both the "Outdoors" and "Market" maps there were therefore significant performance changes between baseline and transfer scores with one or more group. For making sure that these differences were valid we considered the variance between each groups baseline scores with an ANCOVA.

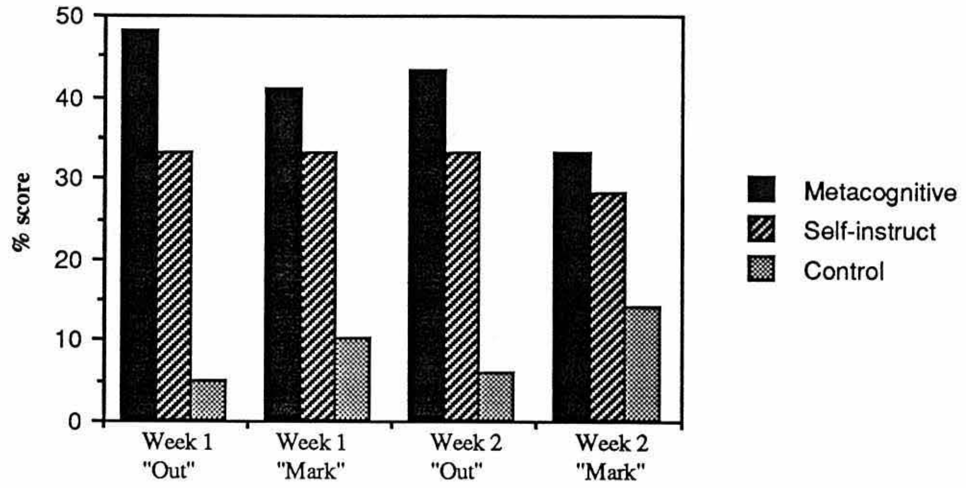
Biased means produced shown in table (table 28).

Table 28: Adjusted condition mean scores for each training group by task ("outdoors" and "market") and time (weeks' one and two) for the Speaker Similar Maps.

	Week One		Week Two	
Condition	Task 1	Task 2	Task 1	Task 2
Meta	48	41	43	33
SIT	33	33	33	28
Control	5	10	6	14

These means are also shown in figure 13.

Figure 13: Biased means for each group in the Speaker Role with nominally similar "outdoors " and "market" maps at baseline, Week One and Week Two



An accurate comparisons of these biased means, for both tasks one and two, is presented in the the following ANCOVA table (table 29) -

Table 29: ANCOVA table for Speaker Similar maps

Source	d.f.	s.s	m.s.	v.r.	p
Cond	2	32335.0	16167.5	7.16	<.01
Covariate	1	52627	52637	23.3	<0.0011
Residual	41	92596.3	2258.4		
Time	1	195.7	195.7	1.38	ns
Task	1	52.6	52.6	0.37	ns
Cond.Time	2	552	276	1.94	ns
Cond.Task	2	1819.4	909.7	6.41	<.01
Time.Task	1	20.3	20.3	0.14	ns
Cd.Ti.Ta	2	169.9	85	0.6	ns
Residual	126	17892.9	142		

When accounting for baseline variance there were significant differences in performance changes between conditions (F(2,41)7.16;p<0.01), and there was a significant time/condition interaction (F (2,126)=6.41;p<.01). That is, performance changes were greater or lesser depending on the condition a person was in. There were no significant differences over time (F(1,126)0.37;p=n.s.) - that is there was no major change in performance over time suggesting that whatever the effects of training were, they maintained.

A'posteriori' Bonferoni testing demonstrated that both the Metacognitive (Mean=42), and Self instructional (Mean=32) groups performed significantly better than the control (Mean=9.22) group, at the 0.05 level, although neither Metacognitive nor SIT differed significantly from one another.

When considering the Bonferoni tests in the context of the graphs in figure 14 above, which show performance gains for both Metacognitive and Self Instructional groups, it seems that such increases in speaker role performance on maps similar to those baseline tested and trained on (the "outdoors" map) signify learning. Further the concurrent high score on a speaker map only shown in post-training conditions (the "market" map), signify near transfer of learning to that task. Further Bonferoni testing of differences within groups over time revealed that the Metacognitive group were performing significantly lower (although still more than the SIT group) in the Week Two. Their high performance did not, therefore, maintain fully at Week Two. The Self Instructional group were performing at the same level at both weeks One and Two.

4. Listener role with maps of nominally similar "outdoors" referents.

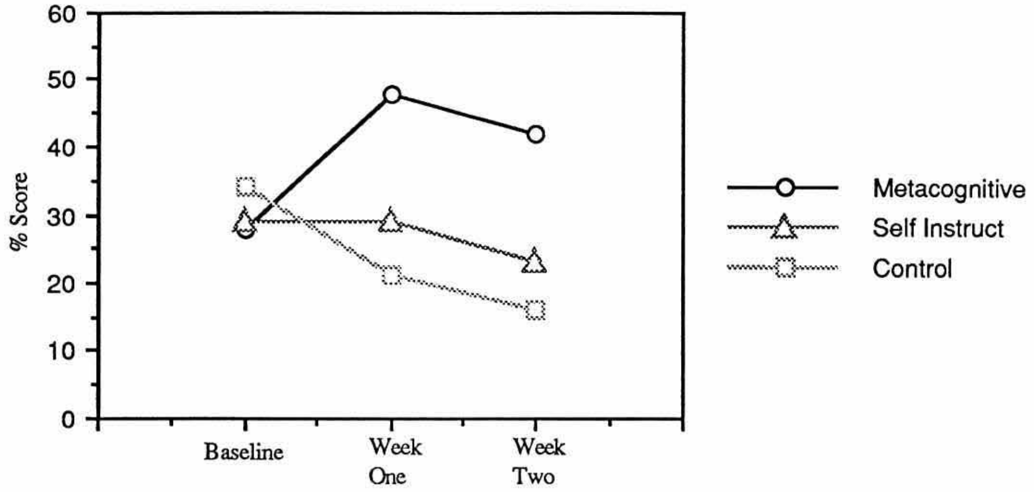
An ANOVA was used to analyse differences within groups over time and between each group's performance on the listener role maps that had nominally similar referents. The following table (table 30) shows each groups mean scores.

Table 30: Means for each training group in the Listener role with nominally similar "outdoors" maps at Baseline, Week One and Week Two.

Condition	Baseline	Week One	Week Two
Meta	28	48	42
SIT	29	29	23
Control	34	21	15

These means are also shown in figure 14.

Figure 14: Means for each group in the Listener Role with nominally similar "outdoors " maps at baseline, Week One and Week Two



This graph suggests there were differences between baseline and post-training situations within groups.

From the data the following ANOVA table (table 31) was produced -

Table 31: ANOVA table for the mean scores of each training group on the "outdoors" map in the listener role

Source	d.f.	s.s.	m.s.	v.r.	p.
Cond	2	6193.8	3096.9	1.86	n.s.
Residual	42	70053.1	1667.9		
Time	2	887.1	443.6	2.67	<0.07
Cond.Time	4	5433.7	1358.4	8.19	<0.001
Residual	84	13934.6	165.9		
Total	134	96502.4			

There was a significant condition/time interaction (F(2,84)=8.19;<0.001). That is whilst the group did not differ significantly at baseline, they did at weeks one and two.

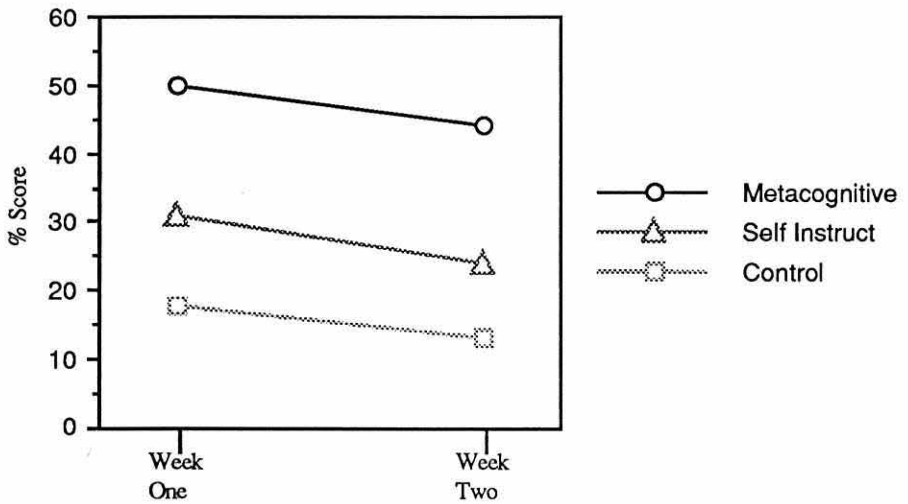
We then used an ANCOVA to account for variance between each groups baseline scores. These biased means are shown in table 32.

Table 32: Adjusted condition means by time for Listener Similar.

Condition	Week One	Week Two
Meta	50	43
SIT	30	24
Control	18	12

These biased means are also shown in figure 15 below.

Figure 15: Biased means for each group in the Listener Role with nominally similar "outdoors" maps at baseline, Week One and Week Two



From these biased means the following ANCOVA table (table 33) was produced.

Table 33: ANCOVA table for Listener Similar

Source	d.f.	s.s	m.s.	v.r.	p
Cond	2	14874.4	7437.2	15.57	<0.0015
Covariate	1	31306.7	31306.7	65.53	<0.0015
Residual	41	19586.6	477.7	2.54	
Time	1	878	878	5.73	<0.02
Cond.Time	2	3	1.5	0.01	ns
Residual	42	6434.7	153.2		
Total	89	69505.2			

There was significant effect of time (F(1,42)5.73;p<0.02), and of conditions (F (2,41)=15.57;<0.001). That is, performance was affected by the conditions people were in, but performance change may not have been consistent over the two time points.

Bonferoni testing showed that the META group (Mean=47) differed significantly to the control group (Mean=16) and to the SIT group (Mean=27) at the 95% level.

Bonferoni results confirm, as suggested in graph above in figure 16, that there are significant performance gains for the Metacognitive group. It seems that such increases in the Metacognitive group indicate an unique far transfer of skills across communication roles. Further Bonferoni testing showed that the there was no significant difference between the Metacognitive group's Week One and Week Two scores. The Metacognitive group's new high score in the Listener role -- through transfer -- was therefore maintained.

5. Speaker role with basic assembly task (Speaker Basic Bridge)

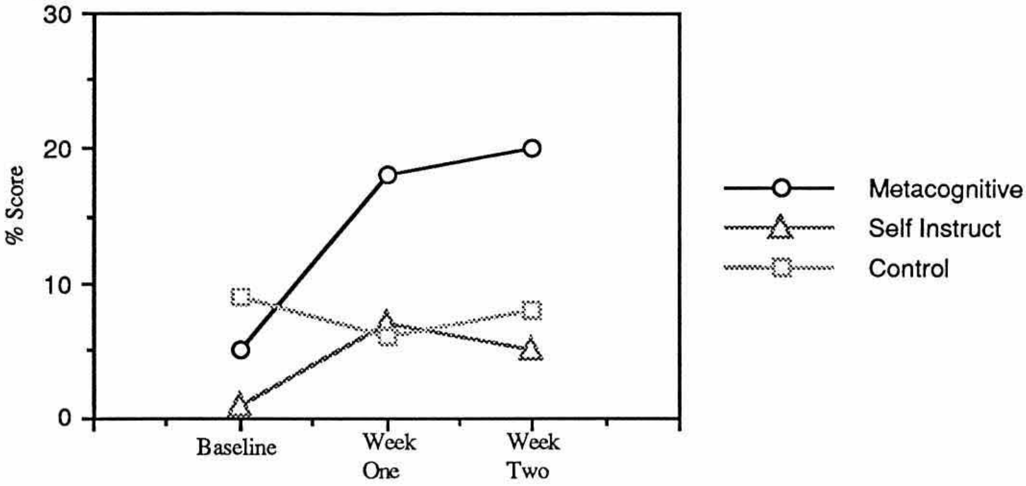
An ANOVA was used to analyse differences in performance within groups over time and between conditions with the basic object assembly task. The following table (table 34) shows each groups mean scores.

Table 34: Means for each training group in the speaker role with Bridge One (the basic object assembly task) at Baseline, Week One and Week Two

Condition	Baseline	Week One	Week Two
Meta	4	17	20
SIT	1	6	5
Control	9	5	8

These means are also shown in figure 16.

Figure 16: Means for each group in the Speaker Role with the basic object assembly task at baseline, Week One and Week Two



From the data the following ANOVA table (table 35) was produced -

Table 35: ANOVA table for the mean scores of each training group with the basic object assembly task in the speaker role.

Source	d.f.	s.s	m.s.	v.r.	p.
Cond	2	2306	1153	1.61	n.s
Residual	41	30076	716.1		
Time	2	992.5	496.2	3.36	<0.05
Cond.Time	4	1491.1	372.8	2.72	<0.05
Residual	84	11494.6	136.8		

The ANOVA showed that there was a significant effect of time (F(2,84)3.36;p<0.05) and there was a significant condition/time interaction (F(4,84)=2.72;<0.05). That is whilst the groups did not differ significantly at baseline, they did at weeks one and two.

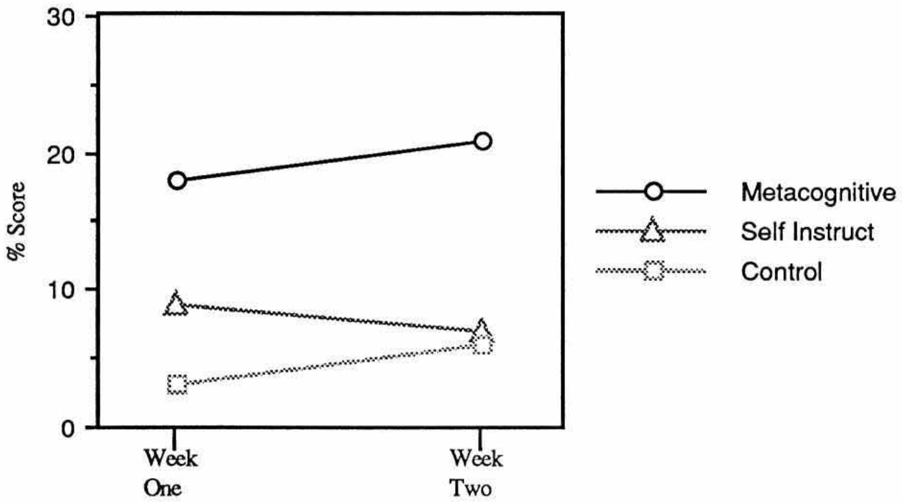
We then used an ANCOVA to account for variance between each groups baseline scores. Each group's biased means are shown in Table 36 below -

Table 36: Adjusted condition mean scores for each training group with the basic object assembly task at weeks one and two

Condition	Week One	Week Two
Meta	17	20
SIT	8	7
Control	3	6

These biased means are also shown in figure 17.

Figure 17: Biased means for each group in the Speaker Role with the basic object assembly task at Weeks One and Two



From the adjusted data the following ANCOVA table (table 37) was produced -

Table 37: ANCOVA table for the mean scores of each training group with the basic object assembly task

Source	d.f.	s.s	m.s.	v.r.	p	Cov.Ef
Cond	2	3403.4	1701.70	3.61	<0.05	0.98
Covariate	1	6623.46	6623.46	14.06	<0.00105	
Residual	41	19312.07	471.03	1.31		
Time	1	44.93	44.94	0.61	ns	1
Cond.Time	2	90.75	45.37	0.62	ns	1
Residual	42	3075.51	73.23			1
Total	89	32299.54				

The ANCOVA showed that there was a significant effect of conditions ($F(2,41)=3.61;p<0.05$). Furthermore there were no significant differences over time ($F(1,42)0.61;p=n.s.$) indicating a stability in performance.

'Posteriori' Bonferoni testing showed that the Metacognitive group (Mean=19) differed significantly to the control group (Mean=5) at 95%. The SIT group (Mean=8) did not differ significantly to control. The SIT and and the metacognitive groups did not differ significantly form each other.

It is therefore suggested that, as shown in figure 18 above, the Metacognitive group showed significant improvements in ability at instructing the experimenter to assemble objects. Since they were not trained on this task, only on speaker role maps, this improvement signifies a far transfer of skill across task type. The Metacognitive group's performance maintained over two weeks.

6. Speaker role with complex assembly task (Speaker Complex Bridge).

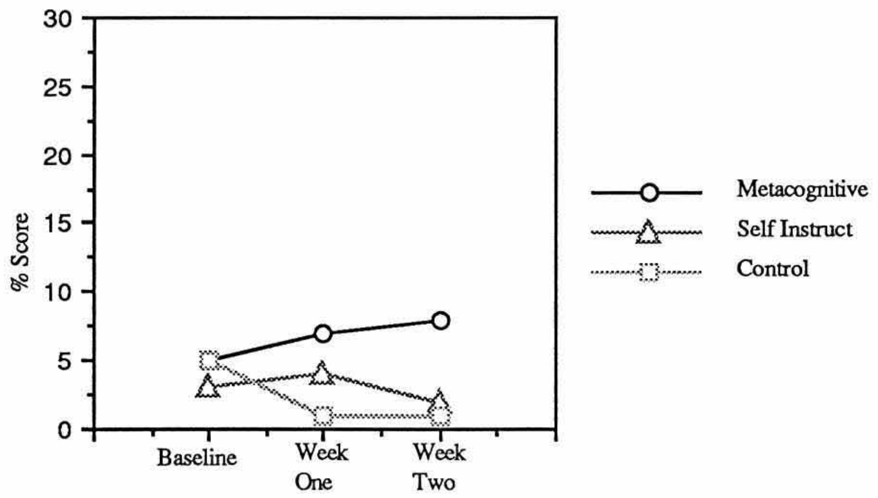
An ANOVA was used to analyse differences in performance within groups over time and between conditions in the speaker role with the complex object assembly task. The following table (table 38) shows each group's mean scores.

Table 38: Means for each training group in the speaker role with the complex object assembly task at Baseline, Week One and Week Two

Condition	Baseline	Week One	Week Two
Meta	5	7	8
SIT	3	4	2
Control	5	1	1

These means are also shown in figure 18.

Figure 18: Means for each group in the Speaker Role with the complex object assembly task (Complex) at baseline, Week One and Week Two



From these group means the following ANOVA table (table 39) was produced -

Table 39: ANOVA table for the mean scores of each training group with the complex object assembly task in the speaker role.

Source	d.f.	s.s	m.s.	v.r.	p
Cond	2	525.82	262.91	0.65	n.s.
Residual	42	16957.26	403.74		
Time	2	28.55	14.28	0.29	n.s.
Cond.Time	4	300.86	75.21	1.55	n.s.
Residual 84	4085.03	48.63			

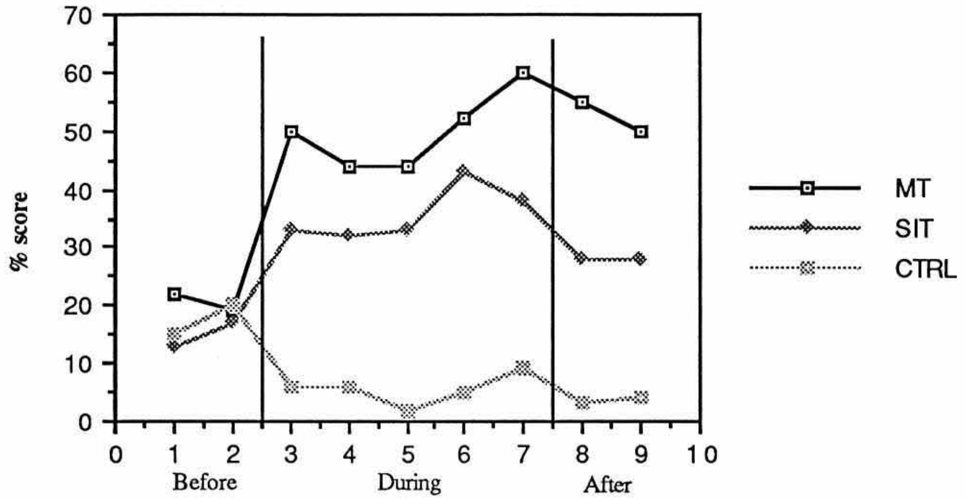
The ANOVA shows that there were no indication of significant differences over time (F(2,42)0.65;p=n.s.) or between conditions (F(2,84)0.29;n.s.), or of a condition/time interaction (F(4,84)1.55;p=n.s.).

7. Performance of each group before, during and after training:

The following graphs profile the degree of "learning" that occured in each condition during training in both the speaker and listener roles with nominally similar referents as compared to pre- and post- training scores.

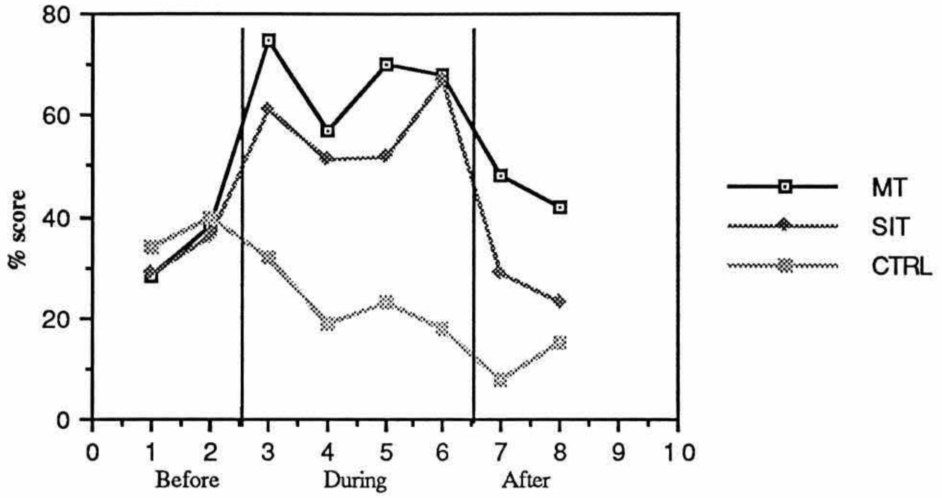
In figure 19, below, it can be seen that both the Metacognitive (MT) and Self-instructed (SIT) groups had increases in performance as speakers when exposed to training. Initially, in training, the instructor took control over the task and supported the subjects' behaviour. This is evident in the initial steep slope of "learning" from data points 2 to 3. The instructor then released more control over to the subjects , resulting in a dip in performance for the Metacognitive group. Towards the end of training performance in both groups increased as subjects performance approximated model behaviour. Higher performance rates than in baseline were maintained after training in both groups. The control group (CTRL) did not benefit from un-instructed practice.

Figure 19: Group performances before (including when dynamically assessed), during and after training on the speaker "outdoors" map with nominally similar referents



In figure 20, below, it can be seen that both the Metacognitive and Self-instructed groups also had increases in performance as listeners when exposed to training. Again the instructor took control over the task and supported the subjects' behaviour at the initial stage of training. This is evident in the initial steep slope of "learning" from data points 2 to 3. The instructor then released more control over to the subjects, resulting in a dip in performance for both groups. Towards the end of training performance in both groups increased as subjects performance approximated model behaviour. After training, however, the Metacognitive group continued to perform at significantly higher rates than in baseline, whilst the Self-instructed subjects performance rates declined to baseline levels. Again the control group did not benefit from un-instructed practice.

Figure 20: Group performances before (including when dynamically assessed), during and after training on the listener "outdoors" map with nominally similar referents

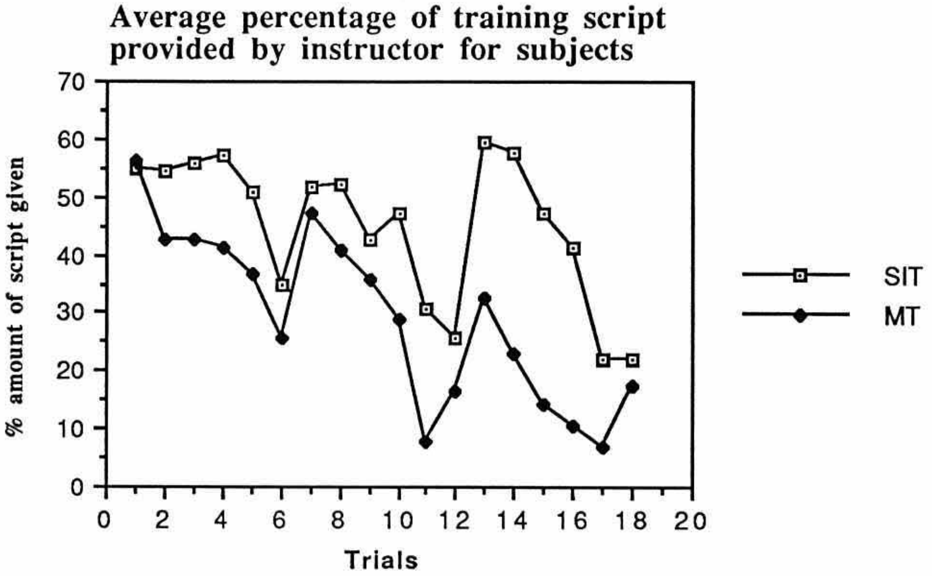


8. Observer ratings of experimenter's performance:

To monitor that the procedures detailed for each training condition were adhered to by the experimenter, two non-Psychology graduates were requested to observe video-taped interactions between the experimenter and a sample of three subjects from each condition (that is 20% of all trained subjects). The observers were asked to record (i) the amount of specific instructions that each subject was enabled to be exposed to in each condition, (ii) the duration of, and (iii) the type and number of reinforcers given, in each session. They were also asked to note if (iv) the experimenter made mention to any subject of the utility of learning speaker skills for becoming better listeners. In the graphs below we have presented the mean observer rating from both observers for each factor.

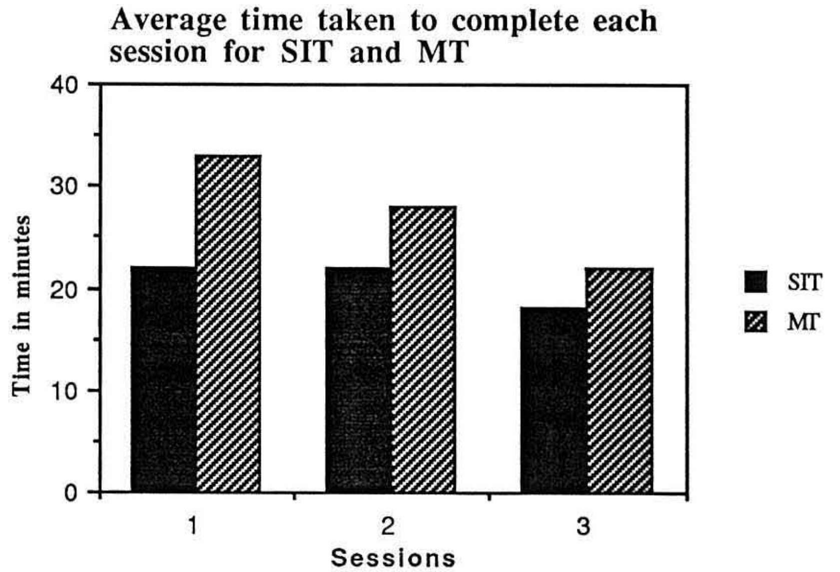
As can be seen in Figure 21 below the amount of instructional support given to subjects was greater at the beginning of sessions and declined towards the end. In this there is co-linearity between both conditions, however the Self-instructed subjects seemed to receive greater instructional support at the end of training.

Figure 21: Average number of instructions from training scripts provided by the instructor for trainees on training trials (1-6, were in session one; 7-12 were in session two; 13-18 were in session three)



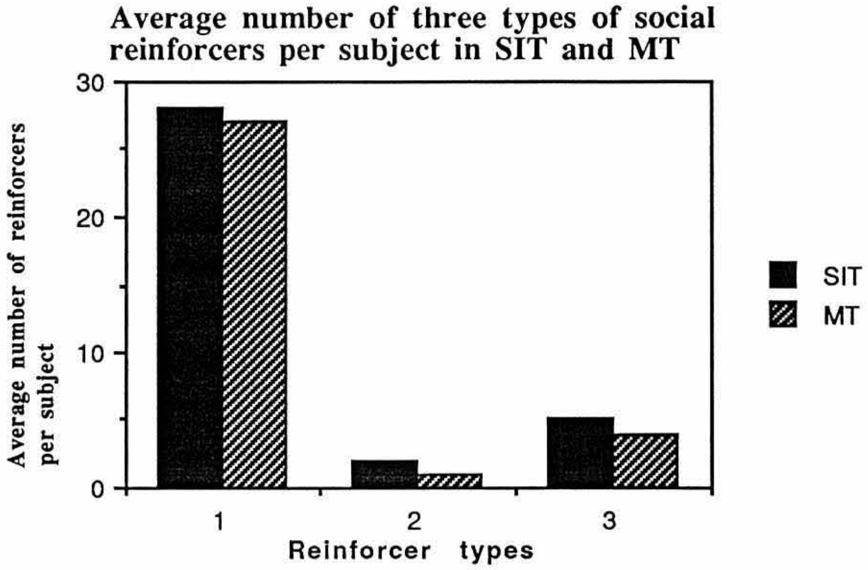
In figure 22 below it can be seen that more time was required for Metacognitive training than Self-instruction, particularly in the first two sessions.

Figure 22: The average time taken to complete each of the three training sessions for the Metacognitive and Self-instructional groups



In figure 23 below it is shown that the number of each type of reinforcer give in each training condition was nearly equal, with a slight bias for more reinforcement in the Self-instructional condition.

Figure 23: Average number of social reinforcers of three types - scripted and un-scripted - (1, e.g. "good"; 2, e.g. "very good"; 3, e.g. "excellent, well done") provided for subjects in the Metacognitive and Self-instructional groups.



Summary of Section two: Intervention Results

Positive effects of training were indicated by performance changes in both Self Instructional and Metacognitive conditions, although greater in the latter.

In the speaker role with nominally distinct referents there was no significant improvement for any group, in fact there was negative transfer for Control and Self Instructional groups. The effects of negative transfer maintained at two weeks after the end of training. For the Listener role with nominally distinct referents there was no major effect of training.

There were, however, a number of positive effects of training. In both Metacognitive and Self Instructional groups there was, first, an increase and maintenance in speaker role scores on the outdoors maps with nominally similar referents, signifying learning -- in particular the learning of the ability to make selective comparisons. Secondly there were high scores on speaker maps with nominally similar referents not shown in either baseline or training (the "market" map), signifying near transfer of learning to tasks similar to those trained on (which also maintained to Week Two). For the Metacognitive group, however, there were increases in listener role performance scores, indicating far transfer of skills across communication roles -- which maintained at Week Two. The Metacognitive group also increased their performance on the basic

Object Instruction tasks which would indicate the far transfer of learning to different speaker role tasks.

Far transfer, or generalisation, was therefore especially evident in the significant increases in listener role and basic Object Instruction scores of the Metacognitive group but not for the SIT group.

During training the Metacognitive and the Self-instructional groups had increases in performance in both the speaker and listener roles. Observer ratings showed that both groups were somewhat matched for reinforcement, but had some variance in time taken for training and instructional support.

Section Three: Correlations between baseline scores and learning and transfer

Since there were significant differences between the baseline scores and post training scores of individuals within both Metacognitive and Self-instructional groups we attempted to focus on the individual characteristics that may make some individuals more adept at gaining from training than others. For this we measured the degree of difference between pre and post - training scores within each condition and then correlated the amount of increase in performance against baseline performances on all the baseline measures - Linguistic, Cognitive and Communicative.

Our measure of actual learning was the difference between scores on the Outdoors map with nominally similar referents in baseline and after training (Learning). Our measure of near transfer was the difference between performance on, again, the Outdoors map with nominally similar referents in baseline, and performance on the Market map with nominally similar referents, which they were only presented with after training (Near Transfer). There were three Far Transfer measures. First of these were far transfer across roles which was measured as the amount of change in the listener role (Far Transfer I) from baseline to post-training conditions (Far transfer I). Then we measured the amount of performance change within both the object assembly tasks on which the subject instructed the experimenter, the basic bridge as Far Transfer II and the complex bridge as Far Transfer III.

In the following section we will first present the significant correlations of performance change, from baseline to the day immediately after ceasing training, on each measure (from Learning to Far Transfer III) within each condition. We will then present correlations of the maintenance of performance change at two weeks after cessation of training, again within each group.

Table 40 below show the correlations between absolute scores in baseline and performance change on learning and transfer measures for the Metacognitive group.

Table 40: Summary of correlations for Learning and Transfer in the Metacognitive Group

*0.001 otherwise 0.01

Rank	Learning	Near Transfer	Far Transfer I	Far Transfer II	Far Transfer III
1	0.79* (Bri.2)	0.95* (Bri.2)	0.62 (BMon)	0.80 (STM.A)	-
2	0.73 (LiNDG.Map)	0.92* (LiNDG.Map)	-	0.75 (LiNSG.Map)	
3	0.61 (MAA.Str)	0.79* (Bri.1)		0.75 (LiNS.Map)	
4	0.60 (MAB.Str)	0.78* (LiNS.Map)		0.75 (Bri.2)	
5		0.76* (LiNSG.Map)		0.72 (Ravens.All)	
6		0.72 (SpND.Map)		0.69 (STM.A)	
7		0.69 (Ravens.All)		0.67 (Bri.1)	
8		0.62 (SCom)		0.66 (SpNSG.Map)	
9		0.60 (RCom)			

There were four major significant correlates to actual learning between absolute scores in the Metacognitive condition. First was the ability to assemble a complex object (r= 0.79), then ability at being a listener, when guided, with nominally distinct referents (r= 0.73), and finally the ability to make strategic responses to ambiguous messages on the communication component tests (Test A: r= 0.61; Test B: r= 0.60).

The second column in table 40 shows a sample of significant correlates to near transfer tests. Scores on both object assemble tasks were highly related to near transfer (Bri.2: r= 0.95; Bri.1: r= 0.79). Performance on three listener map tests were significant correlates to near transfer, when guided with nominally distinct referents (r= 0.92) and with nominally similar referents both unguided (r= 0.78) and guided (r= 0.76). Of the speaker maps the only significant correlate was that with nominally distinct referents (r= 0.72). The only significant psychometric correlate was Ravens progressive matrices (r= 0.69). Two speaker component tests were significant correlates of near transfer, selective comparison (r= 0.62) and referential communication (r= 0.60).

The far transfer of skills across communication roles (column three of table 39 above) had one significant correlate, that of ability on the Basic Monitoring test (r= 0.62).

Far transfer across tasks (that is performance improvements in being a speaker with the basic object assembly task) had a number of strong correlates. The span of short term memory (Test A: r= 0.80; Test B: r= 0.69) was a significant correlate as was ability on the listener maps with nominally similar referents, both when guided (r= 0.75) and unguided (r= 0.75). Performance on both object assemble tasks were further strong correlates (Bri.2: r= 0.75; Bri.1; r= 0.67). Ability on Ravens was also a significant correlate (r= 0.72). The only main speaker test correlate was ability at being a speaker, when guided, with nominally similar referents.

In general ability to reason abstractly , such as for replicating objects (Object Assembly) and for relating patterns (Ravens), and for making selective comparisons (other than in speaker -map tests) were strong correlates to the near transfer of learning in the metacognitive group. Far transfer across task types was also strongly related to cognitive representation and abstraction tests (STM, Object Assembly and Ravens) and to making selective comparisons, particularly in the listener role.

Table 41 below show the correlations between absolute scores in baseline and performance change on learning and transfer measures for the Self Instructional group.

Table 41: Summary of correlations for Learning and Transfer in the SIT Group

Rank	Learning	Near Transfer	Far Transfer I	Far Transfer II	Far Transfer III
1	0.79* (TROG.R)	0.89* (RDLS.C/R)	-	0.76 (Bri.4)	0.92 (Bri.3)
2	0.71 (RDLS.C/R)	0.88* (TROG.A)		0.68 (RDLS.C/R)	
3	0.69 (TROG.L)	0.86* (RDLS.C/A)		0.66 (STM.A)	
4	0.67 (LiNS.Map)	0.85* (TROG.R)		0.65 (TROG.R)	
5	0.65 (RDLS.C/A)	0.74* (SpNSG.Map)		0.64 (RDLS.C/A)	
6	0.64 (SCom)	0.72 (Bril)		0.64 (SCom)	
7	0.64 (RDLS.E/A)	0.72 (STM.A)			
8	0.62 (SpNDG.Map)	0.71 (STM.B)			
9	0.60 (SpNSG.Map)	0.71 (LiNS.Map)			

Table 41: Continued

10	0.70 (TROG.L)
11	0.70 (RDLS.E/A)
12	0.69 (SCom)
13	0.67 (RDLS.E/R)
14	0.65 (SpNDG.Map)
15	0.64 (BPVS.A)
16	0.64 (BPVS.R)
17	0.64 (BMon)

There were a number of significant correlates to actual learning between absolute scores in the Self Instructional condition. TROG was a substantial correlate to learning (TROG.R: r=0.79; TROG.A: r= 0.69), as was Reynell's (RDLS.C/R: r= 0.71; RDLS.C/A: r= 0.65). Of the map tests Listener ability with nominally similar referents was a significant correlate (r= 0.67), as was being a speaker when guided with both nominally distinct and similar referents (r= 0.62 and r= 0.60 respectively). The only component test to show a significant correlation was selective comparison (r= 0.64).

Near transfer of skills was significantly correlated with performance on Reynell's language comprehension test (RDLS.C/R: r= 0.89; RDLS.C/A: R= 0.86), and less so but strongly with performance on Reynell's test of expressive language (RDLS.E/A: r= 0.70; RDLS.E/R: r= 0.67). Near transfer was also significantly correlated with performance on the TROG (TROG.A; r= 0.88; TROG.R: r= 0.85; TROG.L: r= 0.70). Being a speaker when guided with both nominally similar and distinct referents were further strong correlates of near transfer (r= 0.74 and r= 0.65 respectively), as was performance on the basic object assembly (r= 0.72) and short term memory tests (Test A: 0.72; Test B: 0.71). Further correlates of near transfer was performance on the Listener map test with nominally similar referents (r= 0.71), Selective Comparison (r= 0.69), Peabody's Picture Vocabulary (BPVS.A: r= 0.64; BPVS.R: r=0.64) and Basic Perspective test (r= 0.64).

Far transfer of learnt skills to being a speaker with the Basic Bridge task (Far Transfer II) correlated strongly with performance as a speaker on the complex object assembly task in baseline (r= 0.76). It was also strongly related to performance on Reynell's test of language comprehension (RDLS.C/R: r= 0.68; RDLS.C/A: r= 0.64), Short Term Memory (0.66), TROG's raw score (r= 0.65) and Selective Comparison (r= 0.64).

There was only one major correlate to the transfer of skill to being a speaker with the complex object, which was ability in being a speaker with a basic bridge (r= 0.92).

In general actual learning in the Self Instructional condition was most strongly related to ability on language comprehension tests (TROG, Reynell's). Near transfer of learning was also strongly related to language comprehension measures, although there was some, albeit lesser, correlation to cognitive representation (replicating a basic bridge and STM). There was also some correlation between near transfer and baseline ability to make comparisons (such as being a listener with nominally similar referents and Selective Comparison). Far transfer of skills from learning to being a speaker with a basic bridge showed a relationship to the same activity in baseline with a complex task, and also to language comprehension measures, short term memory and selective comparison.

There were no significant correlates to performance change in the control group.

In the following tables we show correlations for the maintenance of learning and transfer two weeks after training was completed. Table 42 below show the correlations between absolute scores in baseline and the maintenance of performance change on learning and transfer measures for the Metacognitive group.

Table 42: Summary of correlations for Maintenance of Learning and Transfer in the Metacognitive Group between absolute measures

*0.001

Rank	Maintain Learning	Maintain Near Transfer	Maintain Far Transfer I	Maintain Far Transfer II	Maintain Far Transfer III
1	-	-	0.66 (Bri.2)	0.78* (TROG.L)	0.93* (Bri.4)
2			0.64 (TROG.R)	0.75* (TROG.R)	0.90* (PMon)
3				0.75 (RDLS.C/A)	0.82* (MAA.Req)
4				0.69 (RDLS.E/A)	0.73 (Bri.3)
5				0.69 (SPNS.Map)	
6				0.69 (LINSG.Map)	
7				0.68 (RCom)	
8				0.67 (RDLS.C/R)	
9				0.60 (LiNS.Map)	

The strongest correlations were for the maintenance of far transfer.

Maintenance of the transfer of skill to the listener role (Far Transfer I) correlated with performance in object assembly (r= 0.66) and to the raw score on the TROG (r= 0.64).

Maintenance of performance in being a speaker on the basic object assembly task (Far transfer II) also strongly correlated with ability on TROG (TROG.L: r= 0.78; TROG.R: r = 0.75), and to both Reynell's receptive and expressive language tests (r= 0.75 and r= 0.69 respectively). It also correlated strongly with performance on three map-tests with nominally similar referents,which were, being an unguided speaker and both being a guided and unguided listener (r= 0.69, r= 0.69 and r= 0.60 respectively). Maintenance of far transfer II also correlated strongly with Referential Communication (r= 0.68).

Maintenance of performance in being a speaker on the complex object assembly task (Far transfer III) correlated with ability on both speaker tasks in which subjects instructed the experimenter to assemble objects (Bri.4, r= 0.93 and for Bri.3 r= 0.73). Maintenance at Far Transfer III also correlated strongly with Perspective Monitoring (r= 0.90) and with ability to request more information on the Message Adequacy Test A (r= 0.82).

Overall it seems that the maintenance of far transfer across tasks, in the metacognitive group, was related to receptive and expressive language abilities as tested on the TROG and the Reynell's.

There were no significant correlates to the maintenance of performance change for neither the Self Instructional or control groups.

Summary of Section Three, Correlations of Learning and Transfer

Correlations between baseline measures on Linguistic, Cognitive and Communicative scores and learning and transfer scores of individuals within both Metacognitive and Self-instructional groups indicated that some individual characteristics may make some individuals more adept than others at gaining from either training.

Metacognitive Group:

The Metacognitive group's absolute scores show that the ability to reason abstractly, such as for replicating objects and for relating patterns (Object Assembly and Ravens), and somewhat the knowledge of making selective comparisons, were strongly related to the near transfer of learning from the maps subject had been trained on ("Outdoors" etc) to new maps ("market"). Far transfer across task types (from being speakers with maps to being speakers with a basic model of a bridge) was also strongly related to cognitive representation and abstraction tests (STM, Object Assembly and

Ravens) and to knowledge of the making of selective comparisons, particularly in the listener role.

Performance based on absolute scores in the second week tests of the maintenance of learning and of near transfer did not produce many correlations. There were, however, a number of significant correlates to the maintenance of far transfer. In the main these correlates were receptive and expressive language abilities.

Self-instruction:

In the Self Instructional condition learning was most strongly related to ability on language comprehension tests. Near transfer of learning was also strongly related to language comprehension measures, although there was some correlation to cognitive representation. There was also some correlation between near transfer and baseline ability to make comparisons, particularly as a listener. Although the SIT group did not generally improve on the Basic Bridge Assembly task, those who did show some improvement within this group demonstrated a relationship to the same activity in baseline with a complex task, and also to language comprehension measures, short term memory and selective comparison.

General Summary and Conclusions

In this chapter we have presented information about the lack of communicative skills of a number of people with learning difficulty. We then presented the results of three methods to teach such skills. One method, Metacognitive, provided most learning and transfer of learning to different situations. We also found that people's success in each of the teaching programs were linked to certain kinds of linguistic and cognitive skills.

There were three sections. In the first section we described our population group in terms of linguistic, cognitive and communicative abilities. Language tests described them as having language skills comparable, on average, to the developmental range 3 years 8 months to 5 years 6 months, and on Raven's Progressive Matrices our subjects scored below the average score of 5.5 year old children. Their digit span was 2.9 on average, with a slight increase with strategy imposition to 3.3.

Communication sub-component tests, which attempted to measure certain sub-skills of communication, in isolation, showed that our subjects had developed skills for making comparisons between referents, but not the metacognitive knowledge of knowing when to use those skills. That is, when asked to make comparisons (in the Selective Comparison test) subjects made distinctions between objects based on names, sizes, colours etc. However in situations that demanded their independent use of such a skill - for targeting a referent - they failed to use it (in the Referential Communication test). Neither did they seem to think such comparisons were necessary for communicating which one of two or more similar objects a person had to choose (in the Perspective

Taking test). Furthermore in listener sub-skills tests, when faced with ambiguous messages for selecting a referent, (such as the message "the tree" when there are two) our subjects had a tendency for choosing one or the other rather than make requests for more information - that is they did not ask "Which one?".

This metacognitive difficulty, not knowing about when and where to use the "comparison" skill, was also shown in more global tests of communication - in giving and receiving instructions for filling in maps and telling others to build objects.

When tested with maps as speakers and listeners, the population produced high scores when given referents that had different names (needing only to be labelled for an automatic comparison). However they received low scores with maps that had referents that had the same names as one another (therefore needing some characteristic other than of name to be described for their distinction). That is they did not spontaneously supply or request comparisons of referents, more than name, in their communication interchanges.

On object assembly tests subjects demonstrated ability to replicate models but not to instruct another person to build replicas, thus again showing adequate skills of discrimination and differentiation between objects, but not the ability to describe these differences.

The common problem for our subjects in all these tests was that they neither tended to say "Which one?" when they were listeners, or think to ask themselves "Which one?" for the listener when they were speakers.

Our adapted Communication tests, both sub-componential and general, were further shown to have commonality with each other through correlational analyses. In particular speaker and listener tasks that involved making comparisons were strongly related, showing that the communication roles share skills that may transfer. Communication tests were also shown to have commonality with two major standardised Psychometric tests, TROG and Ravens.

In section two we presented the results of each of our teaching programs. Positive effects of training were indicated by performance changes in both Self Instructional and Metacognitive conditions, although greater in the latter.

First there was an increase in performance and maintenance of scores in the speaker role with the "outdoors" maps that had nominally similar referents (those that needed comparisons). Secondly they used these skills on tasks that were nearly the same but not shown in either baseline or training (the "market" map), signifying near transfer (which also maintained). For the Metacognitive group, however, there were further transfer of skill to the listener role. There they experience much higher performance scores than in baseline, and as against the other two groups even after only being trained as speakers (these effects were maintained two weeks later). The Metacognitive group also increased their performance on tasks where they had to instruct the experimenter to build an object, indicating yet more "far" transfer of learning.

Both the Metacognitive and Self Instructional groups had therefore learnt the skill of making comparisons for a listener for that listener to choose a referent. Moreover the Metacognitive group had a seemingly greater abstract awareness as to what situations they could attempt to use such a skill, such as in being listeners and in different kinds of speaker tasks.

Once all the subjects had completed training, and had undergone transfer tests, we analysed their degree of change in performance for correlations with baseline scores. Learning itself (on the "outdoors" map) was shown to be related to language skills in the Self Instructional group. Near transfer of skills to maps other than taught on ("market") were correlated, in the Metacognitive group, with ability on cognitive representation and abstract reasoning tests. Near transfer in the Self Instructional group was more related to language measures. Far transfer across communication roles only occured in any significant manner in the Metacognitive group, but no correlations were found. For far transfer across speaker tasks (in particular to instructing another to build a basic bridge) again only occured in the Metacognitive condition, and it was correlated with cognitive factors, although maintenance of such far transfer correlated with language measures.

We had therefore delineated the parameters of our subjects' communicative skills in certain settings -- showing a specific communication problem, that of knowing that comparisons should be made. We then developed different kinds of methods for teaching these skills and found that one, Metacognitive, allowed subjects to develop the ability of transfering skills -- to choose to use the skills in situations dis-similar to those they were trained in. Moreover, on the basis of correlational analyses, Metacognitive training seemed to access our subjects' abstract reasoning ability to a greater degree than the Self -instructional approach.

Chapter 6: Discussion

General introduction:

This research was of two main parts, identification and amelioration - ""Apres le mal, le remede", Diagnosis is crucial but remedy must follow" (Binet in Brown, Campione, Reeve, Ferrara & Palinscar, Personal communication). The diagnoses were performed to identify (i) what communication skills our subjects showed capability of, (ii) to investigate individual differences between people who demonstrate certain skills (or do not) and (iii) to establish relationships between skills to inform us of how training in certain skills might transfer across tasks and roles. We utilised two main approaches for training communicative skills, both descended from Vygotsky's Social-developmental theory -- Self-Instruction and Metacognition.

In the first section of this chapter we shall summarise and discuss the results of our attempt to measure our subjects' communication skills, and in the second section our attempts at training. In the third section we shall consider our findings more generally and provide directions for future research.

SECTION ONE : Assessment of communication abilities

Introduction:

Given that people with learning difficulty have only barely been assessed (see Abbeduto Davies, Solesby & Furman, 1991) for communication skills, we attempted to provide data of their apparent and potential abilities. To do this we attempted to detail our subjects communicative abilities in two environments. Those that isolated sub-components of communication, and those that required their orchestration of such sub-components in more naturalistic, global settings. We then attempted to measure the potential our subjects had of reaching the optimum level of skill required for being both speakers and listeners in these naturalistic environments by providing them with help. After testing we analysed our data for linguistic and cognitive differences between individuals who had shown, or not, certain communicative skill. By such analyses we hoped to provide a depth of detail to guide training for transfer.

Componential analysis of communication skills

Speaker Role:

Subjects in this study demonstrated the basic skill of the speaker's role in knowing that a listener who has a different vantage point might not be able to see the same objects as a speaker could, and thus know what the speaker knows. This is consistent with results obtained by Patterson and Roberts (1982) with six year old children, of whom 86%

knew that a listener did not know the identity of a target before any message was communicated.

Once a speaker has understood that the listener is ignorant of a target referent's identity she or he must decide on what information needs to be communicated to inform the listener. Underlying this ability is the ability to selectively compare differences between objects that share some other common features. The comparison skill can be gauged against the complexity - or grain - of the comparisons that a person can execute to isolate a referent from a number of potential referents. The mean score for all subjects on a Selective Comparison test was 42%. Since the grain of comparison necessary for a referent to be identified was incremented over the thirty trials of this test we were able to pin-point a median level of success lying between trials 18 and 19 (the making comparisons based on size and additions with 4 referent pictures).

Subjects were therefore generally able to make comparisons between a few (2-3) referent pictures based on the name of the objects pictured, and object's shape, size, and colour, but ran into difficulties with a greater number of referents (4-5), especially when comparisons rested on additions and subtractions. That is when when there was a need for a finer grain of comparison. Subjects were therefore able to make gross comparisons between referents, but did not make fine grain comparisons. They therefore had some mastery of an important sub-skill of communication - the description of differences.

The use of the selective comparison skills in the Selective Comparison test was requested by the experimenter. Even if people can isolate differences between referents they might not necessarily do so in their messages for listeners (Sonnenschein & Whitehurst, 1984,a). It may be the case that each skill in isolation, when requested by another person, may be well developed, but they may not have come to work together in a communicative context. That is there may be a more advanced skill which involves the speaker understanding that when the listener is ignorant of the referent's identity then they, as a speaker, must decide on what information the listener needs.

We attempted to measure such an ability with two tests. The first, Perspective Monitoring, co-opted subjects into the speaker role as conspirators with the experimenter in which they were provided with an opportunity to assess a message that a listener is given by a speaker on which they may have to select a referent. In the second, Referential Communication, they were asked to be actual speakers and the experimenter acted as a listener. Both these tests also had the grain of comparison incremented over thirty trials.

On the Perspective Monitoring test the overall group mean was 34%. However, the design of the test led to a number of false positive scores. A number of the subjects responded that the first message was descriptive on every occasion and thus scored 33% without any actual appraisal of messages. By not including such false positive scores the mean score dropped to 21%. It is therefore suggested that the subjects largely failed to notice that messages were ambiguous for the listener, hence they lacked role-evaluative, metacognitive knowledge of the speaker's function.

The median point of ability on this test was between ranks 4 and 5. At these, and for a few further levels, adequate comparisons could have been made on the names or shapes of only two referents. Over half of all subjects therefore had difficulty making comparisons between referents on this test which, in the main, they could deal quite effectively with on the Selective Comparison test.

On the Referential Communication test the overall mean score was 19%. That is subjects were able to identify and communicate a target referent on just under one fifth of the trials. Again we focused on which referent sets our subjects were having most difficulty with. The median point on this test was indicated as rank 4, making comparisons based on either the name or the shape of two referents. Therefore over half of all subjects had difficulty making comparisons between referents on this task which, again, they could deal quite effectively with on the Selective Comparison Test.

We analysed differences between the mean scores of our subjects on each test. It was shown that performance on the Perspective Monitoring Test and on the Referential Communication test were significantly lower than on the Selective Comparison test. Furthermore there was no significant difference between the Perspective Monitoring and Referential Communication scores. Perspective monitoring and referential communication were therefore equally difficult for our subjects as compared to selective comparison.

However, correlational analyses indicated that success on communication tests and the selective comparison test were significantly related. Those who were very able on the selective comparison test were also those who gained the highest performance scores on the communication tests. This would therefore confirm that a deficiency in such comparative skills in communicative situations would lead to communication problems.

In contrast with their performance on the Selective Comparison test, which showed the development of comparison skills when prompted, the significantly lower Perspective Monitoring and Referential Communication scores indicated a lack of metacognitive knowledge of the need to use such comparative skills. Our subjects may therefore have learnt the skills of basic perspective taking and selective comparison in isolation, but they had not, as yet, spontaneously transfered such skills "vertically" into a more complex test arena.

Such findings are similar to those of Roberts and Patterson (1983) with five year old normal children. Their subjects were able to asses the listener's initial knowledge base -- that is they could make basic perspective decisions. They were also capable of making comparisons between referents. However the children varied "considerably" in their ability at assessing the listener's perspective after the listener had received messages, and they were poor on the referential communication task.

It is therefore suggested that the adults with learning difficulty in our study also do not seem to know that to communicate referentially is to describe differences (after Whitehurst and Sonnenschein, 1981). The metacognitive knowledge of the need to make comparisons in a communication setting could therefore be confirmed as a major problem for our population.

Listener Role:

The listener role is that of a respondant. It is in how a listener responds to a speaker that listener abilities can be determined. The main skills that we were interested in within the listener role were those for using messages which were appropriate; making a strategic guess about the content of an ambiguous message based on contextual cues; and, if the message is inadequate, to produce further messages from the speaker by requesting for more information.

We gave our subjects two "message response" tests. In the first they were given some indication that a speaker could provide inadequate messages, and in the second test a speaker's potential for confusability was emphasised.

Given ambiguous messages our subjects had a tendency for selecting a referent rather than requesting for more information. In response to ambiguous messages in the first test they selected a potential referent on 81% of trials and on 78% of trials in the second test. They requested more information 6% of the first test and 13% of the second. They were using comparative skill quite effectively, however, since they only chose an incorrect referent (one not mentioned in the message) an average of 8% of the time.

Interestingly there was a significant increase in requests for more information when the subjects were given a stronger indication of speaker inadequacy. Such fledgling listener skill may therefore not be exhibited unless an a "authoritative" speaker (here the experimenter) betrays and emphasises her/his communicative inadequacy.

When we collapsed the subjects' scores on both tests the overall means of strategic and non-strategic responses were 46% and 35% respectively, which were significantly different. Therefore in selecting a potential referent subjects tended to rely on the contextual cues inherent in the context of the message. In our test the contextual cue provided was that one of two potential referents had extra features added (such as of two houses one had a tree beside it). The addition of the extra feature "suggested" that if the target was the referent with the extra feature (house with a tree) then the secondary characteristic would be mentioned to differentiate it. That our subjects made significantly more context-driven guesses based on a comparison of potential referents' extra characteristics indicate a somewhat effective functioning of selective comparison in the listener role.

As suggested by studies with normal children, individuals with learning difficulty may therefore be capable of a number of communicative skills. When messages are informative they can actually make use of those messages. They might also make strategic guesses of a target referents identity according to the Gricean maxim, that which instructs a listener to assume that the speaker will be informative enough, but not more informative than, "necessary" (Bredart, 1983). As with seven- eight year old children in Bredart's study, some of our subjects might therefore had not asked for more information because they believed that "enough" has been provided within the context of the message. Such findings are consistent with Abbeduto et al., (1991) who showed that children with "mild" to "moderate" "mental retardation" turned to the context of a message when confronted with ambiguous messages. Unfortunately in the same manner as the children in the study by Abbeduto et al., the subjects in this study failed to make many requests for more information. They therefore lacked a crucial listener skill which affects their comprehension, and potential for using, communicative messages.

It may be that even those people that have learnt the skill of requesting information (when given ambiguous messages) fail to utilise such skills and make strategic choices when the speaker is a person that they see as having authority. However in our study, when the speaker's authority was diminished our subjects still generally failed to request more information.

Correlations between tests: After the baseline testing of communication we were to attempt to train communicative skill. We therefore attempted to find commonality between the listener role and the speaker role by correlational analyses so as to provide a framework for representing what the effects of training in each role might be. There was a significant correlation between performance on the perspective monitoring test and the ability to request more information when given ambiguous messages. The principal component shared by each role was therefore an ability to assess messages. This indicates that there may be a developmental link between the skill in each role. More fundamentally it indicates that both roles share a common structural component. Structural components were identified by Gick and Holyoak (1987) as the factors which produce the conditions within tasks for positive transfer to occur across tasks.

General/Global tests of communication

This research was undertaken to provide insights into how training programs can be improved for teaching skills relevant to social settings. However to maintain experimental rigour we required such settings to be tightly controlled. A "naturalistic", setting was provided in the giving and receiving of directions based on maps. These tasks also provided a context for the dynamic assessment of peoples' potential. We also provided a second type of "naturalistic" task for the speaker role, that of giving directions for object assembly. Dynamical assessment involved providing the subjects with hints as to what to do in map-based tests.

Speaker Role with maps:

In the speaker role the subjects had one type of map on which they had to make comparisons between nominally distinct referents (thus just name referents) and on another type they had to make comparisons between nominally similar referents (say how one of two referents of the same name were different). There were therefore two main effects that concerned us in the speaker role. First if the subjects performed at a lower level when they had nominally similar referents than when they had nominally distinct referents, then an inefficient use of speaker skills for making comparisons would be indicated. Secondly, if the subjects' performances on both un-guided and guided tests remained at the same level then they would have not shown a greater potential when guided.

In answer to the first point, we found that subjects scored significantly more on the maps that had nominally distinct referents (67%) than when given nominally similar referents (17%). It was therefore suggested, as it was by the sub-component tests of communication, that our subjects, were failing to make comparisons -- other than by name in the "Nominally Distinct" condition -- for the listener when they were in the speaker role. They did not seem to appreciate that to communicate in this context requires the description of differences.

Furthermore, in reference to the second point, there was no significant difference between scores on the unguided and guided versions of the map tests. By noting how many hints people required until they acted or verbalised a strategy we found that subjects were capable of supplying an average of 31% of their own task appropriate information for monitoring messages and for making comparisons (they were therefore provided with 69% of task information). Therefore they had a degree of skill, but even when given help the subjects still performed at a low level. *Their performance on the second "unguided" maps could therefore be taken as a consistent indication of their difficulties in the speaker role when they have to communicate the identity of one of two nominally similar referents.*

Correlations between tests: Correlational analyses showed that "speaker abilities" with maps that had nominally similar referents were significantly correlated with performance at Selective Comparison and Referential Communication tests. Moreover the same abilities when guided correlated significantly with performance on the Perspective Monitoring test.

It is therefore confirmed that such speaker skills as shown to be underdeveloped with componential tests, the making of comparisons for a listener, can also be seen as underdeveloped on these more naturalistic tests.

Listener Role with maps:
In the listener role there were also two types of maps, one with referents of different names (nominally distinct) and one with referents that shared the same general name (nominally similar). On the first kind of map accurate messages could be given for a listener to isolate a referent on the basis of the primary name of referents, whilst on the second messages would have to include secondary characteristics of referents. The experimenter, acting as a speaker, 'failed' to consistently give comparative messages on the second type of map. Therefore here also we were concerned with two main effects. First if the subjects performed at a lower level when they had nominally similar referents than when they had nominally distinct referents, then they would not be using the listener skill of requesting for more information. Secondly, if the subjects performance's on both un-guided and guided tests remained the same then they would have not shown a different potential when guided.

Our subjects performance on the "Nominally Similar" test (31%) was significantly lower than on "Nominally Distinct" test (71%). Subjects, confronted with an un-helpful speaker, were not able to make requests for more information, such as asking "which one ?". When guided in this role subjects were able to provide 37% of their own task information. They were therefore provided with an average of 63% of task information. They did, in contrast to their performance in the speaker role, make significant gains as listeners on maps with nominally similar referents with the addition of help (from 31% to 40%).

It is therefore suggested, as it was by the Message Adequacy tests, that our subjects were failing to know to evaluate the speaker's role to check if he was making comparisons. They were therefore not demonstrating the meta-cognitive knowledge of communication required for knowing to ask for comparisons. They were able, however, to ask for comparisons when prompted by the experimenter - that is when the experimenter took on a metacognitive role.

The naturalistic listener role test confirms that skills shown to be underdeveloped with componential tests, such as requesting for more information when given ambiguous messages, are problematic for adults with learning difficulty.

Correlations between tests: Correlational analyses showed that listener abilities on maps with nominally similar referents were significantly correlated with performance on the Selective Comparison, Perspective Monitoring and Referential Communication tests, and to ability in the speaker role with nominally similar referents. *Structural commonality* *between communication roles is therefore, again, indicated by global/naturalistic tests of communication.*

Speaker role with object assembly tasks:
We decided to provide our subjects with a further situation that required comparisons, one wherein a person had to tell another how things "fit together".

In the object assembly tests the subjects had to give instructions for the experimenter to construct models of bridges (one "basic" and another "complex"). Before doing such the subjects were requested to view both models and assemble replicas of each. This acted as a pre-check to show if subjects could actually cognitively represent and duplicate the models themselves. To do such required them to be able to differentiate the component parts of the model for themselves as they would have to for "another" in the speaker role.

The overall mean score for assembling a replica of a basic model was 59% and for the complex model 41% . However the mean score for all subjects on both types of bridges in the speaker role (when they had to tell the experimenter how to duplicate the models) was 5%.

The subjects therefore showed themselves to be able to to differentiate 'parts of the whole' for themselves so that they could construct replicas of each bridge, but not to communicate such differentiation for another person. They had some capacity to compare and contrast but not the capacity to do such for another person.

Correlations between tests: Selective comparison and Perspective Monitoring were significantly correlated with instructing another person to assemble an object - the "bridge" tests. Also ability on this test correlated significantly with listener ability with nominally similar referents. *Structural similarities between communication tests in the speaker role and some listener skills would again be suggested by these correlations.*

Individual differences:

To pin-point the developmental characteristics of persons who may have, or not, certain communicative abilities we analysed relationships between performance on the communication tests and on linguistic and cognitive tests.

We had employed a variety of such tests. The language tests were of vocabulary (Peabody), comprehension of grammatical structures (TROG) and general receptive and expressive abilities (Reynell and Sentence Length). Cognitive tests included tests of abstract reasoning (Ravens) and of memory capacity (Short Term Memory Tests).

Of psychometric tests and communication sub-tests significant correlations were found between performance on TROG and Ravens and performance on the speaker role sub-component tests (perspective monitoring, referential communication and selective comparison). Ravens further showed significant correlations to ability on the object assembly tests (those for replicating but not for instructing). Of the psychometric tests and general communication tests there were significant correlations between performances on the TROG and to both Listener and Speaker map tests which had nominally similar referents, and between short term memory capacity (when un-aided by imposed strategies) showed and Speaker and Listener performance, when guided, with nominally similar referents. There were also significant correlations between performance on Ravens and the speaker role tests when un-guided, both with nominally distinct and similar referents. Performance on Ravens also correlated strongly with performance in the listener role, both guided and unguided with nominally similar referents.

Performance on communication tests therefore had commonality with performance on two major standardised measures, TROG and Ravens. Grammatical language skills and abstract reasoning skills are therefore implicated as important predictors of referential communication ability. Furthermore individuals who demonstrate such linguistic or cognitive skill, but not communicative skill, would seem to have a strong potential for gaining from training in communication.

Communication skills: Summary of hypotheses and findings

In general we hypothesised that a majority of people with learning difficulty already have some proficiency at some skills necessary for being speakers (such as taking another person's perspective and selective comparison), but did not organise and orchestrate these skills effectively within communication settings (when they had to monitor perspectives or communicate referentially).

We therefore needed to know if our subjects could take the perspective of another person, and secondly if they made selective comparisons between objects. It was shown that they could take another person's perspective (even when that person was presented to them televisually). They knew that a person with a more constrained vantage-point to themselves knew less than they. It was also shown that they could generally (when asked) make comparisons between objects based on the secondary characteristics of those objects (size, shape etc). However, as the need for more fine grained comparisons increased, the less well they were able to perform.

The skill that seemed to conduct these sub-skills in communication settings was hypothesised to be perspective monitoring. This is the ability to assess the adequacy of messages that oneself gives to a listener for informational accuracy. We hypothesised that such a skill was most likely to be the least developed communication skill by our subjects. We found that our subjects generally failed to notice when messages were ambiguous for a listener, even with items that they were able to successfully compare when asked (in the Selective Comparison test). They also failed to make comparative messages when placed in referential communication settings, again even with items that they were earlier capable of comparing in a less complex environment. It was therefore confirmed that adults with learning difficulty may not know that to communicate referentially as a speaker is to describe differences.

We echoed previous researchers in suggesting that people with learning difficulty might not be proficient at the listener skill of clarifying ambiguous instructions (e.g. when given the message "the tree" and there were two trees they might not ask "which one?"). However it was also thought that they may not do such because they might use the context of the message to infer what the object of that message was (the Gricean fallacy) -- particularly when the speaker was a person they perceived as having authority. It was found that, first, subjects did not generally show a capability for requesting for more information when messages were ambiguous. They did, however, tend to use a strategy based on the context of the message for selecting a referent. It was not thought that the authority they perceived in the experimenter, in general, negated the subjects' ability to request for more information. It was thus concluded that they had not developed a proficiency at the actual skill of requesting information itself.

Some subjects did, however, request more information when messages were ambiguous. This ability was strongly related to ability on the speaker role test of perspective monitoring. The principal component shared by successful subjects in both communication role tests was an ability to assess messages for their informational content. This would seem to be the "upper" level skill required for eliciting selective comparisons (of oneself or others) if none were supplied in a message. It constitutes a structural link between the communication roles.

Our subjects therefore tended not to describe differences for a listener, other than of name. Neither did they attempt to check the adequacy of messages given to a listener for precise comparisons. In sum, they may have learnt the basic skills of perspective taking and selective comparison, but had not transferred such skills "vertically" into the more complex task of referential communication.

Once established in isolation the sub-skills of both spheres of communication were assessed within more naturalistic contexts, in the giving and receiving of map directions, both statically (without help) and dynamically (with measured help). We predicted that our subjects had a greater potential for becoming effective listeners than speakers since listener skills for disamiguating messages seemed to pre-exist those of a speaker. We discovered that in these settings our subjects, as speakers, again failed to make comparisons for a listener, and as listeners failed to ask for comparisons. They did not seem to appreciate that to communicate in this context requires the description of differences.

Furthermore when we provided our subjects with help in both speaker and listener roles there was a significant increase in performance in the listener role, but not in the speaker role. We therefore concluded that the skills for monitoring the informational content of messages and for disambiguating inappropriate messages were not well developed by our subjects, but were, however, more readily developed in our subjects listener rather than speaker role. This would confirm that the communication roles are structurally related. Moreover, in that their listener role manifestation of evaluative skill was most available to be prompted, it would be suggested as a hierarchically inferior skill.

After testing we attempted to pin-point the developmental characteristics of persons who have, or have not, certain communicative abilities. We found that performance on the communication tests had commonality with performance on two major standardised measures, of grammatical understanding (the Test of the Reception of Grammar (TROG)) and of abstract reasoning (Ravens Progressive Matrices). Grammatical and abstract reasoning skills were therefore implicated as major predictors of referential communication ability.

It is therefore confirmed that meta-communicative knowledge of the need to make, and to ask for, comparisons in a communication setting is under-developed by the subjects in this study. Such skills relate communication roles and tasks in structural terms. By including a dynamic assessment component in testing we showed that the subjects were nearer to ask of others for more information than to ask of themselves to provide more information for others. In other words they had reached a higher peak of potential in the listener role than in the speaker role for monitoring the effectiveness of messages. Therefore, structurally, speaker skills of evaluation may be superior to listener skill of evaluation. Training in the most advanced of skills relevant to a domain (yet not to complex to be learnt by a subject) has been suggested as promoting greatest transfer. Evaluative, meta-communicative skills speaker skills were therefore trained.

Recommendations for future research:

We set out with a goal of detailing our subjects' communicative skills. Given that some descriptive data existed for the use of communicative skills in work settings by people with learning difficulty, we concentrated on collecting experimental data. A greater analysis of persons' use of language at work, in education etc would be valuable, for example, subjects' dominance/submissiveness with other clients, co-workers, and specialist co-workers; use of use of non-verbal communication that could indicate confusability when given inadequate information, and as requests for more information; verbal demands for more information, and types of information requested; verbal messages and monitoring of the effectiveness of messages. Such information would provide a more thorough basis for assessing the effect of authoritativeness on their communicative interactions, and provide a link between verbal behaviours that they may not have to their existing non-verbal reactions to communicative success or failure. Most importantly, a wider analysis of their use of communication skills would detail each individual's wider competence in activities which are most meaningful to them.

In the communication tests themselves the present research was constrained by the unavailability of other persons than the experimenter to act as communicators. The experimenter had to interact as a speaker and listener on all occasions.

The Perspective Monitoring test (which relied on a televisual interaction with a "listener") could have been difficult for some subjects to comprehend. We had attempted to assess their ability in accepting, or imagining, a televisual interaction as a "real" interaction by the Perspective Taking test, with positive results. However a more realistic interaction with a stooge would have provided a less cognitively taxing context.

The Referential Communication test required the experimenter to place stimulus materials before the subject for them to communicate to the experimenter which of a number of referents was the target. If there was a stooge listener, then the experimenter could have made absolutely sure that the subject knew which referent was a target by pointing it out -- as in the selective comparison test. As it was on the first few trials the subjects were asked to look for the referent with the line beneath. Another problem was that some subjects may have suspected the experimenter of knowing which referent was the target. There was an attempt to control for this by the experimenter pleading ignorance and showing how the cards came from face down. A stooge would not seem as suspicious.

On the message adequacy tests we attempted to control for the speaker's perceived authoritativeness by having a second section to the test in which the speaker's fallibility was emphasised. It would validate our findings if their performance levels remained the same on these tests as on tests in which they interacted with other persons who they might not view as authoritative according to dominant/submissive measures.

In general the availability of a stooge (and/or the inclusion of other people from their occupational situations) would have provided a greater opportunity for the experimenter to assess the subjects' communicative skills more accurately, particularly as regards the subjects perception of the communicant. The inclusion of others would also have provided a context wherein it would be more possible to give help to the subjects as they had received on the dynamic assessment tests, so as to measure their potential for such skills.

The global tests of communication were supposed to represent more naturalistic environments for communicative skill. Naturality was somewhat constrained by the need to have procedures that were constant over persons and tasks that were easily and consistently scored. As such they might not have been as naturalistic as they could have been. Further situations that could be used as vehicles for this kind of research may include using telephones, or asking clients to direct people about their work centre etc.

As the global tests we chose were similar to those in the communication components tests (in terms of being interchanges between the experimenter and an individual subject requiring perspective monitoring and selective comparisons) the same general criticisms would be true, that the use of a stooge, or of other persons from the work settings, would have increased the accuracy and the generalisability of the results.

Summary - Assessment of communication skills:

Speaker component tests:

On a Selective Comparison test our subjects showed the development of comparison skills when prompted. They failed to use such skill on Perspective Monitoring and Referential Communication tests. This indicated a lack of metacognitive knowledge of the need to use such comparative skills. Our subjects may therefore have learnt the skill of selective comparison in isolation, but they had not, as yet, spontaneously transfered such skills "vertically" into a more complex test arena.

Listener component tests:

Given ambiguous messages our subjects had a tendency for selecting a referent rather than requesting for more information. Even when people [illegible] have learnt the skill of requesting information (when given ambiguous messages) they may fail to utilise such skills and make strategic choices when the speaker is a person that they see as having authority. However in our study, when the speaker's authority was diminished our subjects still generally failed to request more information.

Speaker Global tests:

It was suggested on the global tests of speaker ability that our subjects were failing to make comparisons other than by name. They did not seem to appreciate that to communicate requires the description of differences. Even when given help the subjects still performed at a low level. Their performance when helped could therefore be taken as a consistent indication of their difficulties in the speaker role when they have to communicate the identity of one of two nominally similar referents.

Listener Global tests: (over)

Our subjects were failing to know to evaluate the speaker's role to check if he was making comparisons. They were therefore not demonstrating the meta-cognitive knowledge of communication required for knowing to ask for comparisons. They were able, however, to ask for comparisons when prompted by the experimenter - that is when the experimenter took on a metacognitive role.

SECTION TWO : Training and transfer of communication skills

Introduction:

Our prime goal in this research was to train communication skills for transfer across communication settings. The skills we taught were therefore those for monitoring the progress of communicative interactions - to know to check if the listener knew what the speaker themselves did, and the skills for dealing with communicative failure, such as for dis-ambiguating messages.

Subjects were taught these skills either by Self-instructional training (SIT) or Metacognitive training (MT). The general goal of SIT was to access what individuals say to themselves to affect behaviour, to allow an individual some control over the antecedents of behaviour through verbally mediated self-commands (Gow & Ward, 1985). For this SIT combined verbal and behavioural modelling of the desired behaviours by a trainer for a learner to copy. MT, mainly developed from Campione and Brown's Reciprocal Teaching (RT) (1987), combined metacognitive strategies such as questioning, predicting, summarizing and clarifying with internalising processes such as modelling and guided practice. As in RT these strategies provided a framework for organising and orchestrating task appropriate behaviour, and when used by the trainer they provided an example of expert performance for the trainee to imitate. The dialogue nature of the training also facilitated the learner's engagement in problem solving.

After training in the speaker role (with maps) had ceased the effects of training were measured in changes from baseline performance levels on further, structurally related, tasks. These were in both communication roles. After the subjects were tested on these tasks we attempted to profile successful learners and transferees in each training condition through correlating performance changes from baseline performance to performance at baseline on a variety of psychometric tests. We had hoped to show which personal characteristics made some people more able to profit from each type of training, and to monitor which cognitive and/or linguistic skills each program accessed.

Training effects (over)

Transfer distance can be gauged by the novelty of environments, as compared to the original, that produces the originally learnt response. The more novel the environment, the further transfer is. Transfer tests were therefore designed to measure if subjects who had learnt to communicate more effectively in the speaker role (with maps) transferred their new skills to situations that differed in various ways from those tasks they were trained on.

Training had concentrated on the speaker skills of monitoring for, and providing, comparative information for a listener. These skills were taught explicitly with maps containing general outdoors objects, animals and abstract shapes. The positive effects of training could have included one or more of the following -

1. Increases in speaker role test scores on maps similar to those both tested on in baseline and then trained on (maps with "outdoors" referents), signifying learning.
2. A concurrent increase in performance on a speaker maps not shown in either baseline nor training (maps with "supermarket" icons), signifying near transfer of learning to tasks similar to those trained on.
3. Increases in performance levels in tasks where the subject has to instruct the experimenter to assemble an object, which would indicate the far transfer of learning to different speaker role tasks.
4. Increases in performance levels in the listener role indicating far transfer of skills across communication roles.

Tests for these effects were administered twice, once the day after training had ceased, and then two weeks later. The tests at two weeks after training allowed a measure of the maintenance of training. Negative transfer, signalled by decreases in baseline performance levels, on certain tasks after training was also a possibility.

It should be noted that problems in training for transfer are immense in this area. Since people with learning difficulty are characterised by a lack of transfer (Campione, Brown & Ferrara, 1982; Whitman, 1990), even teaching skills for monitoring their problem solving for knowing when to ask and give information may fail because they might not transfer those skills beyond learning environments. *That is they might not transfer their transfer supports.*

In the speaker role with nominally distinct referents (that is referents that did not need to be selectively compared by more than name) there was no significant improvement for any group, in fact there was negative transfer for the Control group - which maintained two weeks after the end of training.

That there was no significant improvement for either training group is hardly surprising because their performance on such tasks was relatively high before training (with group means over 60%) and therefore learning how to differentiate nominally similar referents should not drastically effect their success at using their pre-existing skills for differentiating between nominally distinct referents. That the control group suffered negative transfer was, however, unexpected. It may be that even if the training groups did not benefit from learning new skills for this type of task, they were more strongly reinforced to continue to use their skills by their increasing success in other areas.

There were, however, positive effects of training in the speaker role when selective comparisons and perspective monitoring checks were needed. In both Metacognitive and Self Instructional groups there were, first, an increase in speaker role scores on the outdoors maps with nominally similar referents (from 22% to 55% in the MT group and from 13% to 28% in the SIT group), signifying learning, which was maintained two weeks later (at 49% in the MT group and at 28% in the SIT group). Secondly, there were also high scores on speaker maps with nominally similar referents not shown in neither baseline or training (the "super-market" map), signifying near transfer of learning to tasks similar to those trained on (with an average score of 47% for the MT group and 29% for the SIT group). Maintenance at the second week of post-training tests was only shown by the self-instructional group on this task (at 24%).

Increases in performance scores indicate that *both the Self-instruction and Metacognitive groups had therefore learnt the task appropriate skills of selective comparison and perspective monitoring. They could use these skills independently without the support of the instructor. They could also remember to use these skills two weeks later on the same task. Furthermore they could, with some insight, independently transfer such skills into a task not seen before, the "super-market" map,* a task "near" to the specifications of the training tasks. The self-instructionally trained group's higher performance remained consistent at the second week of transfer-testing on the "super-market" maps.

Since both explicitly trained groups had learnt speaker skills of monitoring and selective comparison on a variety of map tasks, and transfered those skills to other map tasks, some transfer effects were therefore expected to "further" speaker tasks, those in which one person instructed another to assemble objects.

The Metacognitive group, alone of the three groups, significantly increased their performance, from baseline, on the basic form of the task in which subjects had to instruct another to assemble an object (from 4% to 17%). Increased performance maintained two weeks later (at 20%). They had therefore learnt to apply the skills gleaned from training with two dimensional maps to tasks with three dimensional objects. We take this to be far transfer because, by its three dimensionality, it is a more complex task than the map-based tasks and therefore may require greater levels of skill. This added dimension also explains why subjects failed to show improvements on the complex version of the object assembly task, since such a task involved ever more complex skills, and a more complex configuring of existing skills.

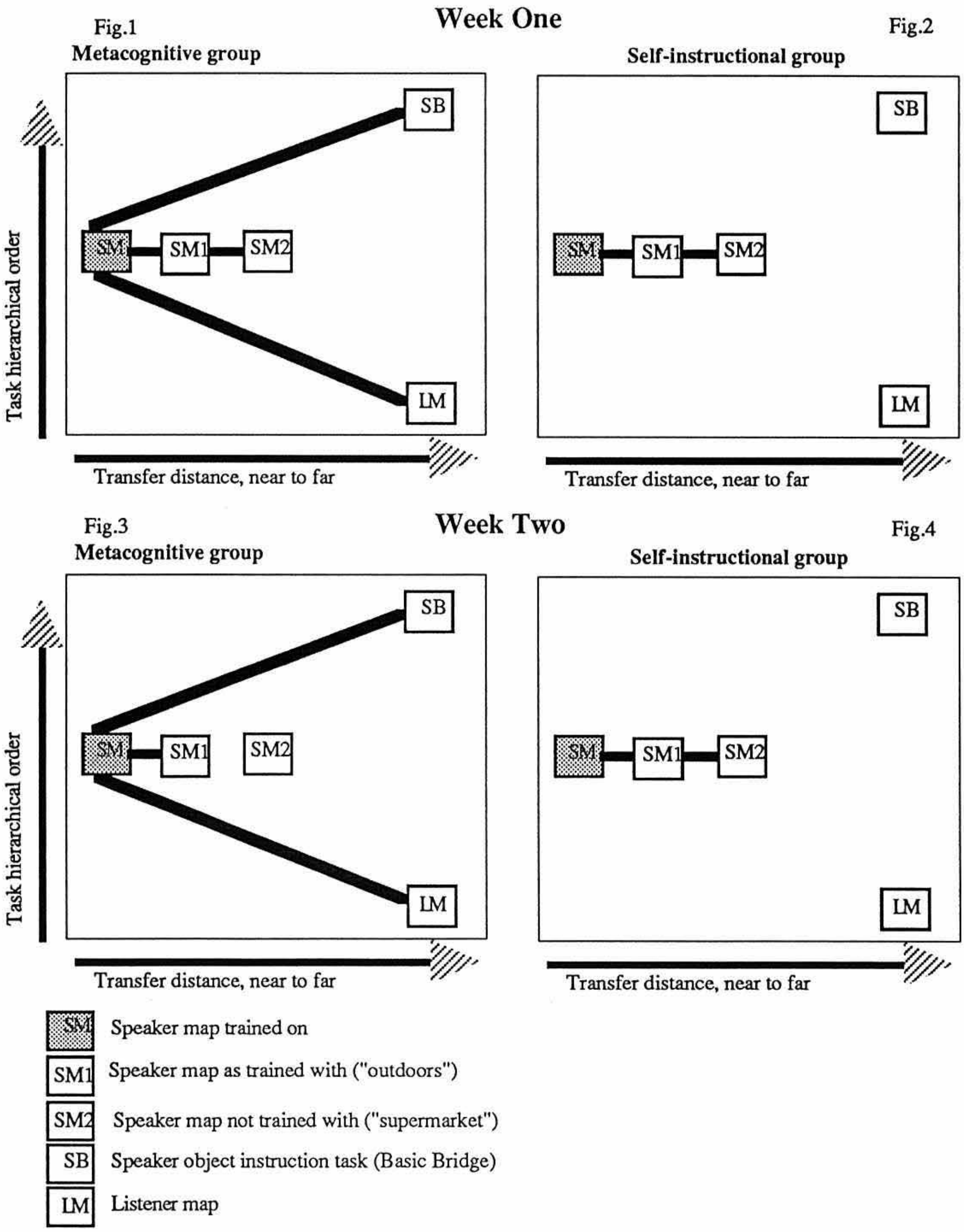
We have discussed above how listener skills for evaluating the speaker's message is a hierarchically inferior skill to that of a speaker assessing her/his own message from the listener's perspective. We therefore expected some transfer to occur from the speaker role to that of the listener. This would also be far transfer since the topography of the task would be changed. That is, being a listener at a surface level might seem to be the opposing ability to that of being a speaker, that of being a physical rather than verbal respondant as opposed to being a verbal stimulant. Many subjects seemed to be working according to such a hypothesis since they tended to behave passively as listeners. In fact an effective listener is active verbally. She/he may respond to the speaker so as to, for example, demand more information.

It should be noted, however, that even though the self-instructional and metacognitively trained subjects were not explicitly taught to be listeners, they were allowed glimpses of an effective listener in their training through the instructor prompting their use of monitoring and selective comparison skills he was in the listener role.

In the Listener role with nominally distinct referents there was no significant effect of training. This was expected since before training they were consistently scoring over 65%. Again, communicative ability when there were nominally distinct referents (and therefore there are referents that do not need to be more precisely compared), could hardly be expected to be affected by the training of monitoring skills for requesting comparisons of more than name. In baseline on maps with nominally similar referents (those that needed comparison of more than name) our subjects performed at a much lower level (at around 30%), indicating a lack of message appraisal and disambiguity skill. Of the three groups trained *only the Metacognitive group had significantly greater performance scores after training* (from 28% to 48%), which maintained two weeks later (at 42%). *The metacognitive group, who had learnt to ask for themselves to check if a listener had understood a message, and to also ask themselves to make comparisons for a listener, had therefore independently manipulated and applied speaker skills for the listener role.* That is they modified trained strategies for becoming active listener's with greater control over their informational needs.

The major training effects, that of positive transfer across tasks and roles that required selective comparisons and message monitoring, have been summarised in figures 1-4 below. The figures were constructed to illustrate the routes and distances of the transfer of learning from the training tasks. We have represented task complexity on the vertical axis, thus transfer up or down would be between hierarchically inferior and superior tasks. Transfer distance is represented on the horizontal axis. The existance of transfer is signalled by a line from the training task to the appropriate transfer task.

Figures 1-4: The routes and distances of positive transfer for Metacognitively and Self-instructionally trained subjects. Figures one and two illustrate the extent of the transfer of learning in the speaker role with maps of nominally similar referents to other speaker maps and listener map tasks with nominally similar referents, and to the basic form of a task wherein a speaker instructs a listener to assemble objects. Figures three and four illustrate the maintenance of these effects at two weeks later.



As can be seen in the figures above, transfer of training occured both for subjects trained to self-instruct and for being metacognitive. The transfer of self-instructional training was mostly confined to tasks similar to those trained on (those horizontally arrayed and which were at the same complexity level as those trained on) which signifies near transfer. Such transfer of skill maintained at two weeks. The transfer of MT was, however, measurable in appreciated performance in both the near transfer and most of the far transfer tasks (tasks both horizontally and vertically arrayed).

The communication skill that we hypothesised that could transfer, evaluative and comparative skill in the speaker role, therefore transfered along many routes and to various distances, depending on it s carrier. The SIT vehicle carried transfer "near" distances, but consistently over time. The metacognitive vehicle carried less consistently over near distances, but to greater distances.

Individual differences and the effects of training:

Since there were significant differences between the baseline scores and post training scores of individuals within both Metacognitive and Self-instructional groups we attempted to focus on the individual characteristics that characterise subjects who were most enabled by each training program.

For this we measured the degree of difference between pre- and post- training scores on all the global communication tests that required monitoring and comparison skills, and then correlated the amount of increase in performance against baseline performances on all baseline measures (linguistic, cognitive and communicative). These effects may also be present two weeks later, and such maintenance effects were also analysed for correlations to baseline measures.

Learning was, of course, the degree of difference between scores on the "Outdoors" map with nominally similar referents in baseline and then after training. Near transfer was measured by the difference between performance on, again, the "Outdoors" map with nominally similar referents in baseline, and performance on the "Supermarket" map with nominally similar referents. There were three Far Transfer measures. First within the speaker role to more complex tasks measured in increases in ability to instruct a listener to construct replicas of bridges (of which there were two tasks) and then across roles, which was measured as the amount of change in the listener role.

The subjects in the Metacognitive group did not show correlations from performance on Psychometric tests to learning. However they did show correlations between learning and performance on a number of communication based tests, such as duplicating a complex bridge (more a test of abstract reasoning than communication), being a listener with nominally distinct referents when guided, and making strategic choices on the message adequacy tests. Their near transfer of learning significantly correlated with the ability to reason abstractly, such as for replicating objects and for relating patterns (Object Assembly and Ravens). "Near transfer" was also significantly related to the making selective comparisons (on the selective comparison test and on the referential communication test), and was strongly related to being a listener with nominally similar referents.

The Metacognitive group's far transfer of skill across task types (from being speakers with maps to being speakers with a basic model of a bridge) was also strongly related to cognitive representation and abstraction tests (short term memory, Object Assembly and Ravens), and to knowledge of the need to ask for selective comparisons in the listener role with maps.

The Metacognitive group's performance at the second week of tests at the maintenance of learning and of near transfer did not produce many correlations. There were, however, a number of significant correlates to the maintenance of far transfer. Maintenance of transfer to the listener role correlated with performance on the basic object assembly task and on the TROG. Maintenance of transfer to the basic object instruction task correlated with receptive and expressive language abilities (as measured on TROG, Reynells Comprehension, and Reynells Expression tests) and to map ability with nominally similar referents.

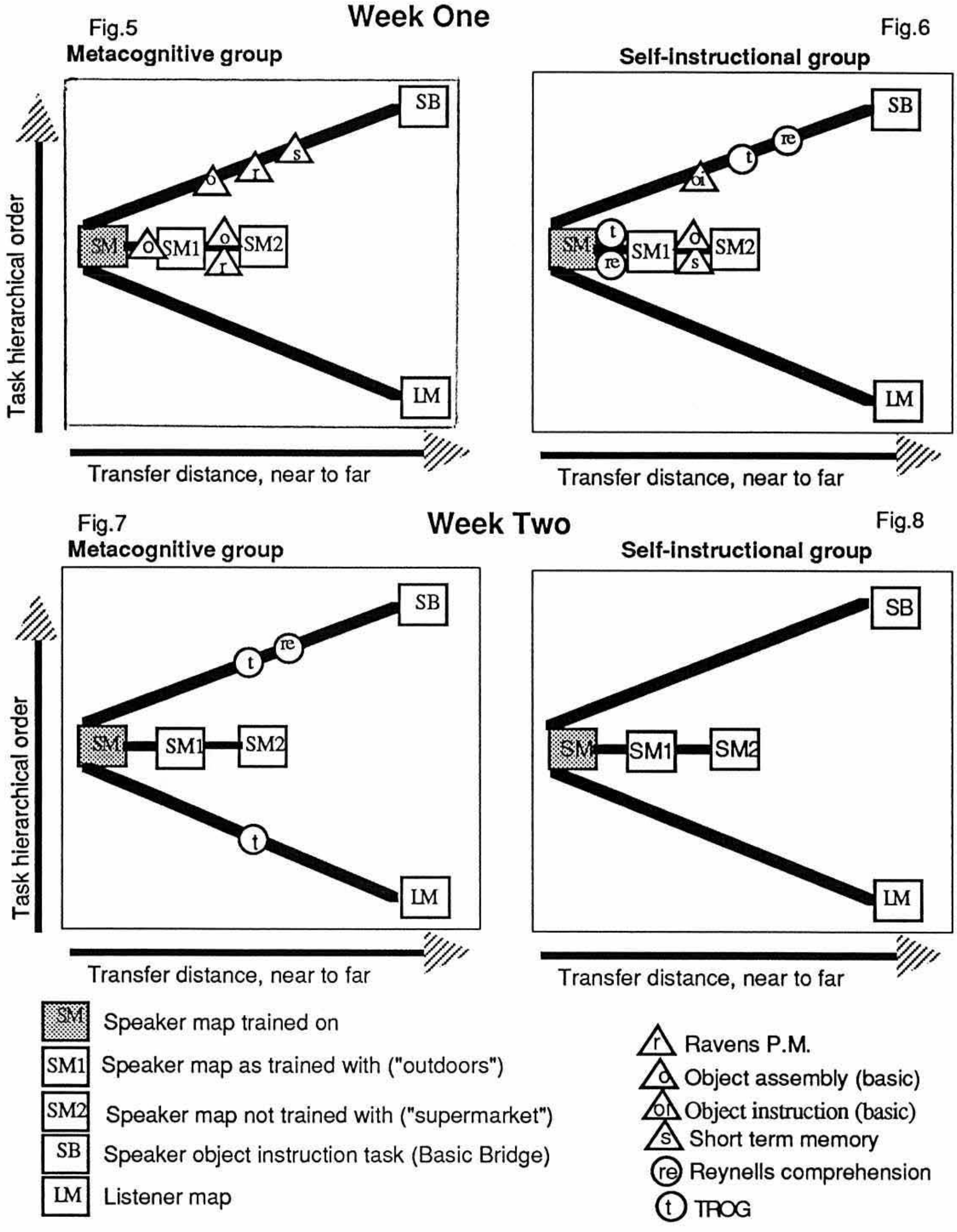
In the Self Instructional condition learning was most strongly related to ability on language comprehension tests (TROG and Reynells Language comprehension tests). Of the communication tests the main correlates to learning were Listener ability with nominally similar referents and being a speaker when guided with both nominally distinct and similar referents. The only component test to show a significant correlation was selective comparison. Their near transfer of learning was also strongly related to language comprehension measures (TROG and Reynells Language comprehension tests). There was also a lesser, but significant relationship between near transfer and cognitive representation (Object assembly and short term memory capacity) and to ability to request comparisons as listeners on maps.

Although the SIT group did not generally improve on the Basic Bridge Assembly task, those who did show some improvement had also demonstrated the same ability at the same activity in baseline with a complex task, and also to language comprehension measures (TROG and Reynells Language tests), short term memory and selective comparison.

Our major aim in such detailing of individual differences was to extract what kinds of cognitive and linguistic abilities were linked to individual success on each training program. We will therefore briefly summarise those here. Learning was linked to object assembly skill for the metacognitive group, whilst it was linked to language comprehension skills (TROG and Reynells Comprehension scores) for self-instructed subjects. Near transfer was related to ability on object assembly and abstract reasoning tests for the metacognitive group, and to language comprehension, object assembly ability and short term memory capacity for the Self-instructed group. Far transfer, from map to bridge based speaker tasks, was related to short term memory capacity, abstract reasoning and object assembly abilities for the metacognitive group, and to language comprehension skills and ability to instruct a listener to construct a complex objects for the self-instructed subjects. Far transfer, from speaker tasks to listener tasks, did not show significant correlations. The maintenance of far transfer effects in the metacognitive group was related to language comprehension performance -- these were the basic bridge task to both TROG and Reynells scores, and the listener task to TROG scores. It should be noted that we have not shown that there are significant differences between each groups' correlations on a particular ability, only that performance in one condition is significantly correlated to such an ability when the other is not.

The major correlational relationship between learning and transfer performance and psychometric test abilities are shown below in figures 5-8. These figures were constructed to illustrate the abilities that correlated with the routes and distances of the transfer of learning from the training tasks. Again task complexity is on the vertical axis and transfer distance is represented on the horizontal axis. All possible transfer routes are shown in the figures below so as take account of individuals in each condition who showed proficiency at transfer tasks even if their peers did not. Note that the "far transfer" illustrated below for the SIT subjects did not occur for the group as a whole.

Figures 5-8: Correlations mapped onto the routes and distances of transfer of subjects explicitly trained. Circular icons represent cognitive tests and triangular icons represent linguistic tests. A transfer route with an icon attached was significantly correlated with performance on the test refered.



As can be seen above in figure 5 the transfer performance of metacognitively trained subjects was substantially linked to their ability to represent and manipulate information abstractly. However (shown in figure 7) their maintenance of far transfer was linked linguistic ability. In figure 6 it can be seen that the transfer of learning of the self-instructed subjects was significantly linked to ability on language measures, and also somewhat with cognitive measures. However the only standardised cognitive measure to correlate with the self-instructed subjects transfer behaviour was short term memory, a test of a persons ability to repeat a string of digits. These correlational variances between Metacognitively trained and Self-instructed subjects indicate that each type of training might have accessed different skills. Skills which many of these group matched subjects possessed. *MT seems to access, for learning and immediate transfer situations, a persons abstract reasoning processes. For the same task demands self-instruction seems to access peoples language comprehension and short term memory storage, and replication, processes. For the maintenance of these effects MT accessed language comprehension abilities.*

It is therefore indicated that the impact of each type of training has on a person's memory might be different. The *MT might be impacting on a person's capacity to represent and manipulate information in an abstract fashion whilst SIT accesses a person's potential for sheer repetition.*

Since performance, in general, on the tasks that we trained were highly correlated to both verbal and abstract reasoning abilities it could be suggested that the presence of measurable abstract reasoning skills indicate a person could benefit from MT and language comprehension from Self-instruction. Most benefit, however, would be provided by accessing both types of abilities, and Metacognitive training, in showing correlations between transfer and cognitive skill, and between the maintenance of far transfer and linguistic skill, seems to be the most effective training device.

Training of Communication skills: Summary of Hypotheses and findings

The skills we attempted to teach were those for monitoring the progress of communicative interactions (to know to check if the listener knew what the speaker themselves did) and the skills for dealing with communicative failure (by dis-ambiguating messages). The transfer of these skills was catered for by utilising two training devices that accessed people's self-regulatory mechanisms, Self-instruction and Metacognition.

We hypothesised that either (i) both training approaches would lead to significant increases in performance on tasks trained on (learning), or that (ii), one training form would have resulted in more substantial learning than the other, or (iii), that neither training device would have led to significant improvements.

We found that both the self-instructionally and metacognitively trained groups had significant increases in performance (against baseline) on the speaker role maps. They had therefore learnt the skills for monitoring communication and for disambiguating messages in the speaker role. They could use these skills independently up to two weeks later on the same task.

We then hypothesised that either (i) both training forms would have led to significant increases in performance on tasks not trained on (transfer), or that (ii), one training form would have resulted in a greater distance of transfer than the other, or (iii), that neither training device would have led to significant transfer effects.

It was found that both groups transfered their new skills to tasks similar ("near") to those trained on, the "super-market" map. However only the subjects in the Metacognitive group had significant increases in performance on tasks that were more distinct from the training task (the far-transfer tasks). The MT group had significant gains at instructing another person to assemble an object (which maintained two weeks later), and they had significant gains in their listener role performances (which also maintained two weeks later). They had therefore applied skills gleaned from training with two dimensional maps to tasks with three dimensional objects. They had therefore learnt skills of asking for themselves to check if a listener had understood a message, and for asking themselves to make comparisons for a listener, and they had then manipulated these skills for knowing to ask for more information in the listener role. They had therefore modified trained strategies for becoming more effective communicators over a broad range of tasks. They had therefore modified trained strategies for becoming active listener's with a gain in control over their own informational needs.

In sum the transfer of self-instructional training was mostly confined to tasks similar to those trained on -- horizontally arrayed near transfer tasks. The transfer of MT occured to both horizontally and vertically arrayed near and far transfer tasks.

It was further hypothesised that certain individual characteristics might have made some subjects more pre-disposed to benefit from training than others. Correlational analyses indicated that those who had shown abstract reasoning skill were facilitated to learn and transfer by MT whilst those who had shown language comprehension and short term memory (storage and replication) abilities gained from Self-instruction. However the maintenance of the Metacognitively learnt skills correlated with language skills.

Recommendations for future research

There were three main groups of methodological aspects which may limit the generality of our results and thus need further research, (i) those involving the interaction between the subjects and training tasks, (ii) between the tasks and training and (iii) between the general training environment and the training devices.

(i) The tasks we chose to test and train were limited to three main types, those with maps (for speaker and listener skill) and those with object assembly tasks. We attempted to ensure that these tasks represented the skills that people with learning difficulties generally fail to demonstrate in their work or recreational environments. However we did not measure nor monitor their communicative skills outside experimental situations (other than most generally), it may therefore be that these tasks (for some people) may have been too distant from their everyday experience to elicit their kinetic skill. Future research should attempt to give a fuller account of subjects' communication skills in a wide range of situations, for detailing more precisely what skills they have and what situations bring out those skills. It may then be possible to measure changes, after training, in those environments.

(ii) It could be argued that the training tasks, being conversational, involved a high degree of language use and therefore the generality of our results would be limited to such language based tasks. The training tasks had a major linguistic component (with a strong correlation between communication abilities and TROG). Moreover positive training outcomes were related to language skills for both Metacognitively and Self-instructionally trained subjects. Some of the training effect must therefore have occured from linguistic commonality between training form and task rather than more exclusively from the contents of training. However it was also the case that abstract reasoning skills correlated with communicative ability at baseline, and the transfer outcomes of MT were related to abstract reasoning skills. It does not therefore seem that the linguistic commonality of training tasks and devices invalidates the generalisation that MT could be beneficial for less verbal and more abstract tasks. Conversely SIT might, therefore, be more limited. We thus suggest that MT might be a valuable training device for a wide range of tasks, which further work might demonstrate.

(iii) Both Self-instruction and Metacognition were 'rich' in the variety of means they employed in training. Both involved verbal and behavioural modelling, feedback, reinforcement and prompts etc. That training led to positive outcomes reflects the fact that people with learning difficulty can make use of complex cognitive training. However since we were concerned with the legitimacy of cognitive training at the broadest level it was not possible to attempt a dismantling of methodologies for delineating which training factors had most effect. It would be advantageous for future practitioners to know which factors were most responsible for gains so as to allow them to concentrate on such factors. For example, although we do not believe that time factors accounted for the different effects of training (for the variance between groups was not substantial since both training regimes required between 20 and 30 minutes per session) it would be beneficial for future trainers to know which aspects of each approach could be dispensed with for decreasing the time needed for training. Such as in the case of MT it is not clear whether the most influential factor in enabling subjects' to engage their communication skills in far- transfer situations were the on- task predictions for future use, or the post-trial predictions.

Dismantling studies might explicate which factors of each training approach were most effective for learning and transfer. Such studies could inform the design of future interventions which might include aspects of either approach.

More generally, we were not able to employ a stooge for communicative exchanges. Therefore because the experimenter was required to prompt the subjects speaker skill from the listener role the subjects were allowed to experience a model of expert 'listening'. Both explicitly trained groups thus experienced a listener asking for message clarifications. With a stooge acting in the listener role the effects of having an 'expert' listener would be minimised and would thus clarify how the metacognitively trained subjects modified their speaker skills to fit the listener role.

The inclusion of a stooge could have provided a means for testing for further transfer. For example the training stooge might be replaced by another stooge, or by the experimenter, at the end of training to check if our subjects used their new skills with different people. It would have been desirable to test for the new skills in our subjects interactions with other clients and co-workers. Permutations of these communicative dyads might be a valuable addition of future research. Future research might also extend training to include situations further from the experimental context, to employment and recreational environments. Such work could be guided by the procedures developed in this thesis.

Summary - training effects:

Learning: Increases in speaker role test scores on maps similar to those both tested on in baseline and then trained on.

Self-instructional and Metacognitive groups learnt the task appropriate skills of selective comparison and perspective monitoring. They could use these skills independently without the support of the instructor. They could also remember to use these skills two weeks later on the same task.

Near transfer: An increase in performance on a speaker maps not shown in either baseline nor training (maps with "supermarket" icons).

Both Self-instructed and Metacognitively trained subjects were able, with some insight, to independently transfer learnt skills into a task not seen before, the "super-market" map.

Far transfer I/II: Increases in performance levels in tasks where the subject has to instruct the experimenter to assemble an object.

The Metacognitive group, alone of the three groups, significantly increased their performance, from baseline, on the basic form of the task in which subjects had to instruct another to assemble an object. None of the groups showed significant improvements on the complex version of the object assembly task.

Far transfer III: Increases in performance levels in the listener role indicating far transfer of skills across communication roles.

The subjects in the Metacognitive group had significantly greater performance scores after training as speakers in their listener role scores. They had learnt to ask for themselves to check if a listener had understood a message, and to also ask themselves to make comparisons for a listener. They had modified trained strategies for becoming active listeners with greater control over their informational needs.

Skills and tasks:

The communication skill that we hypothesised that could transfer, evaluative and comparative skill in the speaker role, therefore transfered along many routes and to various distances. The SIT vehicle carried transfer "near" distances, but consistently over time. The metacognitive vehicle carried less consistently over near distances, but to greater distances.

Correlations:

MT seems to access, for learning and immediate transfer situations, a person's abstract reasoning processes. For the same task demands self-instruction seems to access peoples language comprehension and short term memory storage, and replication, processes. For the maintenance of these effects MT accessed language comprehension abilities. MT might be impacting on a person's capacity to represent and manipulate information in an abstract fashion whilst SIT accesses a person's potential for sheer repetition.

SECTION THREE : General Discussion

Introduction:

The present thesis had the principal aim of establishing methods of training skills that have benefits for the adjustment of persons with learning difficulty to new environments.

Vygotsky suggested that as societies deprived children with learning difficulties communicative experiences so they deprived them skills to develop cognitively (see Gindis, 1988). For example inadequate socialisation deny their very development of skills for independence (Shapiro, 1981), and thus they are made dependent on external control (Whitman, 1990).

The lack of social experiences in childhood, in and of themselves, and in their delay of cognitive development, contributes to dis-advantagement in the adult lives of people with learning difficulties. For example, they have a general un-readiness to communicate in work situations, such as for being able to follow instructions, or for clarifying ambiguous instructions or to request information for performing a task (Lignugaris/Kraft, Salzberg, Stowitschek & McConaughy, 1986; Lignugaris/Kraft, Salzberg, Rule & Stowitschek, 1988). Secondly they found as lacking cognitive abilities for transfering skills that they have learnt in one situation to other situations (Campione, Brown and Ferrara, 1982; Whitman, 1990). Both factors decrease their probability of adjusting to new, normalised situations. For example these skills have been identified as principal factors in an individual's employability. They are also somewhat interdependent, such as if a person monitors and communicates the progress of a problem solving attempt then they could recruit help from others when required. If they do not then they may give up, or if they continue, it could be futile. Communication skills are therefore not only useful in themselves for solving certain classes of problems, more widely they are skills that may elicit support and guidance in further situations. That is they are transfer supports.

Lack of transfer by persons with learning difficulty has been related to their apparent inability to regulate their own cognition (Whitman, 1990). Training that accessed and/or promoted such processes were seen as having the greatest potential for leading to transfer. Vygotsky's social developmental theory of self-regulation has increasingly become a source of ideas for designing cognitive intervention programs. According to this theory people require communicative experiences to learn to control their own behaviour as others controlled them. Training attempts based on social developmental theories therefore attempt to provide an enriched social interaction for aiding clients to learn skills for cognitive regulation. We attempted to train, for transfer, communication skills by two approaches descended from Vygotskian theory.

One intervention, Self-instructional training (SIT), involved the modelling and guided rehearsal of a set of self-commands for a particular group of tasks. A second, Metacognitive training (MT), was developed from Vygotsky's criticism of traditional education, that it exacerbated the "handicap" of people with learning difficulty by not teaching them abstract reasoning (reflective) skills. MT dispensed with verbal rehearsal and provided naturalistic conversations structured around metacognitive strategies of questioning, summarising and predicting performance.

To guide training in communication skills a framework was required for representing skills so as to explicate which were common to a range of tasks. In doing so we hoped to conceptualise how training and transfer tasks could be related for a broad sweep of transfer effects, moreover we could provide our learners with a model of task skills (a schema) that should transfer across distinct but relateable tasks.

From our reading we predicted that communication skills such as basic perspective taking (knowing that people at different locations have a different perspective to one and other) and selective comparison (the ability to draw comparisons, in terms of size, colour shape etc between objects to distinguish one from the other) might well exist in the cognitive repertoire of most people with learning difficulty, but many might not have well developed notions of the need for organising and orchestrating these skills in a communication settings, as listeners or speakers. For example in a situation where one person needs to communicate to another the identity of an object (a grey house from a white house) person with learning difficulty might not, as speakers, describe differences between the objects (not saying "grey house" but only saying "house"), or as listeners they might not ask for comparisons from the speaker, and guess which house was meant. Furthermore the response for utilising such skills as selective comparisons in the listener role might be more developed than in the speaker role since in the former a response to request comparisons is made in the context of an immediate, informational need, ("which one?") whilst in the latter such a response requires an insight into the perspective of the listener and the use of an essentially "listener" skill in a different context ("the listener needs to know which one!") - knowing the "need to know" of others involves awareness of the communicative process, meta-communication.

The implication of this schema was that if skills are trained within contexts which were more complex, such as evaluative skills in the speaker role, then the greater would be the transfer that may be had. That is with an increase in metacognitive ("top-down") knowledge in training then transfer may become more broad than if training only concentrated on sub-skills.

Summary of findings:

It was confirmed by our pre- training tests that the meta-communicative knowledge of the need to monitor messages for communicative precision was under-developed by the subjects in this study. They did not, when in a referential communication task, tend to be able to speak so that others would understand or listen so that they knew that they had not understood, nor ask for more information for greater understanding. However they did have a general potential for such skills, particularly in the listener role.

Training in the most advanced of skills relevant to a domain had been suggested as promoting the greatest degree of transfer. Evaluative, meta-communicative speaker skills were therefore trained.

Both the self-instructionally and metacognitively trained groups learnt the skills for monitoring and disambiguating messages and thus had significant increases in performance on speaker role maps. Both groups also transfered their new skills to tasks similar ("near") to those trained on, the "super-market" map (a transfer which the SIT group maintained two weeks later). Only the subjects in the Metacognitive group "far" transfered their new skills to tasks quite distinct from those trained, to object assembly tasks and to listener role tasks (which maintained). They had therefore applied skills gleaned from training for becoming more effective communicators over a broad range of tasks with a gain in control over their own informational needs. Correlational analyses suggested that those who had shown abstract reasoning skill in baseline were facilitated to learn and transfer by MT whilst those who had shown language comprehension and short term memory skills had gained from Self-instruction. However the maintenance of the Metacognitively learnt skills correlated with language skills.

Theoretical considerations of the present research:

Earlier we made the distinction between Self-instruction and Metacognition that the former was to control one's own behaviour by talking to oneself, and the latter was the "knowing" that one was doing such. This distinction is crucial to our understanding of why there was such different effects from each method. To explain why this is a 'true' distinction, and why it may explain our results, we need to re-consider the contents and methods of each approach.

Speech containing strategic information was the principal 'content' of training. In SIT strategies for communication were held in general and specific instructions. This was because it seemed that the more specific instructions were, then the more readily they would be learnt, but the more general they were, the more generalisable they may be. It was therefore thought that the general instructions (such as "what do I do first?") might enable a person to ask such an abstract question in further situations, and then find their own answers to solve problems. For example to overcome informational ambiguity in either speaker or listener role a person might use the general rule ("What do I do?") to elicit the specific instruction ("If there's two, which one?"). The self-instructionally trained subjects failed such transfer. They did not modify and apply a task appropriate statement of the speaker role to the listener role. The question was therefore why did such abstract statements trained by self-instruction fail to aid the subjects to far-transfer?

The answer we believe is that in SIT the general ('abstract') instructions were taught by a method that cemented them to a certain kinds of situations. Both the general and specific instructions were held in a monologue form, and were taught by verbal rehearsal. Learning such a "list" of instructions by rehearsal makes relatively simple cognitive demands on a learner - the learner only needs to engage in memorial processes to reproduce the self-instructions; it does not require the learner to draw on or integrate existing knowledge (Schleser, Cohen, Meyers & Rodick, 1984). That is, by its very procedures SIT cements abstract concepts to concrete "say and do" actions, thus the 'abstract reasoning' skills which might have directed thinking are relegated to serve only as prompts for further self-instructions.

Not only were the self-commands in SIT taught in an inappropriate manner for far-transfer, but the control over the potential use of self-instructions was not made explicit, or personal, to the learner. For example at the end of the training sessions the subjects were didactically told to use the instructions they had learnt "again tomorrow" etc. They were not made involved in the decisions of whether such self-instruction's were usable, beneficial, or generalisable - they were only told so.

As Schleser et al. (1984) maintain transfer of training requires the use of self-generated search routines in which a learner actively scan and adapt their strategic repertoire to meet the demands of a variety of tasks. The process of the creation of instructions, and of their necessity for guidance, may not have become evident to the learner in SIT. That is it may be that the subjects learnt both the instructions and the behaviours without a development of an awareness of the significance of the creation of self-commands, only of their use. Therefore *SIT's procedures did not allow these seemingly abstract statements to become abstract for guiding problem solving, they remained one element of a set of things to say to oneself in a given a situation. Our subjects could thus follow a set of instructions as given by the instructor, and then internalise those instructions, but they might not be able to generalise the instructions since they are not aware of the process of their generation.*

In summary therefore, even though the professed goal of SIT was to provide a learner with intrinsic control over processing, in common with established SIT practice, our SIT program did not provide our subjects with enough 'inner' control to effect far transfer. Any far-transfer of Self-instructed skill would not have been a due to elements explicit in training but a spontaneous act by the learner. For the most part, therefore, SIT made the environmental similarities between situations drive behaviour, and not, as it would be hoped, the individual.

It should not be forgotten, however, that SIT did lead to our subjects learning speaker skills which did transfer to tasks both similar to those trained (the "outdoors" maps), and to tasks which had different stimuli material (the "supermarket" maps). Moreover such effects were maintained two weeks after the end of training.

In contrast to SIT's rehearsal of monologues, MT 'held' and transmitted communication skills within a dialogue. The dialogue was structured around metacognitive strategies such as questions, predictions and summaries. These were similar to the general instructions in SIT in that they were general problem solving statements ("What could I do? Ask a question?").

The metacognitively trained subjects were, however, enabled to use general statements to guide problem solving in situations quite distinct from those of training. For example they overcome informational ambiguity by asking of themselves "There's two, which one?" for a listener in un-trained speaker tasks (object assembly), and of others in the listener role.

The main reason for this, we propose, is that the abstract skills were trained in a context that encouraged their real use rather than their rote rehearsal. In MT the problem solving skills were introduced and taught to subjects in a dialogue and not as a menu of verbalisations for rehearsal. That is, rather than only encouraging the in-expert to copy the verbal behaviour of the expert, MT encouraged, through questions, summaries and predictions, learners to call on and apply communicative skills. A valuable feature of MT was therefore that the subjects were guided to find out the answers to problems for themselves. That is they did not have to remember and repeat an instruction to "go with" a behaviour, but to actually be involved in the process of generating self-commands. When they could not provide their own self-commands, suggestions were, however, made.

At the end of sessions they were also made involved in evaluating how they had performed, if they had utilised appropriate strategies, and asked to predict how they might perform in future. They were therefore encouraged to actively scan and adapt their strategic repertoire for training tasks in preparation for further tasks. MT therefore had a greater impact on a learner's reasoning processes than SIT by involving the learner in generating strategies.

The suggestion that SIT and MT had different kinds of impact on memory was given support by correlational analyses. Those who learnt most in the SIT condition were those who demonstrated linguistic and rehearsal abilities, whilst those who learnt most in the MT group showed correlations to abstract reasoning abilities. Given that both groups had been matched for cognitive and linguistic skills, the difference between each groups correlations to learning indicated that those who were in the self-instructional group, and had the same degree of abstract reasoning skill as those in the Metacognitive group, did not benefit in the same way from training as their colleagues. What this suggested to us was that MT might be impacting on a persons capacity to process and abstract the meaning of, and the means for creating, self-guiding commands, whilst SIT relied on a persons repetitive power to remember the self-commands. Both types of training therefore impact on memory, but in different ways.

There were, however, beneficial outcomes to accessing language skills. When we analysed correlations for the maintenance of learning it was shown that the SIT group's near transfer of skill remained more consistent than the MT group's. Moreover the MT group's maintenance of far transfer was correlated with linguistic ability. First it may be that the sheer power of rote learning allows a greater trace of learning to remain with a person than that they come to know through the kinds of reasoning processes engendered by MT. Such a conclusion can only be weakly be made since the Metacognitive group were, even in the second week, out-performing the Self-instructional group on the near-transfer task. The metacognitive group might have learnt more, and had forgotten significantly more than the SIT group, but still had enough knowledge for relatively high performance. The second finding does, however, indicate that language ability has a part to play in remembering over the longer term.

It should be noted, however, that such correlations are not indicative of the necessity for persons to have reasoning and language skills for cognitive training, only that having such skills (the former for MT and the latter for SIT) provide a person with the greatest means for benefiting from training.

In summary the strength of MT for transfer, as compared to SIT, is that it did not rely on a "train and hope" strategy for transfer. SIT required an element of spontaneity in learners to learn and utilise skills, particularly in new situations, since they were not allowed access to the generative processes that lay behind the use of self-instructions. As Borkowski, Carr and Pressley (1987) argued, strategy use is never spontaneous but the result of continuous, long-term developmental processes involving a persons knowledge of strategies and motivational beliefs. They proposed training should to re-create aspects of normal development for those who have not shown such development. MT was developed from Vygotsky's theories of normal development, and of learning difficulty. Central to Vygotsky's theory of learning difficulty is the need for training such persons in reasoning and reflecting skills so as to provide means for learning and transfering and also for mastering self-defeating negative emotions. *MT provided a model of thinking and it scaffolded our subjects' own thinking processes for the task at hand. MT engaged the subjects' in the process of generating self-regulatory speech, which may have led to a* *greater sense of self-control and motivation than which is allowed by SIT. MT therefore provided a means for training people with learning difficulty in the processes of "reflective awareness and deliberate control" (Vygotsky, 1978) which Vygotsky believed to be their least developed and most needed of skills.*

Future directions:

Two major needs called for this research: first, for group comparisons of methods of training that lead to transfer, second, for analyses of individual differences leading to differential outcomes from training. These needs created, and had to overcome, research constraints. In the main these were of experimental control and of scarcity of resources and of time. The present research could therefore only address a segment of our subjects' cognitive and communicative skill - albeit with some success. Future research could therefore be guided by both our findings and our failings.

In general the skills that we chose to study seemed to be crucial for social adaptation - "individuals working together can achieve many things that a person alone cannot do and so specific skills are not always so important as the ability to draw on a social chain of support..[so as]..to maintain a life quality" (Leland, 1983, p. 224). The methodologies for the assessment and amelioration of such skills presented in this thesis may complement existing methods for encouraging the adaptive behaviour of people with learning difficulty for coping with the demands of their communities.

Assessment

Our attempts to measure communicative ability were threefold, static and discrete (componential), static and general (global), and dynamic and global (global with help). The dynamic aspect of assessment was to provide a measure of subjects' potential level of skill given certain situational factors (such as level of help) and thus provide a prediction of future behaviour. This was of particular importance because the most common criticism of traditional tests is that they have relatively little value in helping to predict future behaviour (Morgenstern, 1983). We have suggested above specific directions for testing the communication skills of perspective monitoring and selective comparison (more dynamic assessment on discrete tasks and much more global tasks). It is further envisaged that other skills that a person requires for normalised conversations (for example turn taking, feedback statements and self disclosures) could be assessed by the same techniques (componentially and globally in static and dynamic form). For example their potential for utilising conversational skills in work settings could be gauged against a hierarchy of communication rules. Such a method could describe which skills are least, and most, developed - and most importantly, with whom and when they are expressed.

Such directions are important for detailing the skills of which people with learning difficulty are capable, particularly for employment. Although some data exists (see Morgenstern, 1983) such detail at various levels (from the laboratory to the environment) may further aid the process of anchoring the training of skills to individuals' actual needs. This is paramount when considering therapeutic interventions, since the maintenance and transfer of training is strongest when there is a commonality between what people do, can nearly do and are trained to do, to their behaviour in real life situations which have their own rewards.

One aspect of such assessment is that it may show that people have skills which they do not employ. Training might not need, therefore, to concentrate on learning skills but on the transfering of existing skills between situations.

These directions are guided by the need for ever more means of analyses, not merely for individuals' adaptivity to their environments, but also of how individuals may adapt their own environment, by asking of others for their own needs, for example.

Training

Some aspects of Self-instruction had positive effects for persons who had certain language skills, whilst Metacognitive training had even more benefits for persons with abstract reasoning skill. It would be advantageous for future practitioners to know which factors from each device were most responsible for training gains.

A synthesis of certain aspects of each approaches may yield a more powerful training device. For example it was indicated by correlational analyses that MT accessed abstract reasoning skills for "far" transfer effects, however the maintenance of transfer correlated with language ability. Language ability had also correlated with more consistent maintenance on near transfer tests in the SIT group. It would therefore be suggested that aspects of MT could be utilised for a person to abstract and comprehend task needs and thereafter SIT might consolidate such learning. Future studies for dismantling and synthesising methodologies would therefore be valuable for delineating which factors are of most benefit for most transfer and maintenance effect.

Future studies could also attempt to measure more accurately the social validity of cognitive training over the ecological range of people's lives. Although we agree that laboratory work should not be in a vacuum (Rusch, Schutz & Heal, 1983), we were principally concerned with the efficacy of training methods in general and thus it was beyond us to attempt to train for, or catalogue, changes in subjects' lives outside the experimental situation. This work must therefore be seen as exploratory. Further work could concentrate on bridging between laboratory work and real lives. Even so we belive that methods detailed in this thesis could be valuable for training people with learning difficulty in situations over their ecologies, or at least to encourage learning to transfer across ecologies. For example in the learning of transportation, dietary and currency skills. Moreover it should be remembered that Reciprocal Teaching was principally designed for children to learn skills in groups. MT could also be similarly utilised.

Further work is also required for examining the relationship between training in, and perceptions of, self-control. We had hoped to access our subjects' self-perceptions but our measures were ineffective. We could make stronger claims for Metacognitive training's apparent ability to promote self-control if such control were gauged by standardised measures. Future research to determine the most efficacious methods of gauging the locus of control of persons with learning difficulty would be warranted.

Concluding remarks:

Belmont and Butterfield (1978) suggested that if we were to effect generalisation we have to ask how people with learning difficulty could be trained to invent for themselves programs for new situations. The goal was to make clients capable of making strategies learnt in previous situations meet the demands of new situations, independently (Williams & Ellis, 1991).

The literature indicated that such processes could be taught, but no systematic means existed (Rusch et al., 1983). Since there have been fundamental developmental processes denied to a majority of people with learning difficulty, and that they are capable of developmental progress along normal pathways, developmental theories of self-regulation seemed reasonable blueprints for training attempts. We therefore adapted and applied training procedures developed for children with learning disabilities for teaching adults with learning difficulties communication skills and, moreover, the means for assessing the similarities of conversational situations, trained and un-trained, for they themselves to choose to use their learnt skills.

Both the Self-instructional and Metacognitive groups learnt the task appropriate skills of selective comparison and perspective monitoring. They were also able to transfer these new skills into a new speaker map- task. However only the Metacognitive group significantly increased their performances in instructing another to assemble objects and in requesting information from others as listeners. They had thus become more efficient speakers and more active listener s. We further showed, through correlational analyses, that MT might be impacting on a person's capacity to represent and manipulate information in an abstract fashion whilst SIT accesses a person's potential for sheer repetition.

We must caution against extrapolating "backwards" from our data on individual differences, to assume that since some persons may not show certain skills then cognitive training should be denied to them. It should be taken "forwards" to mean that there are limitations to our imagination, which more research and thought might ameliorate. Most importantly our findings add to the understanding that such persons as have learning difficulty can make use of complex cognitive training. As Binet remarked in the first quarter of this century , "We must react against this brutal pessimism" (Binet, in Brown et al. Personal communication) that denies people by pre-judgement means and opportunity to learn.

References

Abbeduto, L., Davies, B., Solesby, S. and Furman, L. (1991). Identifying the referents of spoken messages: Use of context and clarification requests by children with and without mental retardation. *American Journal on Mental Retardation*, **95**, no 5, 551-562.

Ackerman, B.P. (1981). Performative bias in children's interpretations of ambiguous referential communication. *Child Development*, **52**, 1224-1230.

Agran, M., Salzberg, C.L. and Stowitstchek, J.J. (1987). An analysis of the effects of a social skills training program using self-instructions on the acquisition and generalization of two social behaviors in a work setting. *Journal of the Association for Persons with Severe Handicaps*, **12**, 131-139.

Agran, M., Fodor-Davis, J. and Moore, S. (1986). The effects of self-instructional training on job-task sequencing: suggesting a problem solving strategy. *Education and Training of the Mentally Retarded*, **December**, 273-281.

Anderson, J.R. (1983). The architecture of cognition. Cambridge Mass: Harvard press.

Appel, F.L., Cooper, R.G., McCarel, N., Sims-Knight, J., Yussen, S.R. and Flavell, J.H. (1972). The development of the distinction between perceiving and memorizing. *Child Development*, **43**, 1365-1381.

Bandura, A. (1977). *Social learning theory*. New Jersey: Prentice.

Bedrosian, J.L. and Prutting, C.A. (1978). Communicative performance of mentally retarded adults in four conversational settings. *Journal of Speech and Hearing Research*, **21**, 79-95.

Belmont, J.M., Butterfield, E.C. and Borkowski, J.G. (1978). Training retarded people to generalize memorization methods across memory tasks. M.M. Gruneberg and R.N. Sykes (Eds) *Practical aspects of memory*. London: Academic Press.

Belmont, J.M. and Butterfield, E.C. (1971). Learning strategies as determinants of memory deficiencies. *Cognitive Psychology*, **2**, 411-420.

Bender, N.N. and Johnson, N.S. (1979). Hierarchical semantic organization in educable mentally retarded children. *Journal of Experimental Child Psychology*, **27**, 277-285.

Beveridge, M. and Conti-Ramsden, G. (1987). Social cognition and problem solving in persons with mental retardation. *Australia and New Zealand Journal of Developmental Disabilities*, **13**, 99-106.

Billings, D.C. and Wasik, B.H. (1985). Self-instructional training with pre-schoolers: An attempt to replicate. *Journal of Applied Behavioral Analysis*, **18**, 61-67.

Bishop, D. (1982). *Test for reception of grammar*. Chapel Press.

Borkowski, J.G., Carr, M. and Pressley, M. (1987). "Spontaneous" strategy use: Perspectives from metacognitive theory. *Intelligence*, **11**, 61-75.

Bornstein, P.H. and Quevillion, R.P. (1976). The effects of self-instructional package on overactive preschool boys. *Journal of Applied Behavior Analysis*, **9**, 179-188.

Bornstein, P.H. (1985). Self-instructional training: A commentary and state-of-the-art. *Journal of Applied Behavior Analysis*, **18**, 69-72.

Bredart, S. (1983). Children's interpretation of referential ambiguities and pragmatic inference. *Journal of Child Language*, **11**, 665-672.

Brown, A.L. and Barclay, C.R. (1976). The effects of training specific mnemonics on the metamnemonic efficiency of retarded children. *Child Development*, **47**, 71-80.

Brown, A.L., Campione, J.C., Reeve, R.A., Ferrara, R.A. and Palinscar, A.S. (Personal communication). Interactive learning and individual understanding: The case of reading and mathematics. Landsmann (Ed), *Culture, schooling and psychological development*. Hillsdale, New Jersey: Erlbaum.

Brown, A.L., Campione, J.C. and Murphy, M.D. (1977). Maintenance and generalization of trained metamnemonic awareness by educable retarded children. *Journal of Experimental Child Psychology*, **24**, 191-211.

Brown, A.L., Campione, J.C. and Barclay, C.R. (1979). Training self-checking routines for estimating test readiness: Generalization from list learning to prose recall. *Child Development*, **50**, 501-512.

Brown, A.L., Campione, J.C., Bray, N.W. and Wilcox, B.L. (1973). Keeping track of changing variables: Effects of rehearsal training and rehearsal prevention in normal and retarded adolescents. *Journal of Experimental Psychology*, **101**, 123-131.

Brown, A.L., Campione, J.C. and Webber, L.S. (Personal communication). *Interactive learning environments: A new look at assessment and instruction.*

Brown, G.D.A., Sharkey, A.C. and Brown, G. (1987). Factors affecting the success of referential communication. *Journal of Psycholinguistic Research*, **16**, 535-549.

Budoff, M. (1974). *Learning potential and educability among the educable mentally retarded (final report project No. 312312).* Cambridge, Mass: Research Institute for Educational Problems, Cambridge Mental Health Association.

Burgio, L.D., Whitman, T.L. and Johnson, M.R. (1980). A self-instructional package for increasing attending behavior in educable mentally retarded children. *Journal of Applied Behavioral Analysis*, **13**, 443-459.

Butterfield, E.C. (Personal communication). *On solving the transfer problem.*

Campione, J.C. and Brown, A.L. (1974). The effects of contextual changes and the degree of component mastery in transfer of training. H.W. Reese (Ed), Advances in child development and behavior (Vol. 9). New York: Academic press.

Campione, J.C. and Brown, A.L. (1987). Linking Dynamic Assessment with school achievement. Lidz, C.S. (Ed) *Dynamic Assessment*. New York: Guilford.

Campione, J.C., Brown, A.L. and Connell, M.L. (1989). Metacognition: On the importance of understanding what you are doing. R.I. Charles and E.A. Silver (Eds), *Research Agenda for mathematics education: The Teaching and Assessing of Mathematical Problem Solving*. Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Campione, J.C., Brown, A.L. and Ferrara, R.A. (1982). Mental Retardation and intelligence. Sternberg, R.J. (Ed) *Handbook of human intelligence.* Cambridge: Cambridge University Press.

Campione, J.C., Brown, A.L., Ferrara, R.A., Jones, R.S. and Steinberg, E. (1985). Breakdowns in flexible use of information: Intelligence-related differences in transfer following equivalent learning performance. *Intelligence*, **9**, 297-315.

Chase, W.G. and Simon, H.A. (1973). Perception in chess. *Cognitive Psychology*, **4**, 55-81.

Clark, A.M. and Clark, A.D.B. (1978). Criteria and classification of subnormality. Clark, A.M. and Clark, A.D.B. (Eds) *Readings from Mental deficiency.* London: Methuen.

Connel, J.P. (1985). A new multidimensional measure of children's perceptions of control. *Child Development*, **56**, 1018-1041.

Cormier, S.M. and Hagman, J.D. (1987). *Transfer of Learning.* London:Academic Press.

Cosgrove, J.M. and Patterson, C.J. (1977). Plans and the development of listener skill. *Developmental Psychology*, **13**, 557-564.

de Groot, A.D. (1965). *Thought and choice in chess.* The Hague: Mouton.

Dunn, L.M., Dunn, L.M., Whetton, C. and Pintilie, D. (1982). *British picture vocabulary scale.* NFER-Wilson.

Evenglesti, D., Whitman, T. and Johnston, M.B. (1986). Problem solving and task complexity: An examination of the relative effectiveness of self-instruction and didactic instruction. *Cognitive Therapy and Research*, **10**, 499-508.

Feignbaum, E.A. (1981). Expert systems in the 1980s. *Expert Systems: Management Tutorial,* British Computer Society.

Feuerstein, R. (1979). *The dynamic assessment of retarded performers: The learning potential assessment device, theory, instruments, and techniques*. Baltimore: University Park Press.

Flavell, J.H. (1971). First discussant's comments: What is memory development the development of?. *Human Development*, **14**, 272-278.

Flavell, J.H. (1979). Metacognition and Cognitive Monitoring. *American Psychologist*, **34**, 906-911.

Flavell, J.H. and Wellman, H.M. (1977). Metamemory. In R.V. Kail and J.W. Hagen (Eds), *Perspectives on the development of memory in children*. Hillsdale, NEW JERSEY: Erlbaum and Associates.

Flavell, J.H., Freidricks, A.G. and Hoyt, J.D. (1970). Developmental changes in memorization processes. *Cognitive Psychology*, **1**, 324-340.

Flesch, R.F. (1960). *How to write, speak and think more effectively*. New York: Harcourt Brace

Friedling, C. and O'leary, S.G. (1979). Effects of self-instructional training on second- and third- grade hyperactive children: A failure to replicate. *Journal of Applied Behavior Analysis*, **12**, 211-219.

Frost, R. (1971). *The poetry of Robert Frost*. E.C. Lathem (Ed). London: Jonathan Cape.

Gagne, R.M. (1970). *The conditions of learning* (2nd edition). New York: Holt, Reinhart and Winston.

Gelzheiser, L.M. (1984). Generalization from categorized memory tasks to prose by learning disabled adolescents. *Journal of Educational Psychology*, **76**, 1128-1138.

Gentner, D. (1979). Are scientific analogies metaphors? A. Ortoney (Ed); *Metaphors and thought*; New York: Cambridge University Press.

Gick, M.L. and Holyoak, K.J. (1987). The cognitive basis of knowledge transfer. Cormier, S.M. and Hagman, J.D. (Eds), *Transfer of Learning*. London: Academic Press.

Gick, M.L. and Holyoak, K.J. (1980). Analogical problem solving. A. Aitkenhead and M. Slack (Eds); *Issues in Cognitive Modelling*. Laurence Erlbaum Associates.

Gindis, B. (1988). Children with mental retardation in the Soviet Union. *Mental Retardation*, **26**, 381-384.

Gilhooley, K.J., Wood, M., Kinnear, P.R. and Green, C. (1988). Skill in map reading and memory for maps. *The Quarterly Journal of Experimental Psychology*, **40A**, 87-107.

Glucksberg, S., Krauss, R.M and Weisberg, R. (1966). Referential Communication in nursery school children: Method and some preliminary findings. *Journal of Experimental Child Psychology*, **3**, 333-342.

Goodnight, J.A., Cohen, R. and Meyers, A.W. (1984). Generalization of self-instruction: The effect of strategy adaptation training as a function of cognitive level. *Journal of Applied Developmental Psychology*, **5**, 35-44.

Gould, S.J. (1977). *Ever since Darwin: Reflections in Natural History*. Pelican.

Gould, S.J. (1984). *The Mismeasure of Man.*. Pelican.

Gow, L. and Ward, J. 1985. The use of verbal self-instructional training for enhancing generalization outcomes with persons with a developmental disability. *Australia and New Zealand Journal of Developmental Disabilities*, **11**, 157-168.

Guevremont, D.C., Osnes, P.G. and Stokes, T.F. (1988). The functional role of preschoolers' verbalisations in the generalization of self-instructional training. *Journal of Applied Behavioral Analysis*, **21**, 45-55.

House of Commons Second Report from the Social Services Committee Session (1984 - 1985). *Community care, with special reference to adult mentally ill and mentally handicapped people*. London: Her Majesty's Stationery Office.

Hughes, C. and Rusch, F.R. (1989). Teaching supported employees with severe mental retardation to solve problems. *Journal of Applied Behavior Analysis*, **22**, 365-372.

Kahney, H. (1986). *Problem solving a Cognitive approach.* Oxford University press.

Kendall, P.C. (1990). Challenges for cognitive strategy training: The case of mental retardation. *American Journal on Mental Retardation*, **94**, 347-362.

Kendall, P.C. and Hollon, S.D. (1979). Cognitive-behavioral interventions: overview and current status. Kendal, P.C. and Hollon, S.D. (Eds) *Cognitive-Behavioral Interventions: Theory Research and Practice.* New York: Academic Press.

Keogh, D.A, Whitman, T.L, Maxwell S.E. (1988). Self-instruction versus external instruction: Individual differences and training effectiveness. *Cognitive Therapy and Research*, **12**, 591-610.

Kramer, J.J. and Engle, R.W. (1981). Testing awareness of strategic behavior in combination with strategy training: Effects on children's memory performance. *Journal of Experimental Child Psychology*, **32**, 513-530.

Kreutzer, M.A., Leonard, C. and Flavell, J.H. (1975). An interview study of children's knowledge about memory. *Monographs of the Society for Research in Child Development*, **40**, 1-59.

Leland, H. (1983). Adaptive behavior scale. J.L. Matson and J.A. Mulick (Eds) *Handbook of Mental Retardation*; New York: Pergamon.

Lennox, D. and Polling, A (1984). Self-instructional training with mentally retarded individuals: A review of the literature. *The Mental Retardation and Learning Disability Quarterly*, **12**, 30-38.

Lignugaris/Kraft, B., Rule, S., Salzberg, C.L., and Stowitschek, J.J. (1986). Social interpersonal skills of handicapped and nonhandicapped adults at work. *Journal of Employment Counseling*, **March**, 20-30.

Lignugaris/Kraft, B., Salzberg, C.L., Rule, S. and Stowitschek , J.J. (1988). Social-vocational skills of workers with and without retardation in two community employment sites. *Mental Retardation*, **26**, no 5, 295-305.

Lignugaris/Kraft, B., Salzberg, C.L., Stowitschek J.J. and McConaughy, E.K. (1986). Social Interaction Patterns Among Employees in Sheltered and Nonprofit Business Settings. *The Career Development Quarterly*, **December**, 123-155.

Lindsay, A.D. (1932). *The Republic of Plato*. Temple Press: Letchworth.

Luria, A.R. (1959). The directive function of speech in development and dissolution: Part I, Development of the directive function of speech in early childhood. *Word*, **15**, 341-353.

Luria, A.R. (1961). *The role of speech in the regulation of normal and abnormal behaviour*. J. Tizard (Ed), London: Pergamon.

Malin, N. (1987). Community care: Principles, policy and practice; N. Malin (Ed) *Reassessing Community Care*. Croom Helm: London.

Markman, E.M. (1977). Realizing that you don't understand: Elementary school children's awareness of inconsistencies. *Child Development*, **50**, 643-655.

McConaughy, E.K, Stowitstchek, J.J., Salzberg, C.L. and Peatross, D.K. (1989). Work supervisors' ratings of social behaviors related to employment success. *Rehabilitation Psychology*, **34**, 3-15.

Meichenbaum (1975). Theoretical and treatment implications of developmental research on verbal self-control of behavior. *Canadian Psychological Review*, **16**, 22-27.

Meichenbaum, D. (1977). *Cognitive-behavior modification: An integrative approach.* New York: Plenum press.

Meichenbaum, D. and Asarnow, J. (1979). Cognitive-behavioral modification and metacognitive development: Implications for the classroom. P.C. Kendal and S.D. Hollon (Eds) *Cognitive-Behavioral Interventions: Theory Research and Practice*. New York: Academic Press.

Meichenbaum, D.H. and Goodman, J. (1971). Training impulsive children to talk to themselves: A means of developing self-control. *Journal of Abnormal Psychology*, **77**, 115-126.

Meichenbaum, D. and Goodman, S. (1979). Clinical use of private speech and critical questions about its study in natural settings. Zivin, G. (Ed) *The development of self-regulation through private speech: The origins of behavior series*. M.L. Lewis and L.A. Rosenblum (Eds); J.Wiley.

Meichenbaum, (1979). Teaching children self-control. *Advances in Clinical Child Psychology*, **2**, 1-33.

Mill, J.S. (1982). *Utilitarianism*.. Glasgow: Collins.

Miller, G.E. (1985). The effects of general and specific self-instruction training on children's comprehension monitoring performances during reading. *Reading Research Quarterly*, **20**, 617-628.

Morgenstern, M. (1983). Standard intelligence tests and related assessment techniques. J.L. Matson and J.A. Mulick (Eds) *Handbook of Mental Retardation*; New York: Pergamon.

Newell, A. and Simon, H.A. (1972). *Human problem solving*. New Jersey: Prentice Hall.

Palinscar, A.S. and Brown, D.A. (1986). Enhancing instructional time through attention to metacognition. *Journal of Learning Disabilities*, **20**, 66-75.

Patterson and Roberts, (1982). Planning and the development of communication skills. D. Forbes and M.T. Greenberg (Ed's) *New Directions for child development: Children's planning strategies*. San Francisco: Jossev-Bass.

Pressley, M. (1990). Four more considerations about self-regulation among mentally retarded persons. *American Journal on Mental Retardation*, **94**, 369-371.

Race, D. (1987). Community care: Principles, policy and practice; Malin, N. (Ed) *Reassessing Community Care*. Croom Helm: London.

Raven, J.C. (1947). *Progressive matrices, sets A, Ab, B*. London: Lewis and Harrap.

Reeve, R.A. and Brown, A.L. (1985). Metacognition reconsidered: Implications for intervention research. *Journal of Abnormal Child Psychology*, **13**, 343-356.

Reynell, J.K. and Huntley, M. (1985). *Reynell developmental language scales*. NFER-Wilson.

Roberts, R.J. and Patterson, C.J. (1983). Perspective taking and referential communication: The question of correspondence reconsidered. *Child Development*, **54**, 1005-1014.

Robinson, E.J. and Robinson, W.P. (1977). Children's explanations of communication failure and the inadequacy of the misunderstood message. *Developmental Psychology*, **13**, 156-161.

Rusch, F.R., Schutz, R.P. and Heal, L.W. (1983). Vocational training and placement. J.L. Matson and J.A. Mulick (Eds) *Handbook of Mental Retardation*. New York: Pergamon.

Schleser, R., Cohen, R., Meyers, A.W. and Rodick J.D. (1984). The effects of cognitive level and training procedures on the generalization of self-instructions. *Cognitive Therapy and Research*, **8**, 187-200.

Schleser, R., Meyers, A.W. and Cohen, R. (1981). Generalization of self-instruction: Effects of general versus specific content, active rehearsal, and cognitive level. *Child Development*, **52**, 335-340.

Schloss, P.J. and Wood, C.E. (1990). Effect of self-monitoring on maintenance and generalization of conversational skills of persons with mental retardation. *Mental Retardation*, **2**, 105-113.

Schneider, W. and Pressley, M. (1989). *Memory development between 2 and 20*. New York: Springer-Verlag.

Shapiro, E.S. (1981). Self-control procedures with the mentally retarded. *Progress in Behavior Modification*, **12**, 265-297.

Skinner, B.F. (1971). *Beyond freedom and dignity.* New York: Alfred. A. Knopf.

Skinner, B.F. (1953). *Science and Human Behavior.* New York: Free Press.

Snodgrass, J.G. and Vanderwart, M (1980). A standardized set of 260 pictures: Norms for name agreement, image agreement familiarity, and visual complexity. *Journal of Experimental Psychology: Human Learning and Memory*, **6**, 174-215.

Sokolov, A.N. (1972). *Inner speech and thought.* New York-London:Plenum.

Sonnenschein, S. and Whitehurst, G.J. (1983). Training referential communication: The limits of success. *Journal of Experimental Child Psychology*, **35**, 426-436.

Sonnenschein, S. and Whitehurst , G.J. (1984)a. Developing referential communication: A hierarchy of skills. *Child Development*, **55**, 1936-1945.

Sonnenschein, S. and Whitehurst , G.J. (1984)b. Developing referential communication skills: The interaction of role-switching and difference rule training. *Journal of Experimental Child Psychology*, **38**, 191-207.

Spitz, H.H. (1972). A note on immediate memory for digits: Invariance over the years. *Psychological Bulletin*, **6**, 92-103.

Spitz, H.H. (1966). The role of input organization in the learning and memory of mental retardates. 29-56. N.R. Ellis (Ed) *International Review of Mental Retardation (Vol 2).* New York: Academic.

Stokes, T.F. and Baer, D.M. (1977). An implicit technology of generalization. *Journal of Applied Behavioral Analysis*, **10**, 349-367.

Stone, A. (1985). Vygotsky's developmental model and the concept of proleptic instruction: Some implications for theory and research in the field of learning disabilities. *Research Communications in Psychology, Psychiatry and Behavior*, **10**, 129-152.

Thackwray, D., Meyers, A. and Schleser, R (1985). Achieving generalization with general versus specific self-instructions: Effects on academically deficient children. *Cognitive Therapy and Research*, **9**, 297-308.

Thomas, D. (1963). *Miscellany One: Poems, Stories, Broadcasts.* London: Everyman.

Vocate, D.R. (1987). *The Theory of A.R. Luria: Functions of Spoken Language in the Development of Higher Mental Processes.* Hillsdale, New Jersey: Laurence Erlbaum Associates.

Vurpillot, E. (1968).The development of scanning strategies and their relation to visual differentiation. *Journal of Experimental Child Psychology*, **6**, 632-650.

Vygotsky, L.S. (1962). *Thought and Language.* Kozulin, A. (Ed). MIT press: Cambridge, Massachusettes.

Vygotsky, L.S. (1978). *Mind in Society: The Development of Higher Psychological Processes.* Cambridge, Mass: Harvard University Press.

Vygotsky, L.S. (1987). The problem of mental retardation (a tentative working hypothesis). *Soviet Psychology*, **26**, 78-85.

Wambold, C.L. and Hayden, C. (1975). Training cognitive strategies in the mildly retarded: An applied approach. *Education and training of the Mentally Retarded,* **10**, 132-137.

Wellman, H.M. (1983). Metamemory revisited. *Contri. hum. Dev.*, **9**, 31-51.

Whitehurst, G.J. Sonnenschein, S. (1981). The development of informative messages in referential communication: Knowing when vs. knowing how. W.P. Dickson (Ed), *Children's oral communication skills.* New York: Academic Press.

Whitman, T. and Johnson, M.B. (1983). Teaching addition and subtraction with regrouping to educable mentally retarded children: A group self-instructional training program. *Behavior Therapy*, **14**, 127-143.

Whitman, T.L. (1987). Self-instruction, individual differences, and mental retardation. *American Journal of Mental Deficiency*, **92**, 213-223.

Whitman, T.L. (1990). *Self-regulation and mental retardation. American Journal on mental retardation,* **94**, 347-362.

Williams, W.H. and Ellis, N.C. (1991). Transfer of training of communication skills for people with learning difficulties. Paper presented at the Experimental Analysis of Behaviour conference, April, 1991. UCNW Cognitive Neuroscience Unit, Technical report No. 57.

Winston, D.H. and Brown, K.H. (1979). *Artificial intelligence: An MIT perspective, Vol 1.* MIT press.

Wolfsenberger, W. (1972). *The principle of normalization in human services.*Toronto: NIMR.

Wong, B.Y.L. and Jones, W. (1982). Increasing metacomprehension in learning disabled and normally achieving students through self-questioning training. *Learning Disability Quarterly*, **5**, 228-240.

Zivin, G. (1979). *The development of self-regulation through private speech: The origins of behavior series.* M.L. Lewis and L.A. Rosenblum (Eds). J.Wiley.

Appendix: 1

Short term memory test, Practice Set, Set A and Set B

Practice:

(2) (5) (4 5) (6 3)

Set A:

(4) (7) (2) (3) (8)
(2 6) (4 1) (8 3) (7 9) (4 6)
(2 8 4) (9 5 6) (4 6 1) (9 8 4) (3 7 5)
(5 7 3 9) (3 5 2 7) (9 4 5 2) (7 6 2 3) (2 7 5 9)
(9 3 4 1 7) (3 2 5 5 7) (1 5 3 7 6) (8 9 4 6 7) (5 1 6 7 2)
(4 9 7 5 3 4) (6 4 5 2 6 7) (5 6 3 5 1 2) (7 9 4 5 3 4) (2 4 8 6 4 6)
(3 7 5 6 7 3 1) (9 4 2 5 7 8 4) (2 1 4 5 7 4 3) (5 3 6 4 5 2 7) (3 5 3 6 8 5 6)

Set B:

(23) (45) (76) (32) (63)
(67 3) (5 53) (4 98) (87 2) (2 43)
(67 45) (34 81) (73 24) (56 18) (12 89)
(28 54 3) (18 67 4) (3 50 11) (95 45 2) (49 4 71)
(77 53 42) (45 21 67) (55 42 97) (63 78 51) (80 81 33)
(91 4 56 32) (42 67 5 39) (21 9 63 59) (41 52 8 92) (14 38 1 37)

Appendix: 2 - Connel's test of the Locus of Control

Why Things Happen

Interviewer:____________________
Person Responding:______________
Date:___________________________
Location:_______________________

Sample Questions

a. I like Neighbours more than Eastenders

very true sort of true not very true not at all true

b. I really like going out to a pub

very true sort of true not very true not at all true

----

1. When I win at sport I usually can't understand why I won.

very true sort of true not very true not at all true

2. when I am unsuccessful , it's usually my own fault.

very true sort of true not very true not at all true

3. The best way for me to get the instructor to like what I've done is to get him or her to like me.

very true sort of true not very true not at all true

4. If someone doesn't like me I usually don't understand why.

very true sort of true not very true not at all true

5. I can be good at any sport if I try hard enough.

very true sort of true not very true not at all true

6. If an instructor doesn't want me to do something I want to do, I probably won't be able to do it.

very true sort of true not very true not at all true

7. When I've done well in the centre I usually can't understand why.

very true sort of true not very true not at all true

8. If someone doesn't like me it's usually because of something I did.

very true sort of true not very true not at all true

9. when I win at a sport, it's usually because the person I was playing against played badly.

very true sort of true not very true not at all true

10. When something goes wrong for me , I usually can't figure out why it happened.

very true sort of true not very true not at all true

11. If I want to do well in the centre its up to me to do it.

very true sort of true not very true not at all true

12. If my instructor doesn't like me I probably won't be very popular with the other members of his/her group.

very true sort of true not very true not at all true

13. Many times I can't understand why good things happen to me.

very true sort of true not very true not at all true

14. If I don't do well in the centre , it's my own fault.

very true sort of true not very true not at all true

15. If I want to be an important member of my group I have to get the popular members there to like me.

very true sort of true not very true not at all true

16. Most of the time when I lose a game I can't understand why I lost.

very true sort of true not very true not at all true

17. I can pretty much control what will happen in my life.

very true sort of true not very true not at all tru

18. If I have a bad instructor, I won't do well in the centre.

Very true sort of true not very true not at all true

19. A lot of the time I don't know why people like me.

very true sort of true not very true not at all true

20. If I try to catch something (ball) , and I don't, it is usually because I didn't try hard enough.

very true sort of true not very true not at all true

21. If there is something I want to get I usually have to please the people in charge to get it.

very true sort of true not very true not at all true

22. If I an instructor thinks I've done bad work, I usually don't understand why.

very true sort of true not very true not at all true

23. If someone likes me , it's usually because of the way I treated them.

Very true sort of true not very true not at all true

24.When I lose in an outdoor game, its usually because the person I played against was much better at the game to begin with.

Very true sort of true not very true not at all true

25. When I win an outdoor game , a lot of times I don' t know why I won.

Very true sort of true not very true not at all true

26. When I don't do well at something , it's usually my own fault.

Very true sort of true not very true not at all true

27. When I do well in the centre , its because the instructor likes me.

Very true sort of true not very true not at all true

28. When another member here doesn't like me , I usualy don't know why.

Very true sort of true not very true not at all true

29. I can be good at any sport if I work on it hard enough.

Very true sort of true not very true not at all true

30. I don't have much of a chance to do what I want if the instructors don't want me to do it.

Very true sort of true not very true not at all true

31. When an instructor thinks I've done good work I usually don't understand why I did so well.

Very true sort of true not very true not at all true

32. If someone is mean to me , it's usually because of something I did.

Very true sort of true not very true not at all true

33. When I play an outdoor game against someone else , and I win, its probably because the other person didn't play very well.

Very true sort of true not very true not at all true

34. A lot of the time, I don't know why something goes wrong for me.

Very true sort of true not very true not at all true

35. If I want to get the istructors here to think I've done good work, its up to me to do it.

Very true sort of true not very true not at all true

36. If an instructor doesn't like me , I probably won't have many friends in his/her class.

Very true sort of true not very true not at all true

37. When good things happen to me , many times there doesn't seem to be any reason why.

Very true sort of true not very true not at all true

38. If an instructor thinks I've done bad work, its my own fault.

Very true sort of true not very true not at all true

39. If I want the other members here to think that I'm an important person, I have to be friends with the really popular people here.

Very true sort of true not very true not at all true

40. When I don't win at an outdoor game, most of the time I can't understand why.

Very true sort of true not very true not at all true

41. I can pretty much decide what will happen in my life.

Very true sort of true not very true not at all true

42. If I don't have a good instructor, I won't do well in the centre.

Very true sort of true not very true not at all true

43. A lot of times there doesn't seem to be any reason why someone likes me.

Very true sort of true not very true not at all true

44. If I try to catch a ball and I miss it, it's usually because I didn't try hard enough.

Very true sort of true not very true not at all true

45. To get what I want I have to please the people in charge.

Very true sort of true not very true not at all true

46. When I don't do well in the centre I usually don't understand why.

Very true sort of true not very true not at all true

47. If someone is my friend, its usually because of the way I treat them.

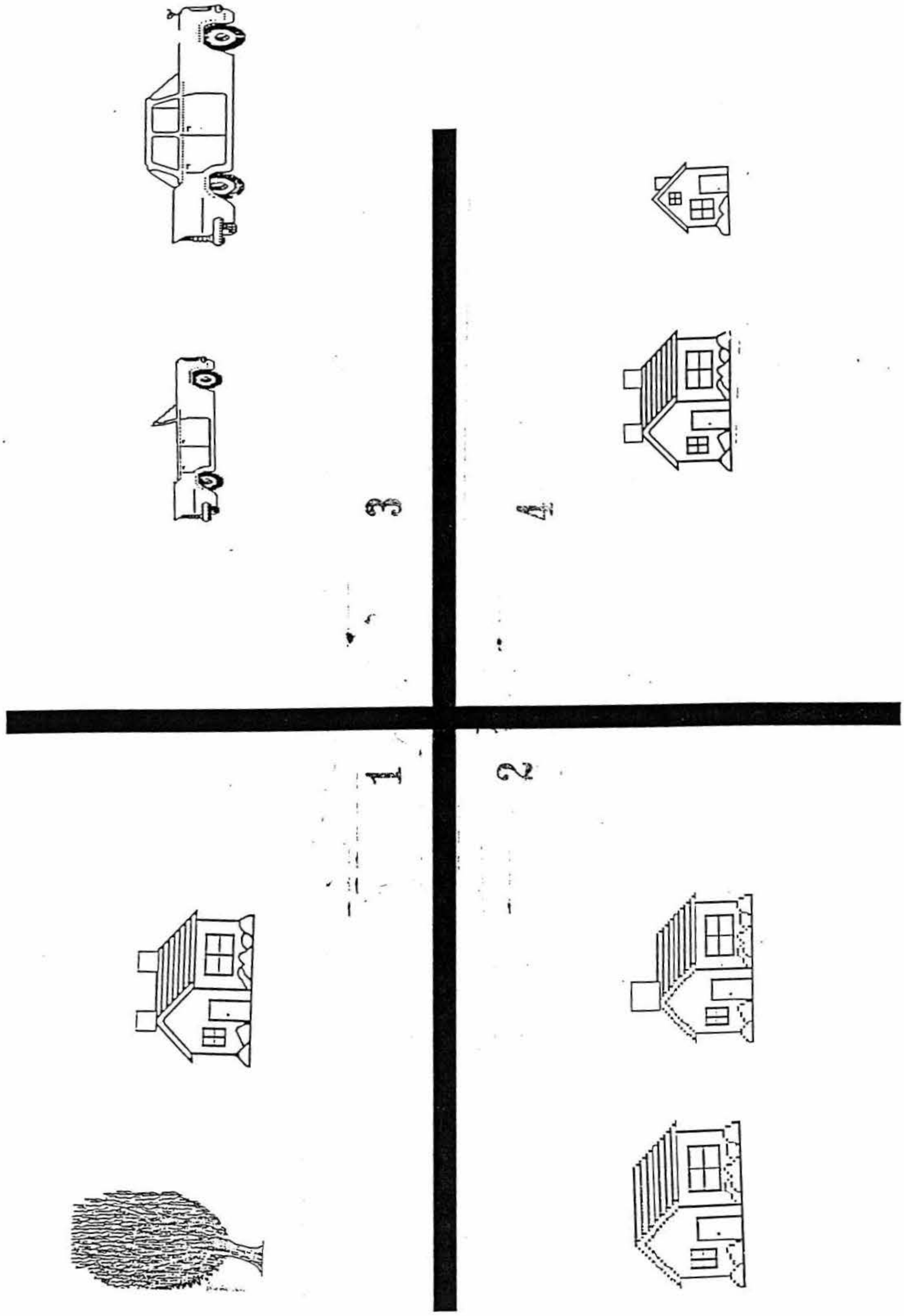
Very true sort of true not very true not at all true

48. When I don't win at an outdoor game , the person I was playing against was probably a lot better than I was.

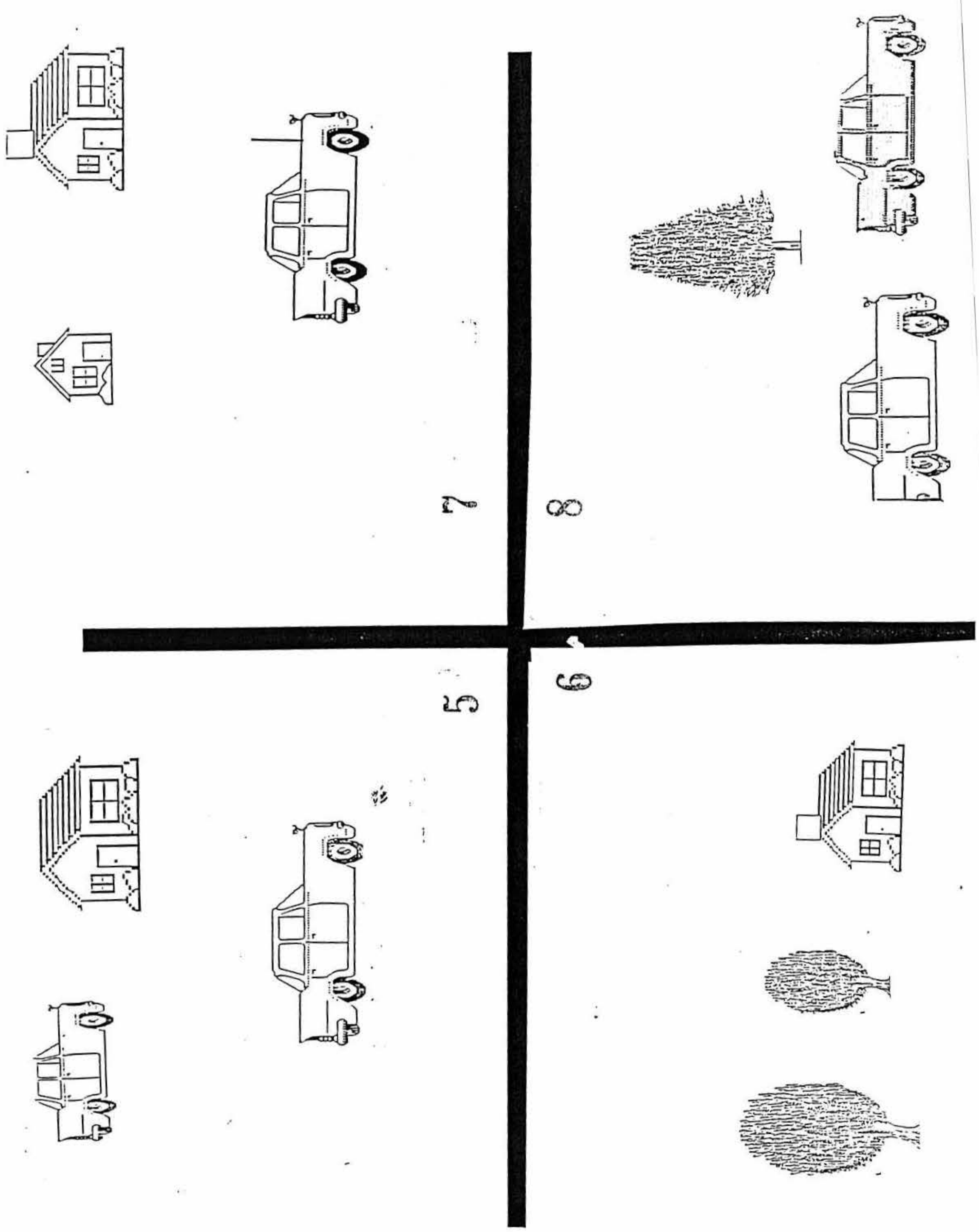
Very true sort of true not very true not at all true

Appendix: 3
Perspective monitoring: Referent sets for

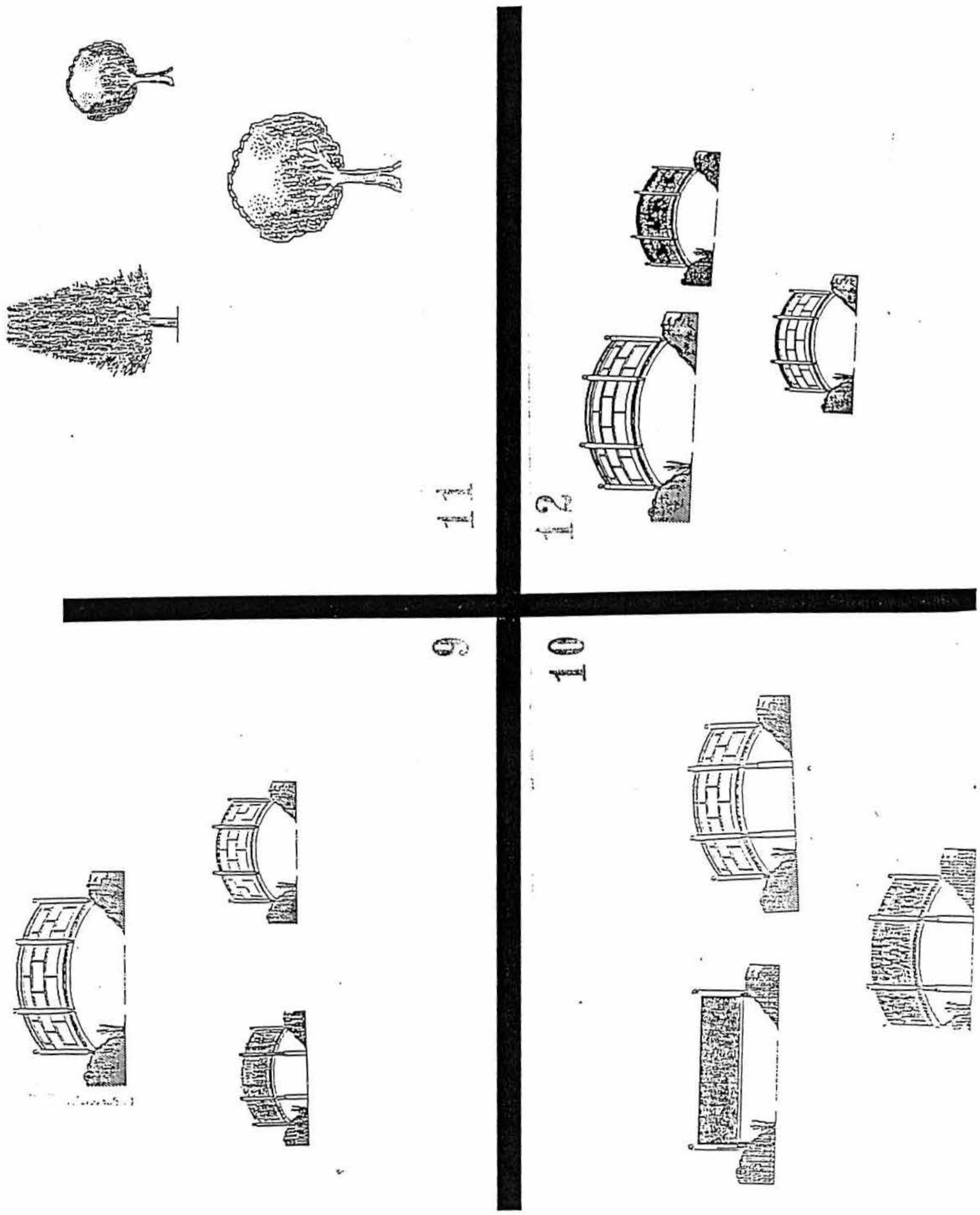
Appendix: 3 continued



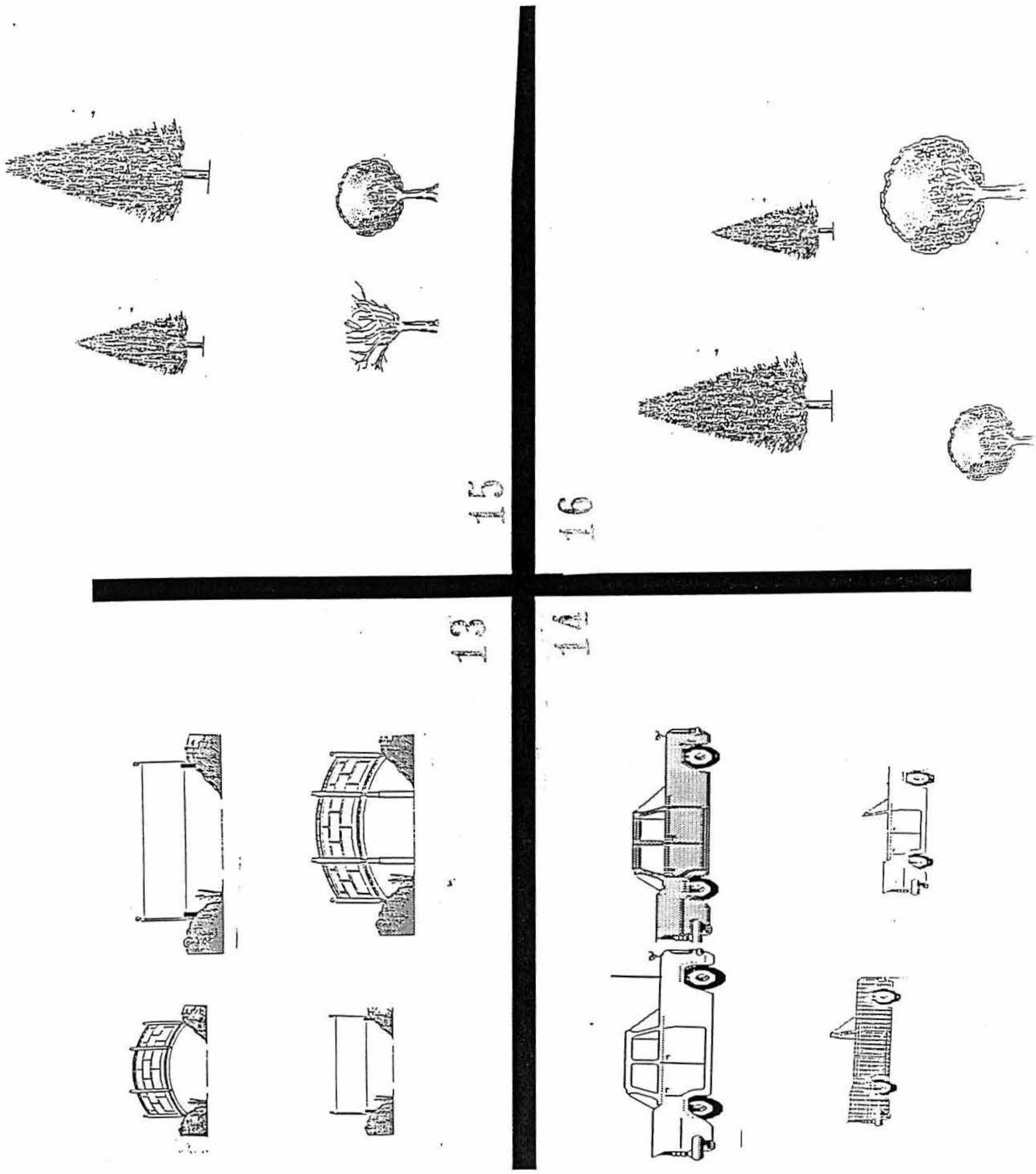
Appendix: 3 continued



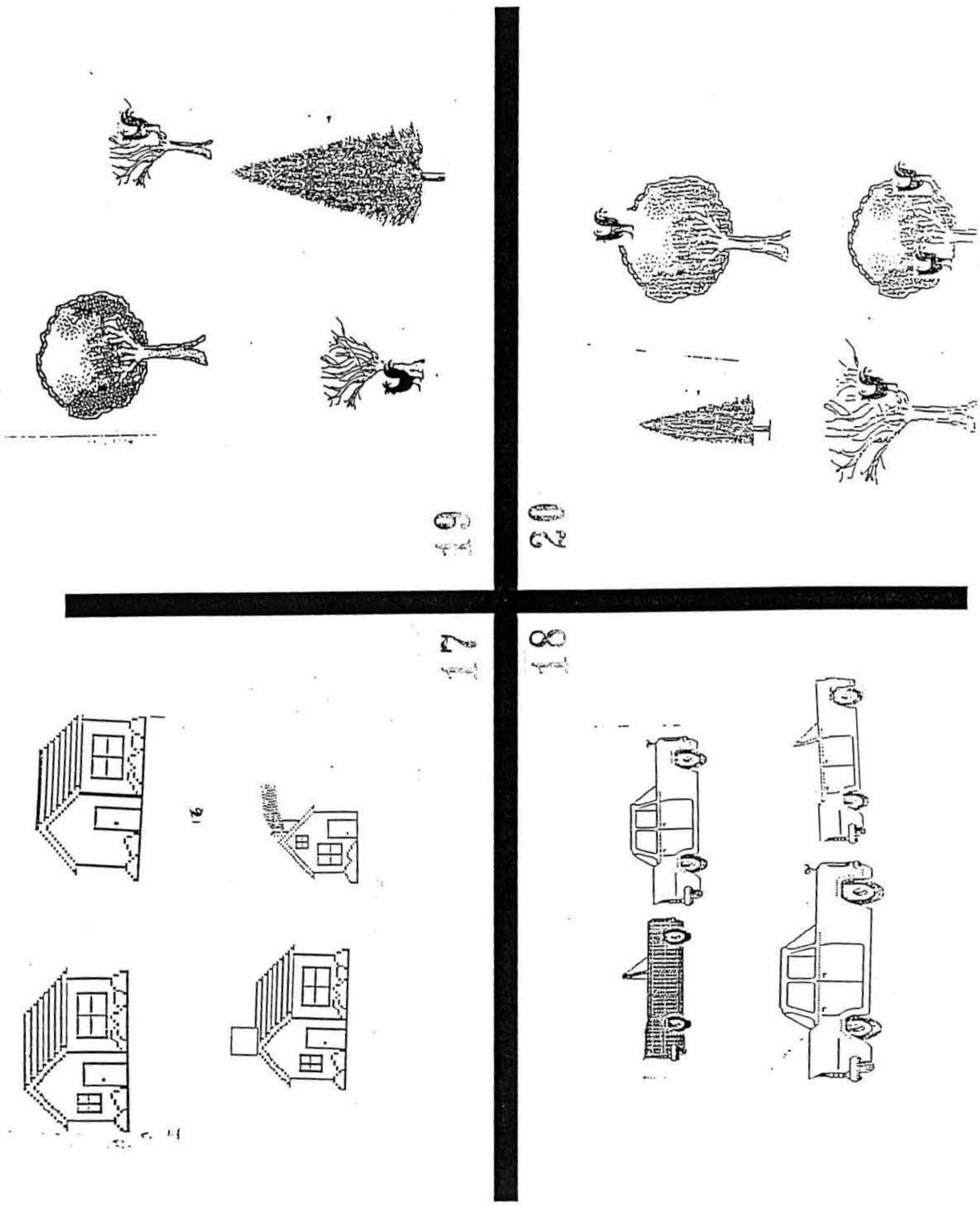
Appendix: 3 continued



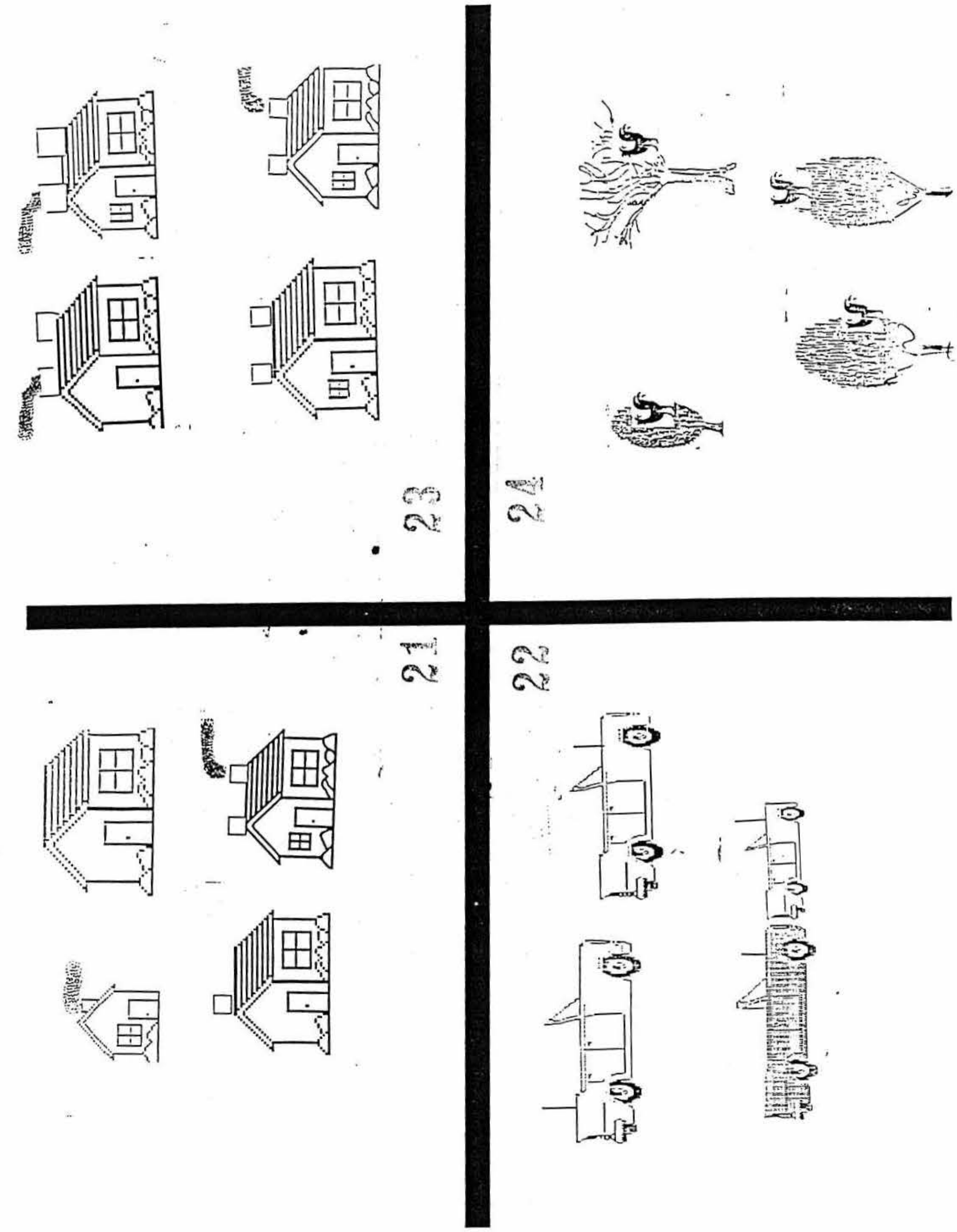
Appendix: 3 continued



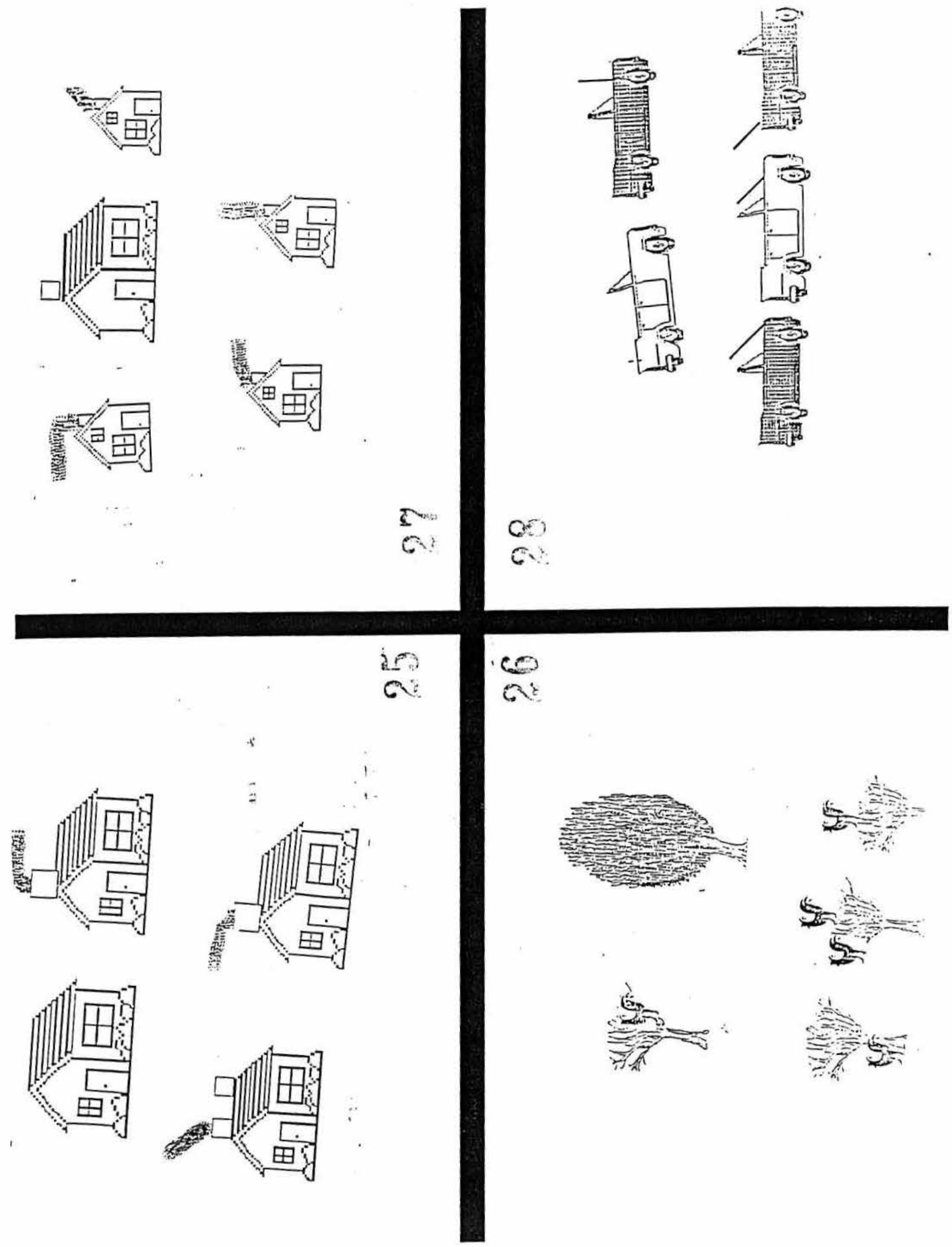
Appendix: 3 continued



Appendix: 3 continued

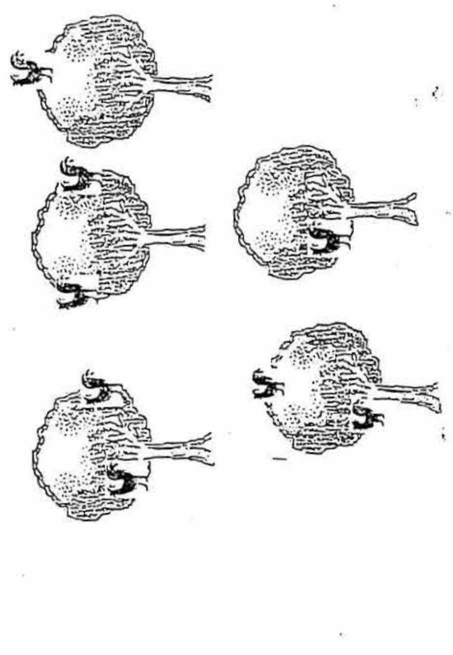


Appendix: 3 continued

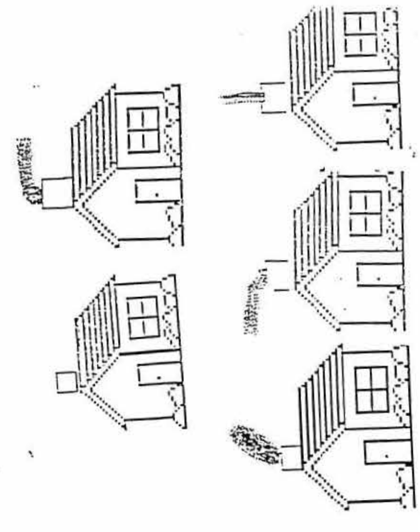


Appendix: 3 continued

29



30



Appendix: 4
Perspective monitoring: Messages for

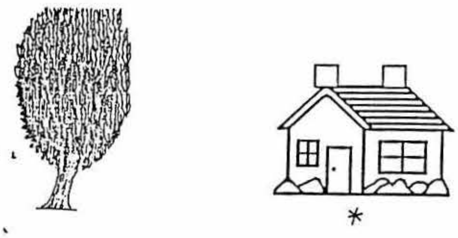
Trial	Message 1	Message 2	Message 3
1.	tree		
2.	house/ chimney		
3.	big car		
4.	small house		
5.	car	big	
6.	tree	small	
7.	house	big	
8.	car	white	
9.	bridge	big	
10.	black bridge	rounded	
11.	small tree		
12.	white bridge	big	
13.	small bridge	rounded	
14.	small car	no top	black
15.	big tree		
16.	big tree	rounded	
17.	smokey house		
18.	small car	no top	white
19.	big tree	triangular/ fir	
20.	big tree	rounded	two birds
21.	small house		
22.	white car	aerial on front	big
23.	smokey house	smoke going left	two windows
24.	big tree	bird on it	bird on top
25	smokey house	smoke/ straight up	
26.	small tree	bird	bird below
27.	smokey house	smoke to right	nearly straight up
28.	black car	no roof	aerial on back
29.	tree with birds	one below one on top	
30.	smoke	smoke going right	straight right

Appendix: 5

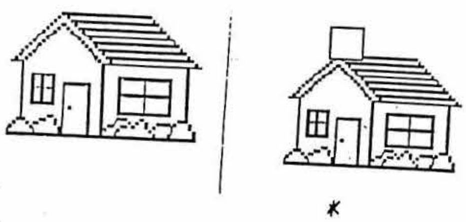
Selective comparison

Referent sets in the Selective Comparison test, the asterixed referent required comparison to the other referents in that set.

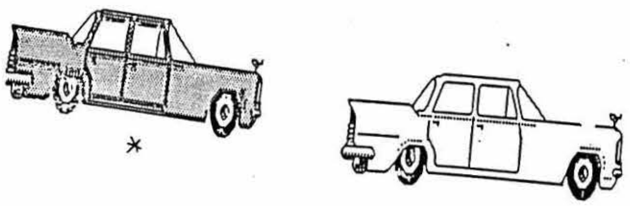
1



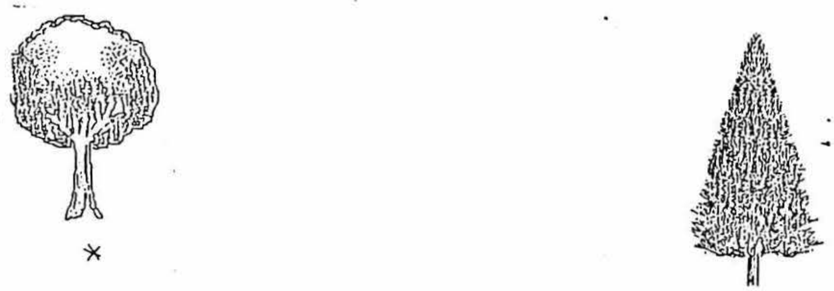
2



3

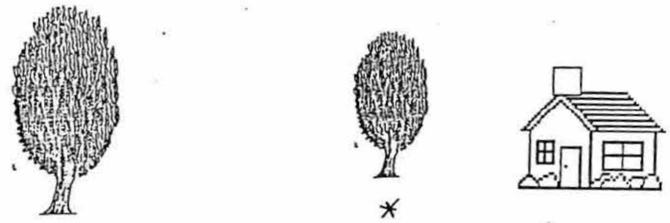


4



Appendix: 5 continued

5 

6 

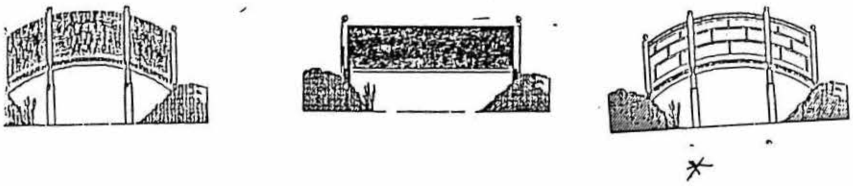
7 

8 

Appendix: 5 continued

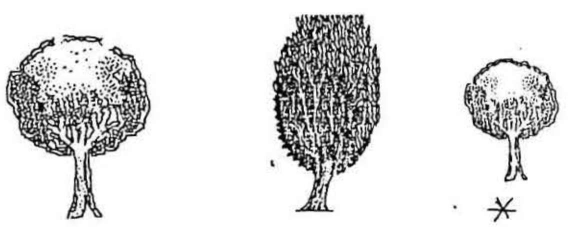
9

10

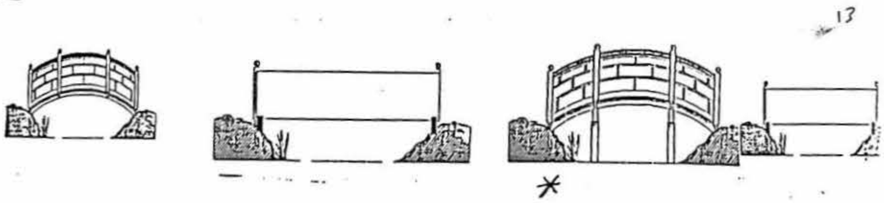


11

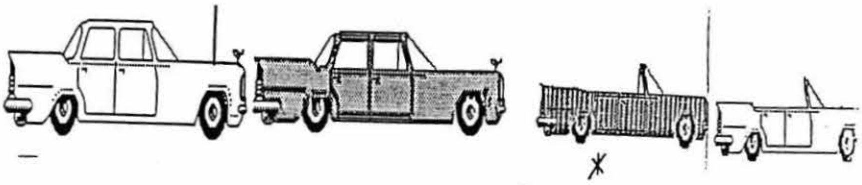
12



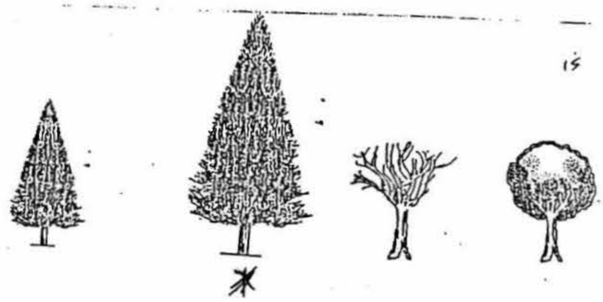
13



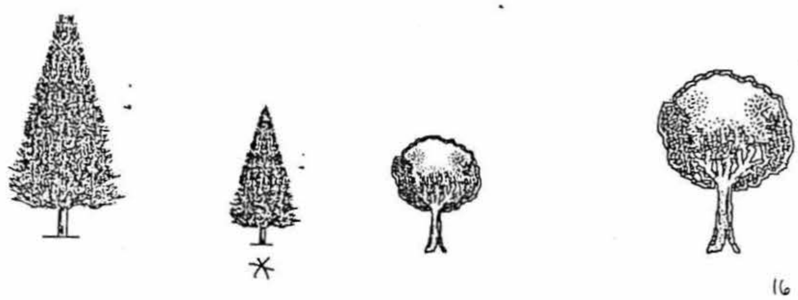
14



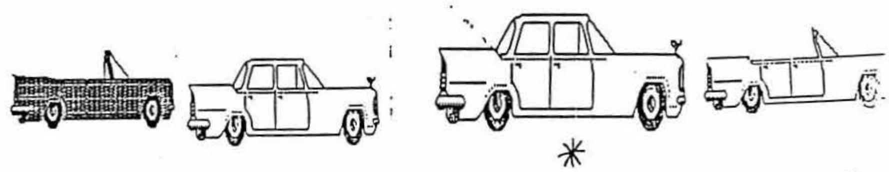
15



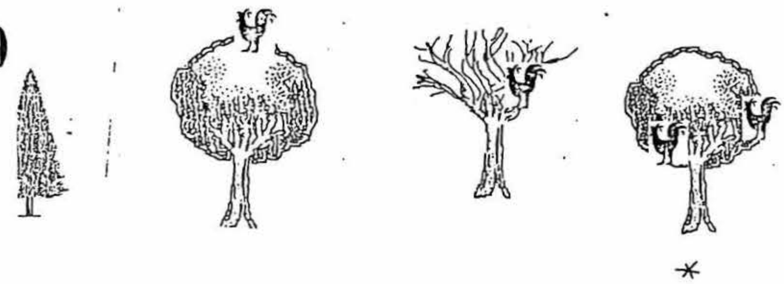
16



17 

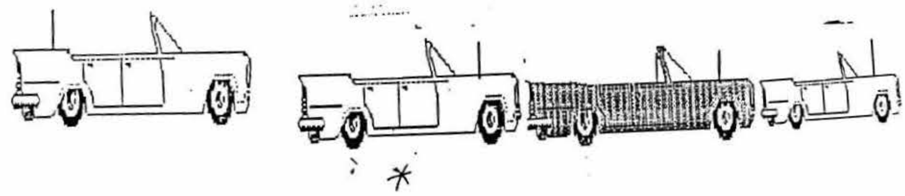
18 

19 

20 

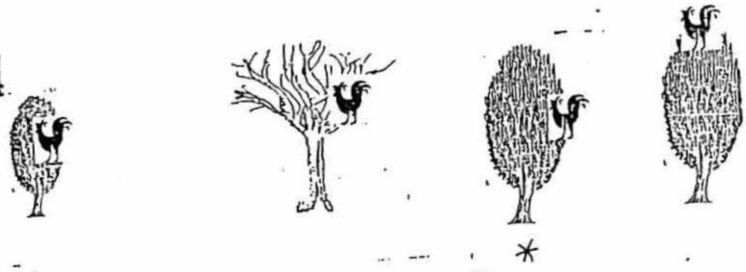
21

22



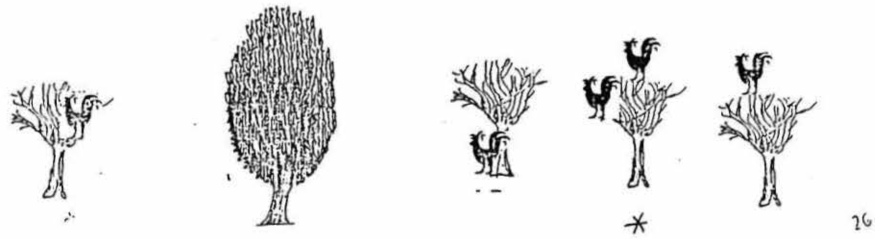
23

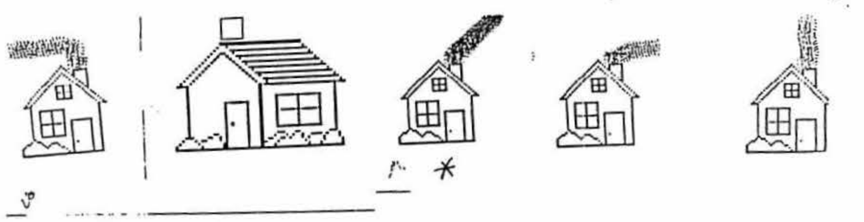
24

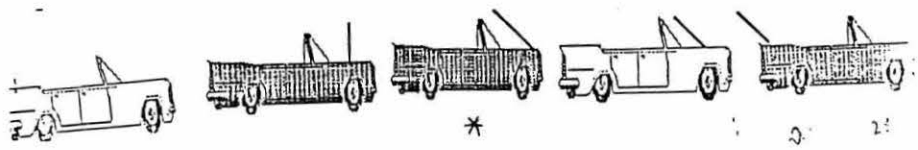


Appendix: 5 continued

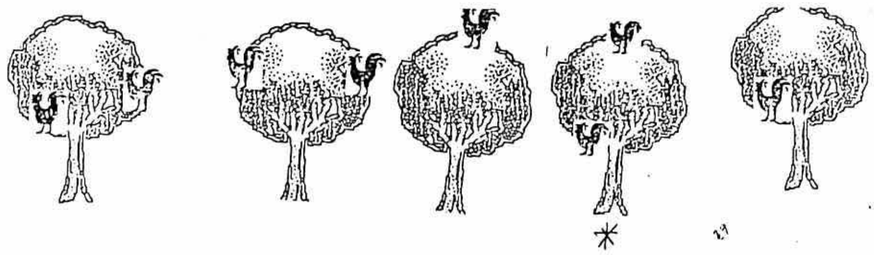
25


26


27


28


29

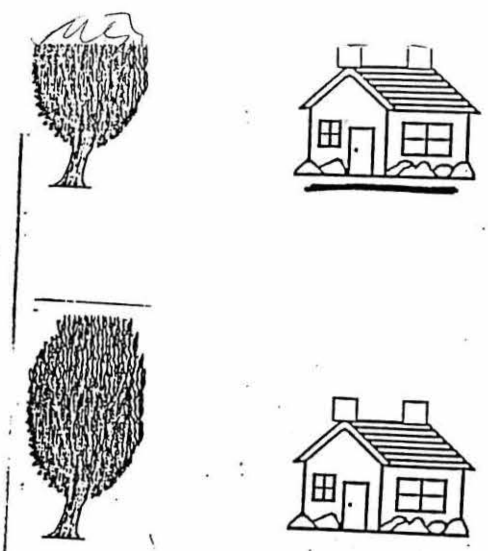


30

Appendix: 6
Referential communication test

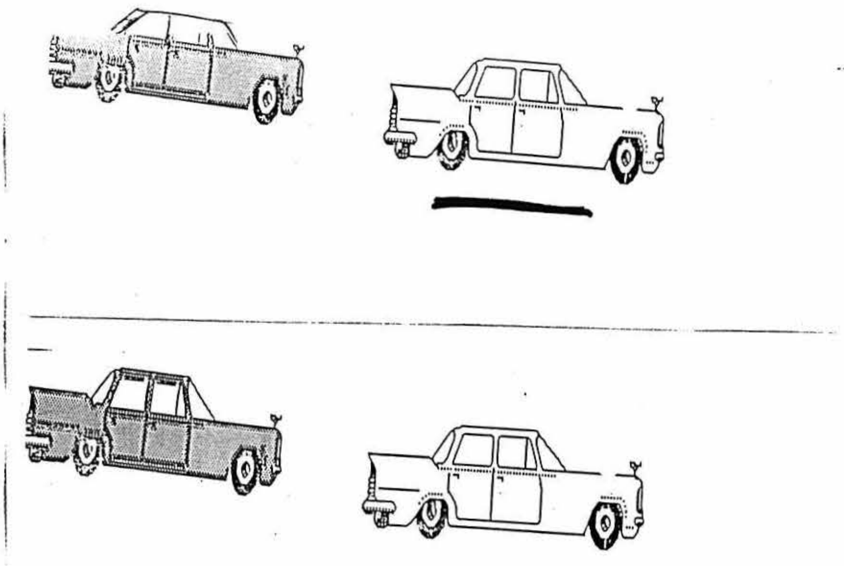
In the (i) referent set a referent has been underlined (targeted) for a speaker to differentiate for the listener who has the referent set (ii), who then has to underline the corresponding referent if it is made distinct.

The upper set of each pair was given to the subject who acted as a speaker. The lower set was given to the experimenter (the listener).



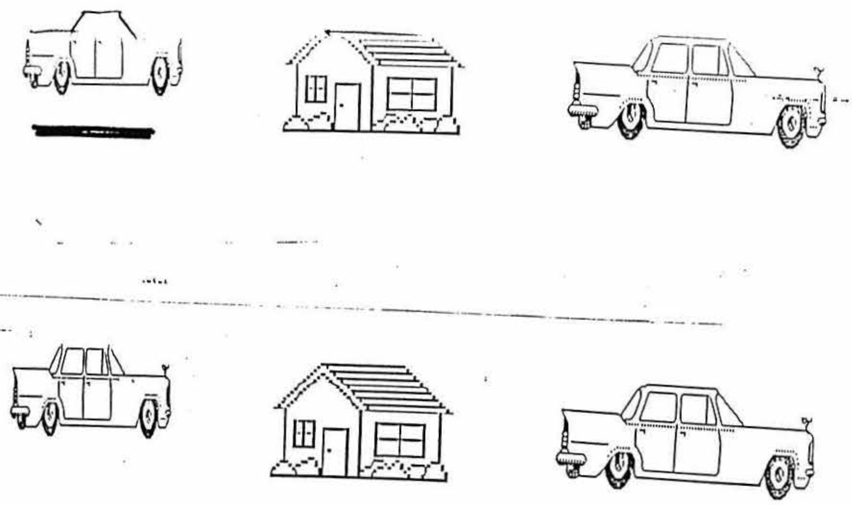
1

2

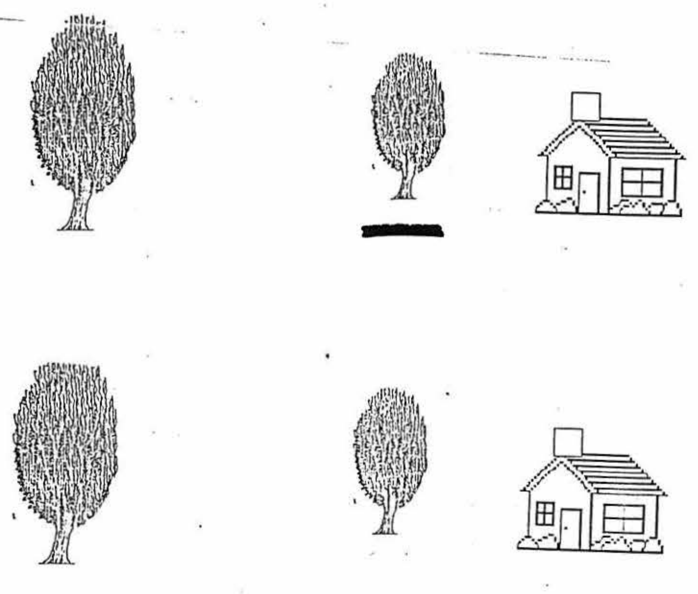


3

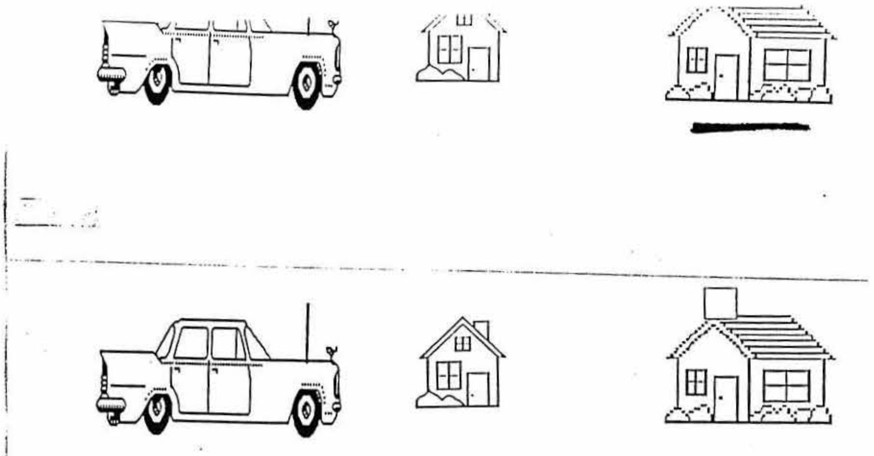
4



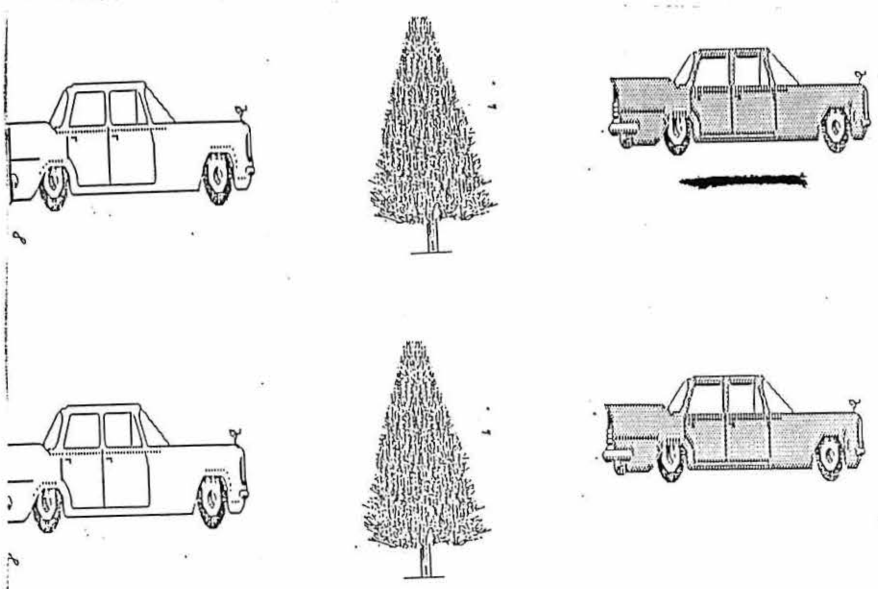
5



6

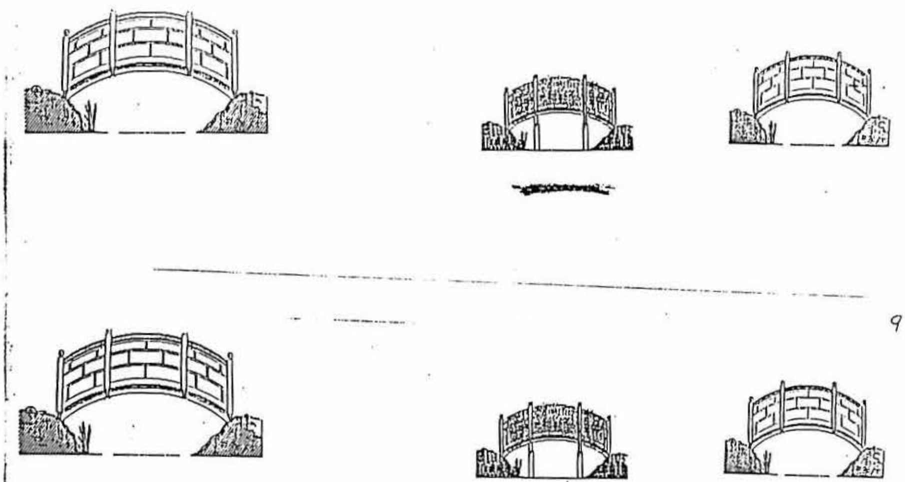


7



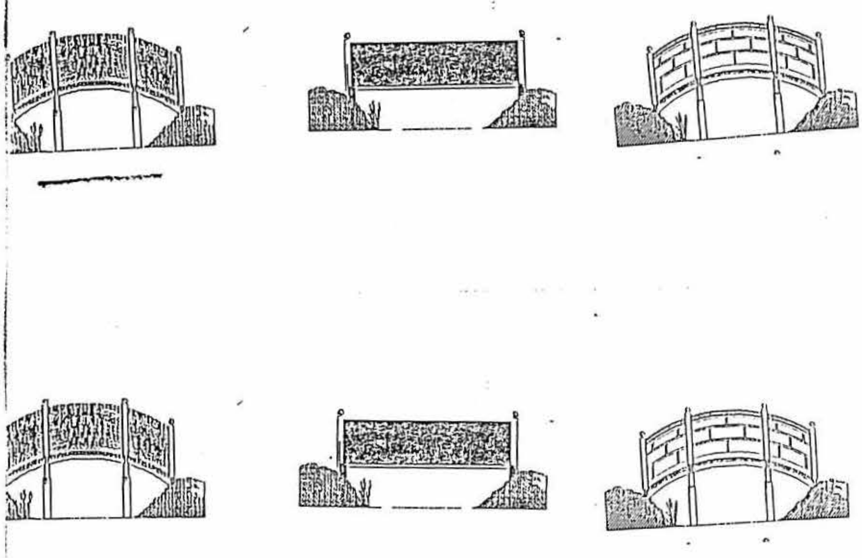
8

Appendix: 6 continued



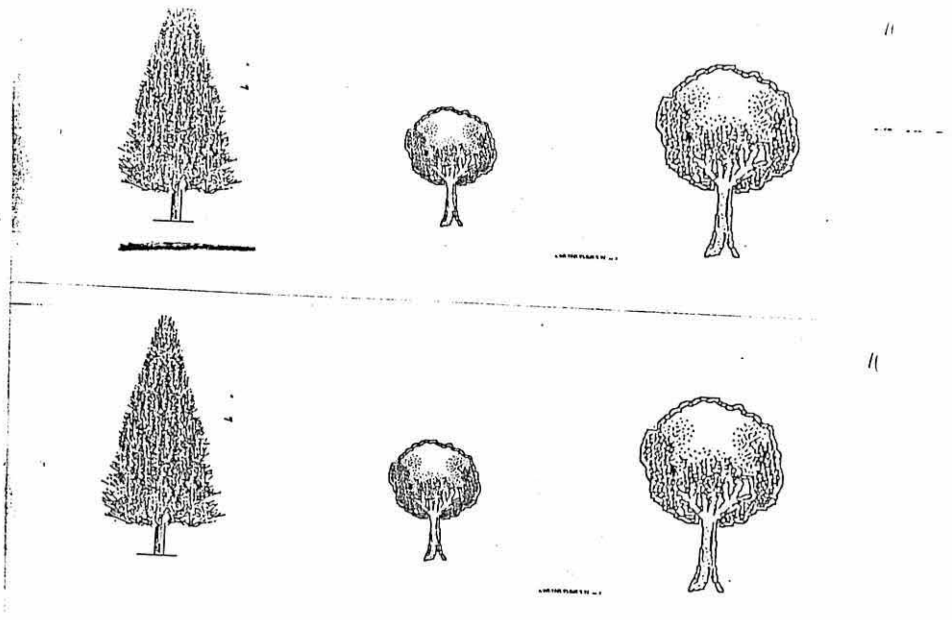
9

9

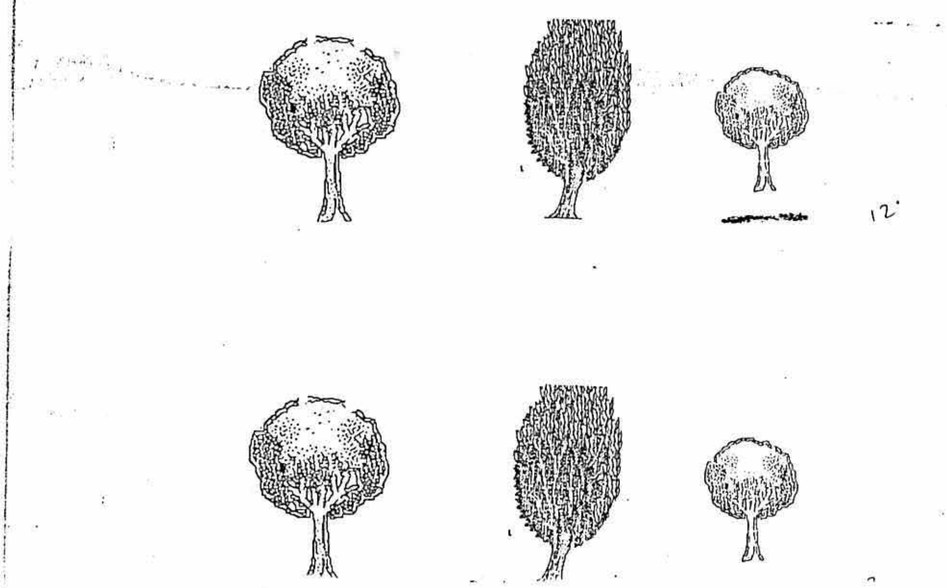


10

10

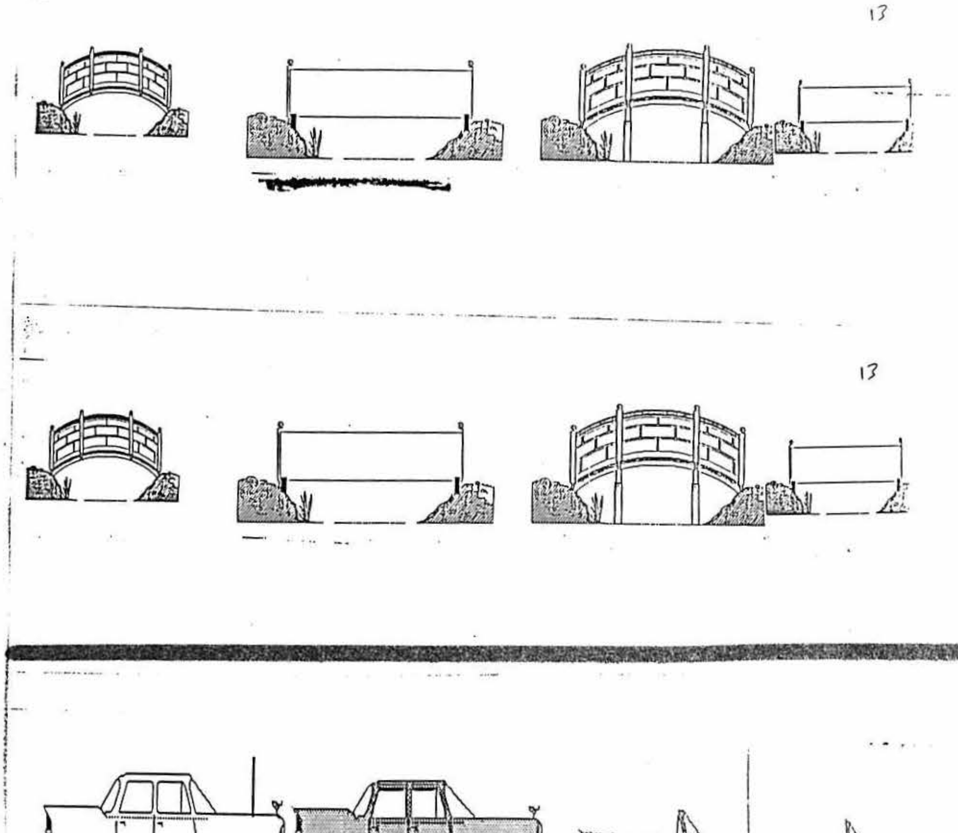


11

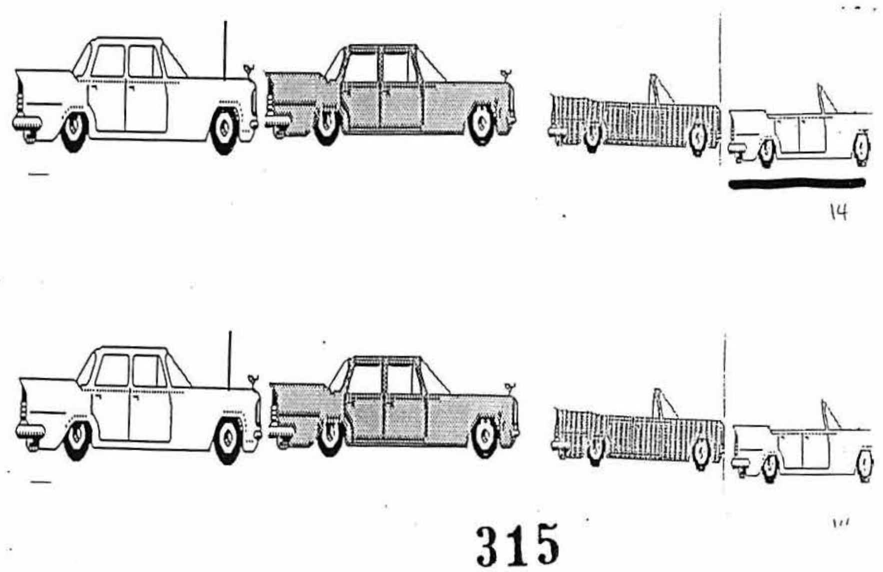


12

Appendix: 6 continued

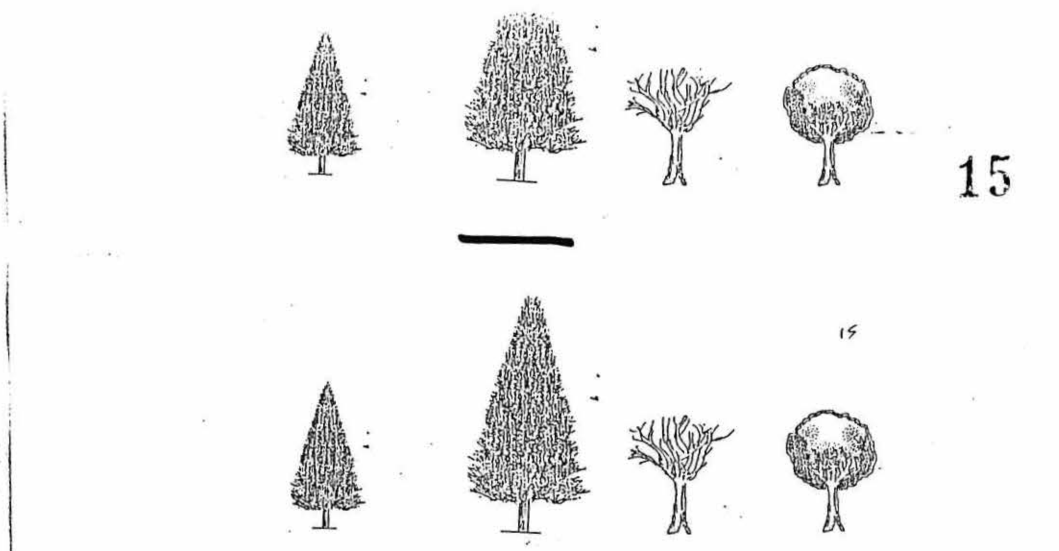


13

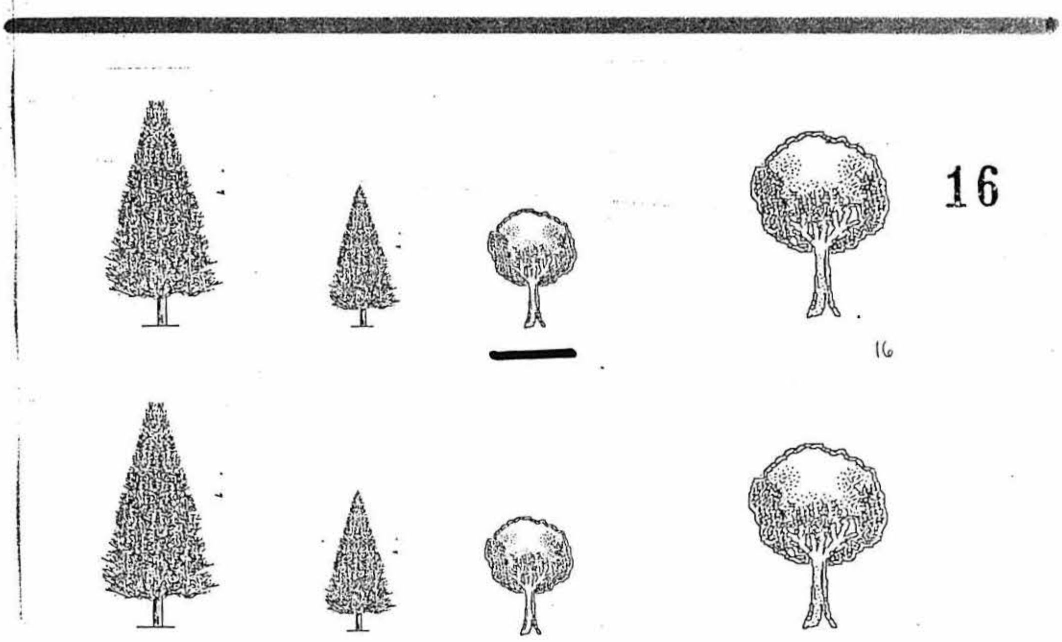


14

Appendix: 6 continued



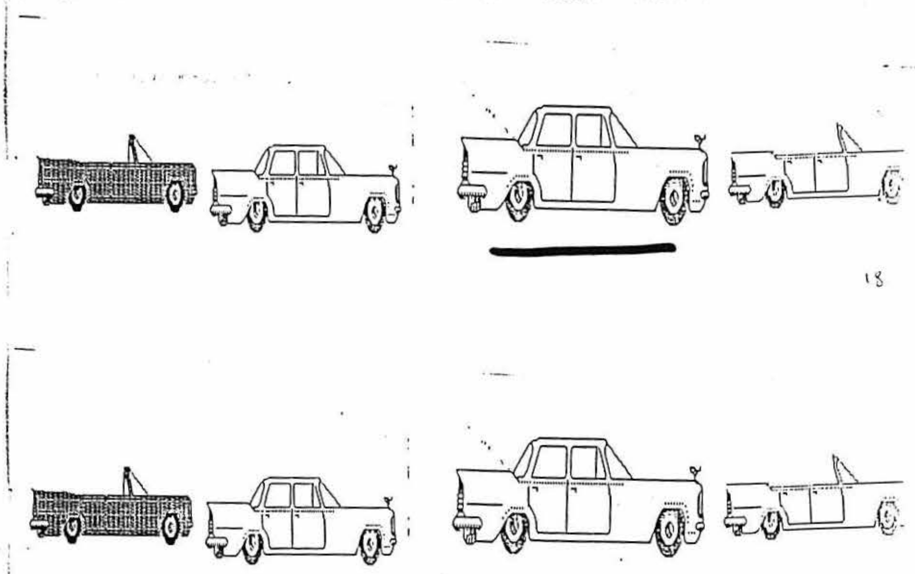
15



16

Appendix: 6 continued

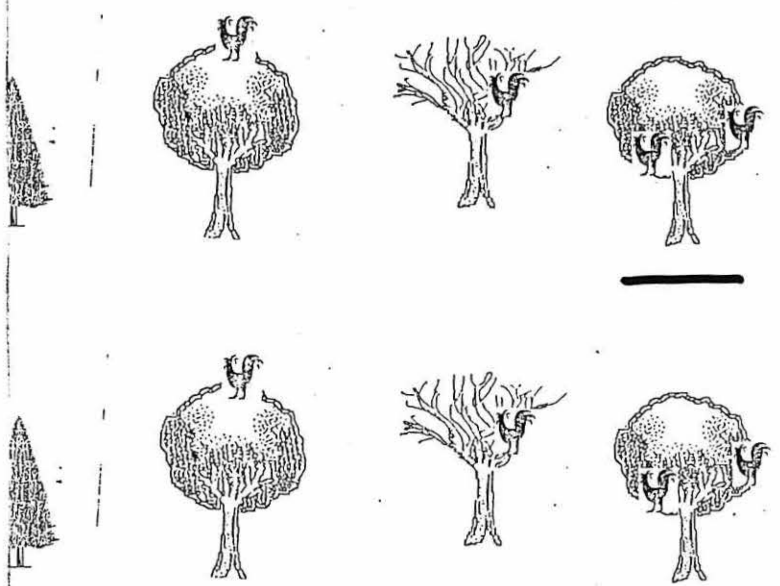
17



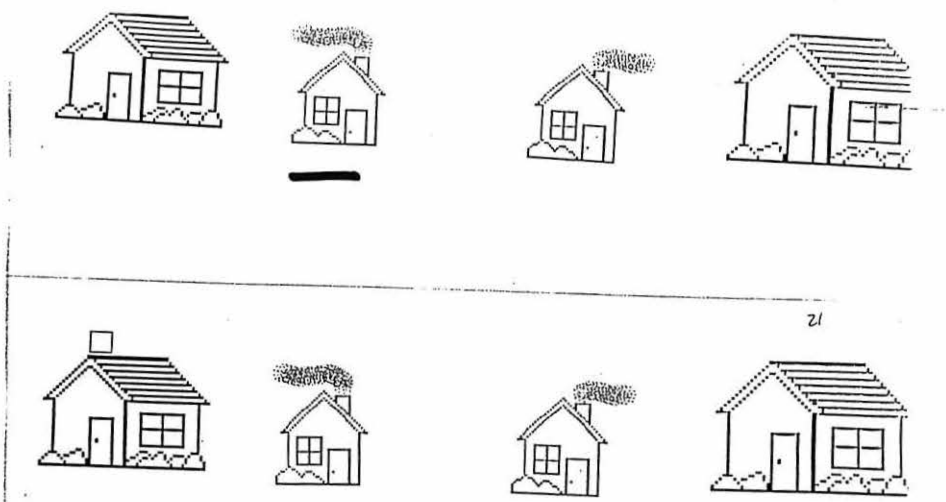
18

Appendix: 6 continued

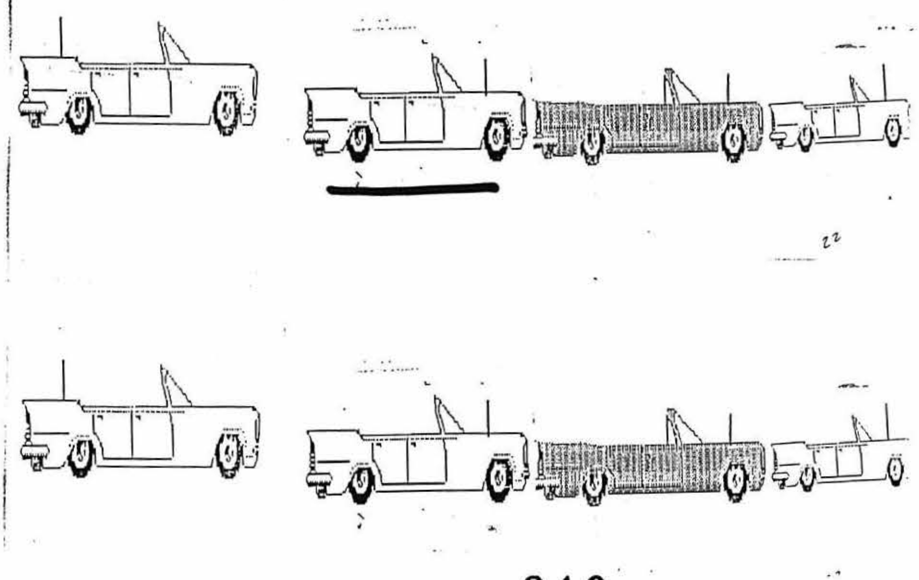
19



20

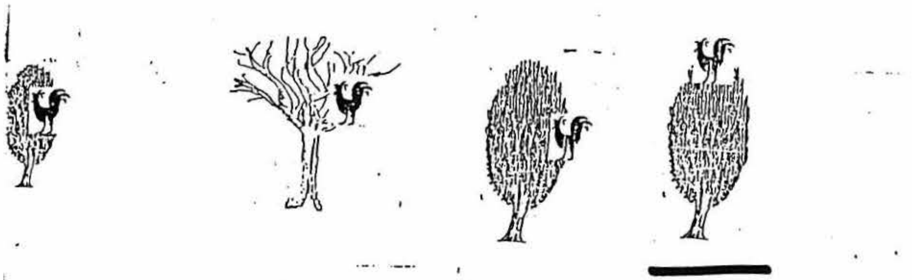


21



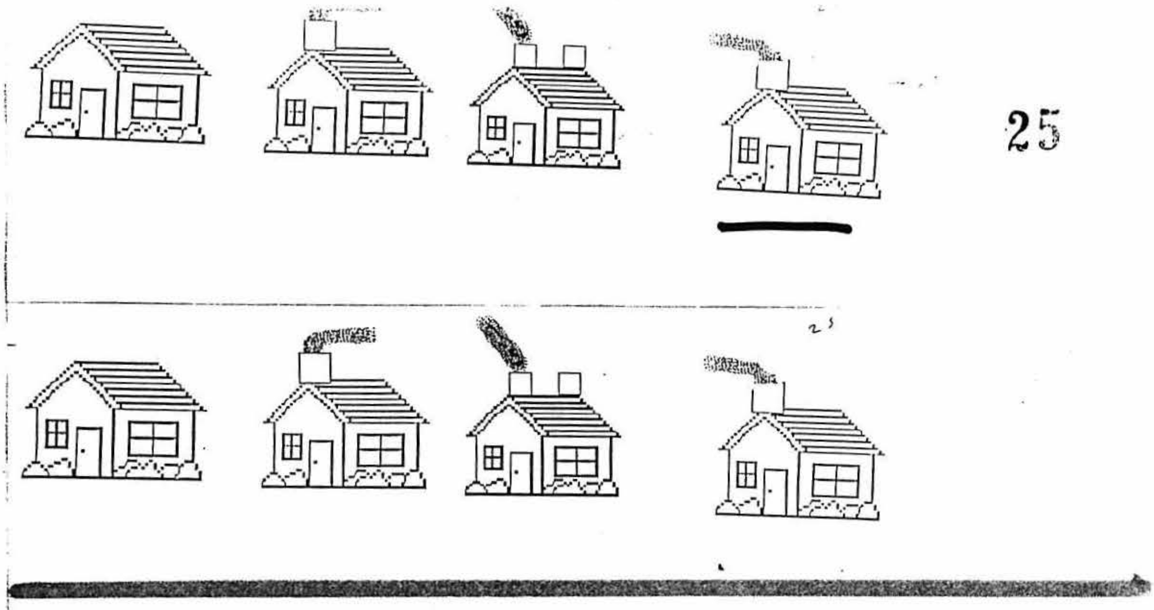
22

23

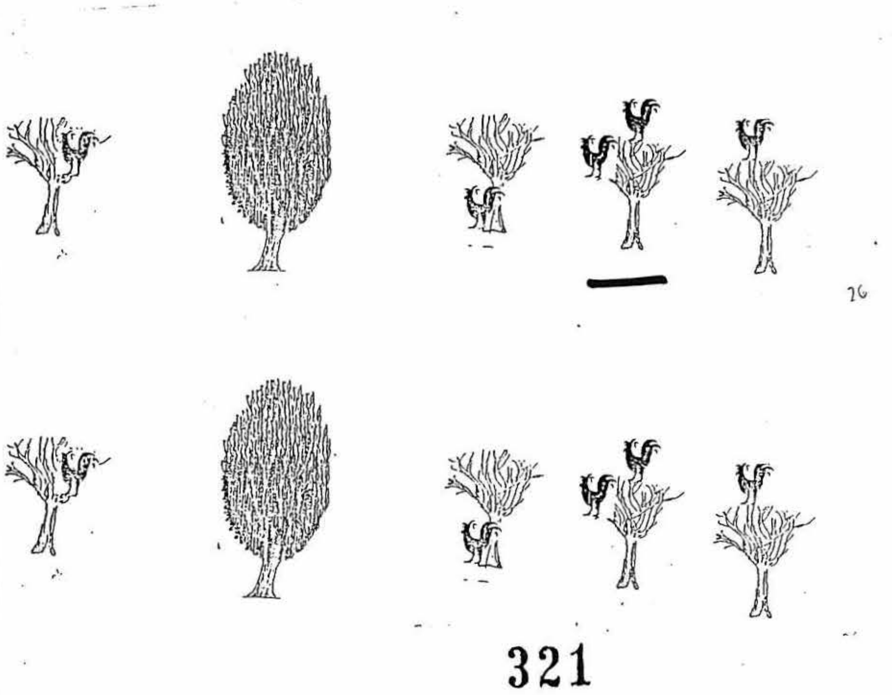


24

25

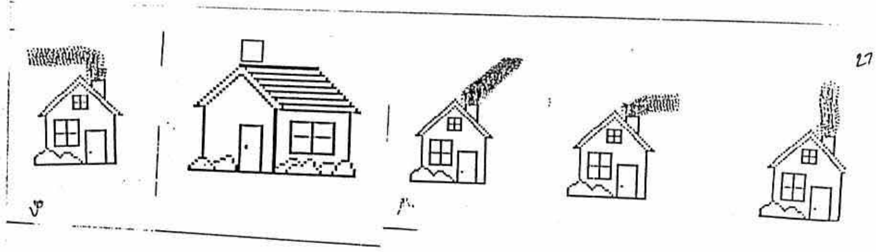


26

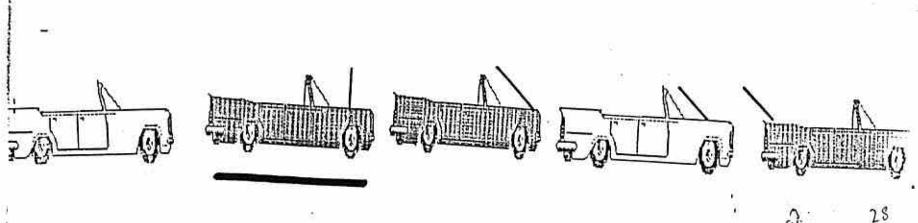


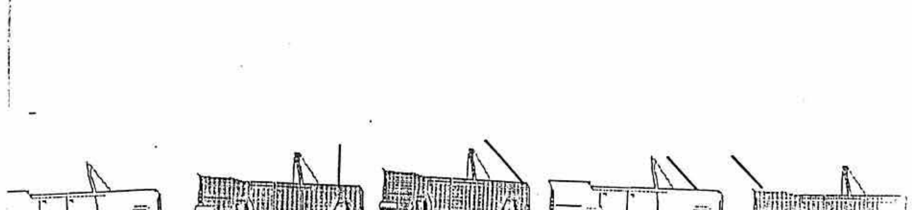
Appendix: 6 continued

27

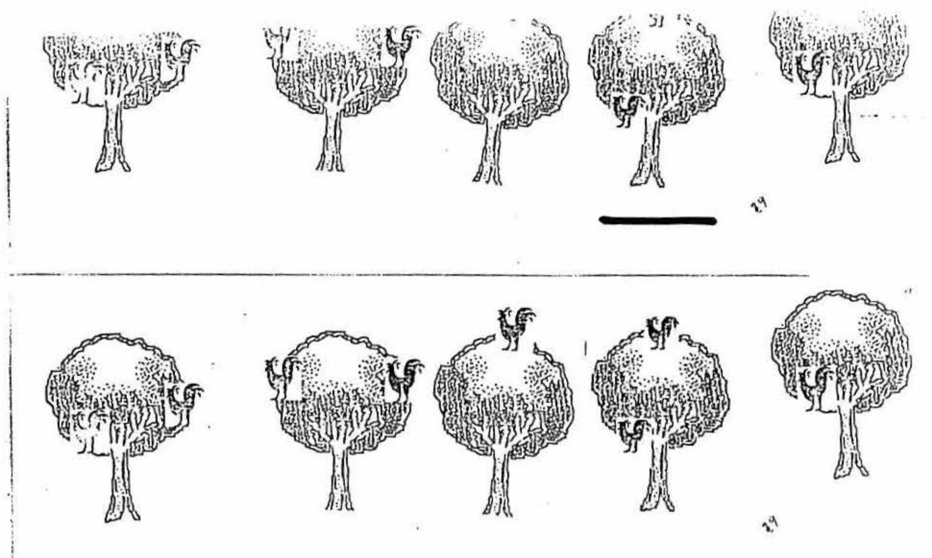


28





Appendix: 6 continued



29

30

Appendix: 7
Message adequacy: Three series, Practice (P), A and B

Referent sets in the message adequacy tests. In series, 'A', subjects were reminded that what a person, such as the experimenter, says to them might be inadequate. In the second series 'B', they were given a stronger indication of a speaker liability to give inadequate messages and also given a large circle to tick if messages are inadequate.

Practice trials:

1

2

3

4

Appendix: 7 continued

Message adequacy: SET A -

1

2

3

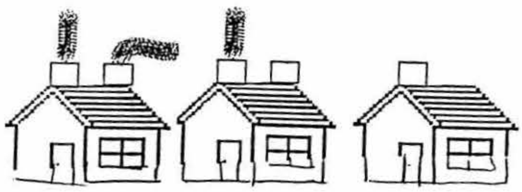
4

5

Appendix: 7 continued

Message adequacy:

6



7

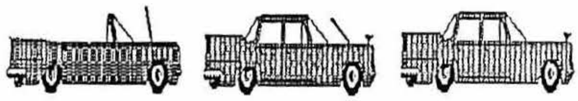
8

9

10

Appendix: 7 continued

Message adequacy:



11

12

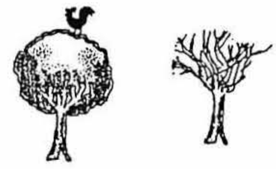
13

14

15

Appendix: 7 continued

Message adequacy:



16

17

18

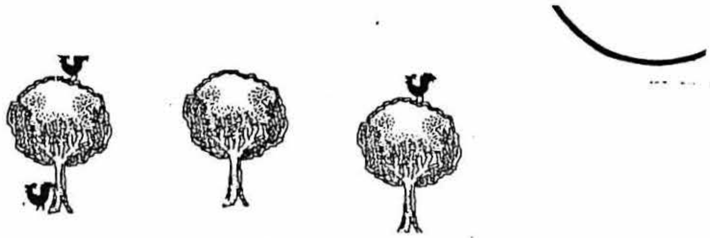
19

20

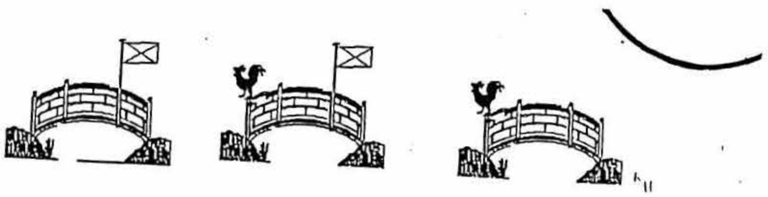
Appendix: 7 continued

Message adequacy: SET B -

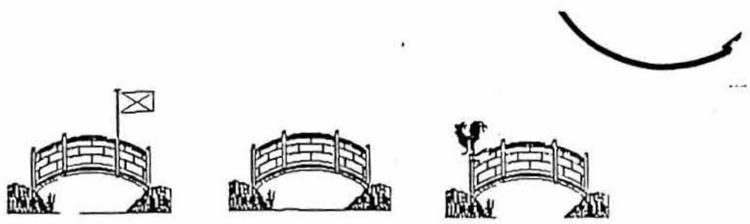
1



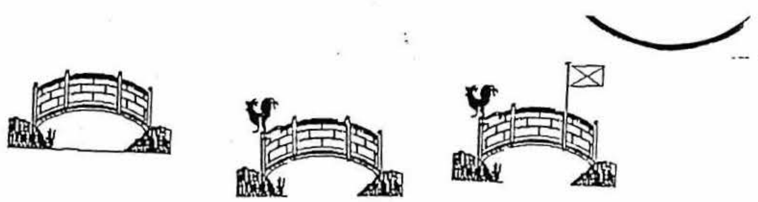
2



3



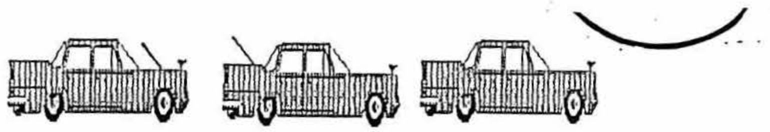
4



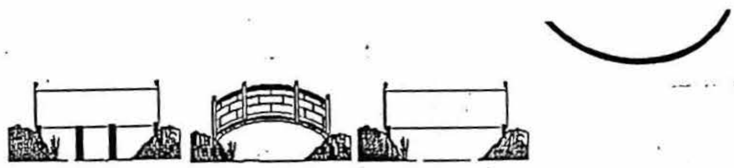
5

Appendix: 7 continued

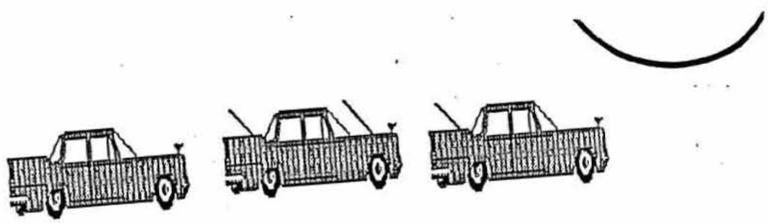
Message adequacy:



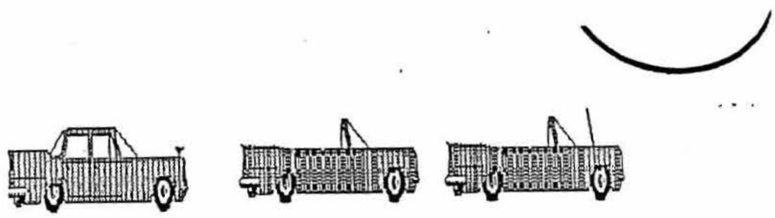
6



7



8



9

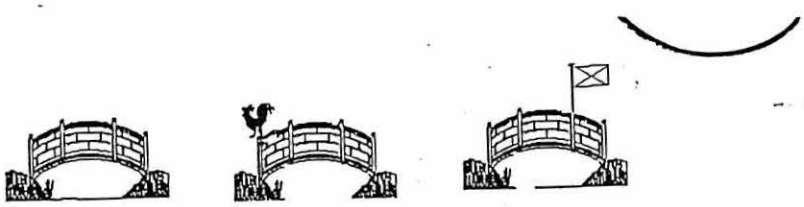
10

Appendix: 7 continued

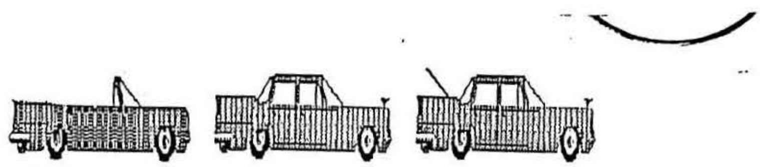
Message adequacy:

11

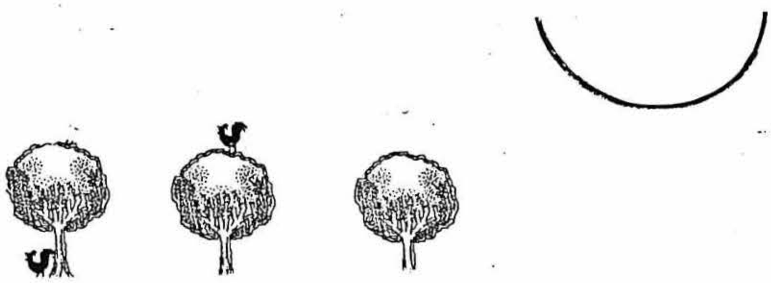
12



13



14



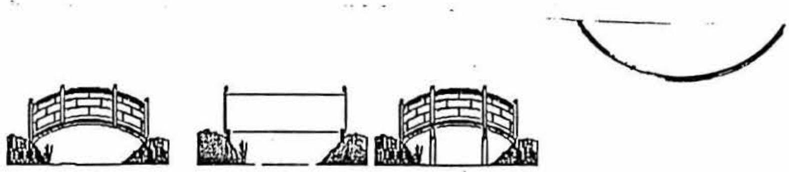
15

Appendix: 7 continued

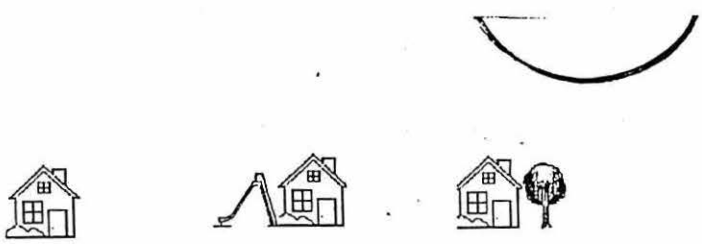
Message adequacy:

16

17



18



19

20

Appendix: 8
Message Adequacy test: Messages for

Practice:
1. house no roof
2. house no chimney
3. car with roof
4. house with two chimneys

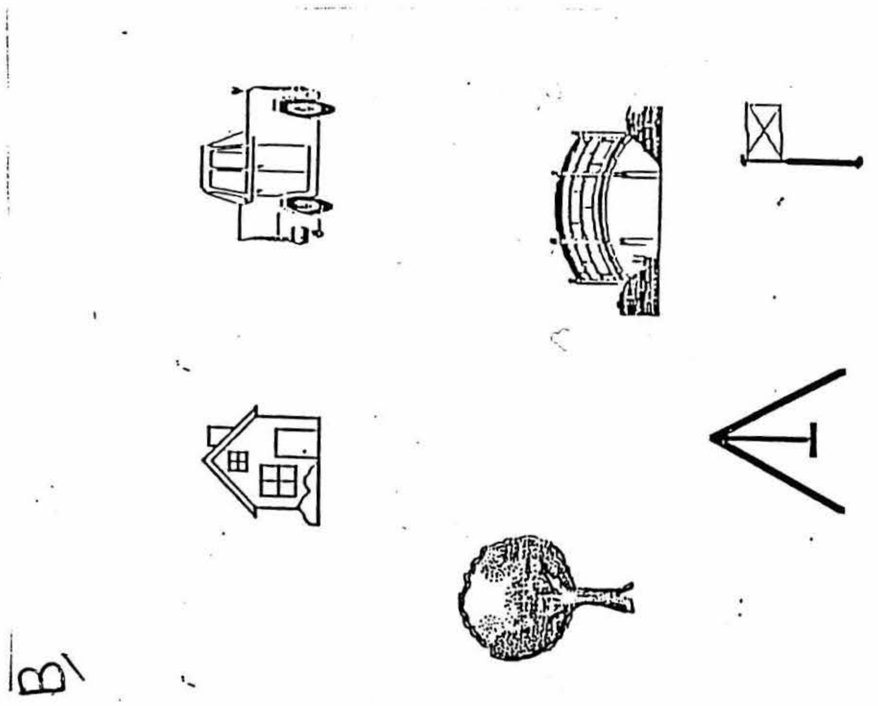
Series A
1. house with chimney
2. tree no leaves
3. house with smoke going straight
4. bridge with legs
5. house with chimney
6. house with tree
7. house with smoke straight up
8. tree with swing
9. bridge with flag
10. house with tree
11. car with no roof
12. round bridge
13. brifge with legs
14. car with roof
15. house with small window
16. tree with no leaves
17. round bridge
18. bridge with flag
19. house with small window
20. tree with swing

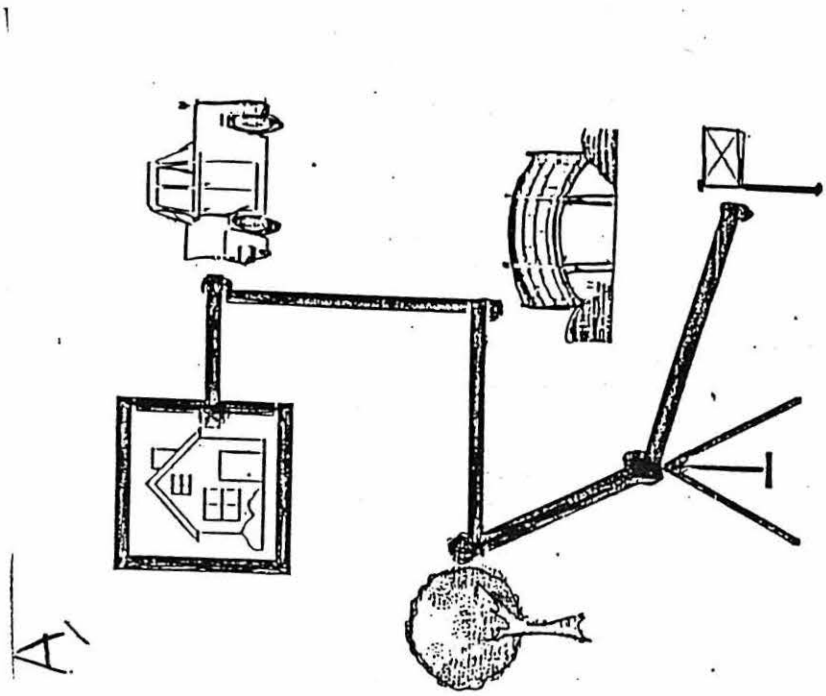
Series B:
1. house with two windows
2. tree with bird on top
3. bridge with flag
4 tree with bird
5. tree with bird
6. car with aerial on back
7. flat bridge
8 car with aerial on back
9 car no roof
10. house with smoke
11. house with smoke
12. house with two windows
13. bridge with flag
14. car no roof
15. tree with bird on top
16. house with slide
17. house with big window
18. flat bridge
19. house with slide
20. house with big window

Appendix: 9

Subject tested as a speaker with maps.

Practice: <u>(A for speaker and B for listener)</u>

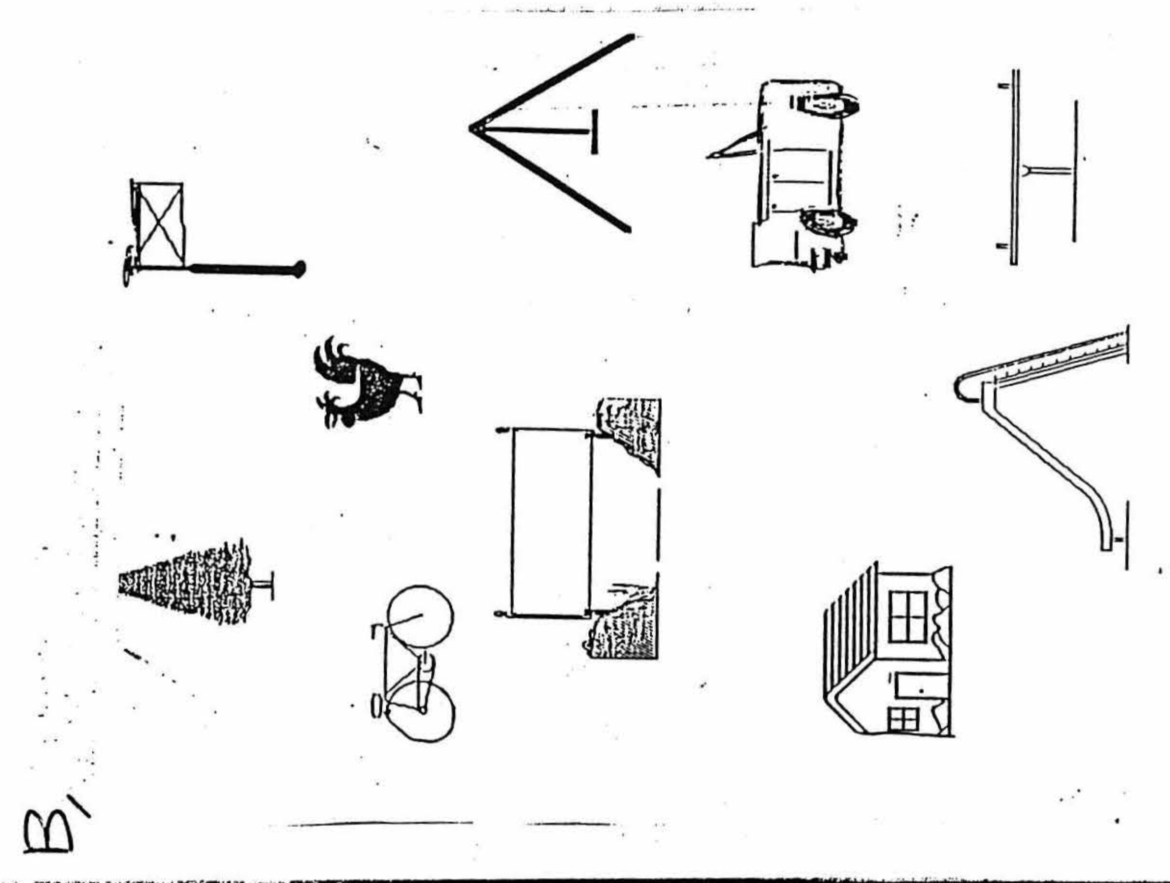


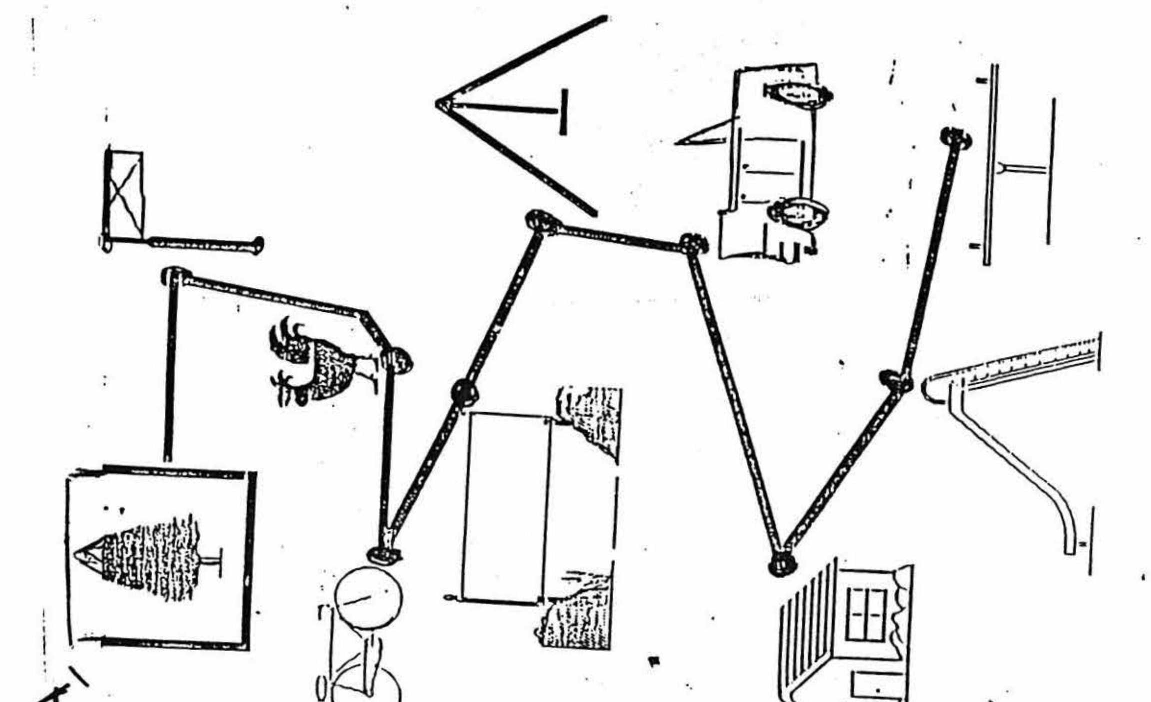


(Appendix: 9 continued)

1. Subject as a speaker with nominally distinct referents (SpND)

(A for speaker and B for listener)

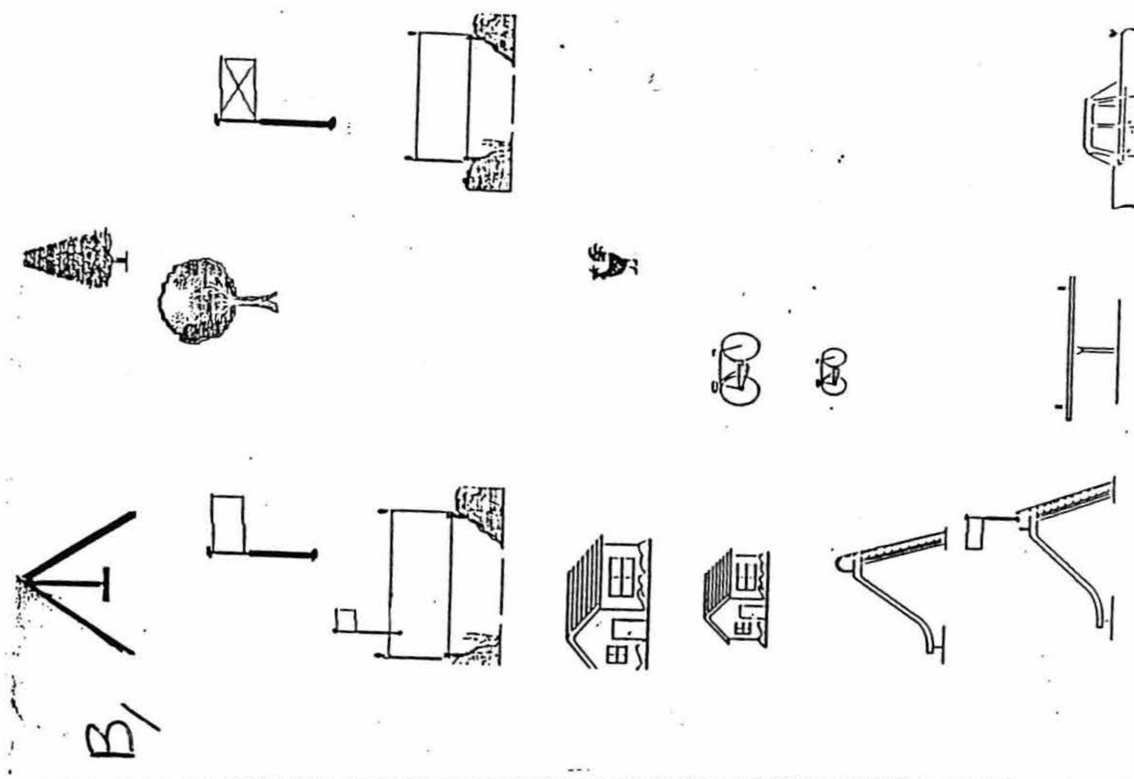


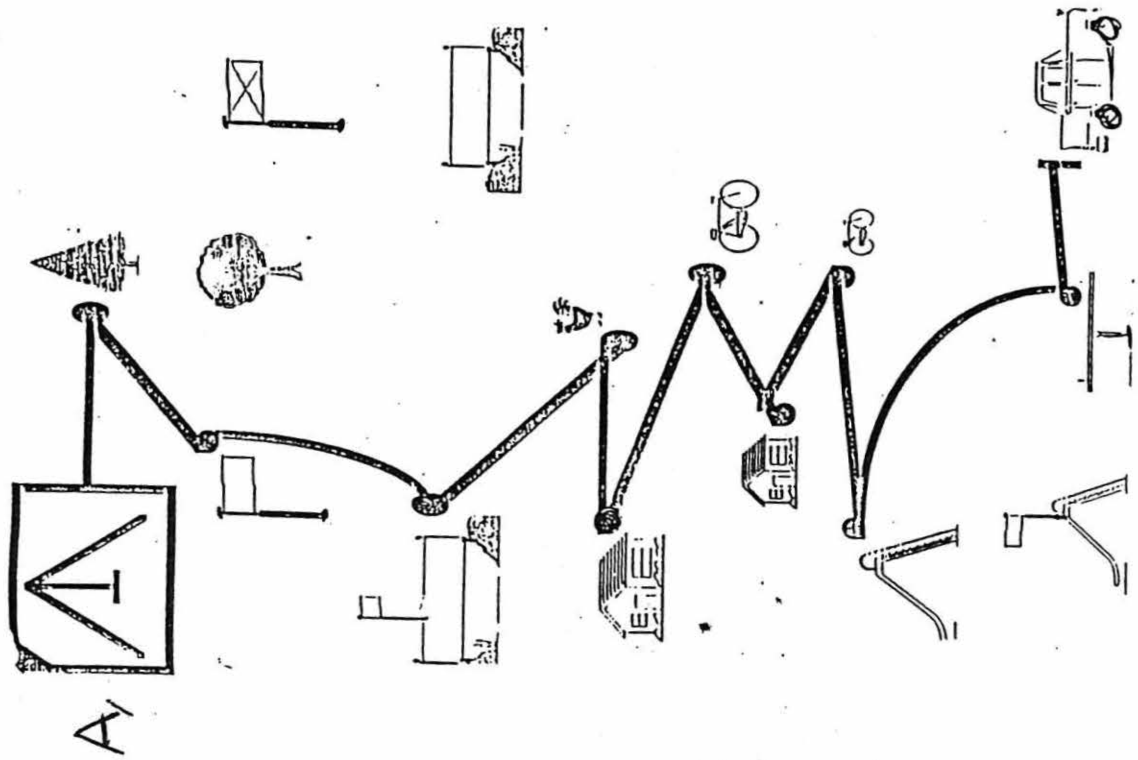


(Appendix: 9 continued)

2. Subject as a speaker with nominally similar referents (SpNS).

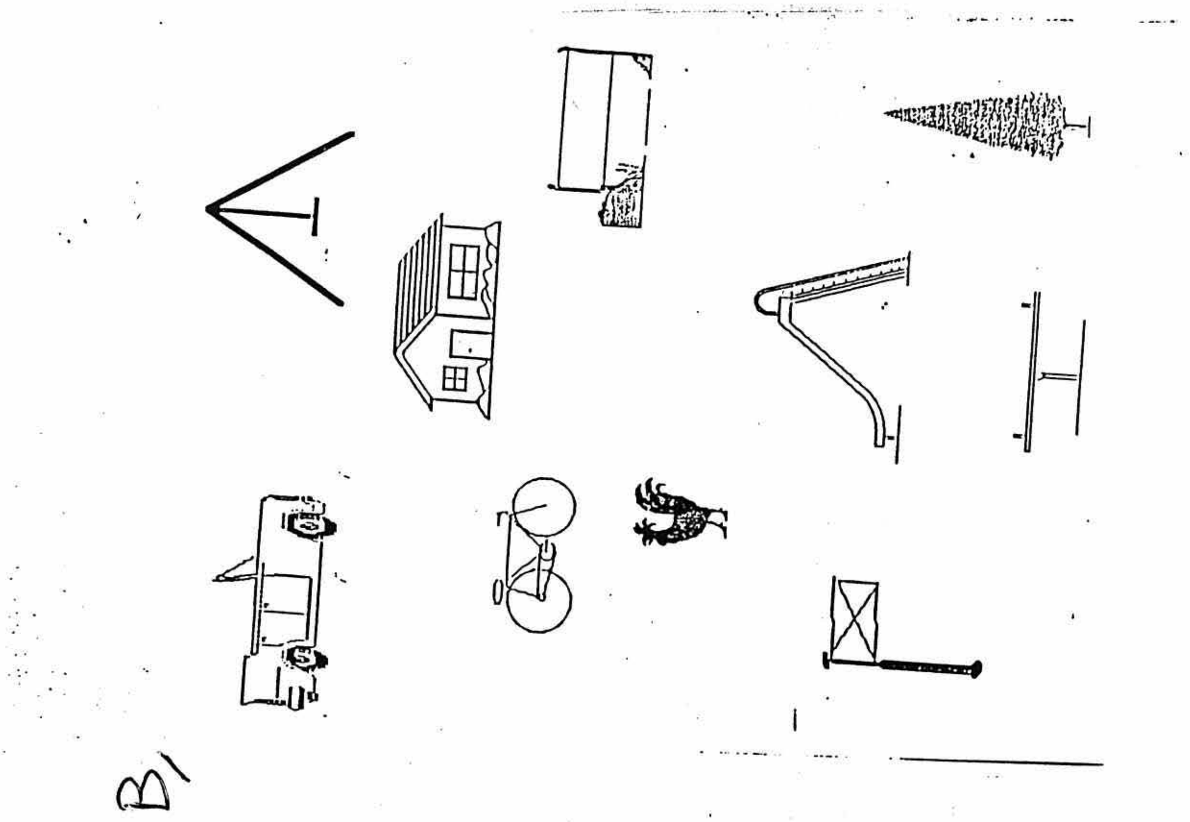
(A for speaker and B for listener)

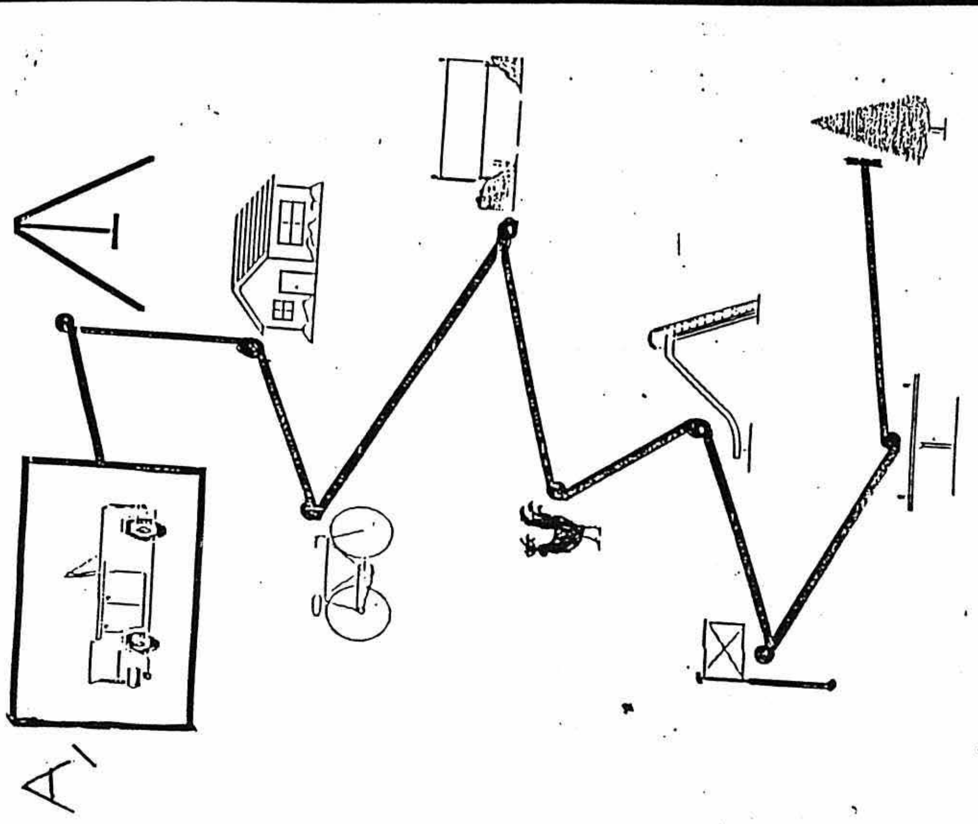




(Appendix: 9 continued)

3. Subject as a speaker with nominally distinct referents, and guidance from experimenter (SpNDG).
(A for speaker and B for listener)

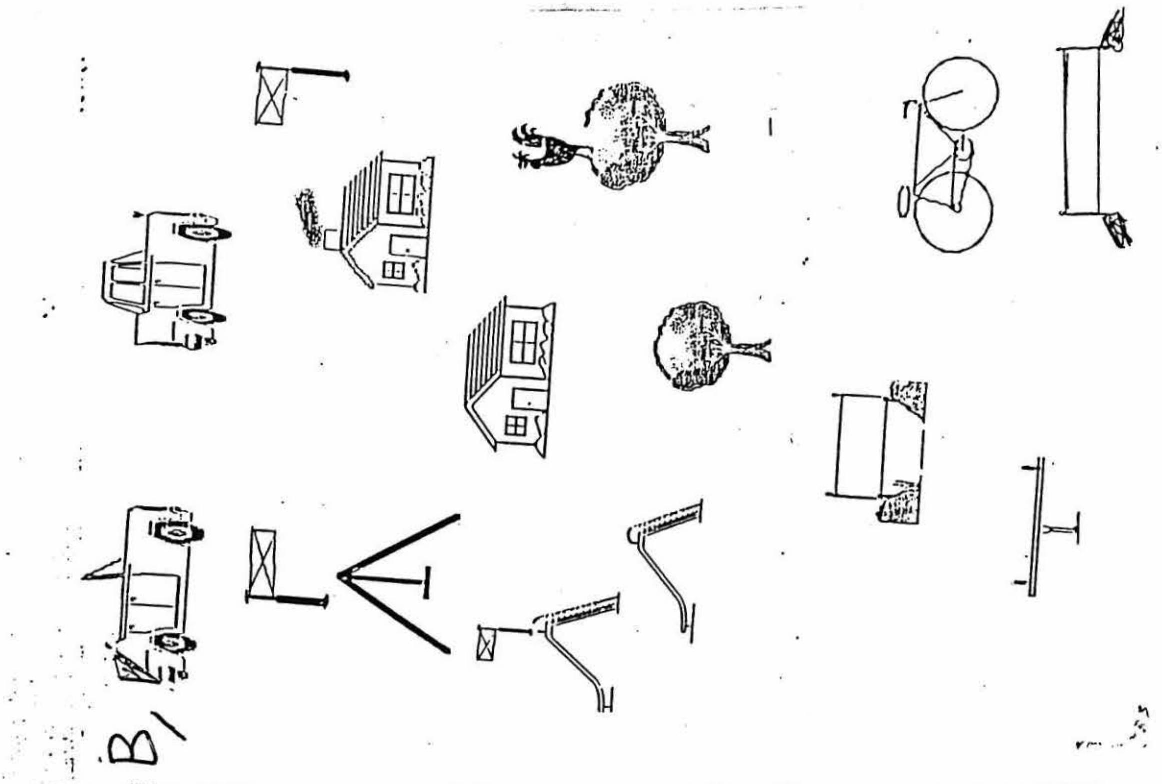


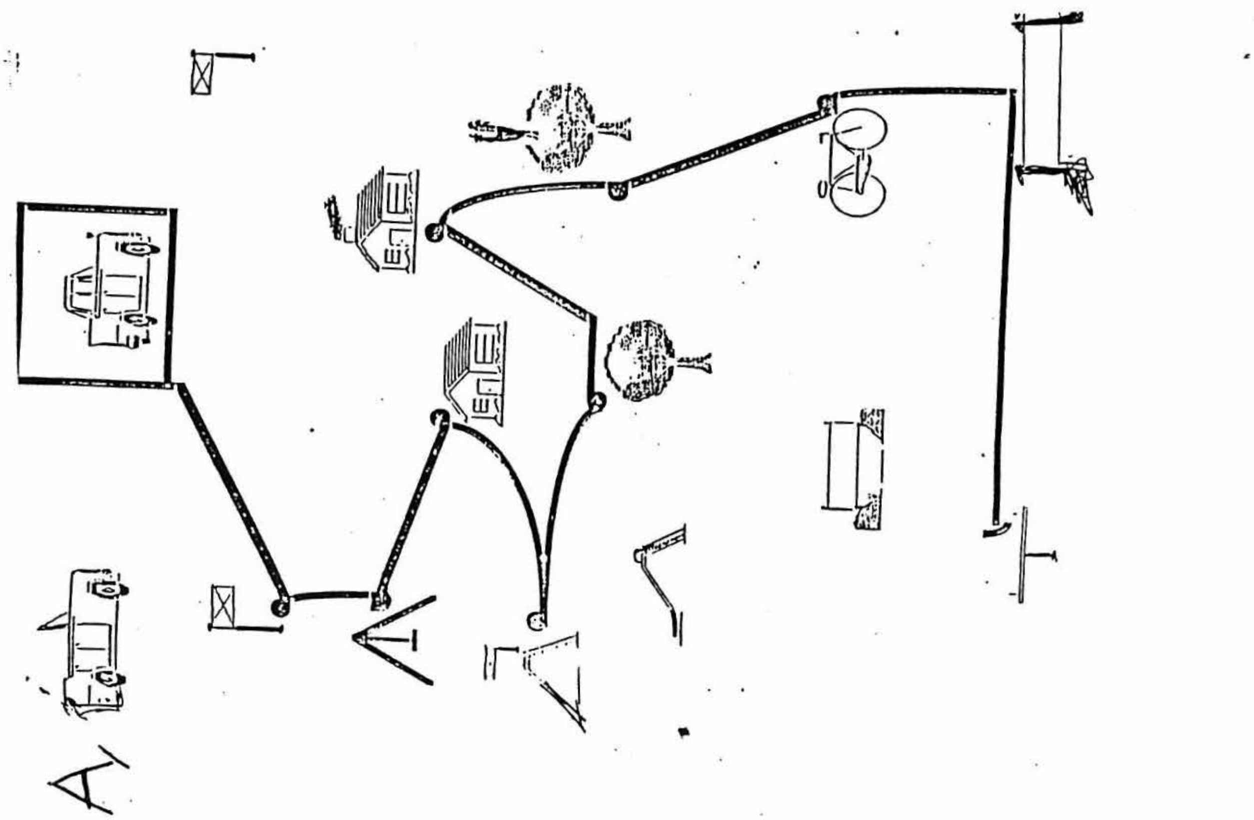


(Appendix: 9 continued)

4. Subject as a speaker with nominally similar referents, and guidance from experimenter (SpNSG).

(A for speaker and B for listener)

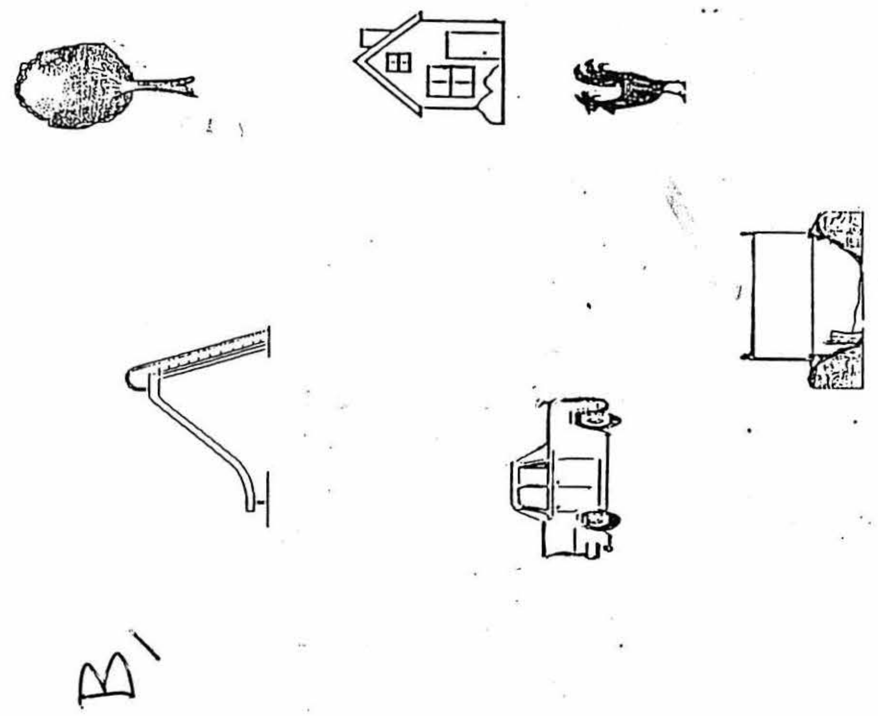


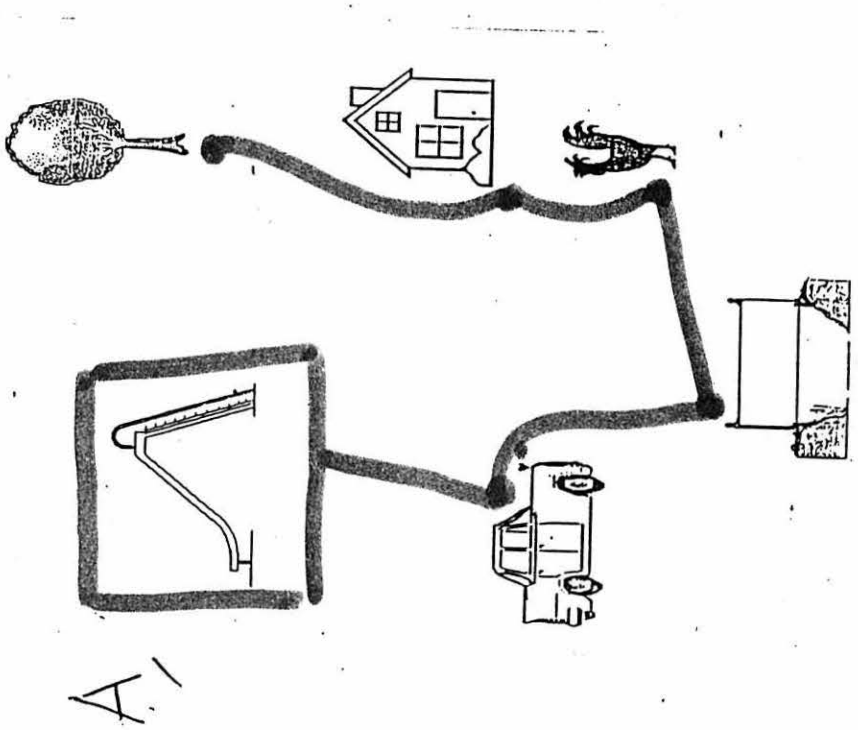


Appendix: 10

Subject tested as a listener with maps.

Practice: <u>(A for speaker and B for listener)</u>

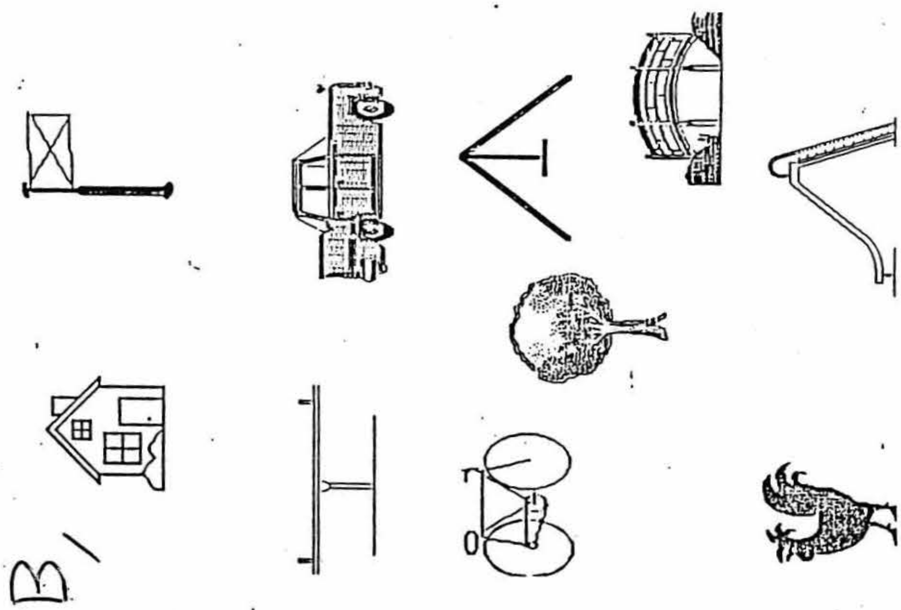


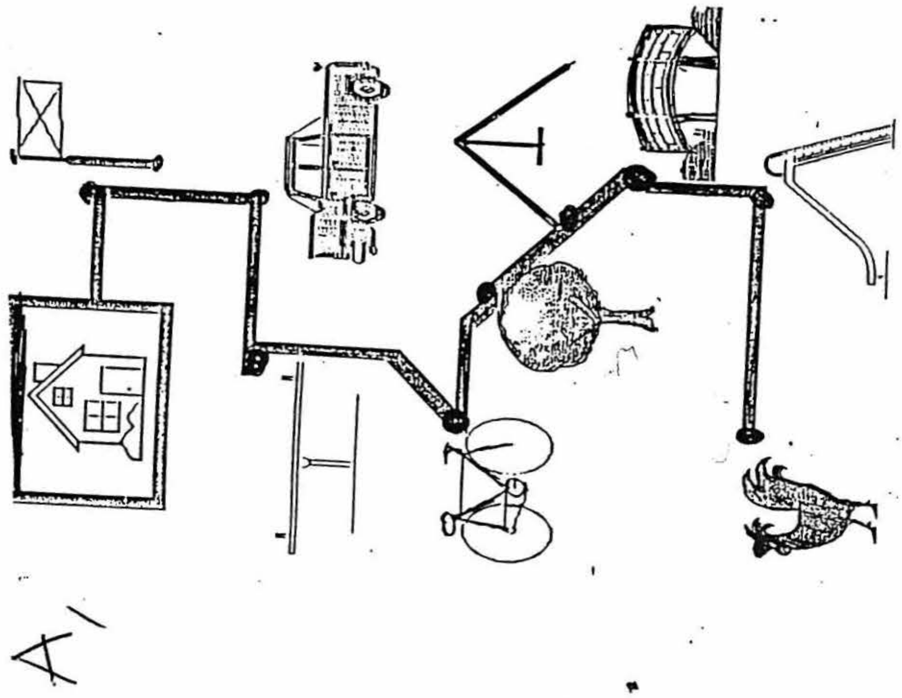


(Appendix: 10 continued)

1. Subject as a listener with nominally distinct referents (LiND)

(A for speaker and B for listener)

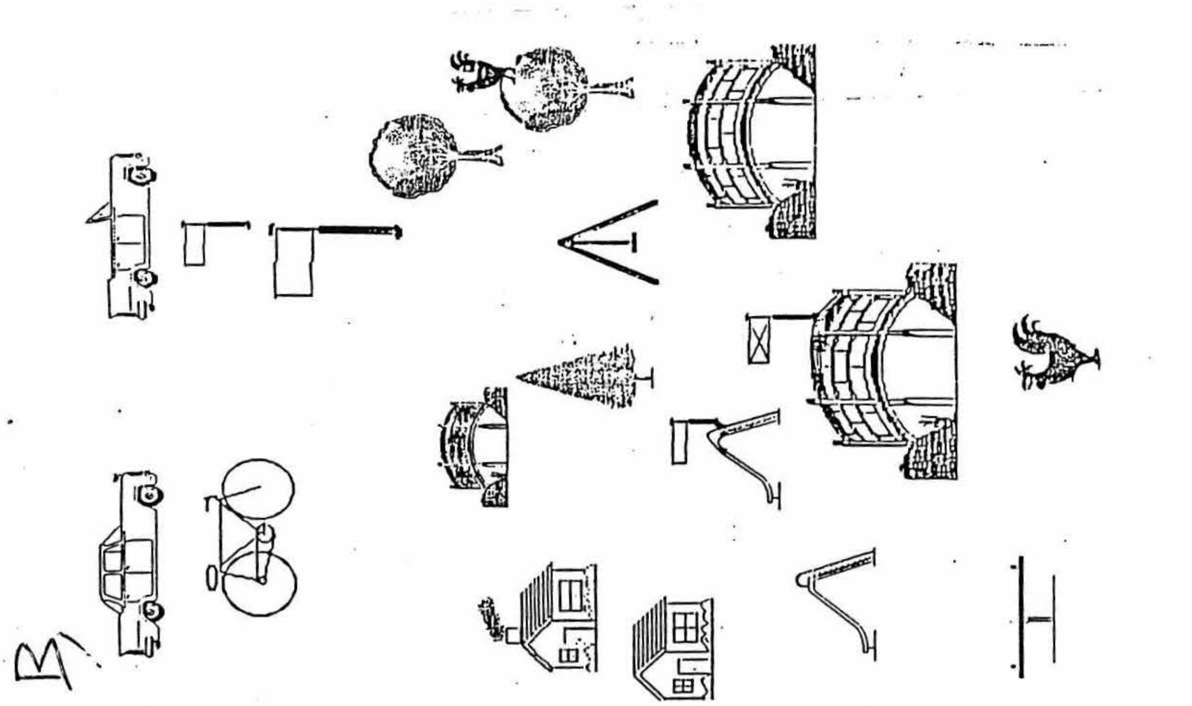


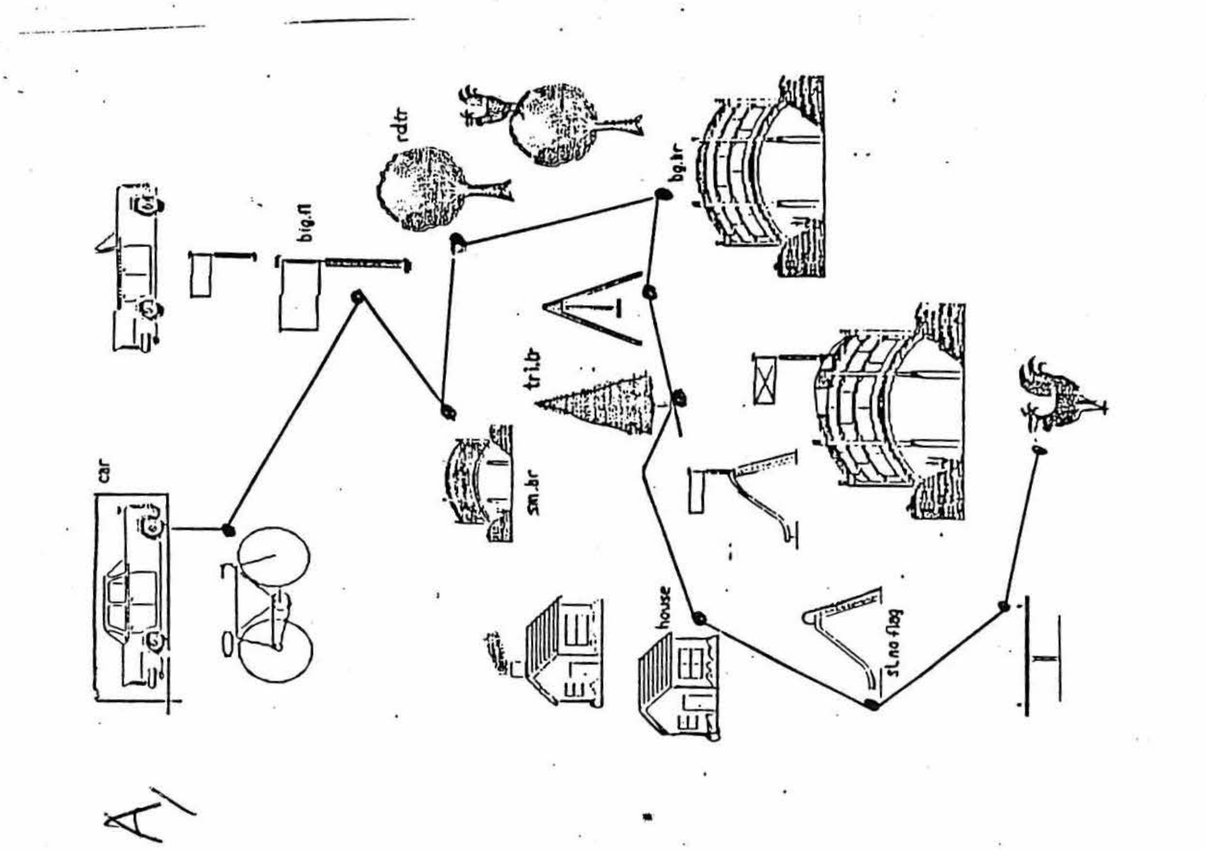


(Appendix: 10 continued)

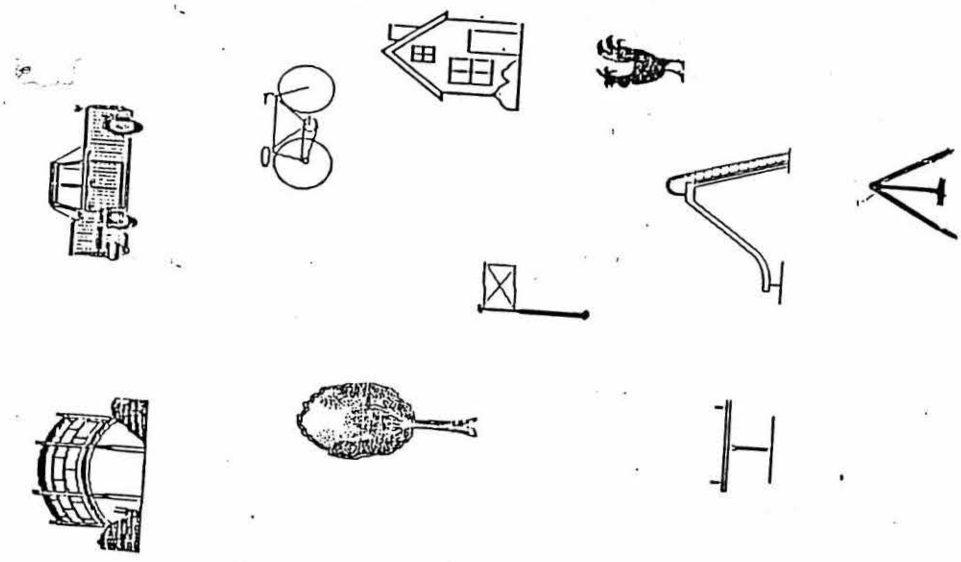
2. Subject as a listener with nominally similar referents (LiNS).

(A for speaker and B for listener)

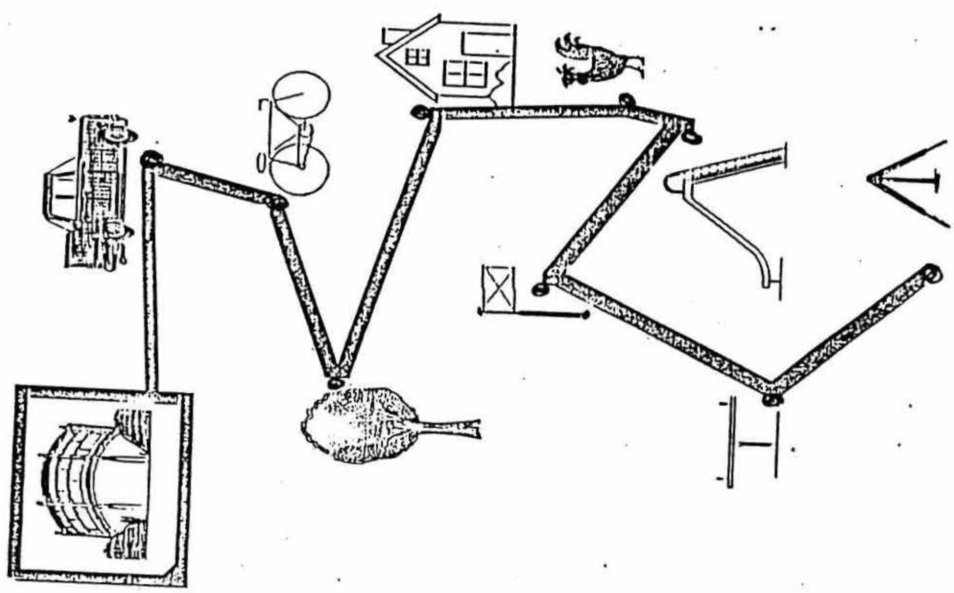




(Appendix: 10 continued)
3. Subject as a Listener with nominally distinct referents, and guidance from experimenter (LiNDG).
(A for speaker and B for listener)



B

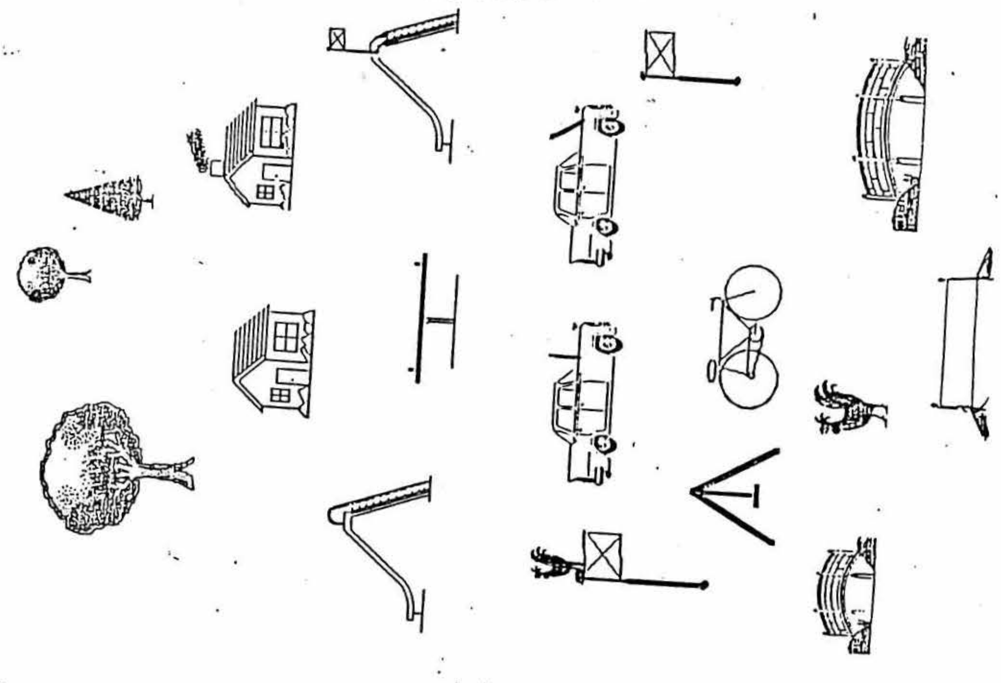


A

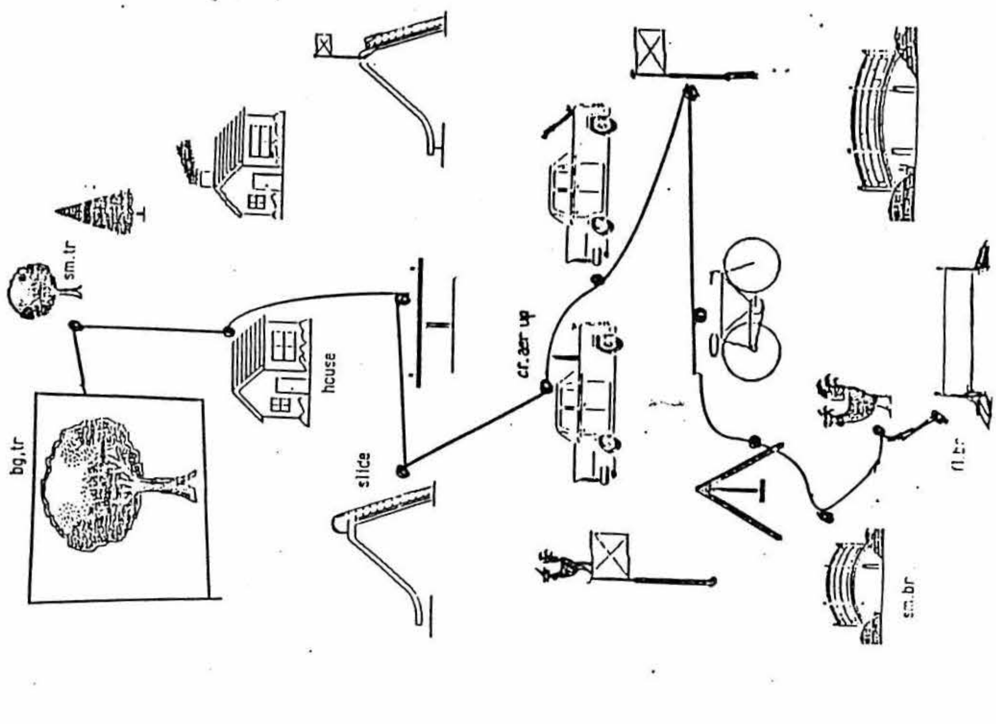
(Appendix: 10 continued)

4. Subject as a listener with nominally similar referents, and guidance from experimenter (LiNSG).

(A for speaker and B for listener)



B



A

Appendix: 11
Hinting hierarchies for speaker and listener role

Speaker Role Hinting Hierarchy:

Instruction:
E-"I'll try and help by talking about what you could do,
-- the speaker"

Task Orienting ;
1. What is it ?
2. Its a Map-like Thing !

Task Function :
3. What has it got ?
4. yours got things joined up by a road!
5. Do you know something I don't ?
6. Has mine got a road ?
7. No only you have a road

Task Clarification;
8. *Are you going to tell me something ?*
9. tell me how the road goes
10. tell me how the road goes from one thing to another
11. From the THING in SQUARE to
12. the next, and ...
13. To the next...

Monitor:
1 How do you know that I'm doing all-right ?

Monitor Clarification
2. That is , that I'm joining up the things on my map Ok- - like yours. (?)
3. How do we find out if Im joining them up Ok?
4. Could you ask me something ?
5. Could you ask if I knew what to do ?
6. What should I know what to do ?
7. Could you ask me if I know to make a line from X to Y ?
8. Do you now know that I'm on the right one ?

Selective Comparison: (for map with nominally similar referents)
1. How do you make sure I get the right one ?
2. <u>If theres 2 how do you make sure</u> I pick the right one ?
3. Is one different to the other ?
4. Is X different to xy ?
5. How is X different to xy ?
6. X has .....and Y has.....
7. And I should pick ?
the one with the ?)
8. Question : did I get it right ?

Appendix 1 continued

Listener Role Hinting Hierarchy:

Task Demands:

1. **What do we need to do ?**
2. making a road
3. **What do you need to know ?**
4. how to make a road
5. Will I be telling you something ?
6. Will I tell you how to get from one thing and another on your map.
7. I'm going to tell you how the road goes.

Monitor:

1. **How do you know that you got it right ?**
2. that you're at the right place
3. Would you check ?
4. Could you check by asking me something ?
5. could you ask if you're right to be at where you are
6. Could you ask "am I right to be at X ?"
7. Now can you tell if you're in the right place ?

Speaker Inadequacy: (for map with nominally similar referents)

1. **What do you do if what I say doesn't make sense ?**
2. If there are more than one X's of the same type
3. if there are 2 X's
4. Could you ask me something ?
5. Do you ask me to tell you how they're different ?
6. that x is ...and Y is...
7. Could you ask me which of the X's to go to ?

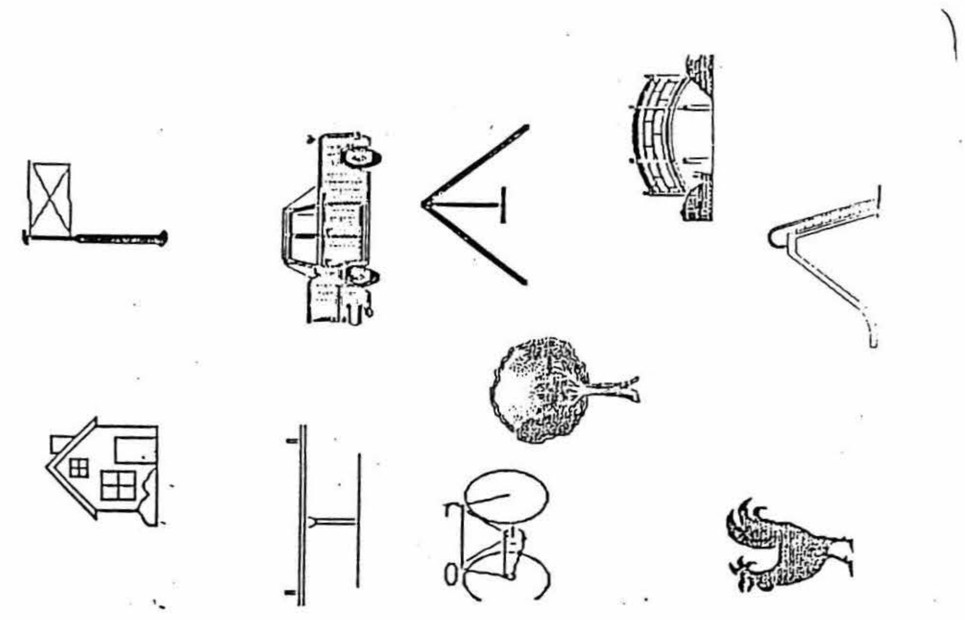
Appendix: 12

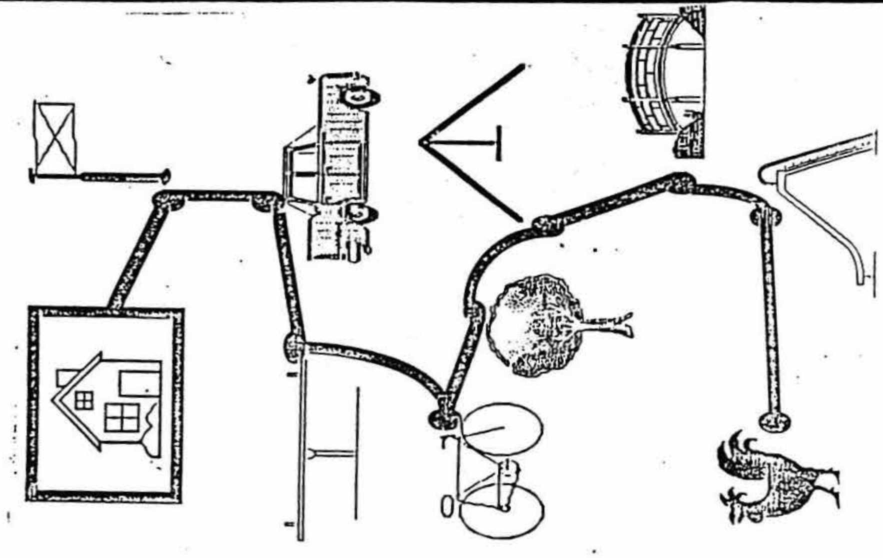
Maps used throughout training for all subjects.

Trials 1-6 for session one, trials 7-12 for session two and trials 13-18 in session three

(Left map for speaker and right map for listener)

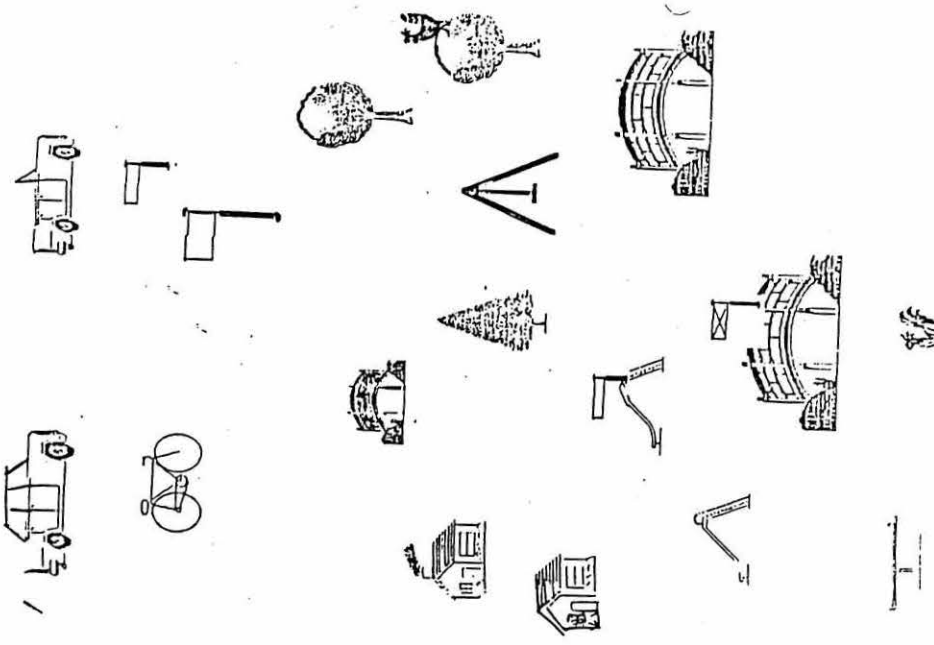
Trial 1. Outdoors.nominally distinct

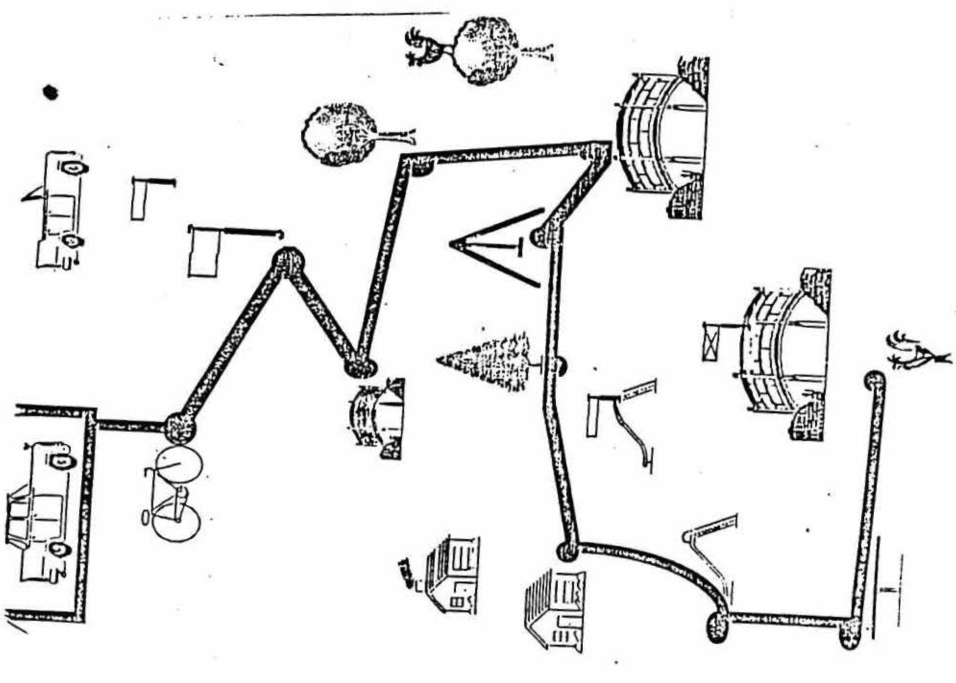




Appendix:(continued) 12

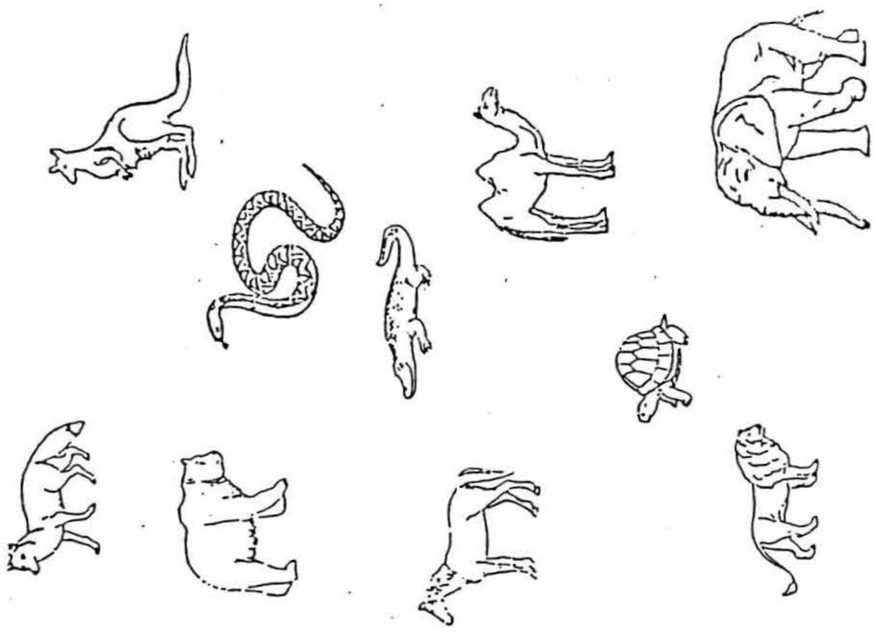
Trial 2. Outdoors.nominally similar

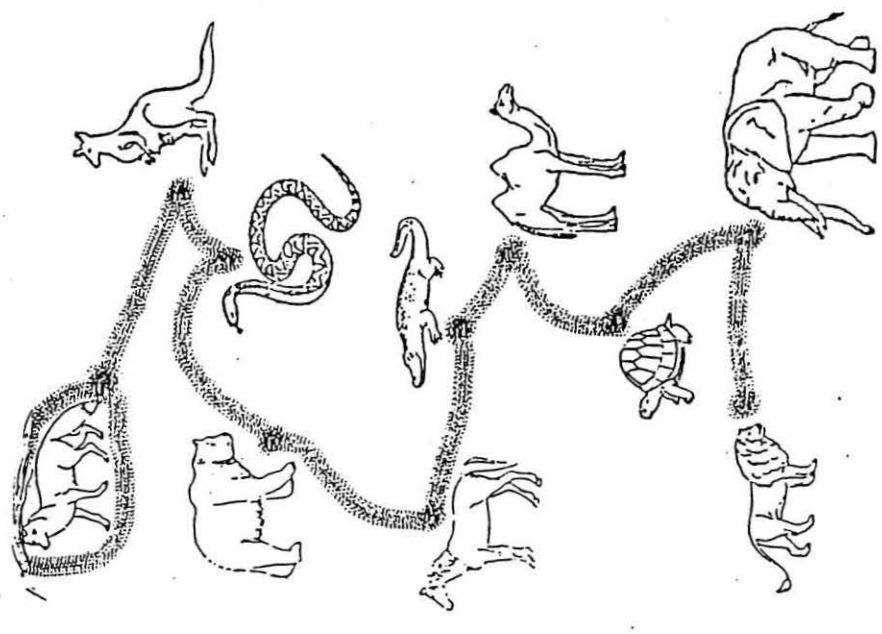




Appendix: (continued) 12

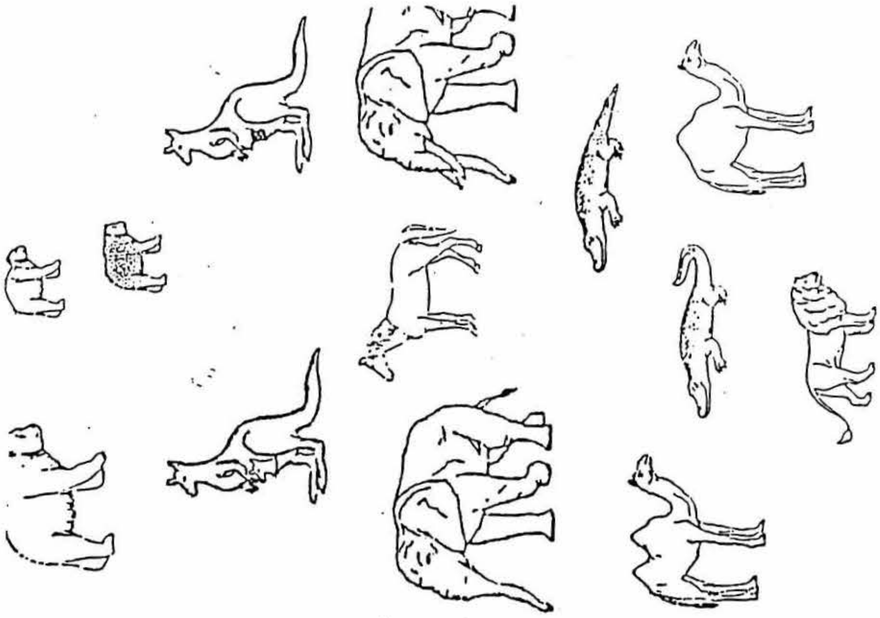
Trial 3. Animals.nominally distinct

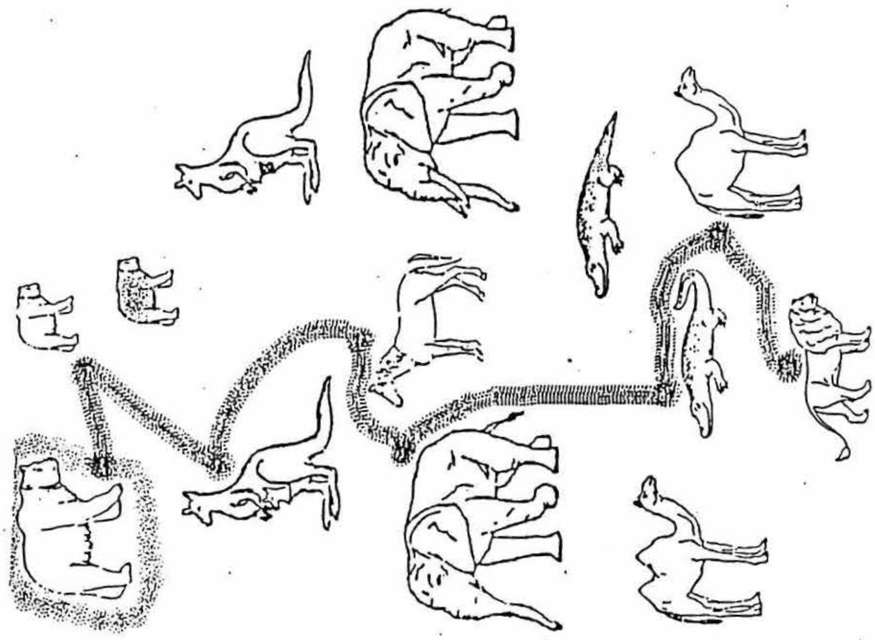




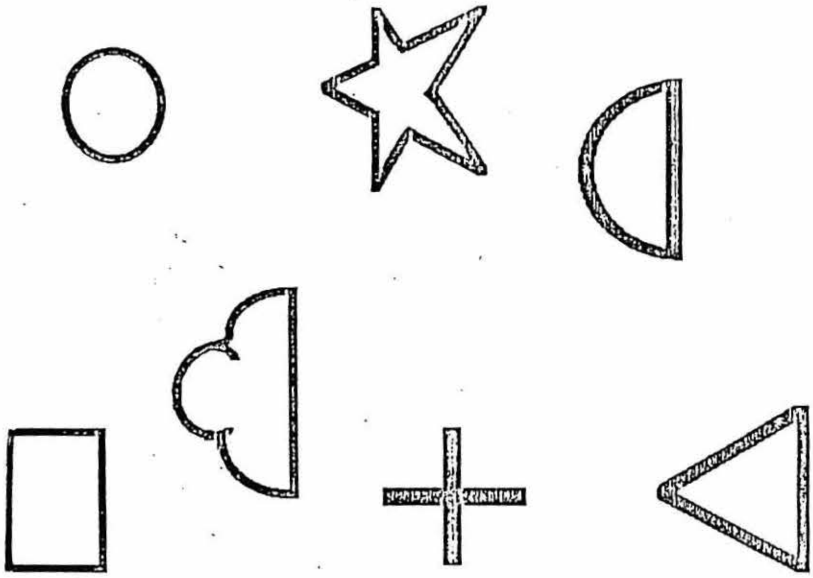
Appendix (continued) 12

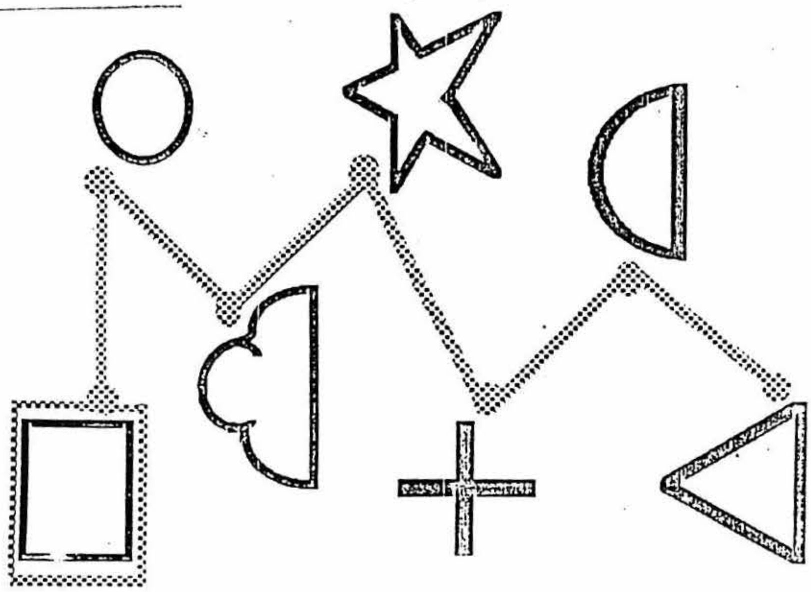
Trial 4. Animals.nominally similar





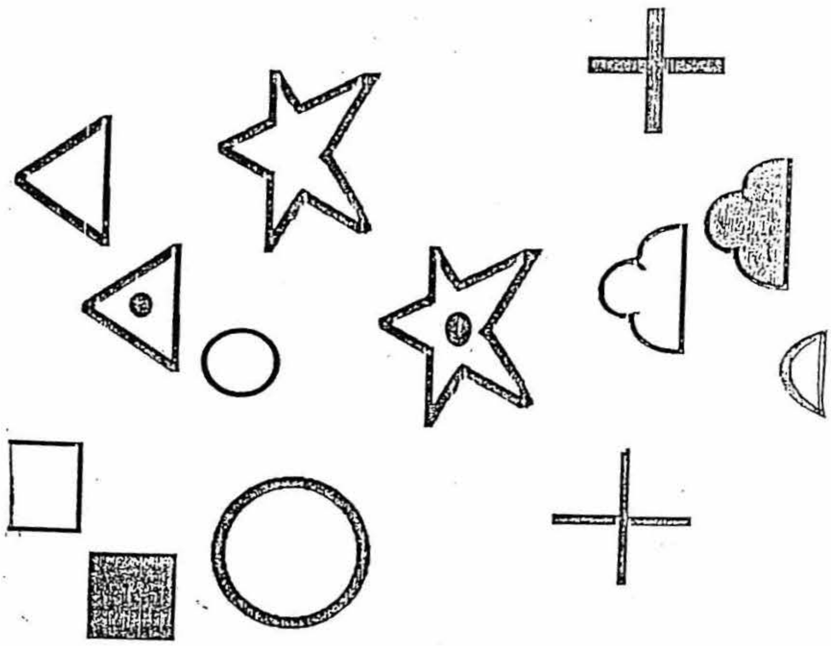
Appendix(continued) 12
Trial 5. Shapes.nominally distinct

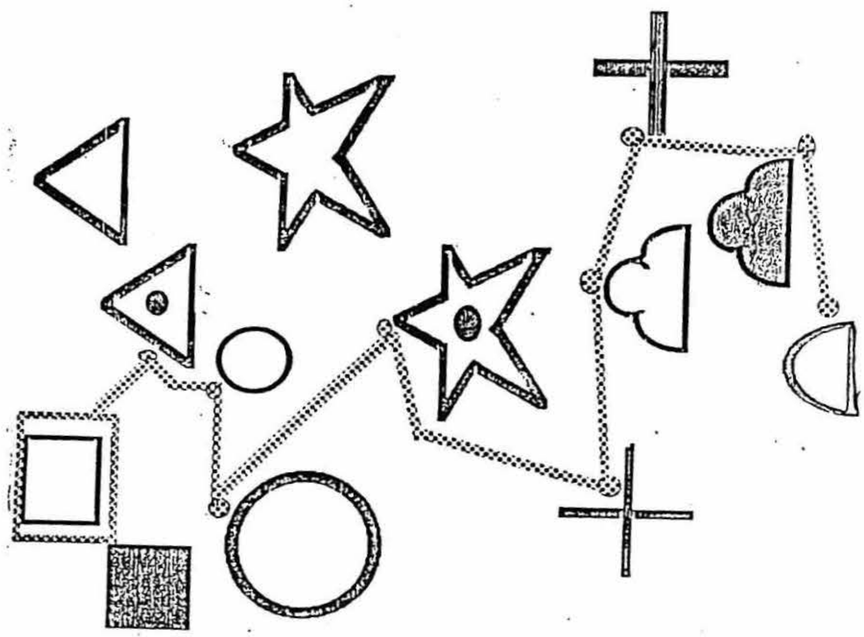




Appendix: (continued) 12

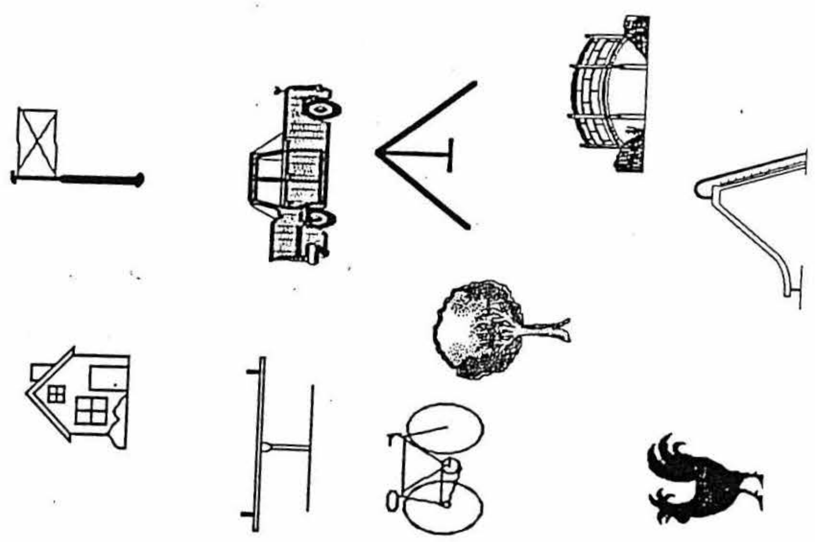
Trial 6. Shapes.nominally similar

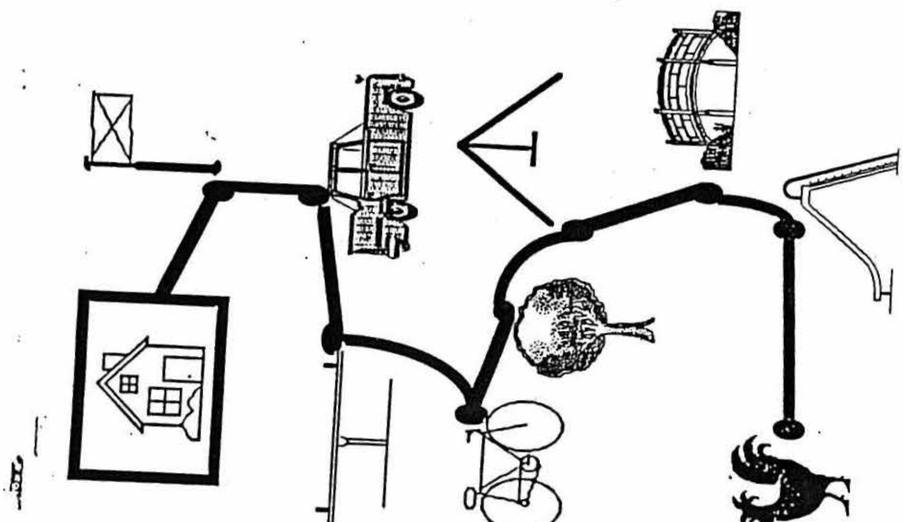




Appendix (continued) 12

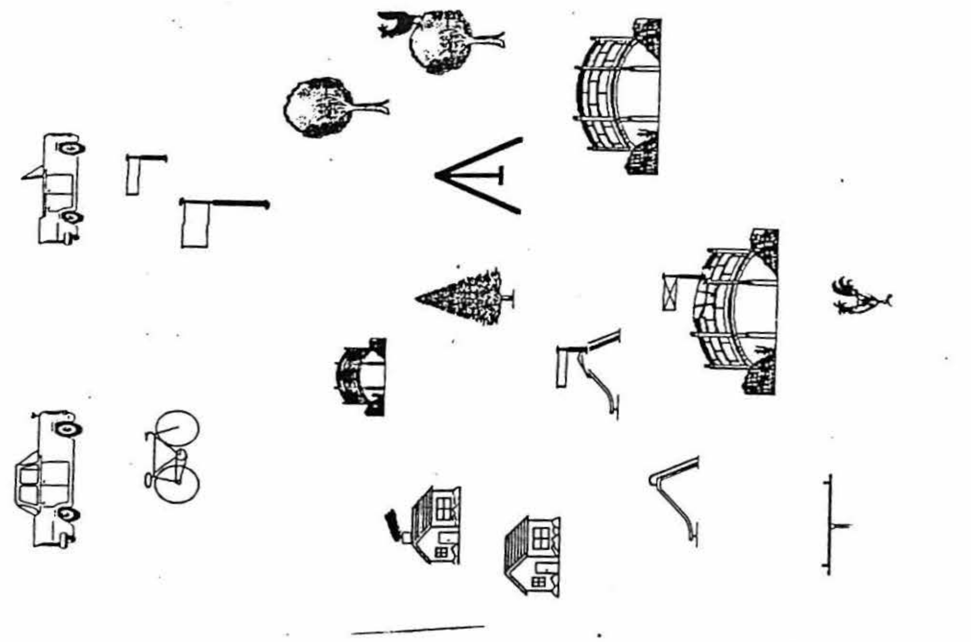
Trial 7. Outdoors.nominally distinct

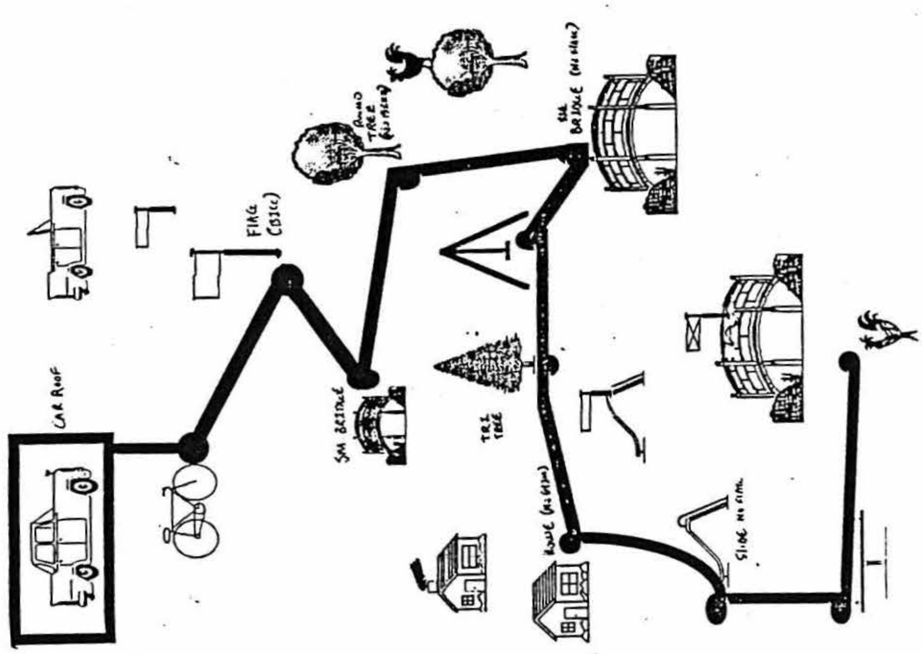




Appendix: (continued) 12

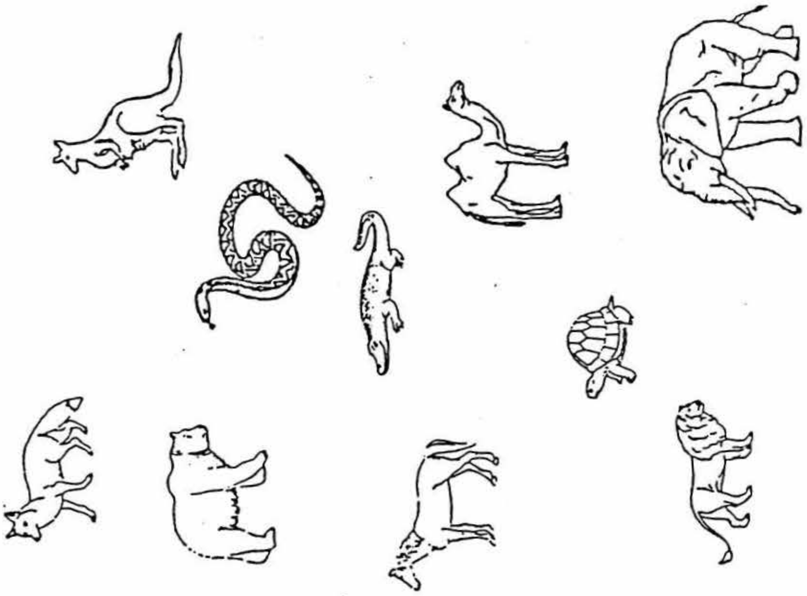
Trial 8. Outdoors.nominally similar

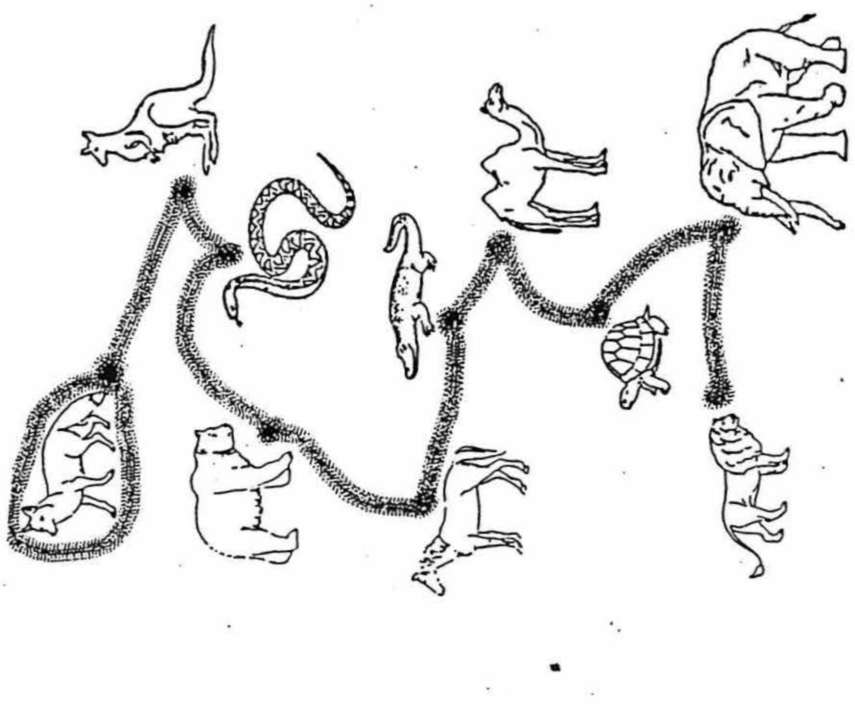




Appendix(continued) 12

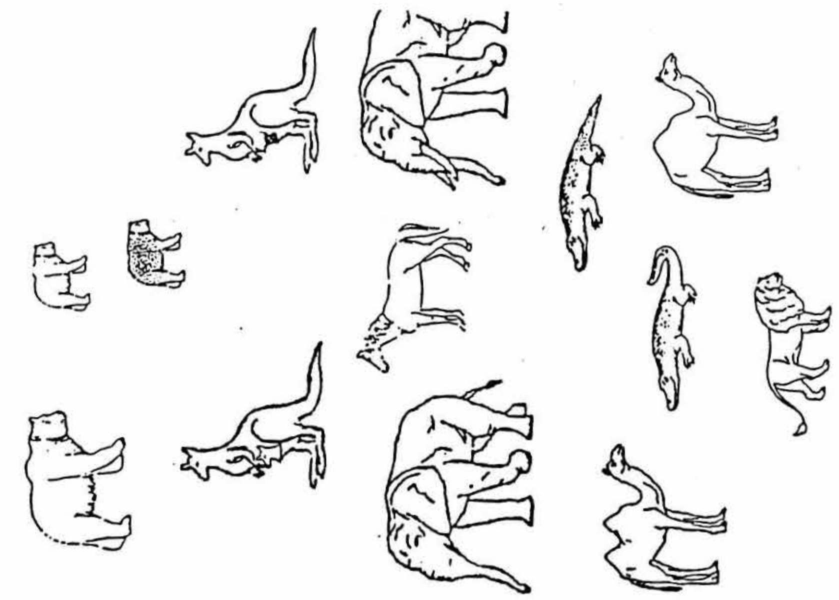
Trial 9. Animals.nominally distinct

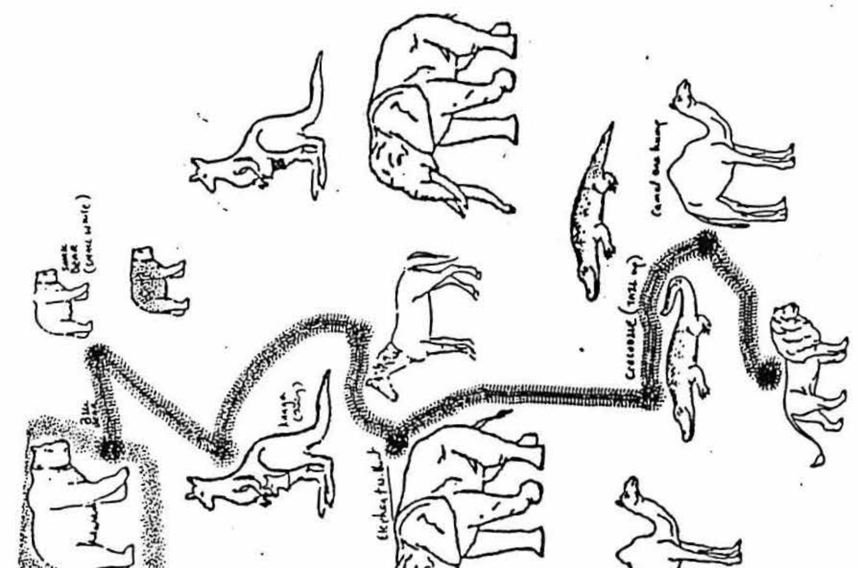




Appendix: (continued) 12

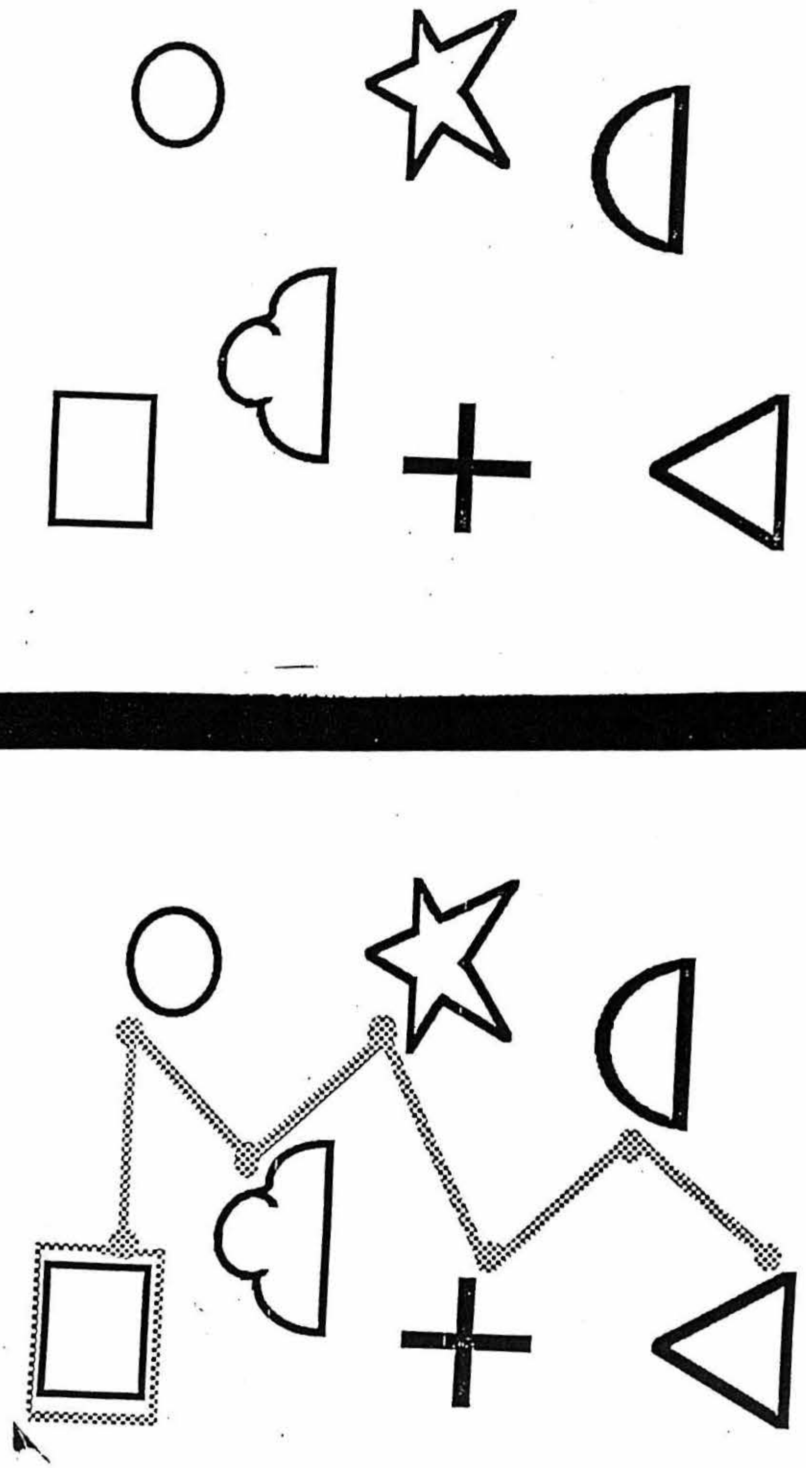
Trial 10. Animals.nominally similar





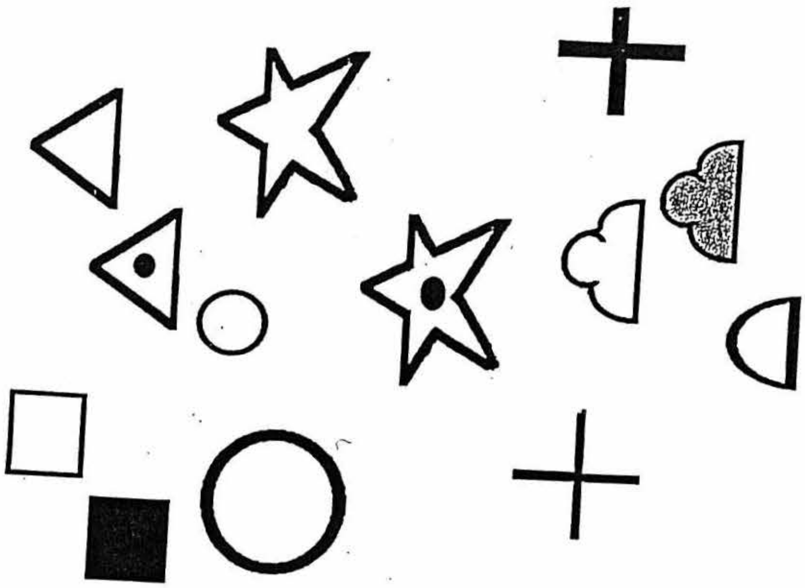
Appendix: (continued) 12

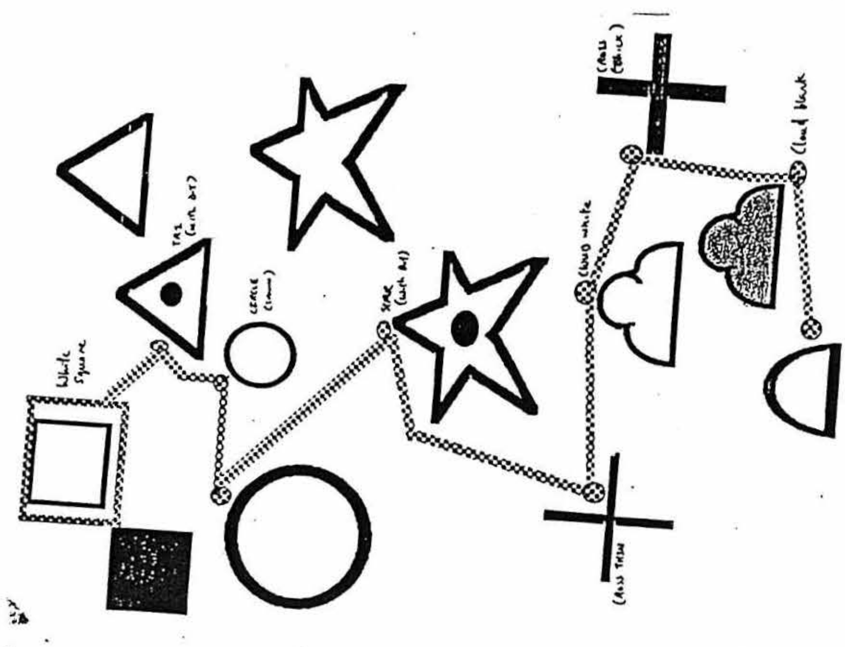
Trial 11. Shapes.nominally distinct



Appendix:(continued) 12

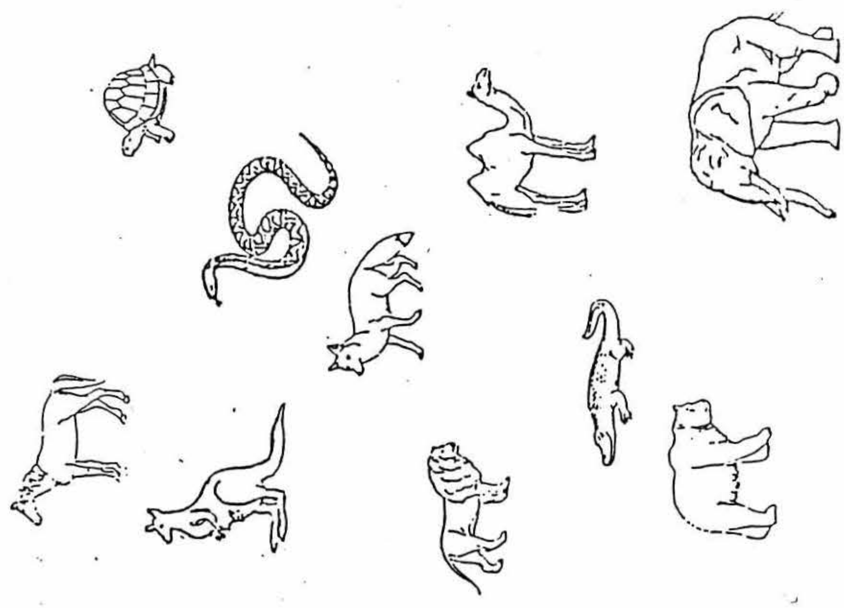
Trial 12. Shapes.nominally similar

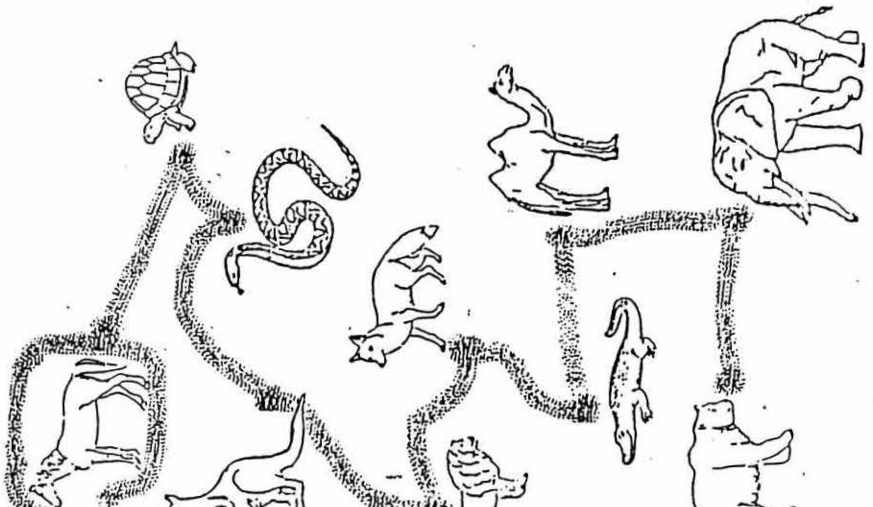




Appendix:(continued) 12

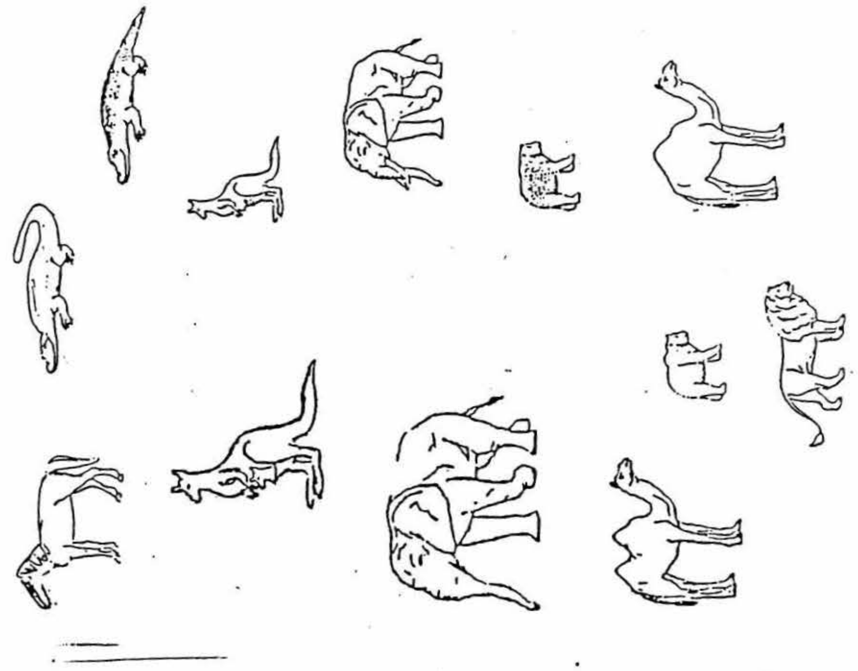
Trial 13. Animals.nominally distinct

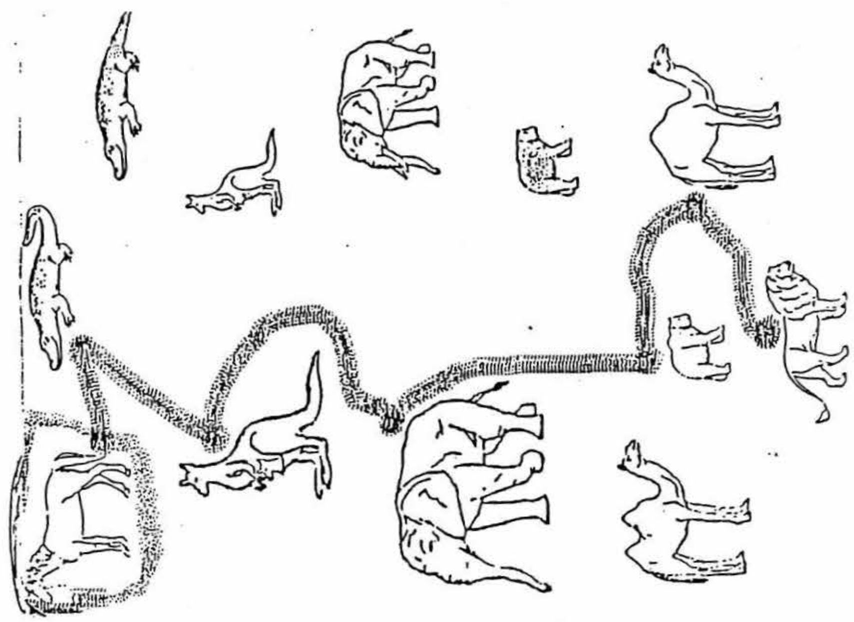




Appendix: (continued) 12

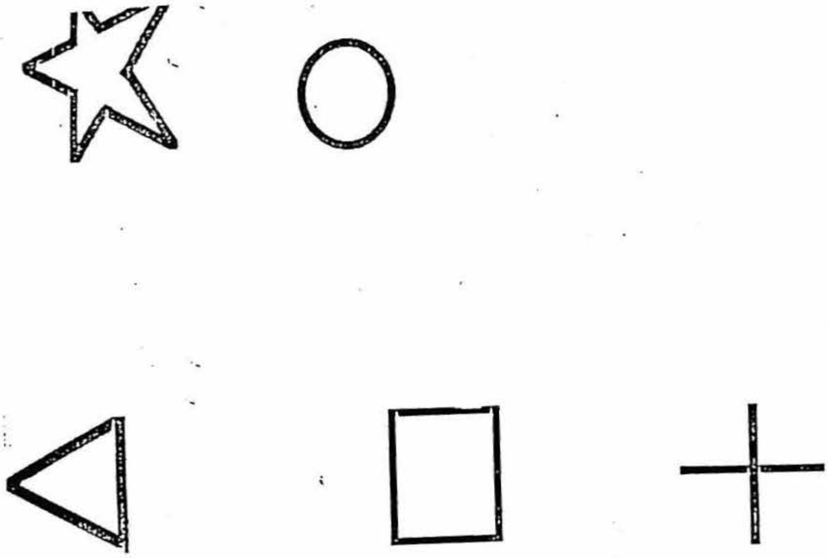
Trial 14. Animals.nominally similar

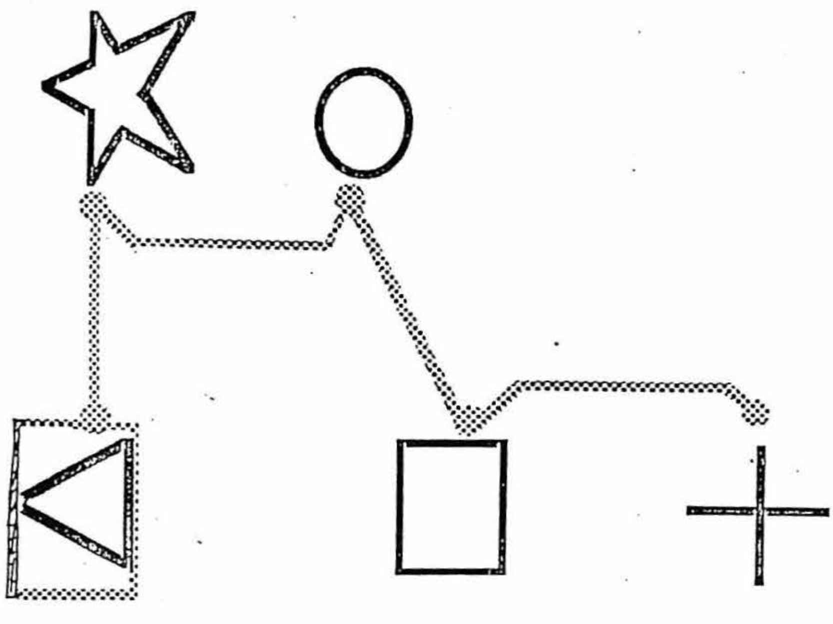




Appendix:(continued) 12

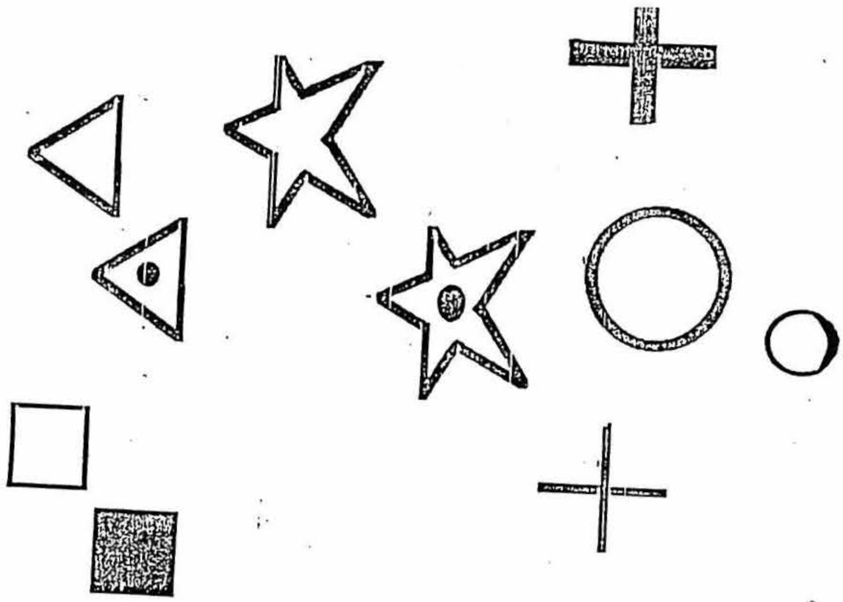
Trial 15. Shapes.nominally distinct

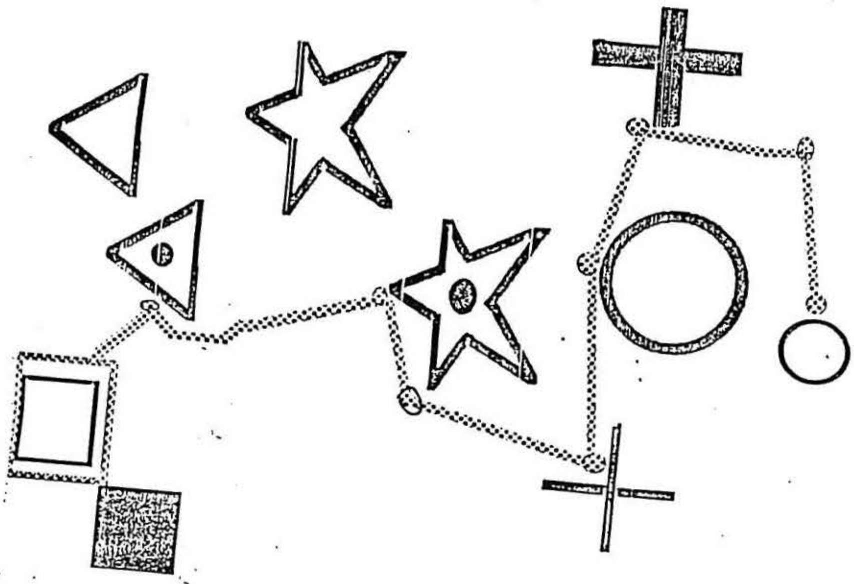




Appendix: (continued) 12

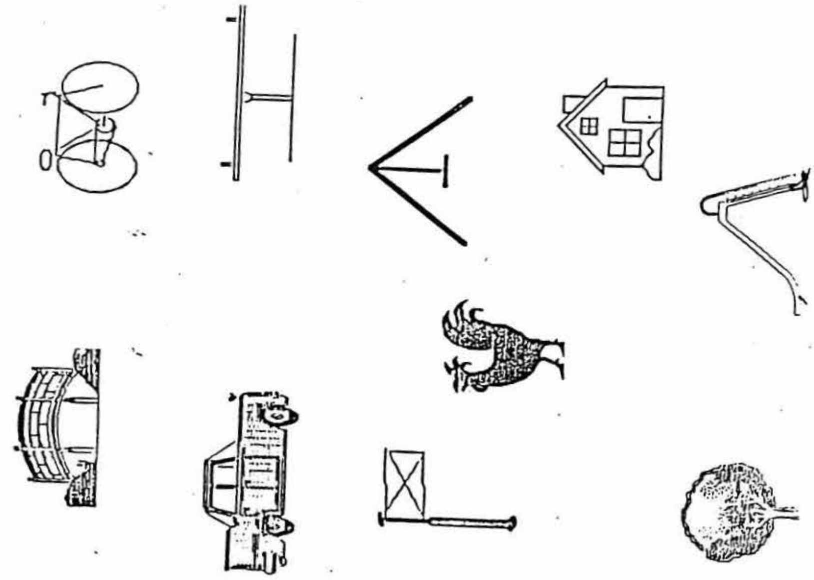
Trial 16. Shapes.nominally similar

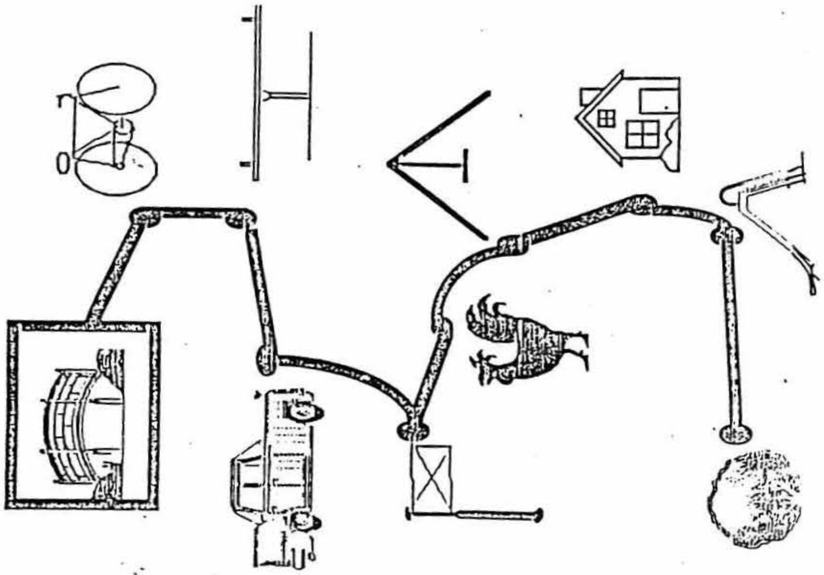




Appendix(continued) 12

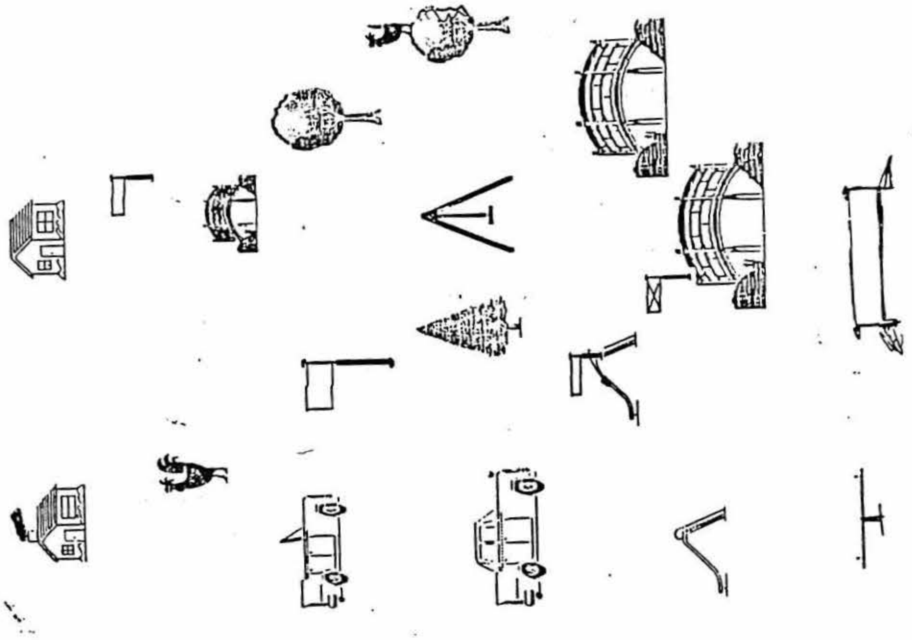
Trial 17. Outdoors.nominally distinct

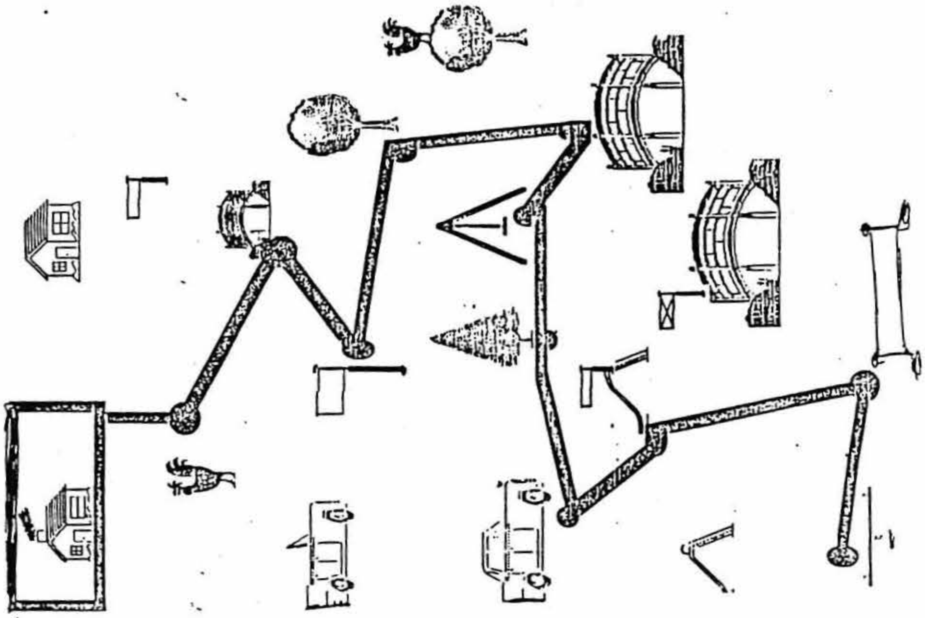




Appendix:(continued) 12

Trial 18. Outdoors.nominally similar





Appendix: 13

Samples of Metacognitive and Self-instructional interactions: Taken from one subject in each condition, at trial 10 (Animals. Nominally Similar)
S = Subject E= Experimenter

Metacognitive trial

S: Theres a Kanga at the top...
E: Well now...how do you make sure I get the right one?
if theres two, how do you make sure I get the right one?
is one different to the other?
S: One's small, the other's big
E: Which one do I go to?
S: The big one - to the bear
E: ...is one diffrent to the other?
S: The white one
E: Now what question do you ask...?
S: Did you get there?
E: Yes.....
S: To the elephant. There's two elephants...the one's got horns (the other hasn't)...[now to] crocodile, get there?
E: No
S: Oh there's two...one's black and one's white, you get there?
E: No
S: Oh the black one

Self-instructional trial

E: We say the instructions outloud don't we...[they are]
"What do I do?
I have to tell you how the line goes..."
S: Kangaroo
E: Say it after me -
"If theres two which one?" That's what we say isn't it
S: Which one, there's one by itself and one with a small one. The one by itself
E: Now what do you say?
S: Did you get there?...[to the] elephant
E: Now what do you say, if there's two which one
S: the one with the tusks...
E: From the elephant to the
S: To the croc
E: Now what do you say...
S: One with the tail
E: If theres two the one with the tail up or down?
S: down
E: Well done
S: Two humps, one hump, horse

Appendix: 14

Example of checklist provided for independent observers for noting the effectiveness of training for each trial

----

Checklist for Training Conditions External Validification: Tick or note

Subject:__________Training Date:__________ Condition:_________

===
===============

Trial No	Duration	Subjects's Role	Subject, Experimenter & Screen Positions	Experimenter's Performance At role: Percent of dialogue covered
		Sp Li □ □		

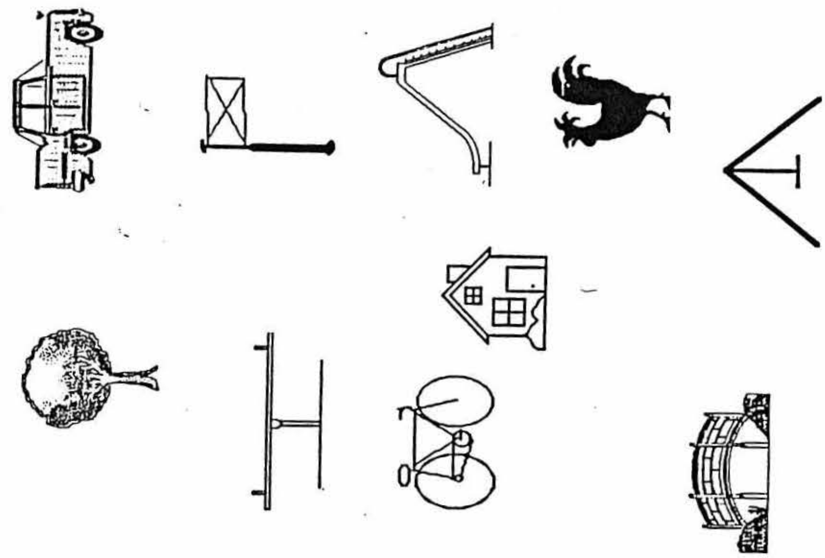
===
===============

Dialogue: Generalisation and Specific aspects covered	General Prompts After/ During	Reinforcers Type and Before & (N, Negative, P, Positive)	Mention of Listener Role Number
Gen/Spe □ □	B&A/Dur □ □	N P1 P 2 P3 □ □ □ □	

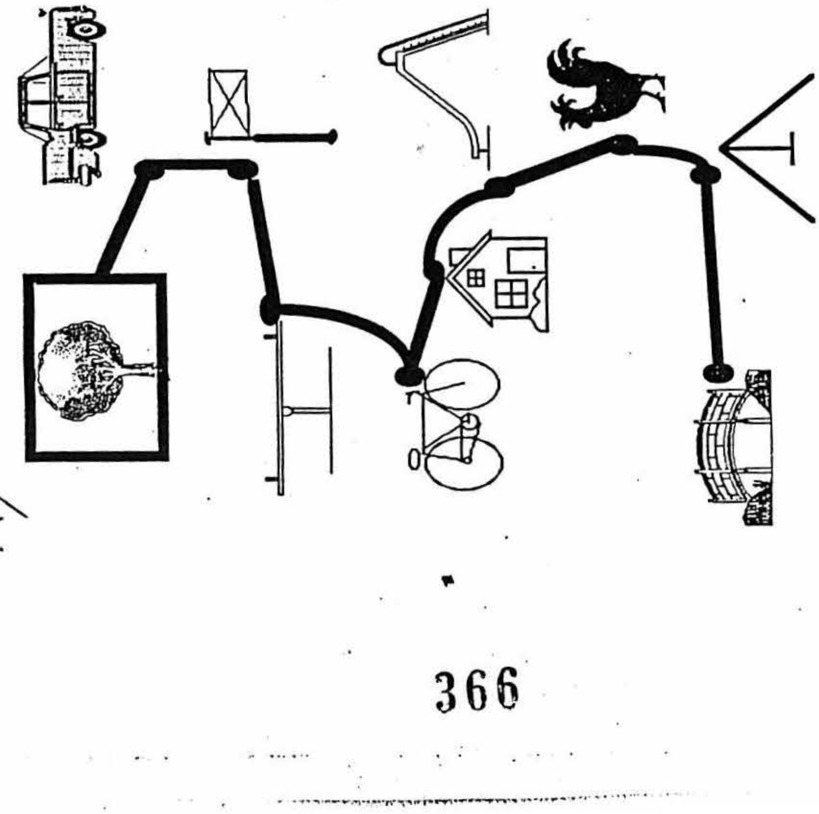
____

Appendix: 15
Maps for first week of transfer tests

1. Outdoors, nominally distinct
(A for speaker and B for listener)



B

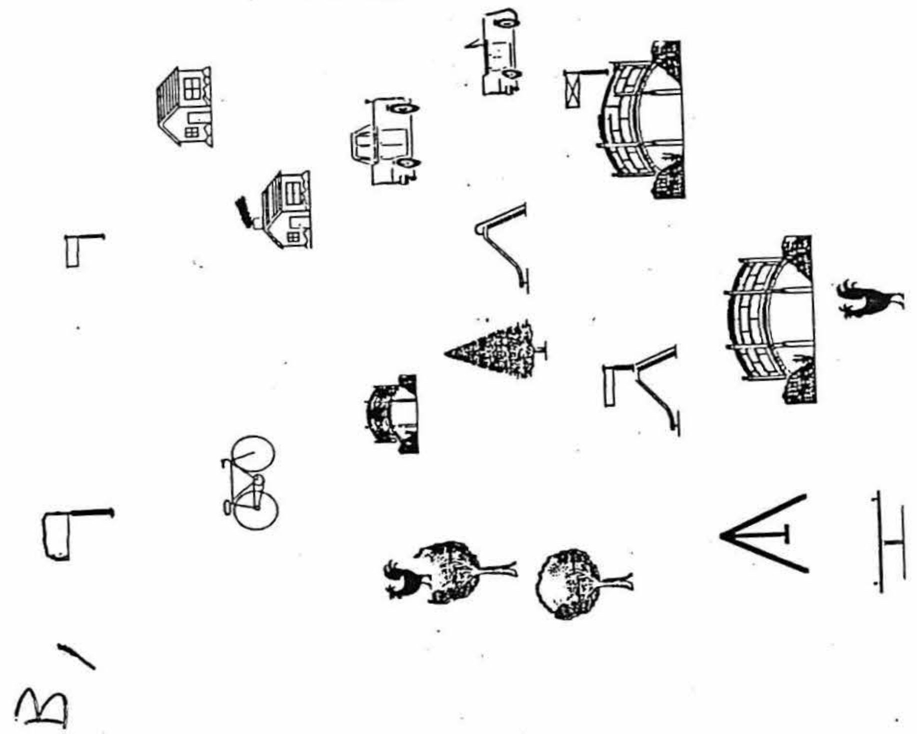


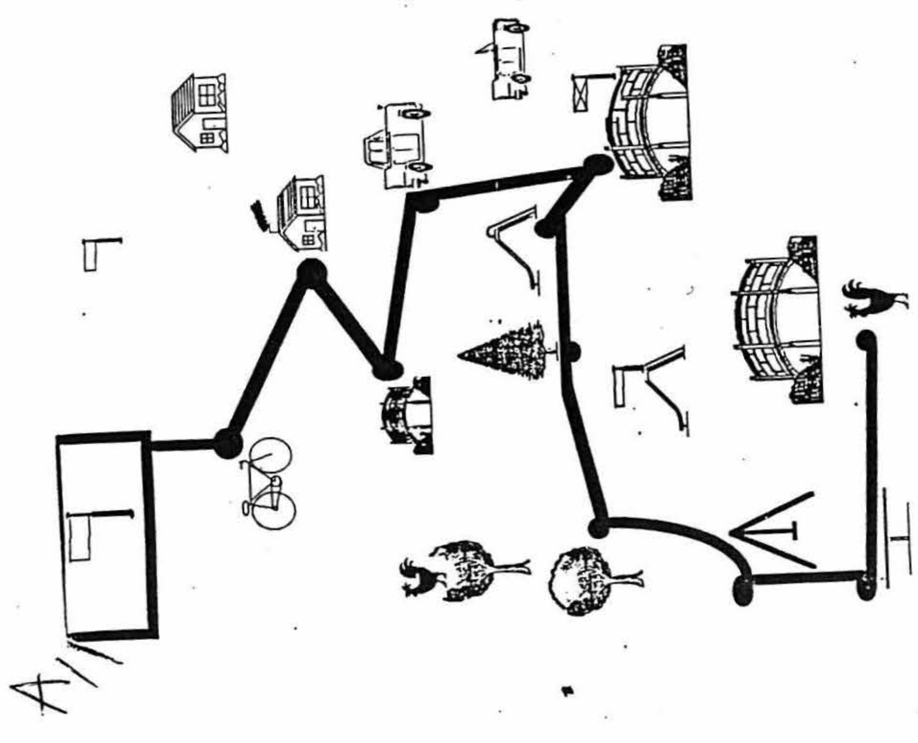
A

Appendix:(continued) 15

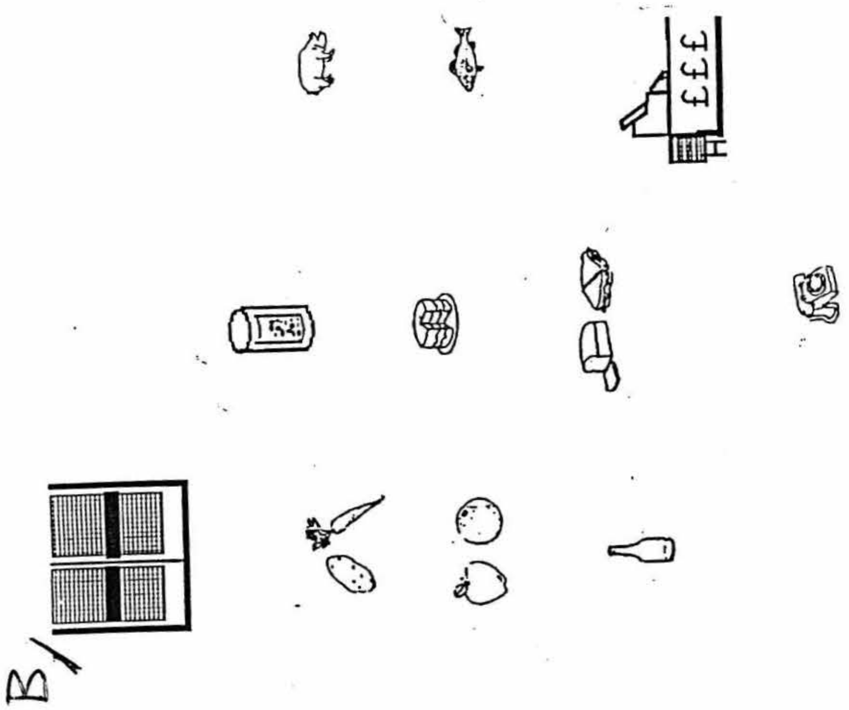
2. Outdoors, nominally similar

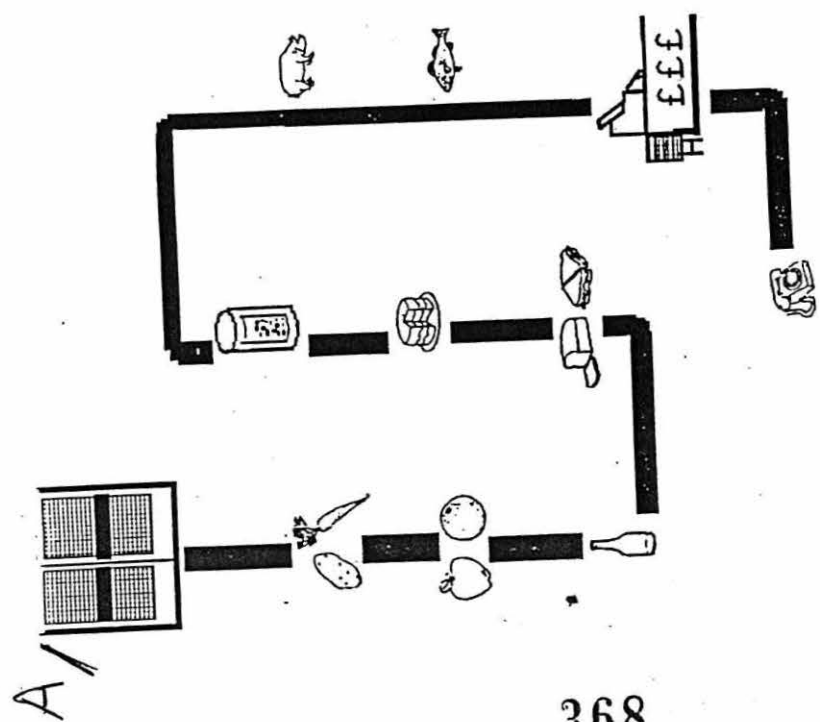
(A for speaker and B for listener)





Appendix: (continued) 15
3. Market, nominally distinct
(A for speaker and B for listener)

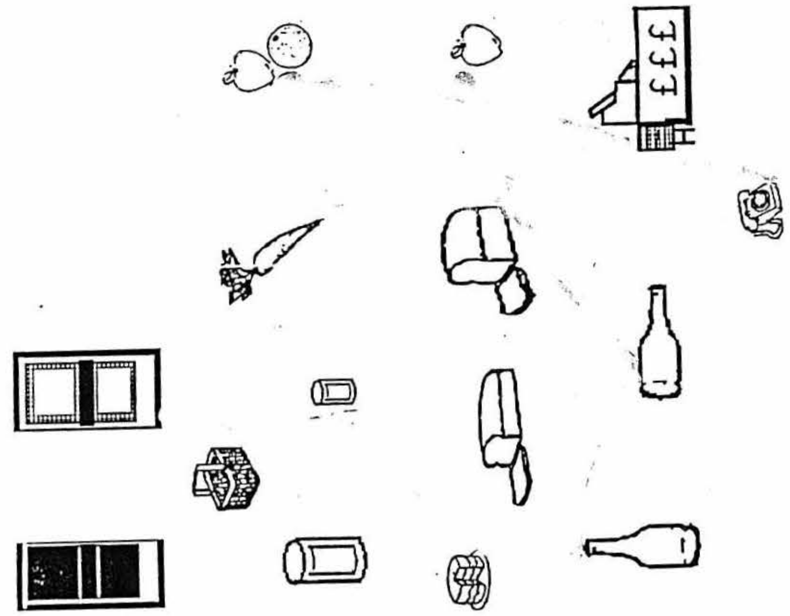




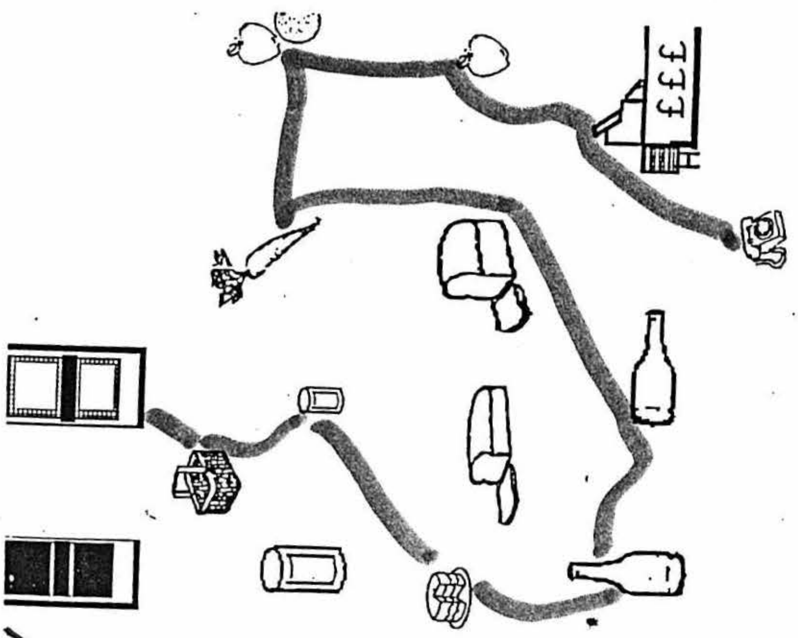
Appendix: (continued) 15

4. Market, nominally similar

(A for speaker and B for listener)



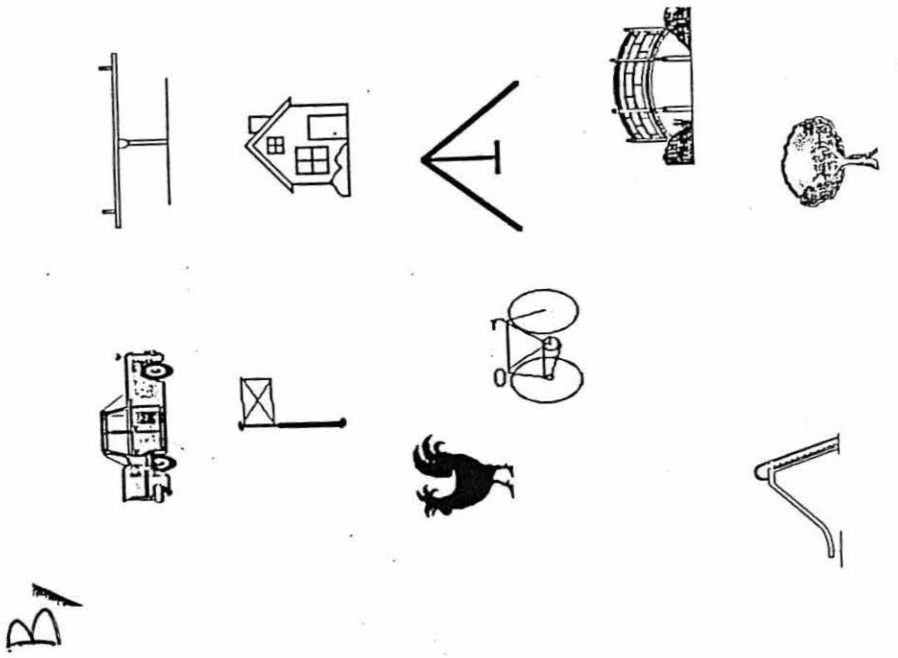
B

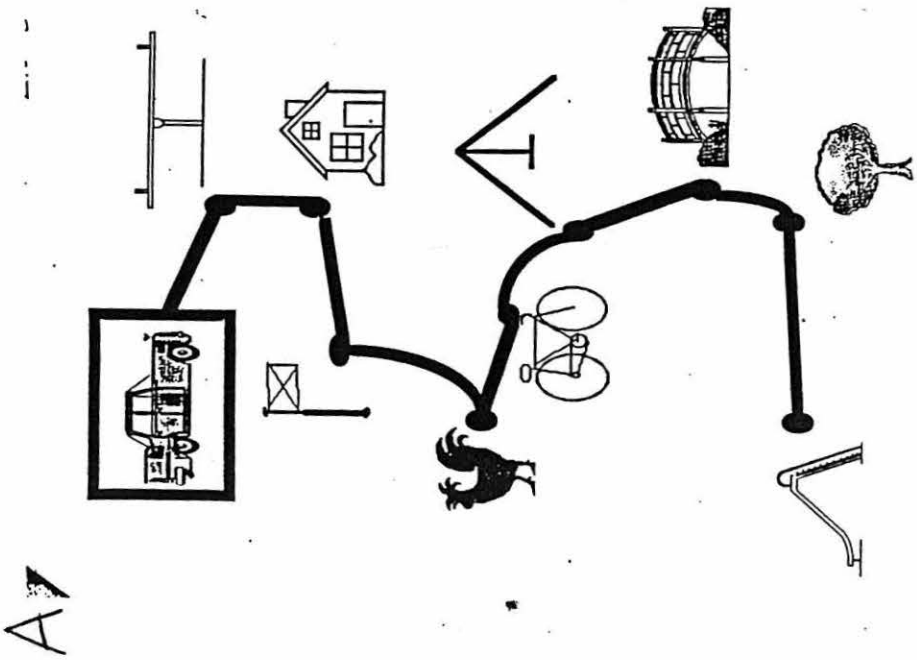


A

Appendix: (continued) 15
Maps for first week of transfer tests

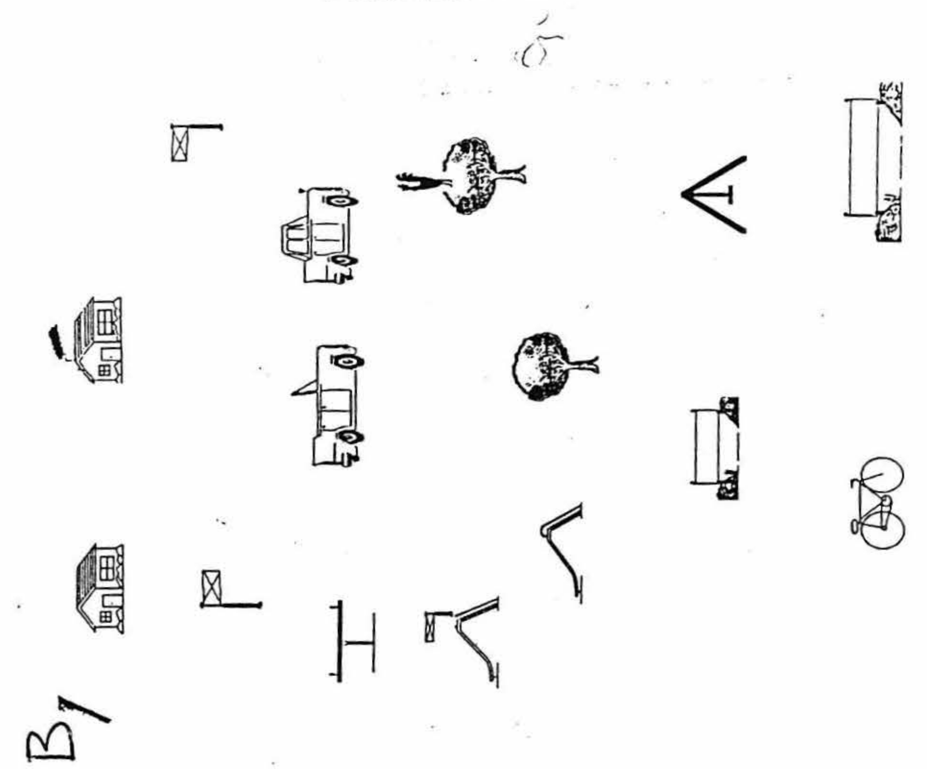
5. Outdoors, nominally distinct
(A for speaker and B for listener)

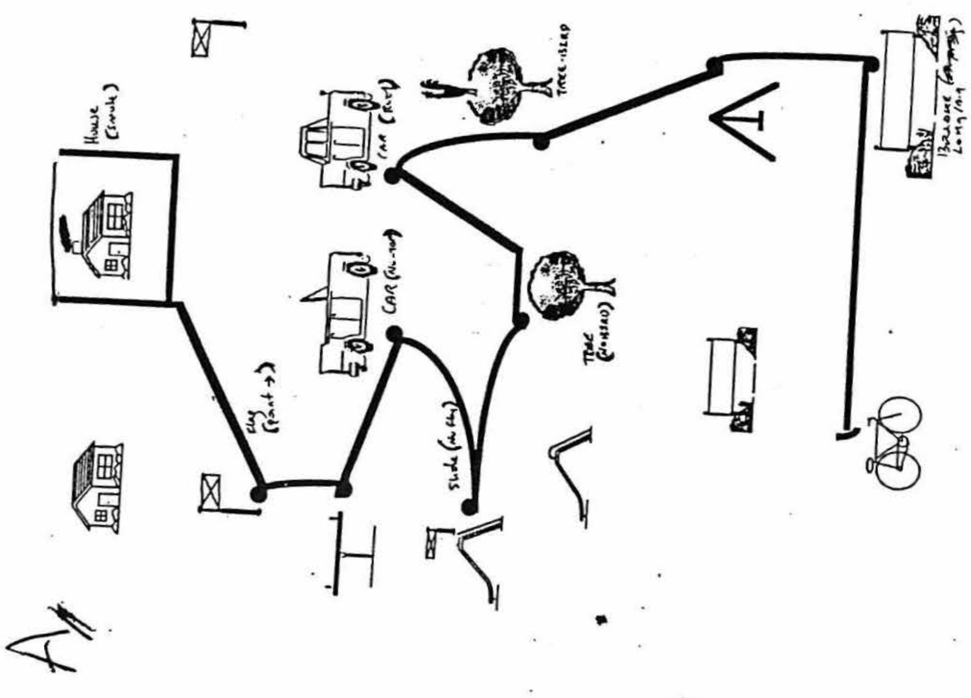




Appendix: (continued) 15
Maps for first week of transfer tests

6. Outdoors, nominally similar
(A for speaker and B for listener)

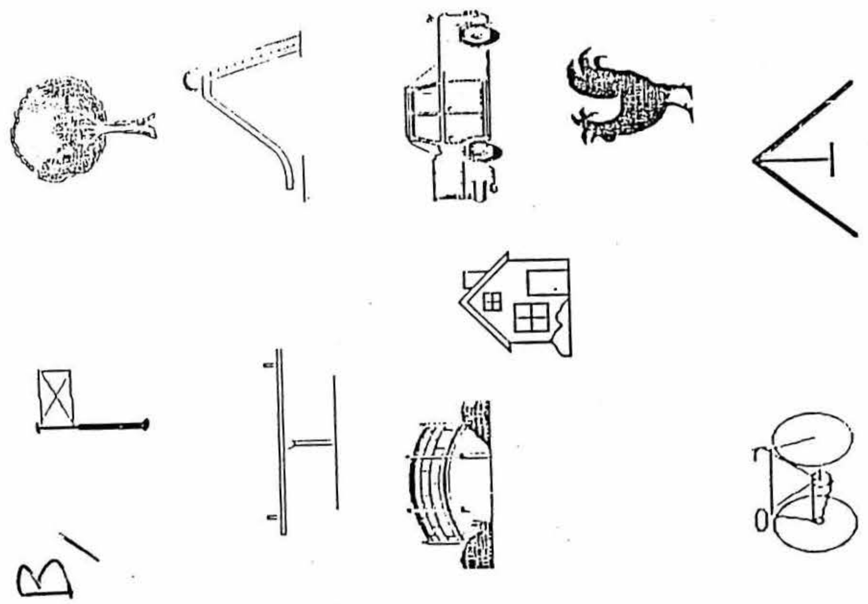


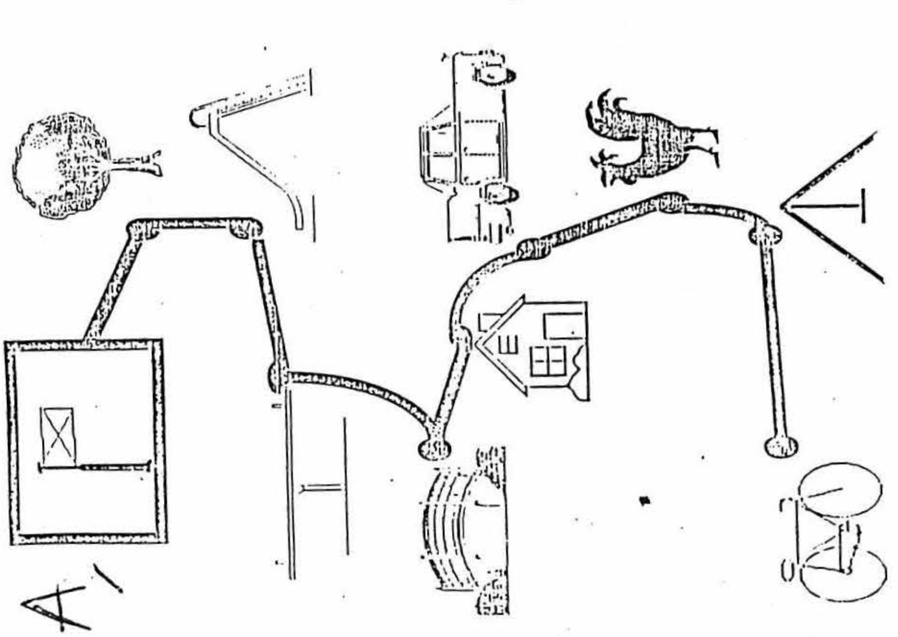


Appendix: 16

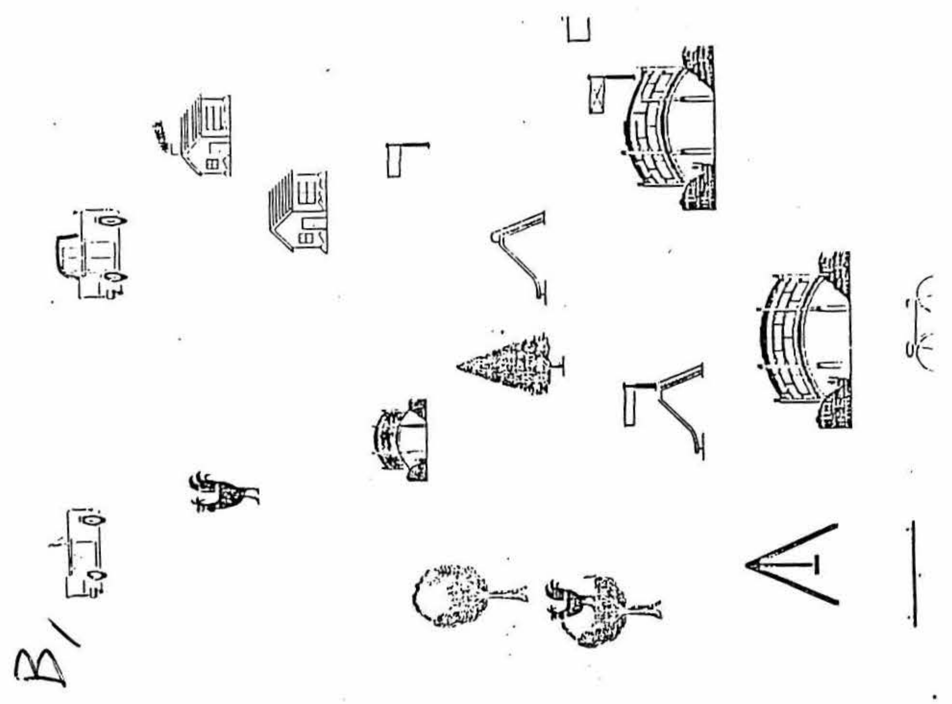
Maps for second week of transfer tests

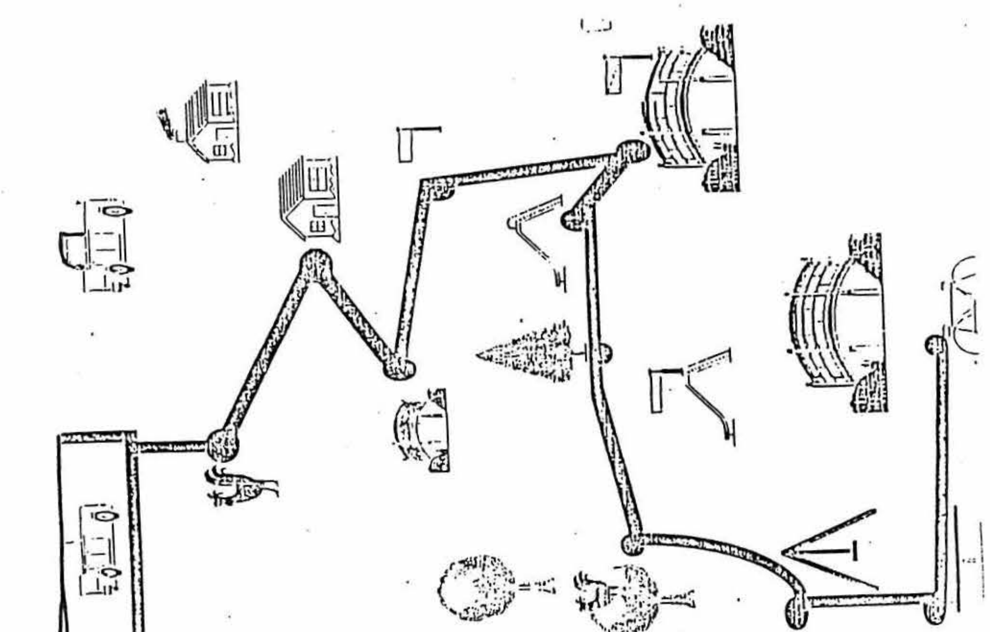
<u>1. Outdoors, nominally distinct</u>
<u>(A for speaker and B for listener)</u>





Appendix: (continued) 16
2. Outdoors, nominally similar
(A for speaker and B for listener)

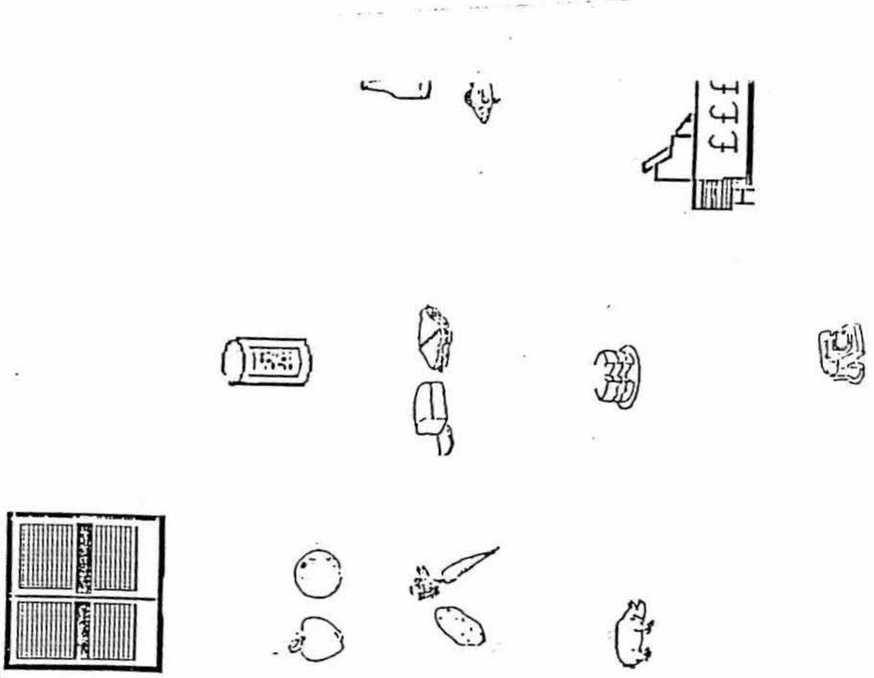




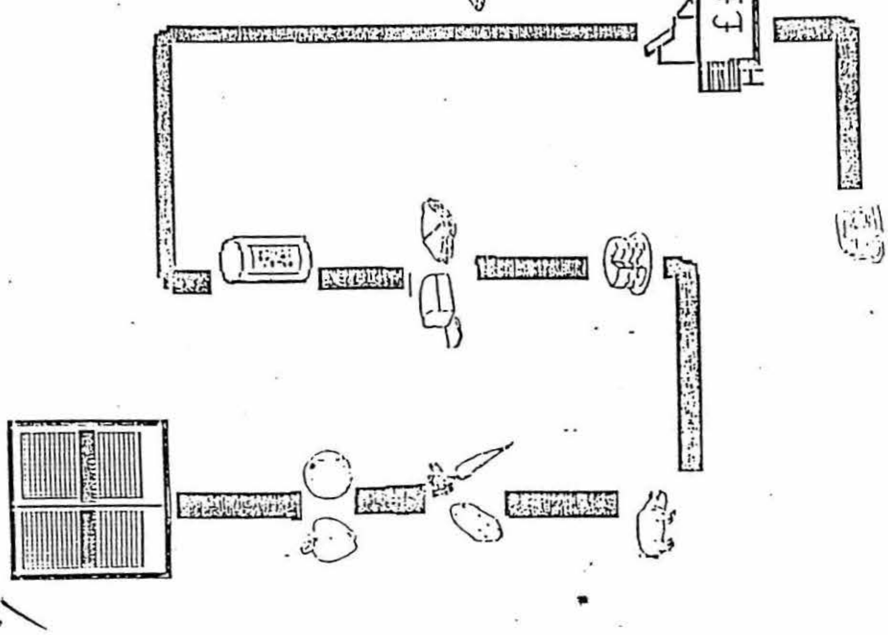
Appendix: (continued) 16

3. Market, nominally distinct

(A for speaker and B for listener)



B/

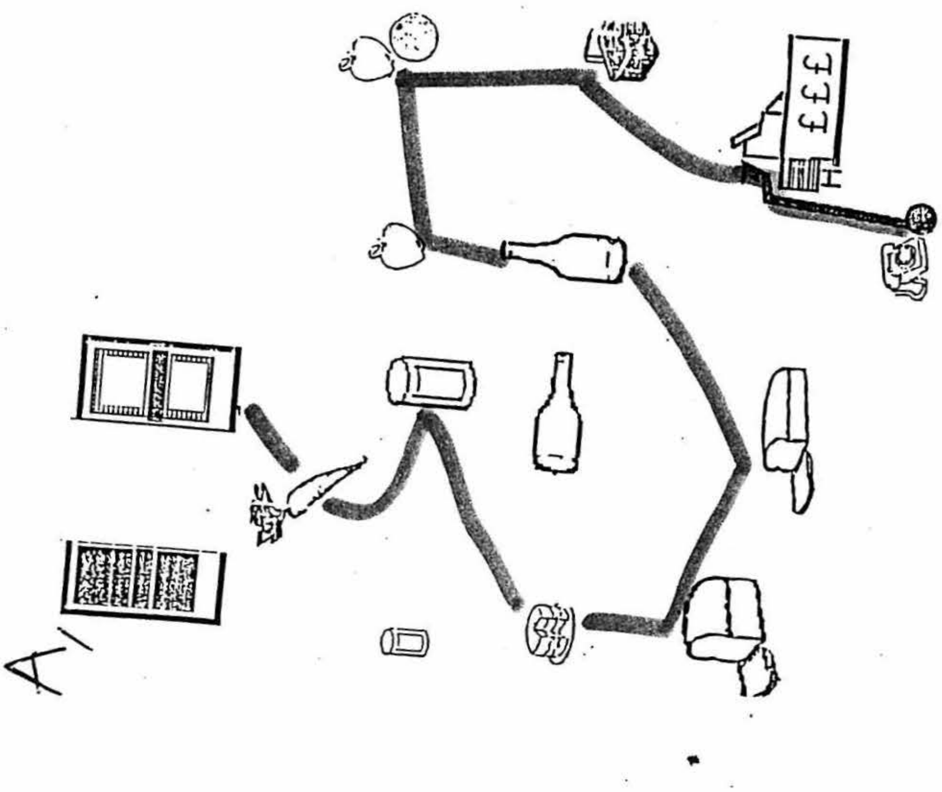


A/

Appendix: (continued) 16

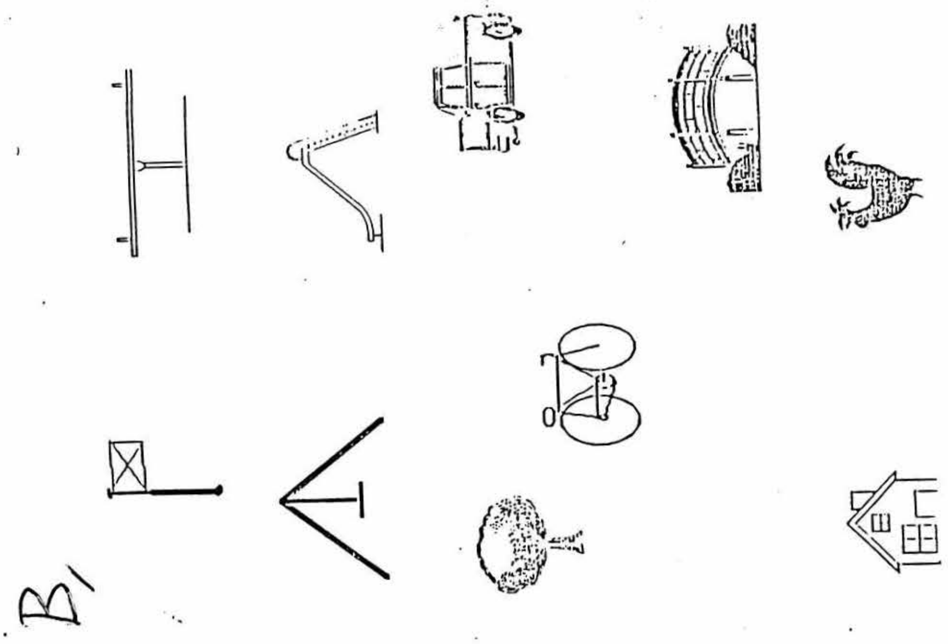
4. Market, nominally similar

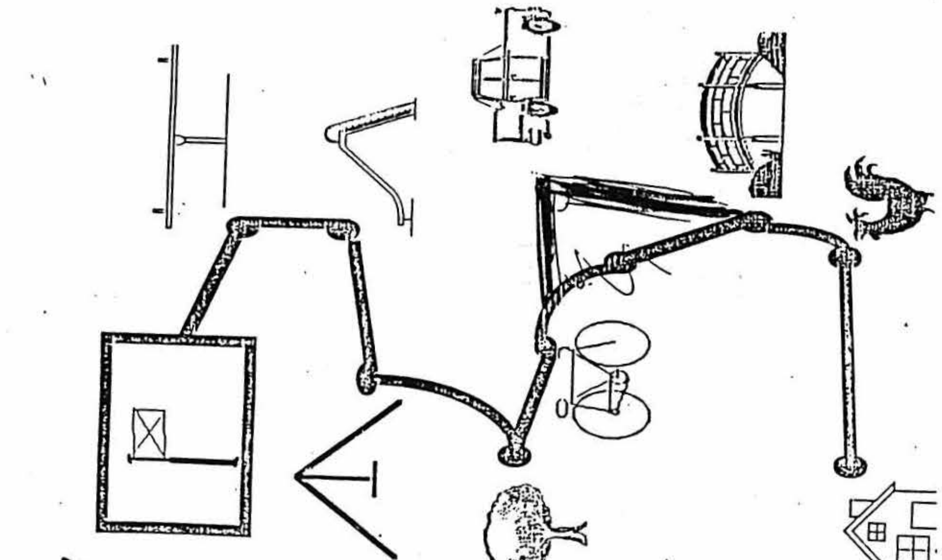
(A for speaker and B for listener)



Appendix: (continued) 16
Maps for second week of transfer tests

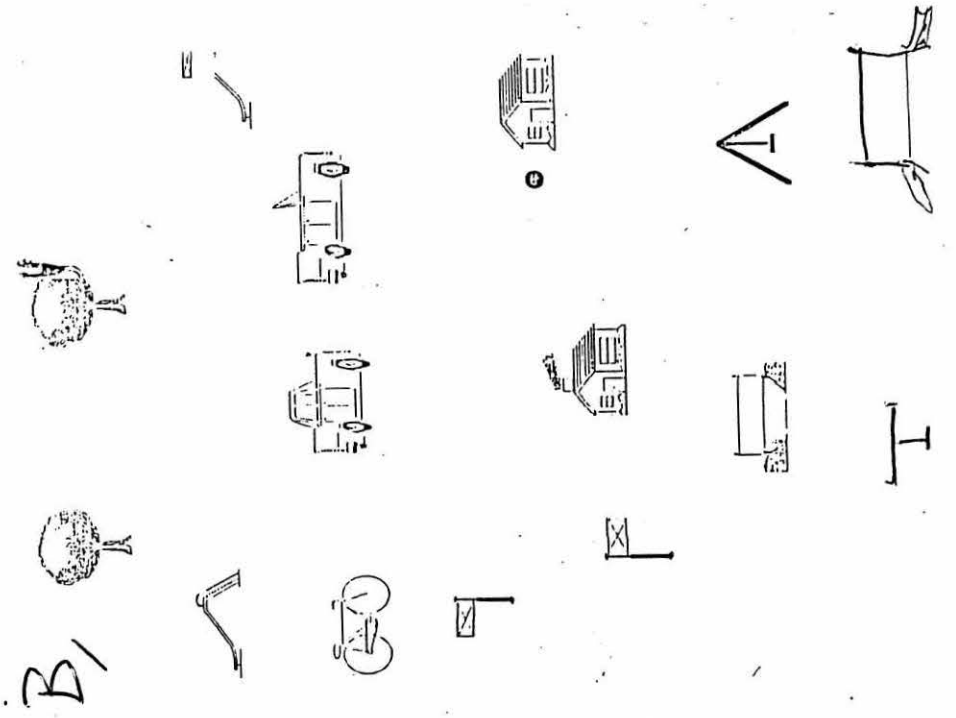
5. Outdoors, nominally distinct
(A for speaker and B for listener)

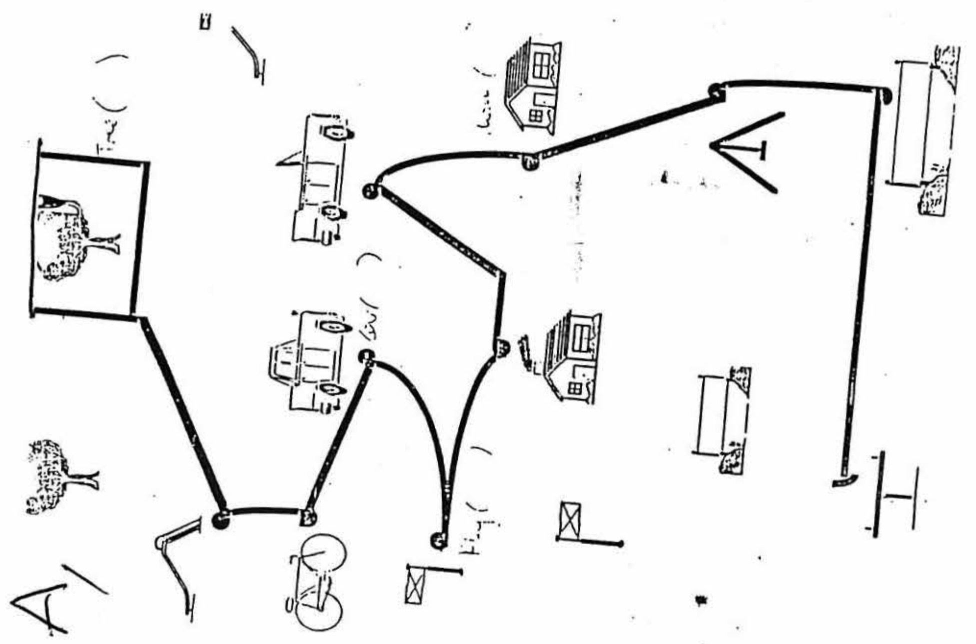




Appendix: (continued) 16
Maps for secondweek of transfer tests

6. Outdoors, nominally similar
(A for speaker and B for listener)





Appendix: 17

Baseline scores of all subjects on psychometric tests (M1-15 are Metacognitive; S1-15 are Self-instructional C1-15 are Control)

subject	BPVS raw	BPVS age eq	TROG raw	TROG age eq	TROG fail at
M1	8	3.583	7	4.5	9
M2	17	7.75	9	5	10
M3	12	5.33	3	-1	7
M4	18	8.25	10	5.3	11
M5	10	4.41	9	5	11
M6	11	4.83	5	4	6
M7	8	3.58	5	4	7
M8	8	3.58	4	-1	7
M9	13	5.25	4	-1	6
M10	6	2.83	2	-1	4
M11	8	3.58	3	-1	4
M12	12	5.33	3	-1	5
M13	11	4.83	5	4	7
M14	7	3.16	6	4.25	7
M15	10	4.4	4	-1	5
S1	20	9.5	13	6	-1
S2	14	6.25	8	4.75	9
S3	13	5.75	9	5	11
S4	9	4	4	-1	5
S5	18	8.25	10	5.25	14
S6	10	4.41	3	-1	7
S7	13	5.75	6	4.5	8
S8	10	4.41	2	-1	4
S9	13	5.75	6	4.25	7
S10	12	5.33	2	-1	7
S11	8	3.58	5	4	7
S12	8	3.58	4	-1	6
S13	18	8.25	5	4	10
S14	11	4.83	6	4.25	9
S15	9	4	3	-1	4
C1	19	8.892	6	4.25	10
C2	18	8.25	8	4.75	10
C3	19	8.91	11	5.6	14
C4	17	7.75	6	4.25	7
C5	7	3.16	3	-1	7
C6	17	7.75	7	4.5	13
C7	10	4.41	3	-1	4
C8	17	7.75	7	4.5	9
C9	10	4.41	7	4.25	13
C10	7	3.16	3	-1	5
C11	15	6.66	8	4.75	11
C12	13	5.75	8	4.75	10
C13	12	5.3	3	-1	4
C14	15	6.6	7	4.5	8
C15	5	2.5	4	-1	5

Appendix: (continued) 17

subject	DIGIT SA	DIGIT SB	CON. cog unk	CON. cog oth	CON. cog int
M1	4	5.2	3.75	4	3.75
M2	3.2	2.4	4	4	3.5
M3	-1	-1	1.5	2.75	2
M4	3.6	4.2	4	3.5	3
M5	2.8	3.2	69	62	63
M6	3.6	4.2	37.5	50	31
M7	2.8	3.2	62	62	56
M8	1.4	2.2	56	50	56
M9	3.2	3.4	62	62	62
M10	1.4	1.8	62	56	50
M11	1.8	1.8	56	48	56
M12	1.8	1.6	-1	-1	-1
M13	2.6	2.4	62	43	53
M14	2.4	3.6	59	56	50
M15	1.4	1.2	-1	-1	-1
S1	4.4	5.2	1.25	2.75	4
S2	2.8	3.4	3.5	3.25	3
S3	2.6	3.2	37	68	37
S4	1	1.4	56	37	50
S5	4.6	5.2	56	56	50
S6	3.2	3.4	75	56	25
S7	4.4	4.6	62	31	25
S8	2.4	2.8	62	62	43
S9	1.6	2.2	50	50	56
S10	1.4	2.6	56	68	48
S11	1.4	-1	-1	-1	-1
S12	1	1.8	-1	-1	-1
S13	1.8	2.2	50	50	50
S14	2.6	4.2	68	75	56
S15	1.6	1.6	62	56	56
C1	5.4	6.2	2.75	2.75	1.25
C2	4.8	7.2	1.75	2.5	2.5
C3	3.8	4.6	2.5	2.75	3.25
C4	4.2	4.6	2	2.75	3
C5	1.6	2.2	-1	-1	-1
C6	4.2	4.2	81	62	31
C7	-1	-1	-1	-1	-1
C8	4.8	4.2	69	69	62
C9	2.8	3.4	-1	-1	-1
C10	1.2	1.4	-1	-1	-1
C11	3.2	3.2	56	62	62
C12	1	3.8	-1	-1	-1
C13	1.6	2.6	62	56	56
C14	5.2	5.2	50	50	50
C15	2.2	2.2	42	50	50

Appendix: (con'tinued) 17

subject	Con. soc unk	CON. soc oth	CON. soc int	CON. phys unk	CON. phys oth
M1	3.25	3.5	3.5	3.25	3.5
M2	4	3.25	4	3.5	4
M3	1.5	1.75	1.25	2.25	2
M4	2.25	3.75	3.25	2.5	3.5
M5	69	69	56	62	50
M6	43	50	43	75	37
M7	56	50	50	69	69
M8	50	50	50	50	43
M9	56	68	75	75	62
M10	56	56	56	62	50
M11	62	50	50	68	50
M12	-1	-1	-1	-1	-1
M13	59	62	59	56	59
M14	75	62	68	62	68
M15	-1	-1	-1	-1	-1
S1	2.75	2.75	4	2.75	4
S2	4	3.5	4	2.5	4
S3	43	37	56	62	43
S4	43	43	37	75	37
S5	43	43	50	56	43
S6	87	37	56	50	62
S7	37	25	50	25	43
S8	62	56	56	68	68
S9	40	50	50	62	50
S10	68	62	56	62	62
S11	-1	-1	-1	-1	-1
S12	-1	-1	-1	-1	-1
S13	50	50	50	56	50
S14	75	62	75	75	62
S15	53	43	46	56	50
C1	1.75	2.25	1.75	2.5	2.25
C2	2.5	4	4	2.5	2.5
C3	1.25	3	2.75	2.5	1.25
C4	2.75	3.5	3.25	2.5	3
C5	-1	-1	-1	-1	-1
C6	68	50	37	50	37
C7	-1	-1	-1	-1	-1
C8	62	56	56	62	62
C9	-1	-1	-1	-1	-1
C10	-1	-1	-1	-1	-1
C11	50	44	50	50	56
C12	-1	-1	-1	-1	-1
C13	68	65	62	59	75
C14	50	43	50	50	50
C15	56	56	50	50	50

Appendix: (continued) 17

subject	CON. phys imt	CON gen unk	CON gen oth	CON gen int	CON unk
M1	3.75	3.25	4	3.25	3.375
M2	4	3.5	3.25	3	3.75
M3	1.5	1.25	1.5	1.25	1.62
M4	3.25	3.25	3	3.25	3
M5	62	75	62	56	68.7
M6	56	50	25	56	51
M7	56	56	56	56	60.75
M8	56	50	50	50	51
M9	62	68	68	68	66
M10	56	50	50	50	58
M11	68	59	62	44	61
M12	-1	-1	-1	-1	-1
M13	50	59	50	44	59
M14	62	62	50	56	59
M15	-1	-1	-1	-1	-1
S1	3.75	3.25	1.25	4	2.5
S2	4	3.5	3.5	3	3.37
S3	37	43	56	31	43
S4	37	43	56	43	54
S5	50	62	56	50	54
S6	50	81	37	50	73
S7	37	43	37	25	42
S8	37	56	56	75	62
S9	56	50	50	48	50.5
S10	62	68	62	62	10.25
S11	-1	-1	-1	-1	-1
S12	-1	-1	-1	-1	-1
S13	50	50	56	50	51
S14	56	68	75	68	71
S15	50	65	56	56	59
C1	1.25	3.5	3	2.5	2.75
C2	3	1.75	1.75	2.25	2.125
C3	3.25	3.5	2.75	2.5	2.4375
C4	3	3	2.5	2.75	2.56
C5	-1	-1	-1	-1	-1
C6	50	56	56	31	64
C7	-1	-1	-1	-1	-1
C8	56	69	62	69	65.5
C9	-1	-1	-1	-1	-1
C10	-1	-1	-1	-1	-1
C11	56	62	44	62	8.75
C12	-1	-1	-1	-1	-1
C13	50	68	68	59	64
C14	50	50	50	50	50
C15	56	56	50	50	51

Appendix: (continued) 17

subject	CON oth	CON int	RPM A %	RPM Ab %	RPM B %
M1	3.75	3.5	50	66.6	50
M2	3.625	3.625	58.3	50	33.3
M3	2	1.5	83.3	50	33.3
M4	3.4375	3.1875	50	66.6	41.6
M5	60.7	59.2	66	58	50
M6	40	46	41	16	25
M7	59.2	54.5	25	25	16
M8	48	53	41	8.3	8.3
M9	66	67	33.3	16.6	16.6
M10	53	53	16.6	25	8.3
M11	51	54	16.6	16.6	16.6
M12	-1	-1	75	75	33
M13	53	50	58.3	41.6	16.6
M14	59	59	83	25	8.3
M15	-1	-1	66	25	33
S1	2.687	3.937	50	33.3	25
S2	3.56	3.5	58.3	25	16.6
S3	56	31	58	33.3	25
S4	43	42	66	25	25
S5	50	50	66	33	16
S6	48	45	33	25	16
S7	34	34	25	16	8
S8	60	53	58	41	41
S9	50	52.5	41	0	8
S10	10.25	9	16.6	25	16.6
S11	-1	-1	41.6	16.6	16.6
S12	-1	-1	33	8.3	16.6
S13	51	50	25	25	33
S14	68	63	66	58	8.3
S15	50	52	41.6	25	16.6
C1	2.56	1.687	41.6	33.3	16.6
C2	2.687	2.937	41.6	41.6	33.3
C3	2.4375	2.9375	75	66.6	41.6
C4	2.93	3	75	41.6	33.3
C5	-1	-1	33	8.3	8.3
C6	51	37	58	25	8.3
C7	-1	-1	50	16	33
C8	62.2	60.7	50	16	8
C9	-1	-1	58.3	25	33.3
C10	-1	-1	33.3	16.6	16.6
C11	8.25	9.25	25	16	16
C12	-1	-1	41.6	33	25
C13	66	56	41	33.3	8.3
C14	48	50	50	8.3	16.6
C15	51	51	16.6	16.6	16.6

Appendix: (con /tinued) 17

subject	RPM A raw	RPM Ab raw	RPM B raw	RPM av %	RDLS VC raw
M1	6	8	6	55.3	51
M2	7	6	4	47	56
M3	10	6	4	55.5	43
M4	6	8	5	52.7	-1
M5	8	7	6	58	58
M6	5	2	3	27.3	52
M7	3	3	2	22	45
M8	5	1	1	19.2	43
M9	4	2	2	22	43
M10	2	3	1	16.6	34
M11	2	2	2	16.6	37
M12	9	9	4	61	35
M13	7	5	2	38.7	41
M14	10	3	1	38.8	52
M15	8	3	4	41.3	37
S1	6	4	3	36	64
S2	7	3	2	33.3	57
S3	7	4	3	38.6	56
S4	8	3	3	38.6	39
S5	8	4	2	38.3	65
S6	4	3	2	24.6	36
S7	3	2	1	16.3	59
S8	7	5	5	46.6	47
S9	5	0	1	16.3	48
S10	2	3	2	19.4	46
S11	5	2	2	24.9	39
S12	4	1	2	16.4	40
S13	3	3	4	27.6	40
S14	8	7	1	44.1	41
S15	5	3	2	27.7	44
C1	5	4	2	30.3	61
C2	5	5	4	38.8	63
C3	9	8	5	61.08	60
C4	9	5	4	49.9	-1
C5	4	1	1	16.5	49
C6	7	3	1	30.4	52
C7	6	2	4	33	40
C8	6	2	1	24.6	49
C9	7	3	4	38.9	82
C10	4	2	2	16.7	34
C11	3	2	2	19	58
C12	5	4	3	33	-1
C13	5	4	1	27.3	37
C14	6	1	2	24.9	58
C15	2	2	2	16.6	38

Appendix: (continued) 17

b-met-7

subject	RDLS VC AQ	RDLS EX RAW	RDLS EX AQ	Av Sen-len
M1	4	51	4.54	5.07
M2	4.54	56	4.69	7.46
M3	3.33	43	3.45	3.53
M4	-1	-1	-1	-1
M5	4.9	53	4.9	5.6
M6	4.1	48	4.1	6.8
M7	3.5	44	3.6	3.5
M8	3.3	45	3.7	4.1
M9	3.33	45	3.7	3
M10	2.75	27	2.25	1.5
M11	2.91	46	3.83	3.07
M12	2.83	35	2.75	2
M13	3.16	43	3.45	4.3
M14	4.1	45	3.7	2.4
M15	2.9	40	3.1	2.5
S1	6.75	-1	-1	00
S2	4.70	48	4.7	6.84
S3	4.55	54	5.1	7.6
S4	3.2	25	2.00	2.3
S5	7	49	4.2	5.7
S6	2.8	42	3.3	4
S7	5.1	54	5.1	6.8
S8	3.7	38	3	4.8
S9	3.75	55	5.33	4.4
S10	3.58	46	3.83	2.83
S11	3	42	3.33	1.76
S12	3.08	38	3	2
S13	3.08	42	3.33	3.8
S14	3.16	34	2.7	4.1
S15	3.4	37	2.9	2.1
C1	5.66	-1	-1	8.83
C2	6.20	55	-1	6.14
C3	5.33	53	4.87	6.64
C4	- 1	48	4.083	5.63
C5	3.83	43	3.45	3
C6	4.1	54	5.1	5.5
C7	3.1	52	4.7	2.5
C8	3.8	49	4.2	2.8
C9	7	43	3.45	- 1
C10	2.75	44	3.58	3
C11	4.87	42	3.33	4.08
C12	- 1	- 1	- 1	- 1
C13	2.9	48	4.1	6.6
C14	4.9	53	4.9	4.9
C15	3	37	2.9	5.9

Appendix: 18

Baseline scores of all subjects on communication tests

subject	Base-pers	Pers-Mon	Sel-com	Ref-com	M.Ad. A Str
M1	100	43.3	56.6	30	40
M2	-1	36.6	46.6	40	80
M3	90	36.6	53.3	40	20
M4	100	66.6	83.3	73.3	30
M5	100	30	66	60	50
M6	100	37	50	10	60
M7	100	33.3	33.3	3.3	30
M8	40	33.3	46	10	20
M9	95	33.3	30	0	10
M10	70	33.3	3.3	3.3	30
M11	50	33.3	33.3	0	50
M12	100	33.3	40	23	60
M13	40	30	63	36	50
M14	100	36.6	56.6	26	80
M15	40	36.6	30	20	30
S1	100	43.3	63.3	43.3	80
S2	100	30	43.3	23.3	50
S3	100	30	47	3.3	60
S4	20	33.3	37	20	20
S5	100	37	50	27	70
S6	80	30	20	13	40
S7	100	33.3	43	30	60
S8	0	30	40	27	30
S9	70	33.3	43	10	50
S10	60	33.3	17	3.3	70
S11	50	30	30	0	30
S12	20	33.3	33.3	0	20
S13	100	30	36.6	0	30
S14	70	33.3	43	50	40
S15	60	33.3	26	6	40
C1	100	53.3	60	33.3	60
C2	100	53.3	56.6	46.6	50
C3	100	33.3	53.3	40	60
C4	-1	36.3	46.6	33.3	80
C5	50	17	23	3.3	30
C6	100	40	50	13	60
C7	90	30	33.3	10	60
C8	40	33.3	13.3	3.3	40
C9	40	30	33.3	0	40
C10	40	30	40	3.3	50
C11	100	30	46.7	0	30
C12	90	33	60	17	80
C13	50	20	43	20	10
C14	100	33.3	40	16.6	80
C15	80	33.3	33.3	6.6	40

Appendix: (continued) 18

subject	M. Ad A nstr	M.AD. A. x	M.Ad.A.req	M.Ad.B.Str	M.Ad. B.nstr
M1	40	10	10	30	10
M2	20	20	0	80	10
M3	50	30	0	60	20
M4	0	1	60	10	0
M5	30	0	20	60	40
M6	40	0	0	70	20
M7	50	20	0	50	40
M8	60	0	20	30	40
M9	70	10	10	10	0
M10	0	70	0	0	10
M11	30	20	0	50	20
M12	20	20	0	70	20
M13	30	20	0	60	40
M14	20	0	0	80	20
M15	50	0	0	50	40
S1	20	0	0	70	30
S2	50	2	0	50	50
S3	40	0	0	70	30
S4	40	40	0	40	50
S5	10	10	10	10	0
S6	20	30	10	40	50
S7	40	0	0	60	40
S8	70	20	0	40	60
S9	50	0	0	60	40
S10	10	20	0	50	50
S11	30	40	0	50	50
S12	80	0	0	20	70
S13	50	20	0	50	50
S14	20	0	0	70	30
S15	60	0	0	40	50
C1	30	10	0	50	40
C2	20	0	30	40	10
C3	20	10	10	50	0
C4	20	0	0	40	60
C5	60	10	0	40	60
C6	40	0	0	50	50
C7	30	0	10	20	30
C8	20	20	20	50	40
C9	40	20	0	10	60
C10	40	10	0	10	70
C11	30	0	40	30	10
C12	20	0	0	40	50
C13	30	0	40	20	0
C14	20	0	0	60	40
C15	60	0	0	40	40

Appendix: (continued) 18.

subject	M.Ad.B.x	M.Ad.B req	SPND	SPNS	SPNDG
M1	10	50	100	50	100
M2	20	0	80	25	100
M3	20	0	100	29.1	-1
M4	0	90	100	58.3	100
M5	0	0	85	54	95
M6	0	0	80	12.5	25
M7	10	0	100	41.6	100
M8	0	30	50	0	15
M9	0	90	10	0	65
M10	0	90	0	0	10
M11	30	0	50	8.3	30
M12	10	0	100	8.3	80
M13	0	0	100	20.8	100
M14	0	0	85	20	40
M15	0	0	45	8.3	50
S1	0	0	55	20	77.7
S2	0	0	70	16.6	80
S3	0	0	85	25	100
S4	10	0	80	12.5	65
S5	0	0	100	33	100
S6	10	0	40	8.3	40
S7	0	0	95	0	80
S8	0	0	95	20.8	40
S9	0	0	55	8.3	20
S10	0	0	100	21	85
S11	0	0	25	0	30
S12	10	0	25	0	20
S13	0	0	45	8.3	10
S14	0	0	90	20.8	100
S15	0	0	40	12.5	30
C1	0	10	40	8	50
C2	0	50	80	16.6	80
C3	0	50	60	33.3	100
C4	0	0	100	25	100
C5	0	0	55	12.5	45
C6	0	0	100	41.6	100
C7	10	40	35	8.3	35
C8	10	0	65	12.5	40
C9	30	0	35	8.3	0
C10	20	0	15	0	25
C11	0	60	85	20.8	40
C12	10	0	75	8.3	80
C13	0	60	10	12.5	40
C14	0	0	85	8.3	80
C15	0	0	85	12.5	100

Appendix: (continued) 18

B-COM.4

subject	SPNSG	SPNDG TD	SPNDG MON	SPNSG TD	SPNSG MON
M1	55.5	49.2	12.5	75	12.5
M2	25	72.2	37.5	72.2	37.5
M3	-1	-1	-1	-1	-1
M4	66.6	66.6	50	83.3	50
M5	25	23	0	30	0
M6	4.5	23	0	23	37
M7	20.8	7.6	0	7.6	0
M8	0	0	-1	23.3	-1
M9	9	0	0	0	0
M10	9	0	0	0	0
M11	9	0	0	0	0
M12	0	0	0	0	0
M13	31.8	0	0	0	0
M14	27	0	0	0	0
M15	9	0	0	0	-1
S1	33.3	73.3	50	93.3	0
S2	50	33.3	37.5	55.5	87.5
S3	25	15.3	14.2	31	0
S4	18	54	0	54	0
S5	37	23	12.5	23	12.5
S6	9	23	12.5	23	50
S7	29	0	50	0	50
S8	0	15.4	0	15.4	0
S9	0	23	0	23	0
S10	22.7	23	12.5	0	0
S11	0	0	12.5	0	0
S12	0	0	0	0	0
S13	9	0	0	0	0
S14	13.6	0	0	0	0
S15	9	0	0	0	12.5
C1	25	33.3	12.5	38.8	12.5
C2	25	66.6	37.5	94.4	28.5
C3	50	55.5	25	72.2	25
C4	42.5	66.7	62.5	83.3	50
C5	20.8	0	0	0	0
C6	45.8	0	0	23	25
C7	0	0	0	0	0
C8	0	30.7	0	15.3	0
C9	9	0	0	0	75
C10	9	0	0	0	0
C11	22.7	0	0	7.6	25
C12	9	7.6	0	15.3	0
C13	0	0	0	0	25
C14	22.7	0	25	0	25
C15	27.2	0	0	0	0

Appendix: (continued) 18

subject	LIND	LINS	LINDG	LINSG	LIND TD
M1	57.1	55.5	50	77.7	75
M2	37.5	70	66.6	100	66.6
M3	-1	100	50	-1	-1
M4	75	100	66.6	100	91.6
M5	75	95	54	95	83
M6	0	75	12.5	65	37.5
M7	0	40	8.3	55	18
M8	- 1	0	12.5	35	20.8
M9	37.5	65	0	45	8.3
M10	0	15	0	33	0
M11	0	45	0	30	8.3
M12	12.5	85	33	100	45.8
M13	0	100	45.8	100	58.3
M14	0	85	25	100	54
M15	0	100	0	45	9
S1	33.3	100	70	88.8	62.2-
S2	12.5	100	75	70	75
S3	25	100	75	100	96
S4	0	30	0	55	20
S5	37.5	100	20	85	4.5
S6	0	75	12.5	60	0
S7	87	70	33	55	42
S8	0	80	25	100	45.8
S9	0	95	12.5	95	31.8
S10	0	95	54	100	75
S11	0	55	0	30	0
S12	75	0	0	30	8.3
S13	0	15	0	25	8.3
S14	0	90	45.8	100	66.6
S15	25	25	12.5	80	16.6
C1	12.5	60	58.3	100	75
C2	14.2	100	41.6	60	66.6
C3	12.5	100	66.6	100	83.3
C4	37.5	100	75	100	75
C5	0	33.3	29	33.3	0
C6	0	55	20.8	55	20.8
C7	0	55	37.5	65	20.8
C8	0	65	25	80	12.5
C9	75	68.75	16.6	100	45.8
C10	0	65	0	30	12.5
C11	66	100	33	100	58
C12	12.5	85	25	55	33
C13	0	15	0	0	0
C14	25	100	41	100	45
C15	0	100	45.8	100	66.6

Appendix: (continued) 18

subject	LIND MON	LINSG TD	LINSG MON	LINSG SP.I	BR1
M1	14.2	71.4	14.2	0	100
M2	14.3	71.4	42.8	42.8	100
M3	-1	-1	-1	-1	85.7
M4	71.4	85.7	71.4	57.1	100
M5	28	14.2	14.2	14.2	100
M6	42.8	28.5	42.8	14.2	100
M7	14.2	14.2	28.5	28.5	71.4
M8	0	0	0	0	0
M9	0	0	14.2	0	28
M10	0	0	0	0	28
M11	0	0	0	0	28
M12	0	0	0	0	-1
M13	0	0	0	12.5	-1
M14	0	0	0	0	100
M15	-1	0	-1	0	35
S1	28.5	71.4	28.5	28.5	42.8
S2	28.5	71.4	57.1	42.8	85.7
S3	0	0	0	42.8	100
S4	0	0	0	57	100
S5	42.8	42.8	14.7	42.8	100
S6	28.5	14.2	43	0	42.8
S7	71.4	42.8	71.4	28.5	42.8
S8	0	-1	57	71.4	-1
S9	71.4	0	57	0	71
S10	0	0	0	0	14
S11	0	0	0	14.2	14
S12	0	0	0	0	0
S13	0	0	0	0	0
S14	0	0	0	12.5	100
S15	0	0	0	0	28
C1	16.6	71.4	28.5	0	57.1
C2	42.8	71.4	28.5	14.2	100
C3	0	57.1	71.4	100	100
C4	71.4	100	57.1	100	100
C5	0	0	0	0	28.5
C6	14.2	0	14.2	0	14.2
C7	0	0	0	0	57.1
C8	0	0	0	0	14.2
C9	0	0	42.9	28.6	100
C10	0	0	0	0	0
C11	0	7.6	25	75	71
C12	57.1	0	25.6	0	71
C13	0	0	14.2	0	50
C14	0	0	0	0	28
C15	0	0	0	0	85.7

Appendix: (continued) 18

subject	BRI.2	BRI.3	BRI.4
M1	87.5	0	0
M2	100	14.2	6.25
M3	100	0	6.25
M4	100	42.8	75
M5	6.2	14.3	0
M6	56.2	0	0
M7	0	0	0
M8	0	0	0
M9	0	0	0
M10	0	0	0
M11	0	0	0
M12	-1	-1	-1
M13	-1	-1	-1
M14	100	0	0
M15	9	0	0
S1	93.7	0	37.5
S2	62.5	14.2	0
S3	100	0	18.75
S4	100	0	0
S5	100	0	0
S6	0	0	0
S7	46.8	0	0
S8	-1	-1	-1
S9	0	0	0
S10	0	0	0
S11	0	0	0
S12	0	0	0
S13	0	0	0
S14	100	0	0
S15	15.6	0	0
C1	12.5	0	0
C2	68.7	42.8	0
C3	100	0	31.2
C4	100	100	56.25
C5	31.25	0	0
C6	43.7	0	0
C7	3.1	0	0
C8	12.5	0	0
C9	40	0	0
C10	0	0	0
C11	15	0	0
C12	87	0	0
C13	0	0	0
C14	15	0	0
C15	0	0	0

Appendix: 19

Transfer scores for all subjects, at week one and week two. (M1-15 are Metacognitive; S1-15 are Self-instructional and C1-15 are Control).

S	SpND 1 out	SpNS 1 out	SpND 1 mark	SpNS 1 mark	LiNS 1 out
M1	100	70.8	90.9	87.5	100
M2	100	91.6	90.9	75	100
M3	100	100	100	87.5	100
M4	90	100	90.9	100	100
M5	70	79.2	72.7	70.8	100
M6	55	87.5	95.4	33	100
M7	65	12.5	81	45.8	100
M8	55	12.5	40.9	0	90
M9	65	0	9	0	80
M10	15	0	0	0	0
M11	65	22.7	0	0	0
M12	100	75	100	58	100
M13	100	87.5	100	79	100
M14	70	87	86	75	100
M15	55	0	50	0	50
S1	100	66.6	95.5	100	100
S2	60	50	63.6	54.1	100
S3	100	100	77	100	100
S4	35	0	54.5	0	15
S5	70	70.8	100	87.5	100
S6	45	0	0	0	100
S7	85	33	86.4	45.8	95
S8	60	0	40	12.5	70
S9	20	15	0	0	0
S10	0	20.8	95.4	29.1	100
S11	0	0	0	0	15
S12	15	27.2	0	0	0
S13	10	0	13.6	0	25
S14	100	41	100	12.5	100
S15	25	0	0	0	55
C1	55	4.2	45	16.6	100
C2	40	0	0	0	100
C3	100	29.1	100	45.8	100
C4	85	0	13.6	8.3	100
C5	0	00	0	0	55
C6	70	12.5	81.2	29.3	85
C7	10	0	13.6	0	30
C8	55	0	0	0	0
C9	55	0	60	0	10
C10	0	0	0	0	55
C11	75	0	36.3	12.5	100
C12	15	0	70	12.5	80
C13	20	0	13	0	25
C14	65	0	50	0	100
C15	65	0	0	0	100

Appendix: (continued) 19

tri-

subject	LiNS 1 out	bri, base 1	bri, comp 1	Column 5
M1	63.3	42.8	18.25	
M2	72.7	42.8	31.25	
M3	77.2	50	12.5	
M4	72.7	71.4	40.6	
M5	59	28.6	6.25	
M6	59	28.5	0	
M7	40.9	0	0	
M8	22.7	0	0	
M9	50	0	0	
M10	0	0	0	
M11	0	0	0	
M12	86	0	0	
M13	50	0	0	
M14	73	0	0	
M15	0	0	0	
S1	63.3	35.7	37.5	
S2	54.5	21.4	28.1	
S3	86.3	14.2	6.25	
S4	0	0	0	
S5	31.8	0	0	
S6	13.6	0	0	
S7	54.5	28.5	0	
S8	54.5	0	0	
S9	0	0	0	
S10	31.8	0	0	
S11	0	0	0	
S12	0	0	0	
S13	0	0	0	
S14	31	0	0	
S15	22	0	0	
C1	22.7	7.1	0	
C2	13.6	50	0	
C3	63.6	14.2	3.1	
C4	36.3	14.2	16.2	
C5	25	0	0	
C6	22.7	0	0	
C7	0	0	0	
C8	22.7	0	0	
C9	22.7	0	0	
C10	31.8	0	0	
C11	23	0	0	
C12	0	0	0	
C13	0	0	0	
C14	23	0	0	
C15	13.6	0	0	

Appendix: (continued) 19

subject	SpND 2 out	SpNS 2 out	SpND 2 Mark	SpNS 2 Mark	LiND 2 out
M1	90	83.3	72	58.3	100
M2	100	100	100	95.8	100
M3	100	79.1	100	62.5	100
M4	90	100	100	95.8	100
M5	85	79.2	68.2	58.3	100
M6	75	50	81	23.8	100
M7	35	8.3	68	0	100
M8	15	0	13.6	12.5	65
M9	50	0	15	0	100
M10	0	0	0	0	55
M11	60	8.3	0	0	0
M12	100	58.3	100	29	100
M13	85	87.5	100	70.8	100
M14	85	75	100	79	80
M15	0	16	68	20	20
S1	90	70.8	100	87.5	100
S2	55	8.3	27.2	25	83.3
S3	100	100	77.3	87.5	85
S4	0	0	0	0	40
S5	60	87.5	77.3	70.1	100
S6	10	0	0	0	85
S7	55	41.6	77.3	50	100
S8	50	29.2	40.9	0	100
S9	20	12.5	60	0	100
S10	85	25	77	12.5	0
S11	0	0	0	0	35
S12	10	13.6	0	0	0
S13	0	0	0	0	0
S14	95	37	100	29	100
S15	50	8.3	13	0	35
C1	65	12.5	63.6	20.8	100
C2	10	0	9	0	100
C3	100	20.8	100	37.5	100
C4	75	0	36.3	0	100
C5	0	0	0	0	65
C6	45	0	86.4	20.8	100
C7	0	0	0	0	15
C8	0	0	0	0	30
C9	25	0	0	0	45
C10	0	0	13.6	0	75
C11	35	20.8	81	0	100
C12	50	0	55	0	100
C13	0	0	0	12.5	0
C14	20	0	59	95	0
C15	85	0	0	0	100

Appendix: (continued) 19

subject	LiNS 2 out	bri basi 2	bri comp 2
M1	68.1	50	18.75
M2	72.7	50	21.8
M3	50	50	15.6
M4	100	78.5	75
M5	86.4	50	0
M6	59	28.5	0
M7	13.6	0	0
M8	0	0	0
M9	36.3	0	0
M10	0	0	0
M11	0	0	0
M12	20.8	0	0
M13	45.4	0	0
M14	77	0	0
M15	0	0	0
S1	72	50	18.75
S2	31.8	14.2	0
S3	86.4	0	0
S4	13.6	0	0
S5	22.7	14.2	15.6
S6	0	0	0
S7	50	0	0
S8	27.3	0	0
S9	13.6	0	0
S10	0	0	0
S11	0	0	0
S12	0	0	0
S13	0	0	0
S14	15	0	0
S15	13	0	0
C1	18	7.1	0
C2	22.7	14.2	0
C3	50	0	0
C4	50	42.8	9.3
C5	13.6	0	0
C6	13.6	0	0
C7	13.6	0	0
C8	0	0	0
C9	13.6	0	0
C10	0	0	0
C11	0	0	0
C12	13.6	28.5	6.2
C13	0	0	0
C14	13	35	0
C15	13	0	0

Appendix: 20

Key for abbreviations for component factor analysis and for correlational tables

BMon	- Basic perspective Monitoring
BPVS.A	- British Picture Vocabulary Scale Age equivalent
BPVS.R	- British Picture Vocabulary Scale Raw score
Bri.1	- assembling a basic Bridge
Bri.2	- assembling a complex Bridge
Bri.3	- instructing the building of a basic Bridge
Bri.4	- instructing the building of a complex Bridge
Connint	- Connel test, internal locus of control
Connoth	- Connel test, significant other locus of control
Connunk	- Connel test, unknown locus of control
LiND.Map	- Listener with Nominally Distinct Map
LiNDG.Map	- Listener with Nominally Distinct and Guided Map
LiNDG.MO	- Listener with Nominally Distinct and Guided Map, Monitoring hints
LiNDG.TD	- Listener with Nominally Distinct and Guided Map, Task Demands
LiNS.Map	- Listener with Nominally Similar Map
LiNSG.Map	- Listener with Nominally Similar and Guided Map
LiNSG.MO	- Listener with Nominally Similar and Guided Map, Monitoring hints
LiNSG.SPI	- Listener with Nominally Similar and Guided Map, Speaker Inadequacy hints
LiNSG.TD	- Listener with Nominally Similar and Guided Map, Task Demands
MAA.Nstr	- Message Adequacy test A, making a Non-Strategic response
MAA.Req	- Message Adequacy test A, Request more information
MAA.Str	- Message Adequacy test A, making a Strategic response
MAB.Nstr	- Message Adequacy test B, making a Non-Strategic response
MAB.Req	- Message Adequacy test B, Request more information
MAB.Str	- Message Adequacy test B, making a Strategic response
PMon I	- Perspective Monitoring I
PMon II	- Perspective Monitoring II
RCom	- Referential Communication
RDLS.C/A	- Reynell Developmental Language Scales Comprehension of vocabulary Age equivalent
RDLS.C/R	- Reynell Developmental Language Scales Comprehension of vocabulary Raw score
RDLS.E/A	- Reynell Developmental Language Scales Expressive vocabulary Age equivalent
RDLS.E/R	- Reynell Developmental Language Scales Expressive vocabulary Raw score
RPM.A/%	- Ravens Progressive Matices test A Percent
RPM.A/R	- Ravens Progressive Matices test A Raw
RPM.Ab/%	- Ravens Progressive Matices test Ab Percent
RPM.Ab/R	- Ravens Progressive Matices test Ab Raw
RPM.All	- Ravens Progressive Matices mean of All tests Percent
RPM.B/%	- Ravens Progressive Matices test B Percent
RPM.B/R	- Ravens Progressive Matices test B Raw
SCom	- Selective Comparison
SLen	- Sentence Length
SpND.Map	- Speaker with Nominally Distinct Map
SpNDG.Map	- Speaker with Nominally Distinct and Guided Map
SpNDG.MO	- Speaker with Nominally Distinct and Guided Map, Monitoring hints
SpNDG.TD	- Speaker with Nominally Distinct and Guided Map, Task Demands hints
SpNS.Map	- Speaker with Nominally Similar Map
SpNsG.CO	- Speaker with Nominally Similar and Guided Map, Comaprison hints
SpNsG.Map	- Speaker with Nominally Similar and Guided Map
SpNsG.MO	- Speaker with Nominally Similar and Guided Map, Monitoring hints
SpNsG.TD	- Speaker with Nominally Similar and Guided Map, Task Demands hints
STM.A	- Short Term Memory test A
STM.B	- Short Term Memory test B
TROG.A	- Test for Reception of Grammar Age equivalent
TROG.L	- Test for Reception of Grammar Level reached
TROG.R	- Test for Reception of Grammar Raw score

Appendix 21:
Full Rotated Factor Matrix: (A textual summary is provided below)

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5
BASEPER	.13056	.16408	.55553	.33546	.27624
PMON	.44337	.24418	.32930	.06542	.29488
SELCOM	.24752	.51552	.26800	.17389	.19652
REFCOM	.30386	.64231	.14350	.17120	.20855
MADASTR	.16766	.07909	.47561	.59481	-.38037
MADANST	-.11659	-.13521	-.29489	-.50516	-.30393
MADAX	.02309	-.11788	-.22738	-.14913	.05536
MADAREQ	.05943	.13971	.07377	-.04518	.79363
MADBSTR	.00571	.26591	.15347	.35942	-.47575
MADBNST	-.04323	-.22237	-.27239	-.12063	-.76740
MADBX	.04884	-.11547	-.11569	-.08878	-.15441
MADBREQ	.17234	-.04269	.01060	-.15181	.89841
MTSS1$	.02742	.66045	.16184	.42721	-.19684
MTSS2$	.09464	.82605	.19979	.08937	.19173
MTSS3$	.15851	.76665	.20745	.25817	-.05062
MTSS4$	.43364	.64260	.25776	.12033	.08191
MTSS3TD	.66364	.42018	.27731	-.00469	.02316
MTSS3MO	.64645	.21784	.34253	.07620	-.01062
MTSS4TD	.67892	.45514	.30863	-.07074	.07656
MTSS4MO	.28401	-.02128	.20289	.02995	.08486
MTSS4CO	.28541	.17465	.19094	.06168	.19036
MTSL1$	.13996	.28465	.20575	.75555	-.01880
MTSL2$	.53364	.48125	.27158	.45854	-.06406
MTSL3$	.15871	.41274	.19823	.74858	-.08505
MTSL4$	.45873	.51471	.15483	.52589	.03951
MTSL3TD	.67088	.41902	.15343	-.01033	.07373
MTSL3MO	.19251	.08984	.20730	.11857	-.03236
MTSL4TD	.70489	.33788	.37638	-.02263	.07086
MTSL4MO	.37006	.08996	.20319	.11902	.08769
MTSLSPI	.40115	.39333	.04226	.21300	.08035
BPVSRAW	.34071	.13895	.64657	.16841	.11899
TROGRAW	.24474	.38582	.58895	.28722	.08778
DIGITSA	.17110	.23144	.82821	.11458	.06563
DIGITSB	.23763	.17884	.80707	.10947	.11936
CONNUNK	-.93424	-.05122	-.13854	-.19053	-.10033
CONNOTH	-.93158	-.03363	-.13203	-.16335	-.06486
CONNINT	-.92084	-.10267	-.14871	-.15970	-.05040
RDLSVRW	.21069	.13860	.64309	.27791	-.09990
SENLEN	.08286	.26170	.41807	.02220	.03056
RPMAV$	.26306	.70537	.00394	.20622	.11782
RDLSERW	.20407	.03128	.74500	.09564	-.02854

	FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9	FACTOR 10
BASEPER	.06553	.03300	.08288	-.24799	.15575
PMON	-.17206	.45018	.05155	.10040	-.02065
SELCOM	.00685	.32672	.48613	-.00918	-.13253
REFCOM	.04274	.45367	.13471	-.05124	-.08309
MADASTR	-.02936	.17342	-.04306	-.14802	-.00676
MADANST	.06040	-.27387	.52622	.10685	.08181
MADAX	-.08963	-.12591	-.80757	-.11260	-.21810
MADAREQ	.10778	.16981	.15250	.22944	.04381
MADBSTR	-.08010	.06793	.16363	-.50021	-.06153
MADBNST	-.02045	-.00494	.11551	.25749	.07438
MADBX	.05056	-.08827	-.16455	.07575	-.83238
MADBREQ	.02730	-.04570	-.09801	.10119	.16746
MTSS1$	.06910	.09592	.06168	-.00811	.16681
MTSS2$	.03643	.03368	.05103	.11014	.02432
MTSS3$	.05254	.00401	.00280	-.10056	.27050
MTSS4$	.19602	.00133	-.00136	.14564	.26282

Appendix 21: (continued) Full rotated factor matrix

	FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9	FACTOR 10
MTSS3TD	.11696	.30278	-.18195	.03522	-.05000
MTSS3MO	.24256	.35590	-.04300	.13733	.17289
MTSS4TD	.13621	.27566	-.04916	.05191	-.01206
MTSS4MO	.76153	.12719	.04249	.18377	-.12181
MTSS4CO	.19311	.15694	.28509	.66320	-.13823
MTSL1$	.16977	.15357	.08511	-.01910	.11859
MTSL2$	.11362	-.08645	.15157	-.01596	.15954
MTSL3$	.03649	-.06914	.05445	.13335	-.02588
MTSL4$	.11206	-.07854	.27997	.01311	.04854
MTSL3TD	.31178	.31012	.03182	.11299	.08026
MTSL3MO	.40831	.74944	.12285	.05658	.17164
MTSL4TD	.28926	.28493	-.01488	.04110	.06878
MTSL4MO	.72745	.37391	.06419	.04864	.00661
MTSLSPI	.49362	-.05857	-.19827	.23990	.07029
BPVSRAW	.12897	.17562	-.01630	-.00461	.05913
TROGRAW	.10533	.13087	.09391	.23786	-.03879
DIGITSA	.15881	.06278	-.03962	.09852	.08615
DIGITSB	.06601	.16041	.03333	.07524	.11320
CONNUNK	-.07875	.04063	-.08885	-.02769	.04937
CONNOTH	-.11773	-.03319	-.02268	-.03177	.08141
CONNINT	-.12771	.03632	-.04169	-.01093	.06417
RDLSVRW	.33064	-.08311	.14504	.40984	-.14106
SENLEN	.59661	-.14023	.31664	-.28050	.05998
RPMAV$	.03887	.10335	.02273	-.07791	-.34444
RDLSERW	.16704	.06202	.37745	-.15566	-.03516

Summary of factors:

This analysis extracted a number of factors from the performance scores of our subjects on psychometric and commmunicative tests at baseline. Factor 1 involves subjects' ability to perform on the perspective taking task (PMON), the basic referential communication task (REFCOM), and on map based tasks for communicating the identity of one of two nominally similar referents as listeners (MTSL2 and MTSL4) and (when guided) as speakers (MTSS4). Factor 1 is also implicated in subjects' ability to make use of hints for the map tasks, as speakers (MTSS3TD, MTSS3MO and MTSS4TD) and as listeners (MTSL3TD, MTSL4TD, MTSL4MO and MTSLSPI), and in subjects' performance on the Peabody vocabulary scale (BPVS).

Factor 2 is involved with ability to perform on two componential tests of communication, both of which require the comparison of differences - either when requested (SELCOM) or spontaneously (REFCOM). Factor 2 is also involved in all global tests of speaker ability with maps (MTSS1, MTSS2, MTSS3 and MTSS4) and in three of the four global tests of listener ability (MTSL2, MTSL3 and MTSL4), and in subjects' ability to make use of hints for understanding task demands (MTSS3TD, MTSS4TD, MTSL3TD, MTSL4TD and MTSLSPI). Factor 2 is also implicated in ability on the Test of the Reception of Grammar (TROG) and on Ravens Progressive Matrices (RPMAV$).

Factor 3 seems to underlie performance on componential tests of perspective taking (BASEPERS and PMON). It is also implicated in performance on a number of receptive language tests - for receptive vocabulary, the reception of grammar and general receptive abilities (BPVSraw, TROGraw and RDLSVRW), and on tests of expressive language (RDLSERW and SENLEN). Factor 3 also seems to underlie short term memory ability (DIGITSA and DIGITSB) and the ability to utilise hints for the map tasks (MTSS3MO, MTSS4TD and MTSL4TD).

Factor 4 is involved with ability to take another's perspective (BASEPER) and ability to perform on the map task in the speaker role in which comparisons can be made by name (MTSS1). Factor 4 is, however, more generally related to listener abilities, in the componentialised use of strategic processes for choosing referents (MADASTR and MADBSTR) and on performance when tested globally with maps (MTSL1, MTSL2, MTSL3 and MTSL4).

The fifth factor extracted involves the ability to request more information when given inadequate messages in componentialised tasks (MADAREQ and MADBREQ). The sixth factor was mainly related to ability to utilise hints (MTSL3TD, MTSL3MON, MTSL3TD, MTSL4MO and MTSLSPI), to comprehend verbal information (RDLSVRW) and to the length of a persons average sentence (SENLEN). The seventh factor is involved with performance on the componential tasks of speaker skill (SELCOM, PMON and REFCOM) and to subjects' ability to utilise hints as speakers (MTSS3TD and MTSS3MO) and listeners (MTSL3TD, MTSL3MO and MTSL4TD). The eighth factor extracted underlies ability to make selective comparisons on the componential task (SELCOM), making strategic choice when given ambiguous messages (MADAST) and performance on tests of expressive language (SENLEN and RDLSERW). The ninth factor is related to ability to make comparisons when guided on the map task (MTSS4CO) and general ability to comprehend verbal material (RDLSVRW).

The main four factors extracted are as follows:

Factor 1 would seem to be a general communication skill which is readilly potentiated. Factor 2 would also seem to be a general communication skill, again being readilly potentiated, but which is strongly allied to skills for abstract reasoning and grammatical understanding. Factor 3 seems to be characterised as being generally linguistic. Factor 4 is generally related to listener abilities, in particular those for making strategic responses for choosing referents when given inadequate messages.