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**Pronoun comprehension in individuals with Down syndrome:
the role of age**

Keywords: Down syndrome; language development; comprehension, pronouns.

Declaration of interest: The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

Abstract

Background: A number of studies have suggested that language in individuals with Down syndrome (DS) may not be simply delayed compared to language in typically developing (TD) children, but deviant. The deviance has been detected in the comprehension of pronouns, and it has triggered proposals for the existence of a specific syntactic deficit in individuals with DS. However, the developmental path of pronoun comprehension in individuals with DS is unknown, as there are no studies examining individuals of different ages.

Aims: A pilot study examining pronoun comprehension in adolescents and adults with DS in comparison with TD children. Research questions include: 1. Are some pronoun types more difficult than others for each of the two groups (DS and TD)? 2. Is there a difference in performance between the two groups? 3. Does performance correlate with chronological age in the DS group?

Methods and Procedures: Using a manual picture selection task, we examined the comprehension of different types of pronouns in fourteen Greek-speaking individuals with DS, ranging from ten to thirty-four years of age. We also tested a control group of TD children as well as a typical adult group. The TD and DS groups were recruited and tested in pre-schools and schools/centres for individuals with learning disabilities, respectively. Within- and between-group comparisons were performed for all conditions. For the DS group, correlations between chronological age and performance in each condition were also explored.

Outcomes and Results: Results reveal a significant positive correlation of age with performance in the DS group, but only in structures that also presented difficulties to TD children. Structures that presented difficulties only to individuals with DS do not appear to be less problematic for older participants.

Conclusions and Implications: These findings provide support to the deviance hypothesis, by suggesting that the syntactic deficit in the comprehension of pronouns in individuals with DS is present in individuals of a wide age range. At the same time, our results, if corroborated by large scale studies, suggest that some aspects of grammatical development in individuals with DS may continue even after adolescence, well into adulthood. We argue that these findings can contribute towards more targeted intervention practices by increasing our knowledge of the behavioural phenotype of DS.

Introduction

There is a long-lasting debate on whether language in individuals with Down syndrome (DS) is slow-but-normal (delayed) or qualitatively different (deviant) compared to language in typically developing (TD) children (Rutter & Buckley, 1994 versus Fowler, 1990). The debate has been central in researchers' attempts to describe the behavioural phenotype of DS and to understand the nature of the impairment (see Perovic, 2006; Vicari, Caselli, & Tonucci, 2000, and references therein). The debate originates in considerations of possible dissociation of language from other aspects of cognition, and has acted as trigger for suggestions for the existence of a specific syntactic deficit in individuals with DS (Fowler, 1990). According to this view, language development in individuals with DS cannot be explained by the development of general cognitive abilities alone (Fowler, 1990). Instead, the disproportionate difficulties encountered in syntax compared to other areas of language by individuals with DS, and the nature of these difficulties, can only be explained by the stipulation of a language-specific deficit which targets certain areas of syntax (Fowler, 1990; see also Chapman, Seung, Schwartz, & Kay-Raining Bird, 1998). The purpose of this paper is to examine an area

that has been argued to provide evidence of such disproportionate difficulties, namely the comprehension of pronouns (Perovic, 2006, 2008; Ring & Clahsen, 2005, cf. Stathopoulou, 2009); the focus on the investigation will be on the relationship between comprehension and chronological age. Pronouns have also been the subject of extensive experimentation in the field of typical language acquisition, as TD children appear to experience problems in the interpretation of certain pronoun types up to the age of six (see e.g. Chien & Wexler, 1990; Conroy, Takahashi, Lidz, & Phillips, 2009).

TD children up to the age of six have been found to encounter difficulties in the comprehension of personal pronouns, in a variety of languages and tasks (e.g. English: Chien & Wexler, 1990; Russian: Avrutin & Wexler, 1992, Dutch: Philip & Coopmans, 1996; Icelandic: Sigurjónsdóttir & Hyams, 1992). Children sometimes interpret sentences such as ‘John is washing him’ as ‘John is washing himself’. This is an extensively studied phenomenon (Conroy, Takahashi, Lidz, & Phillips, 2009, for a list of languages and studies), which is primarily viewed as a processing problem (Baauw, Zuckerman, Ruigendijk, & Avrutin, 2011). The phenomenon has been known as Delay of Principle B Effect (DPBE), as it constitutes an apparent violation of Principle B of Binding Theory¹ (Chomsky 1981). In children’s interpretations, the personal pronoun appears to be bound by a local c-commanding² antecedent (e.g. the noun ‘John’ in the sentence ‘John is washing him’), thus, seemingly violating Principle B. However, children’s structures have been analysed as involving coreference³, not binding, and

¹ According to Principle B, a pronoun must be locally free (i.e. may not be bound by a local antecedent) (Chomsky, 1981).

² C-command is a type of relationship between two constituents in a syntactic tree. A pronoun is bound if a co-indexed element c-commands it. The details of these mechanisms fall beyond the scope of this paper.

³ Coreference: the personal pronoun and the antecedent do not enter in a bound-variable relationship; instead they have different indices which refer to the same entity (Grodzinsky & Reinhart, 1993).

problems have been attributed to children's difficulties in processing pragmatic rules regulating coreference (Grodzinsky & Reinhart, 1993).

Children's difficulties are cross-linguistically limited to the stronger types of personal pronouns (him/her) and are not present in the case of syntactically weaker types of personal pronouns, such as pronominal clitics in languages that have them (e.g. Spanish: Baauw, Escobar, & Philip, 1997; Italian: McKee, 1992; Greek: Varlokosta, 2000; Pronominal clitic in Italian, example 1).

1. Gianni_i lo asciuga
 John him_{CL} dries
 'John dries him'

The absence of DPBE with pronominal clitics has been linked to the fact that local coreference is not possible with clitics⁴ (Conroy *et al.*, 2009).

Children do not have difficulties in the interpretation of reflexive pronouns (himself, herself), which must be bound locally. One of the few cases where reflexive pronouns are problematic have been identified in Greek, in structures that involve two nouns such as 2 (Varlokosta, 2001).

2. I jineka dhipla stin kopela vlepi ton eafto tis ston kathrefti
 the woman next to the girl looks herself in the mirror
 'The woman next to the girl is watching herself in the mirror'

(example after Varlokosta, 2001)

⁴ Clitics must be bound in syntax or in discourse (Baauw *et al.*, 1997).

Greek-speaking TD children sometimes interpret sentences such as 2 as ‘the girl is watching herself’, an interpretation which is not allowed by the adult grammar, according to which the reflexive pronoun must be bound by the noun ‘woman’ (i.e. the woman must be the one watching herself) (Varlokosta, 2001). The reasons and the underlying mechanism for this phenomenon are not yet fully understood (see Varlokosta, 2001).

Recent pilot studies have identified difficulties in the comprehension of pronouns by individuals with DS acquiring a range of different languages (English: Perovic, 2006; Ring & Clahsen, 2005; Serbo-Croatian, Perovic, 2008). Individuals with DS appear to experience problems in the comprehension of reflexive pronouns compared to personal pronouns, following a pattern which is the reverse of that observed in TD children. Difficulties with reflexives were also detected in a pilot study of Greek-speaking adolescents with DS (Stathopoulou, 2009), although in this case participants’ difficulties were not limited to reflexive pronouns; their performance was below that of the typically developing control group in several conditions, including pronominal clitics.

Studies showing a pattern of language comprehension in individuals with DS which is the opposite of that observed in typical development, have given rise to proposals for the existence of a syntactic deficit which affects reflexive pronouns (Perovic, 2006, 2008; Ring & Clahsen, 2005). The proposed deficit consists in difficulties in forming certain syntactic dependencies (A-chains), thus, affecting the comprehension of reflexive (but not personal) pronouns (Ring & Clahsen, 2005). This is in line with a substantial body of recent research, which supports the existence of a specific language impairment in individuals with DS, based primarily on the inferior performance of individuals with DS in linguistic measures compared to TD children of

matched cognitive abilities (Chapman & Hesketh, 2000; Fowler, 1990; Thordardottir, Chapman, & Wagner, 2002; amongst others). Syntax is the area of language development which seems to be particularly affected by this asymmetry, as individuals with DS typically exhibit lower syntactic comprehension and production skills than expected given their general cognitive abilities and language skills (e.g. Abbeduto, Warren, & Conners, 2007; Joffe & Varlokosta, 2007).

The strength of the argument for the existence of such syntactic deficit, however, seems to be weakened by a gap in our knowledge, persistent in the DS literature: although there are numerous studies examining language in individuals with DS, each study is typically limited to one participant age group. For example, in a study examining fifteen children with DS (aged 4 to 7 years), Vicari, Caselli, & Tonucci (2000) found a significant disadvantage in morphosyntactic abilities compared to TD children matched for mental age. Zampini & D'Odorico (2011) report low levels of structural complexity in spontaneous production of twelve children with DS (aged 3 to 5 years), although findings in this case suggest a link between lexical and syntactic skills. In a much cited study of nineteen adolescents with DS, Laws & Bishop (2003) report a bigger disadvantage in grammar than in vocabulary, both in comprehension and production. A similar discrepancy between cognitive skills and syntactic comprehension (but not vocabulary comprehension) was found by Abbeduto *et al.* (2003) in 25 young adults with DS. Within the area of pronoun comprehension, Perovic (2006) studied four adolescents/young adults with DS, between 17 and 21 years of age, while Ring and Clahsen (2005) examined eight adolescents with DS (in two subgroups of four participants, mean ages 12.6 and 13.4). Similarly, six Serbo-Croatian speaking adults with DS, aged 19–29, were tested in Perovic (2008). While the argument for the existence of a syntactic deficit holds that this deficit affects the development of pronoun

comprehension, the data available give us limited snap-shots of individual stages, without offering a view of the comprehension abilities of the population in question across ages.

This research practice follows a trend typical in the field: while there are numerous studies examining various aspects of language in individuals with DS (see Martin, Klusek, Estigarribia, & Roberts, 2009, for a review), the overwhelming majority of the studies examine language and communication in one age group. There is limited knowledge of how language develops into adulthood, and little cross-sectional or longitudinal research covering a wide age range has so far been undertaken (notable exceptions: Chapman, Hesketh, & Kistler, 2002; Laws & Gunn, 2004; Rondal & Comblain, 2002).

Existing research indicates that receptive and expressive morphosyntactic and vocabulary skills remain relatively stable through early adulthood (Laws & Gunn, 2004; Rondal & Comblain, 2002), although there is some evidence of advances in certain areas of language during adolescence and possibly early adulthood (Chapman et al., 2002; Thordardottir et al., 2002). This is typically followed by early decline in cognitive and language abilities, as DS is accompanied by high occurrence of early onset Alzheimer's disease (Zigman & Lott, 2007). Evidence of Alzheimer's related dementia can be found in around 50% of individuals with DS after the age of 50 (Chapman & Hesketh, 2000). Although there is general consensus regarding the decline of language abilities in older individuals with DS, the picture is less clear for younger age groups, in particular in relation to grammatical abilities. The disagreement on whether development of grammatical abilities is possible after childhood (Chapman et al., 2002; Rondal & Comblain, 2002; Thordardottir et al., 2002), combined with the

scarcity of relevant studies, calls for further examination of the development of grammatical structures in individuals with DS.

We are aiming at filling this gap by examining the development of pronoun comprehension in individuals with DS, using a participant pool of Greek-speaking individuals with DS ranging from ten to thirty-four years of age, in comparison with a control group of TD children. We focus on the comprehension of pronominal clitics and reflexive pronouns (3a and 3b, respectively). Neither of the above structures poses problems to Greek-speaking TD children (Varlokosta, 2000, 2001). Structures involving reflexive pronouns with two preceding nouns (example 2 above) are also examined.

3a. O Gufi ton skepase
 the Goofy himCL covered
 ‘Goofy covered him’

3b. O Gufi skepase ton eafto tu
 the Goofy covered the self his
 ‘Goofy covered himself’

(examples after Varlokosta, 2000)

The comprehension of clitic and reflexive pronouns in individuals with DS will first be compared to the scores of the TD child group, in order to establish whether some elements are more problematic for the DS group, as has previously been found. Subsequently, a potential correlation of chronological age and performance in the DS group will be explored. This will give us a first picture of pronoun comprehension

individuals with DS of a wide age range, and a first indication on the relationship of age with the observed deficit in pronoun comprehension.

Methods

Participants

We tested fourteen Greek-speaking individuals with DS (seven female, seven male), aged 11 to 34 years⁵. An equal number of TD Greek-speaking children (nine girls, five boys) were tested as controls.

Participants in the DS group were recruited and tested in six schools and centres for adolescents and adults with learning disabilities on the Greek island of Crete. Specifically, participants 1-4 were attending Special Needs Primary School. Participants 5-14 had graduated (special needs) primary school. At the time of testing, participants 5-7 were attending Special Needs Secondary School, while participants 8-9 were attending a Laboratory of Special Professional Education and Training, which provides professional training to adolescents with special needs at the secondary educational level. Finally, participants 10-14 were attending a Vocational Training Centre within a Centre for individuals with special needs.

Participants in this group were selected on the basis of information provided by their tutors in short interviews; according to tutor reports, selected participants exhibited cognitive abilities ranging from average to high (with regard to the range typical for this clinical population) and had no chronic hearing disease. An additional criterion for the inclusion of participants in the analysis was performance in the control condition: a cut-off point of minimum seven target responses (out of nine) in the control

⁵Results for the adult subgroup (N=7) are reported separately in anonymous.

condition had been pre-determined as requirement for inclusion in both participant groups. All participants who managed to complete the task satisfied this criterion. While it was not possible to obtain measures of participants' non verbal cognitive abilities, measures of their verbal development were taken. These include vocabulary measures, which are generally considered good indicators of mental age in individuals with DS (see Abbeduto et al., 2007 and references therein). Participants' verbal skills were assessed through administration of part of the DVIQ (Diagnostic Verbal IQ test, Stavrakaki & Tsimpli, 2000). The preschool version of the DVIQ was used, which has been designed to measure production and comprehension abilities in children aged 2 years 6 months to 6 years; although the test has not been standardized, there are norms available for the ages 3 years and 5 months to 6 years and 5 months. The productive vocabulary and the comprehension of morphosyntax subtests were administered to all participants. Information on the DS group and scores on the DVIQ can be found in Table 1.

Table 1. Participant information and raw scores on the DVIQ (Stavrakaki & Tsimpli, 2000). DS group.

Participant	Sex	Age (in years;months)	DVIQ Expressive Vocabulary (max27)	DVIQ Comprehension of Morphosyntax (max 31)
DS1	Male	10;08	19	18
DS2	Male	11;01	17	18
DS3	Male	11;01	15	16

DS4	Female	14;02	20	17
DS5	Female	14;07	15	17
DS6	Female	15;11	21	20
DS7	Male	17;09	20	15
DS8	Female	23;04	21	22
DS9	Female	23;07	16	16
DS10	Female	23;11	17	15
DS11	Male	24;11	17	19
DS12	Male	26;05	18	21
DS13	Male	31;05	24	18
DS14	Female	34;03	21	24
AVERAGE		20;02	18.64	18.29
STDEV		92 (months)	2.65	2.67

A control group was formed by individually matching each participant in the DS group to a TD child on the raw scores (+/-1 point) of the productive vocabulary DVIQ subtest. TD children were selected from a participant pool tested for the purposes of a study on pronoun comprehension in TD children (anonymous). TD children were recruited and tested in three pre-schools in Crete, and were reported by staff as having normal linguistic and cognitive development and no hearing or learning disabilities. Details of the participants in the TD group, including their age and raw scores on the DVIQ subtests, are given in Table 2.

Table 2. Participant information and raw scores on the DVIQ (Stavrakaki & Tsimpli, 2000). TD group.

Participant	Sex	Age (in years;months)	DVIQ Expressive Vocabulary (max27)	DVIQ Comprehension of Morphosyntax (max 31)
TD1	Female	4;05	18	22
TD2	Female	4;09	18	14
TD3	Female	5;03	16	14
TD4	Female	6;0	20	21
TD5	Male	5;02	15	16
TD6	Female	6;02	21	24
TD7	Male	5;11	20	20
TD8	Female	5;05	20	20
TD9	Female	4;08	16	17
TD10	Female	4;08	17	23
TD11	Male	5;0	17	22
TD12	Male	5;08	19	19
TD13	Female	6;01	24	28
TD14	Male	5;06	21	24
AVERAGE		5;04	18.71	20.28
STDEV		6.98 (months)	2.46	4.02

There was no significant difference between the two groups in their performance at either subtest: productive vocabulary $t(26) = -0.074$, $p = 0.942$; comprehension of morphosyntax $t(26) = -1.548$, $p = 0.34$. Finally, to check the validity of the experimental

task, an adult group without any history of language or learning disabilities was also tested (N=18, 13 women, 5 men, age range 23-67). Performance of this group was at ceiling (anonymous).

Materials and procedure

A manual picture selection task was used in this study. The task is commonly used in studies examining pronoun comprehension in typical and atypical populations (e.g. Baauw, Zuckerman, Ruigendijk, & Avrutin, 2011) and was selected for its low processing demands (Baauw *et al.*, 2011). The task was based on materials developed within COST (European Cooperation in Science and Technology) Action A33 'Crosslinguistically Robust Stages of Children's Linguistic Performance' (COST Action A33, 2006-2010), adapted for the purposes of the present study. Participants were shown picture pairs and were asked to select the picture that matched a simultaneously presented sentence. Only one of the two pictures corresponded to the adult interpretation of the sentence: picture pairs depicted a character performing an action to another character (in one picture) or to themselves in the presence of the second character (in the other picture). Colour pictures pairs were shown on a 15.6'' laptop screen, while the sentences were read aloud by the experimenter, who is a trained linguist and a native Greek speaker, using neutral prosody. The use of spoken stimuli (rather than pre-recorded speech) helped create a more natural situation and encourage participants to continue with the task.

Test conditions included pronominal clitics, reflexives, and reflexives with two nouns (4a, 4b, and 4c, respectively).

4a. Clitic condition

I mama tin pleni.
the mom herCL is washing

‘Mom is washing her.’

4b. Reflexive condition

O babas skupizi ton eafto tu
the dad is drying himself

‘Dad is drying himself.’

4c. Reflexive with two nouns condition

I vasilisa dipla sti magisa zografizi ton eafto tis.
the queen next to the witch is drawing herself

‘The queen next to the witch is drawing herself.’

A control condition was also included, consisting of nouns only (example 5).

5. Control condition

I majisa chtenizi ti choreftria.
the witch is combing the dancer

‘The witch is combing the dancer’

An introductory sentence presented the two characters. An example of the linguistic stimuli including the introductory sentence is given in 6, while Figure 1 shows the corresponding picture pair.

6. Edo vlepume mia prigipisa ke mia magisa. I prigipisa ti vafi.

Here we see a princess and a witch. The princess herCL is painting.

‘Here we see a princess and a witch. The princess is painting her.’

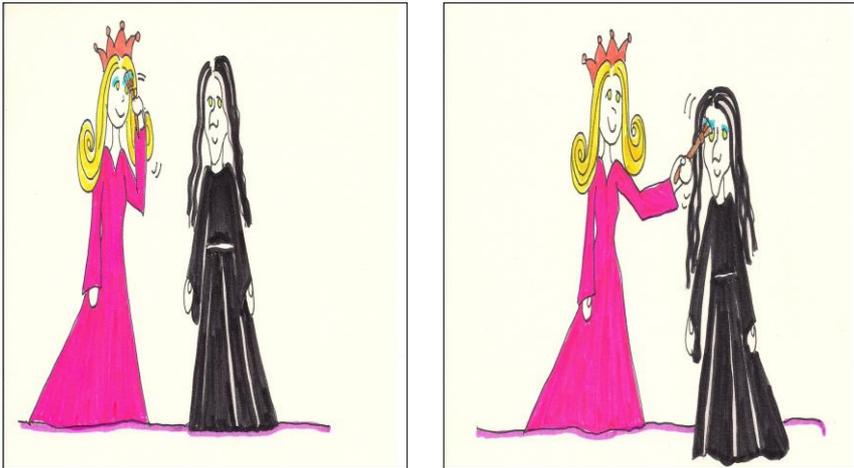


FIGURE 1. Example of the picture stimuli (pictures developed within COST Action A33, 2006-2010).

There were nine trials for each condition, using nine verbs: *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’. Sentences were presented in two different orders, along with items forming another condition, not presented in this article (for relevant information and for the complete list of stimuli, see anonymous). One order was pseudorandomised and was presented to half of the participants, while the other order was the reverse.

In cases when the participant did not respond, the same trial was repeated up to two times. In the cases when it was unclear which of the two pictures was selected by the participant, the participant was encouraged once again to select one of the two pictures.

Results

The distribution of target responses can be seen in Figure 2. Individual results are given in the Appendix.

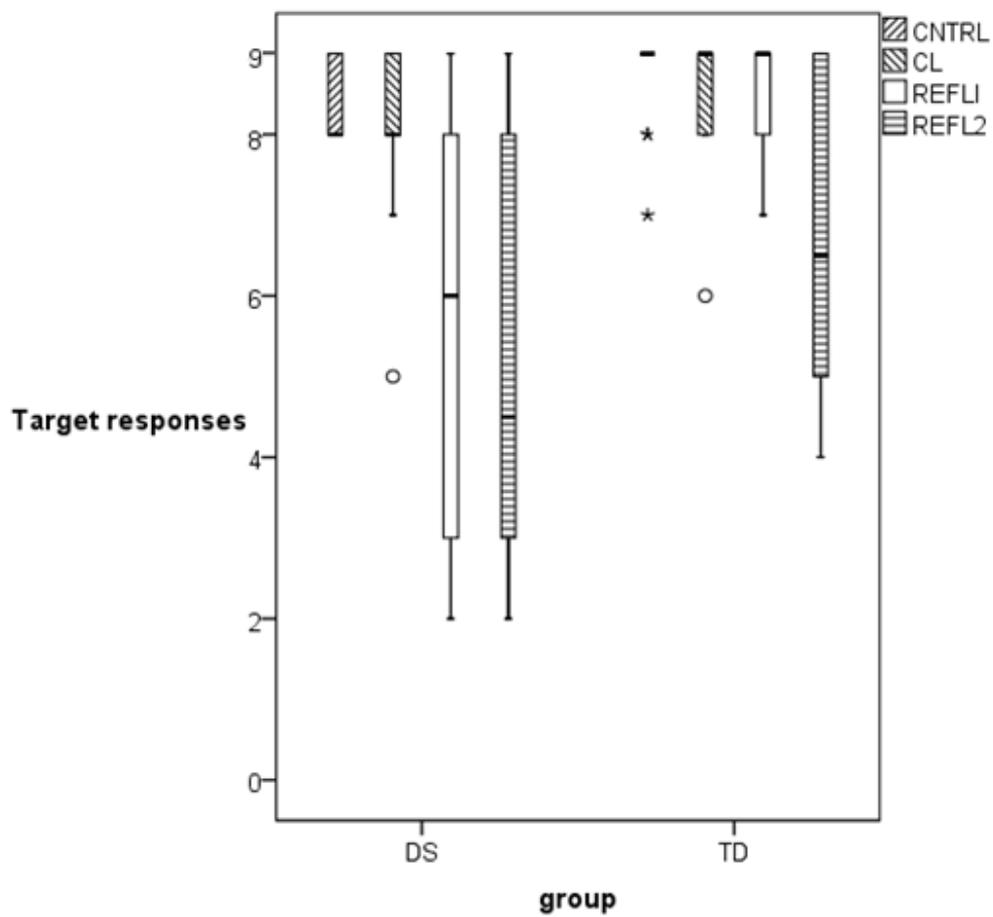


FIGURE 2. Box plot showing the distribution of target responses for each condition. DS and TD group.

In our statistical analysis, non-parametric tests were used as data were not normally distributed. The gender distribution of the two groups was not the same, but there were no gender differences in performance in any of the conditions tested.

The analysis showed that the performance of the DS group differed significantly across conditions ($\chi^2(3) = 22.075, p < 0.001$, Friedman test). Post-hoc analyses (Wilcoxon signed rank tests, significance level set at $p < .016$, Bonferroni correction applied to control for Type I error) showed that performance in the control condition differed significantly from performance in the reflexive condition ($Z = 3.128, p = 0.002, r = 0.591$) and the reflexive with two nouns condition ($Z = 3.068, p = 0.002, r = 0.58$) with large effect sizes, such that the DS group performed better at the control condition. There was no difference between the control and clitic conditions in the same group ($Z = 1.403, p = 0.161, r = 0.265$).

Analysis of the TD data also revealed a significant difference across conditions ($\chi^2(3) = 10.516, p = 0.015$, Friedman test). Pairwise comparisons of the control condition with other conditions showed a statistical significant difference with the reflexive with two nouns condition only, such that children performed worse in the latter condition (control versus reflexive with two nouns $Z = -2.591, p = 0.010, r = 0.49$; control versus clitics $Z = 1, p = 0.317, r = 0.189$; control versus reflexives $Z = -.722, p = 0.47, r = 0.136$, Wilcoxon Signed-Rank Tests, significance level set at $p < 0.016$).

Between-group analysis showed a significant difference with a large effect size in the reflexive condition only, such that the TD group performed better than the DS group in this condition ($U = 25.5, Z = -3.444, p = 0.001, r = -0.651$, Mann-Whitney U

test, significance level set at $p = 0.013$ to allow for multiple comparisons). No significant differences were detected between the two groups in any of the remaining conditions (control $U = 67$, $Z = -1.665$, $p = 0.096$, $r = -0.315$; clitic $U = 62$, $Z = -1.834$, $p = 0.067$, $r = -0.347$; reflexive with two nouns $U = 58$, $Z = -1.856$, $p = 0.063$, $r = -0.351$).

Within the DS group, age was found to strongly correlate with performance in reflexives with two nouns: $r_s(14) = 0.578$, $p = 0.031$, Spearman's rho (see Figure 3). This strong positive correlation was also present when only the seven adult participants in the DS group were considered ($r_s(7) = 0.865$, $p = 0.012$). Performance in no other condition was found to significantly correlate with age (clitics $r_s(14) = -0.131$, $p = 0.656$; reflexives $r_s(14) = 0.343$, $p = 0.23$). Note, however, that the age-performance correlation of the reflexive with two nouns condition is no longer significant if results of the youngest or oldest participant are removed from the dataset ($r_s(13) = 0.489$, $p = 0.09$ without youngest participant; $r_s(13) = 0.352$, $p = 0.261$ without oldest participant). Even though these two participants were not outliers, they had the lowest and highest performance, respectively, and overall results appear to be heavily dependent on their inclusion to the dataset.

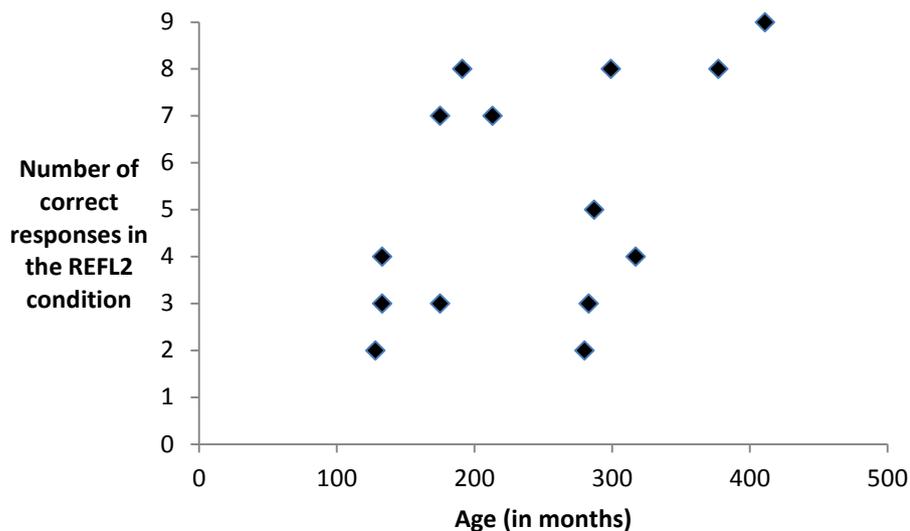


FIGURE 3. Scatterplot showing relationship of age to performance in reflexives with two nouns. Correlation for the DS group.

Finally, Spearman's rho was calculated for DVIQ scores in the DS group and performance in experimental conditions, to check whether individual differences in the participants' linguistic skills could explain their performance in the experimental tasks. No significant correlations were detected, although expressive vocabulary scores and performance at the reflexive condition approached significance (expressive vocabulary and clitic $r_s(14) = 0.276$, $p = 0.339$; expressive vocabulary and reflexive $r_s(14) = 0.533$, $p = 0.05$; expressive vocabulary and reflexive with two nouns $r_s(14) = 0.274$, $p = .342$; comprehension of morphosyntax and clitic $r_s(14) = 0.347$, $p = 0.225$; comprehension of morphosyntax and reflexive $r_s(14) = 0.344$, $p = 0.229$; comprehension of morphosyntax and reflexive with two nouns $r_s(14) = 0.209$, $p = 0.474$).

Overall, the DS group performed worse than the TD group at the reflexive condition only, while both groups had difficulties in the reflexive with two nouns condition. In the latter condition, a strong positive correlation of performance with chronological age was detected in the DS group.

Discussion

In this study, we examined the comprehension of pronouns by Greek-speaking individuals with DS, focusing on the role of age. Results replicate previous cross-linguistic findings (Perovic, 2006, 2008; Ring & Clahsen, 2005) revealing that individuals with DS have disproportionate difficulties in the interpretation of reflexive pronouns compared to personal pronouns (in this case pronominal clitics). Similar difficulties were encountered in a specific reflexive structure which also presented difficulties to the TD child group (reflexives with two nouns). However, the reflexive pronoun that was preceded by two nouns was found to be less difficult for older participants in the DS group, as revealed by a positive correlation of performance with chronological age; no such correlation was detected when the reflexive pronoun was not preceded by two nouns.

Before we proceed to the analysis of our results, we need to introduce a caveat in relation to our sample size. The present study examines participants of a wide age range (from 11 to 34 years), and includes a small sample size of $N=14$. This is combined with the high variability of the target population, which is reflected in the large standard deviations in some of the conditions in the present study (see Appendix). A consequence of the above is that removing individual participants (even if they are not outliers) could alter our results, as was demonstrated in the case of reflexives with two nouns (results section). This could also mean that non significant findings in other conditions could be due to lack of power. As a result, the study should be considered as a pilot, and results can only be tentative. Larger scale studies are required in order for the findings presented here to be corroborated.

With this caveat in mind, the findings regarding reflexives can be considered: these findings shed new light on the debate on language deviance in individuals with DS, and more specifically, on proposals for the existence of a syntactic deficit targeting reflexive pronouns (Perovic, 2008; Ring & Clahsen, 2005). Our results are in line with familiar cross-linguistic pilot data showing problems in the comprehension of these elements in individuals with DS (Perovic, 2008; Ring & Clahsen, 2005), and the present study also offers previously unavailable information on the role of age on reflexive comprehension. While each of the previous studies targeted one age group only, the present study presents data pertaining to a wider age range, from early adolescence to adulthood. The comprehension of reflexive pronouns was problematic for the participants with DS as a group; moreover, no age correlation was detected, indicating that reflexives were not less challenging for older participants. These findings provide support to proposals of deviance in the form of a syntactic deficit targeting reflexive pronouns (Perovic, 2008; Ring & Clahsen, 2005).

Present findings, and in particular the detection of a positive correlation of age with performance in one of the structures tested, are also linked to another controversy in the field, namely the possible presence of a ‘syntactic ceiling’ in individuals with DS. The debate regards whether individuals with DS reach a stage in their development during early adolescence when their linguistic development - and especially their syntactic development - is arrested (e.g. Fowler, 1990) or whether advances continue during adolescence and possibly even adulthood (e.g. Chapman et al., 2002; Thordardottir et al., 2002).

The notion of syntactic ceiling, originally linked to maturational constraints (Fowler, 1990), appears to have polarised researchers, with both sides of the debate presenting arguments and supportive evidence. For example, Chapman et al. (1998), in

a cross-sectional study of individuals with DS between 5 and 20 years of age, showed that mean length of utterance continues to increase throughout adolescence. Although an increase in length of utterance would not necessarily indicate an increase in syntactic complexity, particularly in older individuals, a later study by Thordardottir et al. (2002) confirmed an increase in the use of complex syntactic structures which continues throughout adolescence and early adulthood in individuals with DS. In contrast, other studies have found that growth of grammatical comprehension and production abilities slows down or stops altogether in early adulthood (e.g. Laws & Gunn, 2004). Laws and Gunn (2004) found evidence of a plateau or even a decline in receptive grammatical abilities.

In the present study, the positive correlation with age detected in the comprehension of reflexives when these are preceded by two nouns adds a new dimension to the debate. The data offer a first indication that performance in tests measuring grammatical comprehension can continue to improve after the end of childhood in individuals with DS. This is particularly important, as methodological considerations have also been part of the debate: Rondal and Comblain (2002) argue that advances observed in discourse narratives, such as those analysed by Chapman (1999) (subsequently used in Thordardottir et al., 2002) could be evidence for improvement in peripheral areas of language, such as discourse organisation, but would not constitute evidence for advances in core aspects of language, such as syntax. In this study, using psycholinguistic experimental methods, we obtained results which support the view of a continuous improvement in elements of syntax in individuals with DS.

It is unclear why this age correlation was detected in only one of the reflexive structures tested, and in particular the structure that also presents difficulties to TD children. As no satisfactory analysis of the difficulties in typical development has been

proposed, further theoretical research is essential before we can analyse the nature of the phenomenon in atypical populations⁶. It is possible, for example, that minimality/intervention effects may play a role in these findings; the second noun phrase may act as an intervener between the reflexive and its antecedent (i.e. the first noun phrase), preventing participants from establishing the dependency between the two elements. This is in line with studies on typical development showing minimality effects preventing children from establishing certain types of syntactic relationships (types of A-bar dependencies, for example object relative clauses: “the elephant that the lion is wetting”, Friedmann, Beletti, & Rizzi, 2009; Varlokosta, Nerantzini, & Papadopoulou, to appear). These difficulties have been linked to the immaturity of the developing processing system e.g. limitations of operative memory in children (Friedmann *et al.*, 2009). The fact that in the present study, TD children performed at ceiling with reflexives when only one antecedent was available, would support an analysis along these lines: children have knowledge of the syntactic relationship between a reflexive and its antecedent noun phrase, but fail to establish this when another noun phrase intervenes between the two elements. This possibility could be tested in future studies by performing experimental manipulations currently examined in the A-bar dependency field, e.g. by using inanimate interveners, which appear to be less disruptive than animate ones (Bentea & Durreleman, 2013).

A consequence of the present analysis would be that individuals with DS might encounter difficulties of two different types in reflexive structures with two nouns: problems with syntactic dependencies involving reflexives (evidenced by low performance in the reflexive condition, where only one antecedent was available) and

⁶ We are grateful to an anonymous reviewer for suggestions regarding the interpretation of this phenomenon.

possible additional difficulties due to limited computational resources, as TD children, when the second noun phrase is present. If this analysis is on the right track, then it would be tempting to speculate that the positive age correlation detected in the reflexive with two nouns condition may be due to an increase in computational resources, rather than an improvement in core grammatical abilities. Further theoretical and empirical research in typical and atypical populations is necessary before more can be said on this.

The implications of the present study are not limited to the theoretical domain, but also extend to the clinical arena. The existence of a specific deficit targeting reflexive pronouns indicates that intervention programmes should be designed with particular focus on reflexive elements rather than pronouns in general. This is particularly important, as targeted intervention practices offer significant benefits in this population (Sepúlveda, López-Villaseñor, & Heinze, 2013). Moreover, according to the theoretical interpretation of the deficit as affecting A-chain formation (Ring & Clahsen, 2005), intervention focusing on reflexive pronouns could also have beneficial effects on other structures involving A-chains, such as passives. Finally, the detection of age correlation in one of the structures tested, if corroborated by larger scale longitudinal studies, would suggest that intervention programmes beyond childhood may be particularly beneficial for the comprehension of certain syntactic structures, as there is an underlying potential for improvement.

Limitations and future directions

The present investigation is a pilot study aimed at offering a first look at the role of age in pronoun comprehension in individuals with DS. The small sample size, due to

familiar difficulties in recruiting suitable participants in this population, warrants further research, in order for the trends identified here to be confirmed. Moreover, studies testing participants' non verbal cognitive skills in addition to their comprehension of pronouns would be required to examine possible relationships between performance and cognitive level. As participants in the present study were not tested for non verbal IQ, it is possible that individual differences in the participants' cognitive skills could explain their performance in the tasks. Finally, detected correlations with chronological age call for longitudinal studies, so that the developmental path of pronoun comprehension in this population can be established.

Conclusion

To our knowledge, the results of this study present the first examination of the relationship between pronoun comprehension and chronological age in individuals with DS. Findings offer support to the deviance view on language development in individuals with DS, suggesting that the syntactic deficit that affects the comprehension of reflexive pronouns is present in individuals of a wide age range.. Moreover, the study contributes to the debate on a possible syntactic ceiling in individuals with DS by detecting a positive correlation of age with performance in certain syntactic structures. The significance of our findings extends beyond the theoretical arena: the possibility of improvement in language comprehension after childhood can help inform intervention practices, and detailed knowledge of comprehension abilities can shape the type of relevant input.

What this paper adds

What is already known on the subject?

Recent pilot studies suggest that individuals with Down syndrome have disproportionate difficulties in the comprehension of reflexive pronouns compared to personal pronouns, and the existence of a specific reflexive deficit in individuals with Down syndrome has been proposed as a result. However, no information has been available on the potential role of chronological age in this deficit.

What this study adds

In this pilot study we examined the comprehension of personal and reflexive pronouns in Greek-speaking individuals with Down syndrome focusing on age. Familiar findings showing difficulties with reflexives were replicated; age correlations were detected, but only in reflexive structures that also present difficulties to the typically developing control group. Findings provide support to the specific reflexive deficit hypothesis in Down syndrome, while identifying reflexive pronoun comprehension as an area that would potentially benefit from targeted intervention programmes beyond childhood.

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Appendix. Target responses by participant. Raw scores (maximum 9)

Participant	CONTROL	CLITICS	REFLEXIVES	REFLEXIVES2
DS1	8	8	4	2
DS2	8	8	3	4
DS3	8	8	4	3
DS4	8	9	3	3
DS5	9	8	8	7
DS6	9	9	8	8
DS7	9	8	7	7
DS8	9	9	8	2
DS9	8	9	2	3
DS10	8	5	5	5
DS11	9	7	7	8
DS12	8	8	3	4
DS13	8	7	9	8
DS14	9	9	8	9
AVERAGE	8.42	8	5.64	5.21
SD	0.51	1.1	2.43	2.51
TD1	9	8	9	7
TD2	8	9	9	9
TD3	9	9	7	5
TD4	9	9	7	4
TD5	7	6	9	6
TD6	9	9	9	9

TD7	9	9	9	6
TD8	9	9	8	9
TD9	9	9	8	7
TD10	9	9	8	5
TD11	9	9	9	5
TD12	9	8	9	6
TD13	8	8	9	9
TD14	9	9	9	9
AVERAGE	8.71	8.57	8.5	6.85
SD	0.61	0.85	0.75	1.83