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Pronoun comprehension in Down Syndrome: Deviance or delay?

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Pronoun comprehension in Down Syndrome: Deviance or delay?

Purpose: Results of recent pilot studies suggest that the interpretation of pronominal elements in Down Syndrome (DS) may follow a pattern unattested in typical development, indicating the presence of a selective deficit targeting the comprehension of reflexive pronouns. These findings come at a time when there is a heated debate surrounding pronoun comprehension in typical development as well. We aim to contribute to these debates by examining pronoun comprehension in Greek, a language that exhibits unusual patterns in pronoun comprehension in typical development. **Method:** Seven Greek-speaking individuals with DS and a control group of fourteen typically developing (TD) children were tested. We examined the comprehension of pronominal elements, including strong pronouns, reflexive pronouns, and pronominal clitics, using a picture selection task. **Results:** The data reveal evidence of deviant pronoun comprehension in individuals with DS compared to the TD group. The DS group encountered problems in the interpretation of reflexive pronouns when compared to the TD group, while the performance of the two groups was comparable in all remaining conditions. **Conclusions:** Findings are in line with the selective deficit model of language comprehension in DS, supporting the presence of a cross-linguistic reflexive deficit.

Keywords: Down Syndrome, Language, Language Comprehension

Introduction

According to the traditional view in the literature on Down Syndrome (DS), language development in individuals with DS follows a path similar to the developmental path

observed in typically developing (TD) children, albeit with a slower rate (see Rutter & Buckley, 1994). However, a substantial body of evidence now supports proposals for the existence of a specific language impairment in DS, based on the fact that certain language abilities in individuals with DS are inferior compared to non-verbal cognitive abilities (e.g., Fowler, 1990; Miller, 1999; see Chapman & Hesketh, 2000 for a review). Areas affected include syntax and morphology (Chapman, Seung, Schwartz, & Kay-Raining Bird, 1998). Regarding syntax, one domain which appears to be particularly disadvantaged is the interpretation of passives (Bridges & Smith, 1984; Eriks-Brophy, Goodluck, & Stojanovic, 2003). For example, Bridges and Smith (1984) examined 24 adults with DS, in comparison with an equal number of TD children matched for verbal comprehension and found that while the performance of the two groups in active sentences was comparable, the DS group performed significantly worse than the TD group when tested in passive sentences. Other domains of syntax, such as verb production, are also disproportionately affected by the syndrome: for instance, Hesketh and Chapman (1998) tested 29 individuals with DS matched to a control group of 29 TD children on language abilities (mean length of utterance) and report a significant difference in the number and range of grammatical verbs produced by the two groups. Syntactic comprehension is also challenging for individuals with DS in relation to their cognitive development but also compared to other areas of language comprehension: for example, Abbeduto et al. (2003), in a test of comprehension skills administered to 25 young adults with DS (mean age 16;6), found that syntactic comprehension was not only below that of the mental age matched control group, but also significantly lower than vocabulary comprehension within the DS group (see also Chapman, Seung, Schwartz, & Kay-Raining Bird, 1991).

Recent pilot studies on DS have also revealed patterns that are not attested in the developmental path of TD children in the comprehension of pronouns (Perovic, 2006, 2008; Ring & Clahsen, 2005). While TD children typically go through a stage when they have problems in the comprehension of personal pronouns, but have no such difficulties with regard to reflexive pronouns (Chien & Wexler, 1990), individuals with DS appear to have difficulties in the comprehension of reflexive pronouns instead. Relevant studies have started to identify the deviant pattern in different languages, namely English and Serbo-Croatian (English: Perovic, 2006; Ring & Clahsen, 2005; Serbo-Croatian: Perovic, 2008), while associated analyses propose the existence of a syntactic deficit which affects the comprehension of reflexive pronouns in individuals with DS (Perovic, 2006, 2008; Ring & Clahsen, 2005).

This study aims to examine the interpretation of pronominal elements by Greek-speaking individuals with DS compared to TD children, in order to determine whether the deficit associated with DS cross-linguistically is observed in Greek as well. Selection of language to be tested was made in the context of a heated debate surrounding pronoun acquisition in typical development. The debate concerns which pronominal elements are problematic for TD children up to the age of 6 (Conroy, Takahashi, Lidz, & Phillips, 2009): Greek is central in this debate, as it has two personal pronoun types, neither of which has ever been found to pose difficulties to Greek-speaking TD children (Sanoudaki, 2004; Varlokosta, 2000; Varlokosta & Dullaart, 2001), while problems are present in several well-studied languages, such as English (Chien & Wexler, 1990) and Dutch (Philip & Coopmans, 1996). The Greek data support the view that certain pronoun types are immune to developmental difficulties (Hartman, Sudo & Wexler, 2012).

Pronoun interpretation in TD children

Typically developing children acquiring a range of languages, such as English, Dutch, Russian, and Icelandic, have been found to encounter difficulties in the interpretation of personal pronouns when tested experimentally (e.g., Avrutin & Wexler, 1992; Chien & Wexler, 1990; Philip & Coopmans, 1996). Specifically, English-speaking children up to the age of six sometimes interpret a sentence such as ‘the prince is painting him’ as ‘the prince is painting himself’ (or the equivalent in other languages), allowing the personal pronoun to take a reflexive interpretation. For example, Chien and Wexler (1990), in a large scale study, examined four age groups of English-speaking children (4-7 years, N around 40 in each age group) and found that the four, five, and six year-old groups allowed a reflexive interpretation of personal pronouns around half of the time, while percentages dropped sharply for the seven year-old group. Similar results were obtained for Dutch in the Philip and Coopmans (1996) study, where 37 children aged 4 to 6 were tested using a Picture Selection task. The phenomenon, known as the Pronoun Interpretation Problem (PIP), has been attributed to children’s limitations in working memory (Grodzinsky & Reinhart, 1993).

However, studies examining the interpretation of pronominal elements by TD children have given results that vary greatly, giving rise to a debate on the distribution of the PIP. While research has shown the PIP to be active in a number of languages (English: Chien & Wexler, 1990; Dutch: Philip & Coopmans, 1996; Russian: Avrutin & Wexler, 1992; Icelandic: Sigurjónsdóttir & Hyams, 1992), the phenomenon is not attested in all languages, or with all types of personal pronouns. Specifically, relevant research has shown that the PIP is limited to stronger types of personal pronouns, as children do not encounter similar difficulties in the interpretation of pronominal clitics, in languages that have them, such as

Italian, Spanish, and Greek (Italian: McKee, 1992; Spanish: Baauw & Cuetos, 2003, Greek: Varlokosta, 2000).

1. Greek clitic context

O andras ton agaliase.¹

the man himCL hugged

‘The man hugged him.’

Moreover, the PIP is not active with the strong types of personal pronouns in all languages: research in Greek-speaking TD children has failed to detect any difficulties with the strong type of personal pronouns (Varlokosta, 2000; also in the bilingual acquisition of Greek: Sanoudaki, 2004, in Greek-English bilingual children; Varlokosta & Dullaart, 2001, in Greek-Dutch bilingual children). Varlokosta (2000) examined the interpretation of pronominal elements in 20 Greek-speaking children (age range 3;7-5;6) and found that children did not accept a reflexive interpretation of Greek strong pronouns. Greek has two types of personal pronouns, a weaker type (pronominal clitic, (1)) and a strong type (strong pronoun, (2)). The two types differ in a range of ways (see Mavrogiorgos, 2010; Varlokosta, 2002), including stress placement (only strong pronouns are stressed).

2. Greek strong pronoun context

O andras agaliase afton.

the man hugged himPRON

‘The man hugged him.’

¹ Greek examples are loosely transcribed according to the purposes of the present article.

Greek also contains reflexive pronouns (3), the interpretation of which does not normally present any difficulties in typical development, except when they appear in environments where they are preceded by two nouns as in (4) (Varlokosta, 2000, 2001). In sentences such as (4), children sometimes allow an interpretation where the grandfather (papu) is the referent of the reflexive pronoun (i.e. the grandfather is watching himself) instead of the grammatically correct referent dad (babas). No satisfactory analysis has been given to this phenomenon (see Varlokosta, 2001). As can be seen in the examples, Greek reflexive pronouns are complex elements, consisting of a definite article, a reflexive element, and a possessive (see Iatridou, 1988; Anagnostopoulou & Everaert, 1999).

3. O andras vlepi ton eafto tou ston kathrefti.

the man looks the self his in the mirror

‘The man is watching himself in the mirror.’

4. O babas dhipla ston papu vlepi ton eafto tu ston kathrefti.

the dad next to the grandfather looks the self his in the mirror

‘The father next to the grandfather is watching himself in the mirror.’

Pronoun interpretation in DS

Research on pronoun interpretation in individuals with DS has revealed a pattern that differs from patterns observed in TD children. Perovic (2001) tested the interpretation of pronouns in a group of four English-speaking young adults with DS (age range 17 to 21 years, verbal mental age equivalent (British Picture Vocabulary Scale - BPVS) five years to eight years

one month). Results revealed difficulties in the interpretation of reflexive pronouns but not in the interpretation of personal pronouns. As Perovic (2001) did not test a control group, more recent studies sought to replicate the unusual results in comparison with a group of TD children as controls. Ring and Clahsen (2005) tested eight English-speaking adolescents with DS (two subgroups, mean chronological ages 12 years 6 months and 13 years 4 months, mean mental age five years seven months and six years four months) in comparison with a group of TD children whose chronological age matched the mental age of the participants with DS and report an identical pattern to that found in Perovic (2001): individuals with DS, unlike TD children, had problems in the comprehension of reflexive pronouns. Perovic (2006) tested a group of four English-speaking TD children (age range five years ten months to seven years ten months) as controls for her previous study (Perovic, 2001). The TD children were individually matched to the participants in the group of participants with DS on verbal abilities and results replicated the deviant pattern found in Ring and Clahsen (2005). This difference between TD and DS was also found in Serbo-Croatian, as reported in Perovic (2008), where six Serbo-croatian-speaking adults with DS (age range 19 to 29 years, non-verbal reasoning age equivalent five years six months to eight years; Raven's Coloured Progressive Matrices – RCPM) were tested in comparison with a control group of six TD children (age range five years two months to six years eleven months, matched individually to the DS group on the basis of raw scores on RCPM.)

The findings of these pilot studies have two principal implications. First, they are in line with the plethora of studies indicating that language development in DS is not 'slow-but-normal' (i.e. delayed); instead, it follows a qualitatively different pattern, where certain areas are more problematic than others. Second, these findings indicate that one of the areas hit by this selective impairment in DS may be the comprehension of reflexive pronouns. Ring and Clahsen (2005) develop an analysis along these lines, proposing that DS involves a selective

impairment in forming certain syntactic dependencies, which affects the comprehension of reflexives as well as passives. The proposed analysis follows accounts such as Reuland (2001) and Hornstein (2001), which unify the syntactic mechanisms involved in passivisation and in reflexive binding, and is supported by previous findings showing difficulties in the interpretation of passives in English-speaking individuals with DS (Eriks-Brophy et al., 2003).

A pilot investigation of pronoun interpretation in Greek DS (Stathopoulou, 2009) appears to provide results that depart from the emerging cross-linguistic profile of reflexive deficit in DS. Stathopoulou (2009) examined the language abilities of eight Greek-speaking adolescents with DS (chronological age range twelve years one month to eighteen years seven months, mental age range five years to seven years six months: Stanford-Binet (Terman-Merrill) Intelligence test or Wechsler Intelligence Scale for Children-Revised) in comparison with sixteen TD children, using a Truth Value Judgment Task (Chien & Wexler, 1990). Matching was performed on the basis of mental age (chronological age of children in the TD group was matched to mental age of participants in the DS group). Results indicate that the DS group did not encounter greater difficulties in the interpretation of reflexives than in the interpretation of other pronouns, such as pronominal clitics. In fact, the DS cohort in Stathopoulou (2009) performed significantly worse than mental-age matched TD controls in most of the pronouns and structures tested, including pronominal clitics and reflexive pronouns. If this departure from the cross-linguistically observed pattern is confirmed, it could bring into question the reflexive deficit hypothesis and could potentially require new theoretical mechanisms to account for language-specific patterns. However, as the study in question (Stathopoulou, 2009) involved participants with DS whose grammar was still developing (minimum DS participant age twelve years), it is possible that the findings were due to a slower rate of language development in the individuals tested, leaving open the

possibility that these problems could be overcome with age. These results, therefore, call for a closer examination of pronoun comprehension in this population.

The present study

In this study, we examined the interpretation of a range of pronouns in Greek-speaking individuals with DS. Our main aim was to establish whether the interpretation of pronouns in DS differs from the pattern observed in Greek-speaking TD children, contributing to the question of selective reflexive deficit and to the general deviance versus delay debate.

The current study aimed to address the following main research questions:

1. Is the comprehension of reflexive pronouns in Greek adults with DS below that of TD children?
2. Is the comprehension of other pronouns and structures (reflexives when preceded by two nouns, pronominal clitics, and strong pronouns) in Greek adults with DS below that of TD children?

A positive reply to question 1 (only) would be in line with the emerging cross-linguistic profile of selective deficit in reflexive structures in DS (Perovic, 2001, 2006, 2008). A positive reply to question 2 as well would be consistent with Stathopoulou's (2009) findings, indicating that the difficulties encountered by individuals with DS in the comprehension of the Greek pronoun system may be more general, and not specific to the reflexive pronoun.

Following Perovic (2001, 2006, 2008), the population targeted consisted of adults with DS rather than children. By doing so, we aimed to identify the highest possible

performance achieved in this population, after reports of possible improvement in language skills post-adolescence (see Chapman, Hesketh, & Kistler, 2002). By targeting the end achievement in the test population we ensured that any differences detected between the two groups (DS and TD) are not overcome later on, and would thus correspond to elements of a deviant linguistic profile.

Method

Participants

Seven adults with DS (three male, four female), between 23 and 34 years of age were tested in this study. Fourteen TD children were tested as controls. All participants were monolingual speakers of Greek. Information on participants with DS was obtained using a short questionnaire administered to their tutors, supplemented by short interviews. The questionnaire was designed to elicit information on disorder and background details, and results of psychometric tests. Etiological subtype of DS was not known for any of our participants. As psychometric tests on non-verbal cognitive abilities of participants with DS were not available, we relied on tutors' judgments. The cognitive abilities of participants with DS ranged from average to high, according to their tutors. In order to assess the participants' verbal skills, part of the Diagnostic Test of Verbal Intelligence (DVIQ, Stavrakaki & Tsimpli, 2000) was administered, namely the productive vocabulary and the comprehension of morphosyntax subtests². The former subtest consists of a word elicitation task using pictures.

² At the time of testing, standardised tools for assessing vocabulary or (morpho)syntax in Greek were not available. Although the DVIQ is not a standardised measure, norms are available for the ages 3 years 5 months to 6 years 5 months.

The latter subtest involves a picture selection task, whereby children are asked to select the picture (out of three) that corresponds to a given utterance. We used the preschool version of the test, which has been developed to measure verbal abilities in production and comprehension of vocabulary, syntax and morphology in children aged 3 years 5 months to 6 years. Although it was not possible to obtain measures of participants' non verbal mental age, vocabulary measures are generally considered a good indicator of mental age in individuals with DS (see Abbeduto, Warren, & Conners, 2007, and references therein). Details of the participants in the DS group, including their chronological age and raw scores on the DVIQ subtests, are given in Table 1.

TABLE 1 ABOUT HERE

Participants 1DS and 2DS attended a centre for young people with learning disabilities, while participants 3DS-7DS attended a centre for people with special needs, in the island of Crete. These establishments were the places where participants with DS were recruited and where testing took place.

Fourteen TD children (eight boys, six girls), aged 4 years 5 months to 5 years 11 months, formed the control group. The TD children were recruited and tested in 3 pre-schools in Crete. Children were selected from a larger pool of TD children who were tested for the purposes of a study examining the interpretation of pronominal elements in Greek-speaking TD children (Sanoudaki & Varlokosta, 2012, 2013a). All children were reported by school staff as having normal linguistic and cognitive development, and no hearing or learning disabilities. This group also completed the productive vocabulary and the comprehension of morphosyntax subtests of the DVIQ (Stavrakaki & Tsimpli, 2000). Each participant with DS was individually matched to two TD children on the raw scores (± 2 points) of the

productive vocabulary subtest. The two groups did not differ significantly in their performance at the two subtests: productive vocabulary $t(19)=0.065$, $p=.949$; comprehension of morphosyntax $t(19)=0.584$, $p=.566$. Information on the TD control group is given in Table 2.

TABLE 2 ABOUT HERE

Finally, for the purposes of a comparison with the adult norm, we also include the results of a group of eighteen adults (thirteen women, five men, age range 23-67), reported in Sanoudaki and Varlokosta (2012, 2013a). Adult participants were raised in a monolingual Greek environment in the island of Crete and had only been exposed to another language through formal instruction at school. They all lived in Crete and had no history of language or learning disabilities.

Materials

A manual Picture Selection Task (Gerken & Shady, 1998) was used in this study. The Picture Selection Task has been used in research examining the development of various morphosyntactic contrasts, including the comprehension of pronouns in typical development (Baauw, Zuckerman, Ruigendijk, & Avrutin, 2011; Wexler & Chien, 1985), as well as in atypical populations (e.g., Varlokosta & Nerantzini, 2012, in Greek-speaking children with Specific Language Impairment, Baauw et al., 2011, in Spanish agrammatics with Broca's aphasia). The task was selected for its lower processing demands (Baauw et al., 2011) compared to the other commonly used task (Truth Value Judgment Task, Chien & Wexler, 1990); as such, it was deemed more appropriate for the target population, which is

characterised by reduced cognitive abilities. The lower processing load associated with the Picture Selection Task is likely to provide a more accurate estimate of language abilities in the target population, as performance is less affected by co-existing non-verbal cognitive deficits.

Participants saw two picture stimuli while hearing one sentence stimulus, and were asked to decide which visual stimulus corresponds to the linguistic stimulus. One of the two colour pictures showed a character performing a reflexive action (e.g., a person washing himself), while the other picture showed the same character performing the same action on somebody else. The two characters were present in both pictures (Figure 1). The stimuli used were developed within COST (European Cooperation in Science and Technology) Action A33 'Crosslinguistically Robust Stages of Children's Linguistic Performance' (2006-2010), and were subsequently adapted to the needs of the present study.

FIGURE 1 ABOUT HERE

Figure 1. Example of the picture stimuli (pictures developed within COST Action A33).

Manipulation of the linguistic stimulus created the following test conditions: clitic (CL), strong pronoun (PRON), reflexive (REFL), and reflexive with two nouns (REFL2), as well as one control condition: noun (CNTRL). Each condition included nine trials, creating a total of forty-five trials. Table 3 gives an example for each experimental condition.

TABLE 3 ABOUT HERE

Each linguistic stimulus was preceded by an introductory sentence, presenting the two characters, as in (5).

5. a. Introductory sentence

Edo vlepume ena vasilia ki ena mago.

‘Here we see a king and a wizard.’

b. Stimulus

O vasilias pleni ton eafto tu.

‘The king is washing himself.’

Each of the following verbs was used once for each of the experimental conditions: *skepazi* ‘is covering’, *agaliazi* ‘is hugging’, *agizi* ‘is touching’, *zografizi* ‘is drawing’, *pleni* ‘is washing’, *htenizi* ‘is combing’, *vafi* ‘is painting’, *glifi* ‘is licking’, *skupizi* ‘is drying’. Two practice items, with the verb *vrehi* ‘is soaking’, were also included, in order to familiarise participants with the task. The two characters presented in the picture stimuli were either human or animal characters, and the gender of the two nouns that were used to refer to them always matched (either feminine or masculine).

Two different presentation orders were used, in order to avoid sequence effects, while presentation order was counterbalanced between participants in each group. The first order was pseudorandomised, while the second one was the reverse.

In order to keep participants’ interest in the task, we also included five picture fillers. These were colour drawings of novel animals, which did not require any response, but served instead as potential points for a short break, if this was needed.

Procedure

Each participant was tested individually in a quiet room. For the participants in the child group, the experimenter first spent some time in their classroom or in the schoolyard, so as to become familiar to them. The DVIQ was administered first, and the experimental task followed after a short break. Picture stimuli were shown side by side on a 15.6'' laptop screen, while the linguistic stimuli were read aloud by the experimenter using neutral prosody.

In cases when the participant did not respond, the same trial was repeated twice at most. In the cases when it was unclear which of the two pictures the participant was pointing to, the participant was encouraged to select one of the two pictures. There were short breaks of spontaneous discussion, as well as quiet unstructured play for participants in the child group, introduced by the five filler pictures, as needed.

Results

The box plot in Figure 2 shows the distribution of target responses for each participant group. Individual results can be found in the Appendix.

FIGURE 2 ABOUT HERE

Figure 2. Box plot showing the distribution of target responses for each condition. DS, TD, and adult group

The TD child group performed at ceiling at the control, clitic, and reflexive conditions, but lower at reflexives with two nouns and strong pronouns (76% and 70% target responses, respectively). The difference between conditions in TD children's performance was statistically significant ($\chi^2(4)=25.983$, $p<0.001$, Friedman test). Wilcoxon signed rank tests (significance level set at $p<.012$, corrected to control for Type I error) showed that the difference in performance between the control condition and the reflexive with two nouns condition was statistically significant with a large effect size ($Z=-2.766$, $p=.005$, $r=0.523$), and so was the difference between the control condition and the strong pronoun condition ($Z=-3.215$, $p=.001$, $r=0.608$). Results of comparisons between the control condition and remaining conditions were below significance (control versus clitics $Z=-0.7$, $p=.47$, $r=0.134$; control versus reflexives $Z=-1.26$, $p=.2$, $r=0.239$).

Responses of the DS group at the control condition were at ceiling; the clitic condition was also high (86% target responses), while the remaining conditions presented lower percentages of target responses (67% at the reflexive and strong pronoun conditions, and 62% at reflexives with two nouns). The performance of the DS group differed significantly across conditions ($\chi^2(4)=9.548$, $p=0.049$, Friedman test). Pairwise comparisons of the control condition with other conditions using Wilcoxon signed ranked tests did not reach significance (significance level set at $p<.012$): control versus clitic $Z=1.289$, $p=.197$, $r=0.344$; control versus reflexive, $Z=-2.04$, $p=.04$, $r=0.546$; control versus reflexive with two nouns $Z=2.02$, $p=.04$, $r=0.541$; control versus strong pronouns $Z=2.2$, $p=.03$, $r=0.592$. Note that the latter three comparisons have large size effects, indicating that non-significant p values may be due to small sample size.

A between group analysis showed that there was a statistically significant difference with a large effect size between the DS and the TD child group in the reflexive condition

($U=16$, $Z=-2.64$, $p=.008$, $r=-0.576$, Mann-Whitney U test), such that the DS group performed worse than the TD group. All other between group comparisons remained below significance (control $U=35$, $Z=-1.4$, $p=.15$, $r=-0.236$; clitic $U=28.5$, $Z=-1.82$, $p=.06$, $r=-0.399$; reflexive with two nouns $U=33$, $Z=-1.21$, $p=.22$, $r=-0.265$; strong pronoun $U=40$, $Z=-0.68$, $p=.49$, $r=-0.149$).

Target responses in the strong pronoun condition ranged between 60-70% for all three groups (DS, TD, and adult). There was no statistically significant difference between the three groups in this condition ($H(2)=0.395$, $p=.821$) (Kruskal Wallis H test), as the adult group also performed lower at the strong pronoun condition. Specifically, within-group statistical analysis revealed a significant difference between conditions in the adult group (Friedman test $\chi^2(4)=48.357$, $p<.001$) and post-hoc analyses using Wilcoxon Signed-Rank Tests (significance level set at $p<.012$) showed that this result was due to a significant difference with a large effect size between the control and strong pronoun conditions, $Z=-3.192$, $p=.001$, $r=0.532$. No difference was detected between the control condition and remaining conditions: reflexive $Z=1$, $p=.3$, $r=-0.167$; reflexive with two nouns $Z=0$, $p=1$, $r=0.000$, as adults performed at ceiling at all remaining conditions.

Discussion

In this study we examined the interpretation of pronouns in Greek-speaking individuals with DS compared to TD children. Results did not reveal any differences between the two groups in their interpretation of most elements, including pronominal clitics, strong pronouns, and reflexives preceded by two nouns. However, participants with DS were found to experience problems in their interpretation of reflexives when compared to TD children.

Findings are in line with the view that pronoun interpretation in DS is deviant compared to typical development, providing additional arguments to proposals of a specific reflexive deficit in DS (Perovic, 2008). Language is an especially problematic area for DS compared to other areas of cognition (Fowler, 1990; see also Chapman et al., 1998), and there is evidence that individuals in this population tend to perform worse than would be expected in linguistic tasks, given their non-linguistic cognitive abilities (Caselli, Monaco, Trasciani, & Vicari, 2008; Joffe & Varlokosta, 2007; Laws & Bishop, 2003). The present study, along with studies on Serbo-Croatian and English (Perovic, 2006, 2008; Ring & Clahsen, 2005) pinpoints a specific area that is the target of a language deficit in DS, namely reflexive pronoun interpretation. Crucially, detected difficulties do not extend to all pronouns indiscriminately, something that would potentially be consistent with a general language delay. Instead, only reflexive elements are targeted cross-linguistically.

Of particular importance is the fact that the deviant pattern in pronoun comprehension was detected in Greek, a language whose pronoun comprehension in typical development does not follow the cross-linguistic pattern. For example, Greek-speaking TD children, unlike children acquiring other languages (Chien & Wexler, 1990; Philip & Coopmans, 1996), have been found to give adult-like responses when their interpretation of strong pronouns is tested (Varlokosta, 2000). Note that in the present study both children and adults sometimes gave a reflexive interpretation to strong pronouns; analysis of this finding is beyond the scope of this paper (for discussion see Sanoudaki & Varlokosta, 2012, 2013a). A further peculiarity of Greek typical development, also detected in the present study, involves problems in the interpretation of reflexive pronouns when these are preceded by two nouns, as in (4). Despite these deviations from cross-linguistic patterns in Greek typical development, the reflexive pronoun deficit was detected in Greek DS, as it has in English and Serbo-Croatian

populations. This indicates that the deficit may be due to properties of the reflexive elements, rather than linked to properties of the system of pronouns as a whole.

An additional element that offers support to the reflexive deficit hypothesis is the age of the participants in our DS cohort. If the group tested involved individuals in childhood or adolescence, it would be possible that difficulties detected in the comprehension of reflexive pronouns could be overcome with age. While there is no consensus on the cut-off point of language development in DS (see Rondal & Comblain, 2002), there is evidence of improvement in language skills after adolescence (Chapman, Hesketh, & Kistler, 2002; Thordardottir, Chapman, & Wagner, 2002), followed by a decline associated with early-onset dementia in DS around the age of fifty (Chapman & Hesketh, 2000; Das, Divis, Alexander, Parrila, & Naglieri, 1995). The present study examined adults with DS in their mid-twenties to mid-thirties, and detected that the deviant pattern in pronoun comprehension is present at the end-state of acquisition.

Our findings help establish a consistent cross-linguistic profile for DS. This is particularly important, as individual variability is one of the characteristics of this population (see Martin, Klusek, Estigarribia, & Roberts, 2009). Establishing cross-language generalisations can contribute significantly to the development of efficient monitoring and intervention techniques. Further research is needed in order to determine whether the reflexive deficit is part of a more general deficit in forming syntactic dependencies, as has been suggested (Ring & Clahsen, 2005). Given the recent emergence of evidence that at least some individuals with DS have no difficulties in the comprehension (and production) of passive sentences (Rubin, 2006), the proposed line of research would enhance our understanding of the syndrome and associated deficits.

Although our findings help create a consistent cross-linguistic profile for individuals with DS, they are in apparent inconsistency with a previous investigation of pronoun

interpretation in Greek DS (Stathopoulou, 2009). Recall that in Stathopoulou (2009) the DS cohort performed significantly below the TD group at both clitic and reflexive pronouns. We will now briefly discuss possible reasons for this inconsistency. A marked difference between the two studies is the age group tested: specifically, while the present study focused on adults with DS, Stathopoulou (2009) tested adolescents aged 12-18 years. It is, therefore, possible that an improvement in the comprehension of pronominal clitics takes place after adolescence in individuals with DS, bringing them to the same level as TD children. This would be in line with studies showing the possibility of improvement in language abilities in this population beyond adolescence (Chapman et al., 2002). However, note that the two studies (Stathopoulou, 2009 and the present study) are not directly comparable. Different matching measures were employed (non verbal cognitive abilities in Stathopoulou 2009, linguistic abilities in the present study), both of which have been used in the examination of pronoun interpretation in DS (Ring & Clahsen, 2005, cognitive abilities/mental age; Perovic, 2006, linguistic abilities). Different tasks were also administered (Truth Value Judgment task in Stathopoulou, 2009; Picture Selection task in the present study), both of which have been used in the study of pronoun comprehension in typical and atypical populations (Avrutin & Wexler, 1992, Truth Value Judgment task; Baauw et al., 2011, Picture Selection task). Consequently, it is at present not possible to decide on the exact reasons for the discrepancy between the two sets of findings. For example, differences in task selection may have contributed to the discrepancy between the two studies in the following manner: the higher processing load imposed by the Truth Value Judgment task (Baauw et al., 2011) may have been more challenging for the DS cohort in Stathopoulou's study, resulting in lower overall performance compared to TD children. In contrast, the Picture Selection task employed in the present study requires lower processing capacities, and, as such, may better reflect the true linguistic abilities of the target population. Moreover, the different matching measures

employed by the two studies may have contributed to the difference in the age ranges of the two control groups, and thus indirectly to the discrepancy in results. As language is a particularly challenging area for DS compared to non-verbal aspects of cognition (Chapman & Kay-Raining Bird, 2012), a linguistic matching measure such as the one employed here may have contributed to the lower age of the present control group (mean age 5;02) when compared to the non-verbal matching measure in Stathopoulou (2009) (control group of ten children with mean age of 5;02; two children with mean age 6;02; and four children with mean age 7;04). The higher age of the control group in Stathopoulou (2009) may have been responsible for the across-the-board lower performance of the DS group compared to the TD group. Methodological studies using both tasks and matching measures would be able to ascertain the influence of task selection and matching measures in this case. Finally, a longitudinal study would be able to determine the path of pronoun comprehension in DS and establish whether the apparent inconsistency is due to a developmental change (see also Sanoudaki & Varlokosta, 2013b).

Limitations and future directions

Like previous studies on pronoun comprehension in DS (Perovic, 2001, 2006, 2008; Ring & Clahsen, 2005; Stathopoulou, 2009), the present study involves a small sample size, due to difficulties in identifying suitable participants in this clinical population. Consequently, all existing studies on the topic should be treated as pilot research which indicates that further investigation is essential. It is possible, for example, that the small sample size of the present study may have prevented us from identifying differences between the target and control groups on other conditions in addition to the reflexive condition (although effect sizes were

consistently small). Future research should use larger samples as well as more sophisticated study designs, including longitudinal research.

Longitudinal research on the topic would be central in priorities for future research also for its potential clinical implications. Although the current study and Stathopoulou's (2009) study are not directly comparable, as discussed in the previous section, the results of the two studies, when seen jointly, leave open the possibility that pronoun understanding in (Greek) DS can improve beyond adolescence (in line with findings in expressive language, Chapman et al., 2002). Rigorous future examination of the development of pronoun comprehension in a longitudinal study would help clarify this. If this improvement is confirmed, this would guide speech and language therapy efforts in this population, indicating that treatment should not be limited to children but should also target adolescents and even adults.

Another issue that needs to be addressed in further research is the difference in matching measures across studies, which makes a comparison of results difficult. As indicated earlier, a variety of measures have been used to match the DS groups with TD controls, even in the limited number of studies on pronoun comprehension, and sometimes more than one measure was used within the same study (Stathopoulou, 2009). To allow fruitful comparisons, cross-linguistic research on pronoun comprehension should be conducted using consistent matching procedures and testing techniques. This should be extended to a range of target syntactic structures, so that a more complete cross-linguistic picture of the syntactic abilities in this population can be achieved.

Conclusions

The present study provides support to the view of a specific language deficit in DS compared to language in typical development. Findings, combined with familiar data, create a profile of diminished reflexive pronoun comprehension in DS cross-linguistically. From a theoretical point of view, the study contributes to increasing awareness that poor language skills in DS are not (only) the result of a general cognitive impairment, and it enhances our knowledge of the language phenotype associated with DS.

This knowledge has direct implications for clinical practice: as our knowledge is becoming more sophisticated, monitoring and intervention can become (and are becoming) more targeted (Fidler, Philofsky, & Hepburn, 2007). Speech and language therapy offered to individuals with DS could take into account the specific difficulties with reflexive elements identified here, and offer help to reduce these difficulties. The tendency identified in this population, to have better comprehension of other pronouns (pronominal clitics in Greek-speaking populations, strong pronouns in English-speaking populations), could be used as a tool to support the learning of the more problematic reflexive elements. As the cost of therapy and support for individuals with DS and learning disabilities is significant, such research-informed therapy approach can be more efficient and cost-effective.

Finally, the current findings, especially if confirmed by further large-scale studies, are excellent candidates for outreach activities in the area of DS. Raising awareness on the characteristics of the syndrome and on its specific challenges, not only amongst practitioners working with this population, but also in the general public, would help reduce prejudices. If this is accompanied with appropriate guidance - for example, in this case, on how to bring across a message involving reflexivity - it would also create better communication with and a better environment for individuals with DS.

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References

- Abbeduto, L., Murphy, M. M., Cawthon, S. W., Richmond, E. K., Weissman, M., Karadottir, S., & O'Brien, A. (2003). Receptive language skills of adolescents and young adults with Down or fragile X syndrome. *American Journal of Mental Retardation, 108*, 149-160.
- Abbeduto, L., Warren, S. F., & Conners, F. A. (2007). Language development in Down Syndrome: From the prelinguistic period to the acquisition of literacy. *Mental Retardation and Developmental Disabilities Research Reviews, 13*, 247-261.
- Anagnostopoulou, E., & Everaert, M. (1999). Towards a more complete typology of anaphoric expressions. *Linguistic Inquiry, 30*, 97-118.

- Avrutin, S., & Wexler, K. (1992). Development of principle B in Russian: Coindexation at LF and coreference. *Language Acquisition*, 2, 259-306.
- Baauw, S., & Cuetos, F. (2003). The interpretation of pronouns in Spanish language acquisition and breakdown: Evidence for the "Principle B Delay" as a non-unitary phenomenon. *Language Acquisition*, 11, 219-275.
- Baauw, S., Zuckerman, S., Ruigendijk, E., & Avrutin, S. (2011). Principle B delays as a processing problem: Evidence from task effects. In A. Grimm, A. Muller, C. Hamann & M.E. Ruigendijk (Eds.), *Production-Comprehension Asymmetries in Child Language* (pp. 247-272). Berlin: Mouton De Gruyter.
- Bridges, A., & Smith, J. (1984). Syntactic comprehension in Down's syndrome children. *British Journal of Psychology*, 75, 187-196.
- Caselli, M., Monaco, L., Trasciani, M., & Vicari, S. (2008). Language in Italian children with Down syndrome and with specific language impairment. *Neuropsychology*, 22, 27-35.
- Chapman, R. S., & Hesketh, L. J. (2000). Behavioral phenotype of individuals with Down syndrome. *Mental Retardation and Developmental Disabilities Research Reviews*, 6, 84-95.
- Chapman, R. S., Hesketh, L. J., & Kistler, D. J. (2002). Predicting longitudinal change in language production and comprehension in individuals with Down syndrome: Hierarchical linear modeling. *Journal of Speech, Language, and Hearing Research*, 45, 902-915.
- Chapman, R. S., & Kay-Raining Bird, E. (2012). Language development in childhood, adolescence, and young adulthood in persons with Down syndrome. In J. Burack, R. Hodapp, G. Iarocci, & E. Zigler (Eds.), *The Oxford Handbook of Intellectual Disability and Development* (pp. 167 - 183). New York: Oxford University Press.

- Chapman, R. S., Seung, H. K., Schwartz, S. E., & Kay-Raining Bird, E. (1991). Language skills of children and adolescents with Down syndrome. I. Comprehension. *Journal of Speech and Hearing Research, 34*, 1106-1120.
- Chapman, R. S., Seung, H. K., Schwartz, S. E., & Kay-Raining Bird, E. (1998). Language skills of children and adolescents with Down syndrome. II. Production deficits. *Journal of Speech, Language, and Hearing Research, 41*, 861-873.
- Chien, Y.-C., & Wexler, K. (1990). Children's knowledge of locality conditions in binding as evidence for the modularity of syntax and pragmatics. *Language Acquisition, 1*, 225-295.
- Conroy, A., Takahashi, E., Lidz, J., & Phillips, C. (2009). Equal treatment for all antecedents: How children succeed with principle B. *Linguistic Inquiry, 40*, 446-486.
- Das, J. P., Divis, B., Alexander, J., Parrila, R. K., & Naglieri, J. A. (1995). Cognitive decline due to aging among persons with Down syndrome. *Research in Developmental Disabilities, 16*, 461-478.
- Eriks-Brophy, A., Goodluck, H., & Stojanovic, D. (2003). Sensitivity to A- and A'-dependencies in high-functioning individuals with Down Syndrome. In B. Beachley, A. Brown, & F. Conlin (Eds.), *Proceedings of the 27th Boston University Conference on Language Development* (pp.243-251). Somerville, MA: Cascadilla Press.
- Fidler, D. J., Philofsky, A., & Hepburn, S. L. (2007). Language phenotypes and intervention planning: Bridging research and practice. *Mental Retardation and Developmental Disabilities Research Reviews, 13*, 47-57.
- Fowler, A. E. (1990). Language abilities in children with Down syndrome: Evidence for a specific syntactic delay. In E. Cicchetti, & M. Beeghly (Eds.), *Children with Down Syndrome: A Developmental Perspective* (pp. 302-328). Cambridge: Cambridge University Press.

- Gerken, L., & Shady., M. E. (1998). The picture selection task. In D. McDaniel, C. McKee, & H. Smith Cairns (Eds.), *Methods for Assessing Children's Syntax* (pp. 125-145). Cambridge, Mass: MIT Press.
- Grodzinsky, Y. & Reinhart, T. (1993).The innateness of binding and coreference. *Linguistic Inquiry*, 24, 69-102.
- Hartman, J., Sudo, Y., & Wexler, K. (2012). Principle B and phonologically reduced pronouns in child English. Paper presented at the 5th Generative Approaches to Language Acquisition, North America [GALANA 5], October 11-13, University of Kansas.
- Hesketh, L. J., & Chapman, R. S. (1998). Verb use by individuals with Down syndrome. *American Journal of Mental Retardation*, 103, 288-304.
- Hornstein, N. (2001). *Move! A Minimalist Theory of Construal*. Oxford: Blackwell.
- Iatridou, S. (1988). An anaphor not bound in its governing category. *Linguistic Inquiry*, 17, 766-772.
- Joffe, V., & Varlokosta S. (2007). Patterns of syntactic development in children with Williams syndrome and Down's syndrome: Evidence from passives and wh-questions. *Clinical Linguistics and Phonetics*, 21, 705-727.
- Laws, G., & Bishop, D. V. M. (2003). A Comparison of language abilities in adolescents with Down syndrome and children with specific language impairment. *Journal of Speech, Language, and Hearing Research*, 14, 1324-1339.
- Martin, G., Klusek, J., Estigarribia, B., & Roberts, J. E. (2009). Language characteristics of individuals with Down syndrome. *Topics in Language Disorders*, 29, 112-132.
- Mavrogiorgos, M. (2010). *Clitics in Greek. A Minimalist Account of Proclisis and Enclisis*. Amsterdam: John Benjamins.

- McKee, C. (1992) A comparison of pronouns and anaphors in Italian and English acquisition. *Language Acquisition*, 2, 21-54.
- Miller, J. F. (1999). Profiles of language development in children with Down syndrome. In J. F. Miller, M. Leddy, & L. A. Leavitt (Eds.), *Improving the Communication of People with Down Syndrome* (pp.11-40). Baltimore: Brookes.
- Perovic, A. (2001). Binding principles in Down syndrome. *UCL Working Papers in Linguistics*, 13, 423-455.
- Perovic, A. (2006). Syntactic deficit in Down syndrome: More evidence for the modular organization of language. *Lingua*, 116, 1616-1630.
- Perovic, A. (2008). A cross-linguistic analysis of binding in Down syndrome. In P. Guijarro-Fuentes, M. P. Larrañaga, & J. Clibbens (Eds.), *First Language Acquisition of Morphology and Syntax* (pp. 235-267). Amsterdam/Philadelphia: John Benjamins.
- Philip, W., & Coopmans, P. (1996). The double Dutch delay of principle B effect. In A. Springfellow, D. Cahana- Amitay, E. Hughes, & A. Zukowski (Eds.), *Proceedings of the 20th Boston University Conference on Language Development* (pp. 629-642). Somerville, MA: Cascadilla Press.
- Reuland, E. (2001). Primitives of binding. *Linguistic Inquiry*, 32, 439-492.
- Ring, M., & Clahsen, H. (2005). Distinct patterns of language impairment in Down's syndrome and Williams syndrome: The case of syntactic chains. *Journal of Neurolinguistics*, 18, 479-501.
- Rubin, M. (2006). The passive in adolescents with Down syndrome: A case study. *Down Syndrome Research and Practice*, 11, 88-96.
- Rutter, T., & Buckley, S. (1994). The acquisition of grammatical morphemes in children with Down's syndrome. *Down Syndrome Research and Practice*, 2, 76-82.

- Sanoudaki, E. (2004). Bilingual first language acquisition: On the acquisition of pronominal reference by Greek - English bilingual children [Allilepidrasi kata ti diglossi kataktisi mitrikis glosas: I periptosi ton antonimikon sistimaton ellinikis-aglikis.] In *Proceedings of the 6th International Conference of Greek Linguistics*. University of Crete, ISBN: 960-88268-0-2.
- Sanoudaki, E., & Varlokosta, S. (2012). Binding in Greek: The importance of task selection [Anaforiki desmefsi sta Ellinka: I simasia tis epilosis dokimasias]. In Z. Gavriilidou, A. Efthymiou, E. Thomadaki, & P. Kambakis-Vougiouklis (Eds.), *Selected Papers of the 10th International Conference of Greek Linguistics* (pp. 1100-1109). Komotini: Democritus University of Thrace. <http://www.icgl.gr/en.html>
- Sanoudaki, E., & Varlokosta, S. (2013a). Task effects in the interpretation of pronouns. Manuscript submitted for publication.
- Sanoudaki, E., & Varlokosta, S. (2013b). Comprehension of pronominal elements in Down syndrome: The role of age. Manuscript submitted for publication.
- Sigurjónsdóttir, S., & Hyams, N. (1992). Reflexivization and logophoricity: Evidence from the acquisition of Icelandic. *Language Acquisition*, 2, 359-413.
- Stathopoulou, N. (2009). *The Linguistic Profile of Greek Individuals with Down Syndrome: Evidence from Syntactic and Morphological Phenomena*. Ph.D Dissertation, University of Essex.
- Stavrakaki, S., & Tsimpli, I. M. (2000). Diagnostic verbal IQ test for Greek preschool and school age children: Standardization, statistical analysis, psychometric properties. In *Proceedings of the 8th Symposium of the Panhellenic Association of Logopedists* (pp. 95-106). Athens: Ellinika Grammata.
- Thordardottir, E., Chapman, R., & Wagner, L. (2002). Complex sentence production by adolescents with Down syndrome. *Applied Psycholinguistics*, 23, 163-183.

- Varlokosta, S. (2000). Lack of clitic pronoun distinctions in the acquisition of principle B in child Greek. In S. C. Howell, S. A. Fish, & T. Keith-Lucas (Eds.), *Proceedings of the 24th Boston University Conference on Language Development* (pp. 738-748). Somerville, MA: Cascadilla Press.
- Varlokosta, S. (2001). On the acquisition of pronominal and reflexive reference in child Greek. In M. Almgren, A. Barreña, M.-J. Ezeizabarrena, I. Idiazabal, & B. MacWhinney (Eds.), *Research on Child Language Acquisition* (pp. 1383-1400). Somerville, MA: Cascadilla Press.
- Varlokosta, S. (2002). (A)symmetries in the acquisition of principle B in typically-developing and specifically language impaired (SLI) children. In I. Lasser (Ed.), *The Process of Language Acquisition* (pp. 81-98). Berlin: Peter Lang Verlag Publishing.
- Varlokosta, S., & Dullaart, J. (2001). The acquisition of pronominal reference by Greek-Dutch bilingual children: Evidence for early grammar differentiation and autonomous development in bilingual first language acquisition. In *Proceedings of the 25th Boston University Conference on Language Development* (pp. 780-791). Somerville, MA: Cascadilla Press.
- Varlokosta, S., & Nerantzini, M. (2012) Pronominal and anaphoric reference in Greek specific language impairment. In Z. Gavriilidou, A. Efthymiou, E. Thomadaki & P. Kambakis-Vougiouklis (Eds), *Selected Papers of the 10th International Conference on Greek Linguistics* (pp. 584-591). Komotini: Democritus University of Thrace.
<http://www.icgl.gr/en.html>
- Wexler, K., & Chien, Y.-C. (1985). The development of lexical anaphors and pronouns. *Papers and Reports on Child Language Development*, 24, 138-149. Stanford University.

Appendix

Target responses by participant. Raw scores (maximum 9). DS group

Participant	CNTRL	CL	REFL	REFL2	PRON
DS1	9	9	8	2	7
DS2	9	7	7	8	6
DS3	8	5	5	5	6
DS4	8	9	2	3	7
DS5	8	8	3	4	8
DS6	9	9	8	9	3
DS7	8	7	9	8	5
AVERAGE	8.43	7.71	6	5.57	6
STDEV	0.53	1.49	2.7	2.76	1.63

Target responses by participant. Raw scores (maximum 9). TD group

Participant	CNTRL	CL	REFL	REFL2	PRON
1TD	9	9	8	9	9
2TD	9	9	7	5	8
3TD	9	9	8	6	6
4TD	8	9	9	9	7
5TD	9	9	9	6	4
6TD	9	7	9	5	8
7TD	8	9	9	9	4
8TD	9	9	9	9	3
9TD	9	9	8	7	8
10TD	9	9	8	5	7
11TD	9	8	9	7	8
12TD	9	9	9	5	8
13TD	9	8	9	6	2
14TD	9	9	9	8	6
AVERAGE	8.86	8.71	8.57	6.86	6.29
STDEV	0.36	0.61	0.65	1.66	2.19

Target responses by participant. Raw scores (maximum 9). Adult group

Participant	CNTRL	CL	REFL	REFL2	PRON
1A	9	9	9	9	7
2A	9	9	9	9	7
3A	9	9	9	9	9
4A	9	9	9	9	8
5A	9	8	9	9	2
6A	9	9	9	9	5
7A	9	9	9	9	7
8A	9	9	9	9	0
9A	9	9	9	9	6
10A	9	9	9	8	5
11A	9	9	9	9	7
12A	9	9	9	9	9
13A	9	9	9	9	0
14A	9	9	9	9	9
15A	8	9	9	9	8
16A	9	9	9	9	1
17A	9	9	9	9	1
18A	9	9	9	9	9
AVERAGE	8.94	8.94	9	8.94	5.56
STDEV	0.24	0.24	0	0.24	3.29

Table 1. Details on participants in the DS group, raw scores on the DVIQ

Participant no.	Sex	Age (in years)	Productive Vocabulary (max27)	Comprehension of Morphosyntax (max 31)
1DS	Female	23;04	21	22
2DS	Male	24;11	17	19
3DS	Female	23;11	17	15
4DS	Female	23;07	16	16
5DS	Male	26;05	18	21
6DS	Female	34;03	21	24
7DS	Male	31;05	24	18
AVERAGE		26;09	19.14	19.29
STDEV		4.3	2.91	3.25

Table 2. Details on participants in the TD group, raw scores on the DVIQ

Participant no.	DS group Matched Participant	Sex	Age (in years)	Productive Vocabulary (max27)	Comprehension of Morphosyntax (max 31)
1TD	6DS	Female	5;05	20	20
2TD	3DS	Female	5;03	16	14
3TD	5DS	Male	5;04	20	21
4TD	7DS	Male	4;10	22	17
5TD	1DS	Male	5;11	20	20
6TD	7DS	Male	5;01	22	23
7TD	3DS	Female	4;09	18	14
8TD	6DS	Male	5;06	21	24
9TD	2DS	Female	4;08	16	17
10TD	4DS	Female	4;08	17	23
11TD	4DS	Female	4;05	18	22
12TD	2DS	Male	5;0	17	22
13TD	5DS	Male	5;08	19	19
14TD	1DS	Male	5;07	21	28
AVERAGE			5;02	19.07	20.29
STDEV			6.6 months	2.09	3.89

Table 3. Examples of linguistic stimuli

Condition	Example
CL	<p>I mama tin pleni.</p> <p><i>the mom herCL is washing</i></p> <p>‘Mom is washing her.’</p>
PRON	<p>O papus agaliazi afton.</p> <p><i>the grandpa is hugging himPRON</i></p> <p>‘Grandpa is hugging him.’</p>
REFL	<p>O babas skupizi ton eafto tu.</p> <p><i>the dad is drying himself</i></p> <p>‘Dad is drying himself.’</p>
REFL2	<p>I vasilisa dipla sti magisa zografizi ton eafto tis.</p> <p><i>the queen next to the witch is drawing herself</i></p> <p>‘The queen next to the witch is drawing herself.’</p>
CNTRL	<p>O prigipas skepazi ton nano.</p> <p><i>the prince is covering the dwarf</i></p> <p>‘The prince is covering the dwarf.’</p>

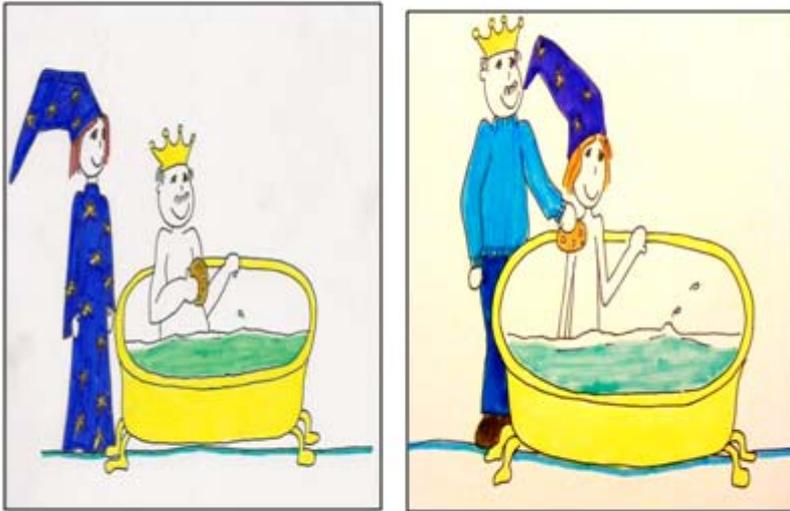


Figure 1. Example of the picture stimuli (pictures developed within COST Action A33).

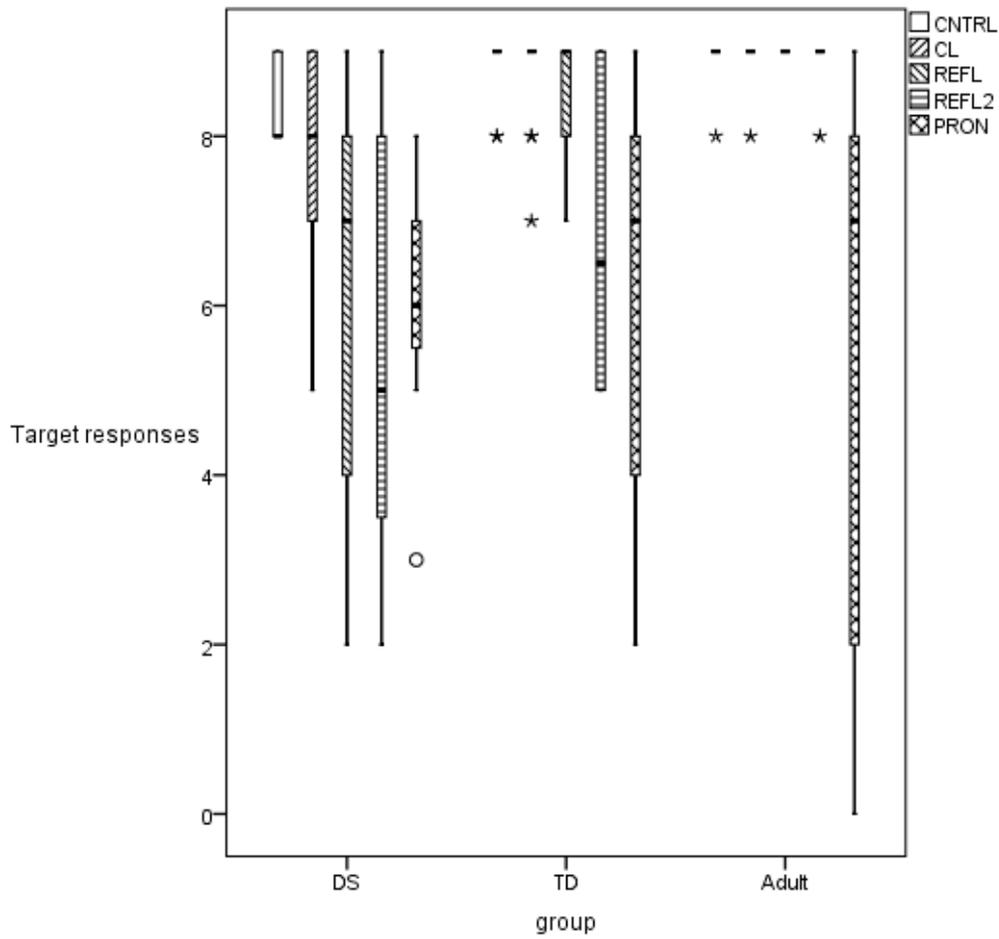


Figure 2. Box plot showing the distribution of target responses for each condition. DS, TD, and adult group