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Lingua 116 (2006) 1616–1630
Lingua
www.elsevier.com/locate/lingua

Syntactic deficit in Down syndrome: More evidence for the modular organisation of language☆

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Received 19 January 2005; received in revised form 8 May 2005; accepted 11 May 2005

Abstract

This study reports on findings from an experimental investigation into the knowledge of binding (the module of grammar regulating the distribution of reflexives and pronouns), in a group of young adults with Down syndrome (DS). Participants with DS were found to have difficulties comprehending reflexives, but not pronouns. In contrast with pronouns, which are interpreted by invoking extra-syntactic mechanisms, the interpretation of reflexives depends on a syntactic relation between the reflexive element and its antecedent. This points to the deficit in DS being syntactic in nature. Such a pattern is exactly the opposite to that found in typically developing English children, who obey the syntactic constraints on the distribution of reflexives early on, but have trouble applying the co-reference rule, a constraint outside syntax proper that regulates the interpretation of pronouns. This result provides evidence that language in DS is not merely delayed, as traditionally described, but also deficient in important respects: the deficit amounts to an inability to establish the syntactic relation between the anaphor and its antecedent. The revealed grammatical deficit supports the hypothesis that modules of the computational system, such as morphosyntax, are relatively more impaired in this population, than those associated with the general processing system, such as lexical knowledge or pragmatics.

Keywords: Down syndrome; Modularity; Language acquisition; Syntax; Binding

☆ This work is based on my Ph.D. dissertation, completed in 2004 at the Department of Phonetics and Linguistics, University College London.

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doi:10.1016/j.lingua.2005.05.011

1. Introduction

If the language faculty is independent from cognition (cf. Fodor, 1983), it should be possible to find cases where an intellectual impairment is accompanied by relatively preserved language. Cases where a selective language disorder is displayed, with the cognitive abilities intact, should be equally possible. Such disparities between language and cognition have been widely reported in the literature, in either direction. A striking example is presented by Williams syndrome (WS) (e.g. Bellugi et al., 1988). Despite attaining IQ levels comparable to individuals with other types of intellectual disorders, language skills in individuals with WS are known to well exceed their level of cognitive abilities. Following a similar pattern, cases of language savants with preserved language but mild to moderate intellectual impairment have been documented by, e.g. Yamada (1990), Smith and Tsimpli (1995). In the latter study, the linguistic abilities of a savant involved mastery of some 15–20 foreign languages. Conversely, language disorders have been evidenced in typically developing (TD) children who have no known cognitive impairment, yet show difficulties in language development and attain very limited level of linguistic achievement. The clearest example documented is specific language impairment (SLI) (see Clahsen, 1991; Rice and Wexler, 1996; van der Lely, 1994).

Furthermore, since the components of the linguistic system itself are also assumed to be relatively autonomous (Chomsky, 1980), we can plausibly expect variation in the development of the distinct language components within the language faculty. This divide usually places the modules of the computational system of the language faculty, namely syntax, semantics and phonology on one side, and modules that are more associated with general conceptual system, such as pragmatics and vocabulary knowledge, on the other. A dissociation along these lines seems to be present in autism spectrum disorders, known for the existence of pragmatic deficits in the absence of major impairments to syntactic knowledge (Tager-Flusberg, 1994).

The two types of dissociations, between language and cognition, and within the language faculty itself, have also been found in the population with DS, but perhaps not in the commonly expected direction. Even when the wide individual differences are taken into account (including the reported rare cases of language savants with DS), language in this population is more noticeably affected than cognitive abilities, which sets DS apart from other types of intellectual disorders. In addition, some aspects of the language faculty seem to be impaired more than others. While linguistically motivated accounts of language impairments in DS are rare, a number of studies have shown that the aspects of language functioning that seem most impaired in this population are those of the computational system, i.e. morphosyntax and phonology, in contrast to those associated with the general processing system, namely lexical knowledge and pragmatics.

To further explore the hypothesis that it is the computational aspects of language are affected in DS, this study investigates knowledge of binding in a sample of individuals with this disorder. Binding is a linguistic component that involves an interaction of both syntactic and extra-syntactic modules in the process of distribution and interpretation of anaphoric expressions, i.e. pronouns and reflexives. The binding theory adopted here incorporates the central notion of Reinhart (1986), namely, that the reference of a pronoun can be determined in one of two ways: syntactically and extra-syntactically. The former is the province of the syntax/semantics interface, whilst the latter is determined at the semantics/discourse interface. Syntactic binding pertains to bound variable anaphora only, where the anaphoric relation is mediated by grammar internal processes. In the framework of Reinhart and Reuland (1993), this relation is regulated by conditions on the reflexivity of predicates and the formation of syntactic chains. In contrast,

non-syntactic binding, i.e. coreference, is a dependency that relies on extralinguistic knowledge and is not subject to syntactic constraints, but to a constraint outside syntax proper, formulated as Rule I, of Grodzinsky and Reinhart (1993). Such a modular approach to binding has received substantial support from findings reported in studies on typical language acquisition. Young children exhibit distinct patterns in their acquisition of binding and coreference, showing difficulties interpreting coreference until late stages of language development, while mastering binding relations early (Jakubowicz, 1984; Chien and Wexler, 1990). If language development in DS is merely delayed, as is often stated in the literature on this disorder, parallel patterns should be expected – difficulties interpreting coreference, as opposed to syntactic binding. However, if it is the case that computational aspects of language are impaired in DS, syntactic binding may be deficient in this population. The results of our experimental study, which are presented in the following sections, will help to decide which of the two theories are in the right direction: delay or impairment.

2. Computational deficits in the language of Down syndrome

Down syndrome, a neurodevelopmental disorder caused by an abnormality in chromosome 21, is not ordinarily called upon as typical example of a dissociation between cognition and language. For typical trisomy 21,[1] the average IQ is around 50 (Kemper, 1988). Studies report mental age (MA) to be about 5 years for adults with DS (e.g. mean chronological age of 30 for a sample reported in Rondal and Comblain, 1996), and slightly higher, around 6, for adolescents with this disorder (e.g. mean chronological age of 18;4 in Rondal and Comblain, 1996). However, linguistic abilities in these individuals seem to be even more compromised than their cognitive abilities. Disparities between measures of MA and measures of linguistic abilities have been recognised in both children and adults with DS (Miller, 1988; Fowler et al., 1994; Rondal and Comblain, 1996). The studies typically report aspects of language abilities in individuals with DS to be much poorer than their MA predicts. For example, Chapman et al. (1998) calculated the minimum length of utterance (MLU)[2] in children between 5 and 8 as equivalent to a TD 2-year-old child. The situation does not seem to change much in later life, as the same study reports the MLU of adolescents to be comparable only to a TD 3-year-old child. Individuals with DS achieve considerably higher scores on measures of vocabulary comprehension than on measures of receptive or expressive syntax, both in English and the few other languages in which linguistic profiles of DS have been examined (Miller, 1988; Fowler, 1990; Fowler et al., 1994).

Importantly, this syndrome is often considered to be more detrimental to language development than other intellectual disorders.[3] A number of studies have shown that the language skills of individuals with WS far exceed the language skills of individuals with DS who have been matched on cognitive measures. Bellugi and coworkers conducted a series of tests comparing the language of children and adolescents with WS and DS, matched on IQ and chronological age. Their findings were that on nearly every language measure, individuals with WS outperformed

[1] There are different types of DS, depending on whether the extra copy of the chromosome 21 is present in each cell (standard trisomy), only some of the cells (mosaicism) or whether this extra copy is attached to another chromosome (translocation). Standard trisomy accounts for about 95% of cases of DS.

[2] MLU is a good predictor of linguistic achievement in typical language development and is widely used in comparisons of children with MR to those who are typically developing. Its usefulness for older children and adults has been questioned, however, as length of an utterance need not always mirror its complexity (and vice versa).

[3] While the observation that language is inordinately impaired in DS seems largely true, a wide individual variation is reported, including even (rare) cases of language savants with DS (Rondal, 1995).

those with DS (Bellugi et al., 1994, amongst others). While it could be the case that the well preserved language of individuals with WS is some special characteristic of this disorder, individuals with DS also seem to fare much worse when compared to other cognitively impaired populations. Comparing French speakers with DS and those with disabilities of an unidentified aetiology, Rondal and Lambert (1983) found that, in contrast to adults with other types of MR, at least half of the utterances expressed by adults with DS were ungrammatical. Tager-Flusberg (1994) reports that particular aspects of syntactic knowledge in children with DS were more impaired than that of children with autism, matched both on chronological age and MLU.

A closer look at the 'linguistic abilities' examined in these studies reveals that the impaired abilities usually mean impaired grammar. Individuals with DS achieve limited MLU, perform poorly on tasks of comprehension and elicitation of grammatical morphemes and more complex syntactic structures (Kernan and Sabsay, 1996; Rondal and Comblain, 1996). Semantics and pragmatics have been reported to be relatively spared, i.e. in line with the cognitive abilities associated with DS (see Rondal and Edwards, 1997; Rosenberg and Abbeduto, 1993 for reviews). Interestingly, whilst pragmatic skills that are independent of language proficiency seem to be comparable to those in non-impaired individuals of the same language level (i.e. non-verbal social interaction, expression of communicative intent and socially appropriate responding), linguistic cohesion, which is more dependent on expressive language and grammar, is limited (Chapman, 1995). Tager-Flusberg (1994) also explicitly points out that the children with DS in her study did better on pragmatic aspects of language than children with autism, although they typically showed grammatical errors not seen in children with autism.

In contrast, phonology and morphosyntax have been reported to be more vulnerable to deficits in the language of individuals with DS. Deletion of unstressed syllables, errors on syllable-final sounds, reduction of consonant clusters, substitutions, omissions and additions of particular sounds persist into late childhood and are often present in adulthood. These features cannot be explained away by appealing to hearing loss or anatomical factors known to impede speech in DS. Moreover, the phonological impairments present in DS are not recorded in other types of intellectual impairments but have more in common with those of phonologically impaired children with no known cognitive defects (Dodd and Thompson, 2001).

Comparisons of correct use of bound and free morphemes in the spontaneous speech of individuals with DS and TD controls often reveal that children and adults with DS exhibit poorer levels of productive morphosyntax than controls matched on MLU or MA.[4] In the spontaneous speech of 48 children and adolescents with DS, aged 5–20, Chapman et al. (1998) found more inconsistent use of both bound morphemes (plural -s, possessive -s, third person singular, contractible auxiliaries and copulas, present progressive -ing, regular past tense -ed) and free function words (copulas, auxiliaries, modal auxiliaries, articles, prepositions, pronouns, adverbial adjuncts, conjunctions and infinitive 'to'), than in MA matched TD controls. Similar rates of omission of grammatical morphemes in individuals with DS were reported in other languages (Vicari et al., 2000, for Italian, Bol and Kuiken, 1990, for Dutch). A number of studies also report that complex syntactic structures are rarely mastered by either children or adults with DS. Fowler (1988) found a total lack of auxiliary inversion and do-support in the attempted question formation of a child who was 9 at the end of her study; similar findings were confirmed in Tager-Flusberg (1994). Subordinate and relative clauses, negated and passive constructions proved out of reach for a large group of French speakers with DS, aged between 7 and 20

[4] See Eadie et al. (2002) and Laws and Bishop (2003) for data showing that individuals with DS whose MLU is over 4.5 use tense markers in line with MA-matched controls.

(Rondal and Comblain, 1996), whilst deficient comprehension and production of passives in both children and adult English speakers with DS has been reported by Bridges and Smith (1984), Eriks-Brophy et al. (2002), Fowler (1990), Ring and Clahsen (2005).

The findings of the reviewed studies all point to deficits in the computational modules of language, i.e. morphology and syntax, as opposed to modules associated with extra-syntactic knowledge. However, the reviewed studies most often focus on the observation of spontaneous language in the population. While a great deal can be learnt from observing the natural course of language development, if we are to obtain a more balanced picture of language abilities in this population, controlled experiments are a necessity. It is through such experiments that we can tap into knowledge easily missed in the uncontrolled environment inherent to studies using observational techniques only. The present study uses a carefully designed experimental paradigm, successfully used in both typically and atypically developing populations, to investigate the phenomena of anaphoric relations, namely, binding and coreference. These aspects of linguistic knowledge involve an interaction of both syntactic and extra-syntactic knowledge, and thus provides a perfect testing ground for the claim that it is syntactic knowledge that is deficient in DS. In addition, specific aspects of anaphoric relations are known to pose particular difficulties to TD children during the course of language acquisition, presenting an opportunity to test the traditional claim that language in DS is essentially normal but severely delayed.

3. Acquisition of binding and modularity: predictions for DS

Different modules of the language faculty interact in governing the distribution of the anaphoric elements: syntax, pragmatics and semantics, but theories disagree in how much weight should be attributed to the influence of factors from each of these three modules. The most influential approach in the generativist tradition, developed by Chomsky (1981, 1986), argues that syntactic principles are solely responsible for the distribution of anaphoric elements[5]:

(1) Principle A: an anaphor must be locally bound in its governing category.
Principle B: a pronoun must be locally free in its governing category.

If these principles are innate, as is presupposed by the theory of Universal Grammar (UG), it would be expected that children show early mastery of the principles which govern the distribution of both pronouns and anaphors. However, a different pattern emerges, which at first sight appears to run counter to this expectation. Structures involving reflexives are correctly interpreted early on, at least from age 4 onwards (Jakubowicz, 1984; Chien and Wexler, 1990):

(2) Bill_i likes himself_i.

The same children however accept the ungrammatical (3) around 50% of the time, even at ages 5 or 6:

(3) *Bill_i likes him_i.

The explanation for this phenomenon, traditionally termed ‘Delay of Principle B Effect’ (DPBE), capitalizes on the distinction between different types of anaphoric relations that reflexives and

[5] See Chomsky (1981, 1986) for precise definitions of the notions ‘bound’ and ‘governing category’.

pronouns enter into: syntactic binding and coreference.[6] In line with Reinhart (1983, 1986), Grodzinsky and Reinhart (1993) argued that the two types of anaphoric relations are subject to constraints originating in distinct modules of the language faculty. Pronouns, like reflexives, are subject to syntactic binding only when acting as bound variables (e.g. in quantified contexts), whereas coreferential interpretation of pronouns is subject to a constraint outside syntax proper, one that operates at the semantics/discourse interface (Rule I in Grodzinsky and Reinhart, 1993,[7] or Principle P in Chien and Wexler, 1990).[8] Child grammar has access to syntactic principles that rule out illicit binding of reflexives and pronouns, but the difficulties pertain to computing extra-syntactic constraints (pragmatic, or processing in nature) that govern coreferential interpretation of pronouns.

This division of labour between syntax and pragmatics in the interpretation of pronouns and reflexives has important implications for our exploration of the linguistic deficit in DS. If it is the case that the linguistic deficit is syntactic in nature, it is predicted that individuals with DS would show difficulties interpreting anaphoric elements whose distribution is constrained by syntactic principles, but may not show difficulties interpreting elements that are governed by constraints outside syntax proper. Note that such a pattern runs against the 'slow-but-normal' characterisation of the language in DS. If the pattern of language development in DS parallels that found in TD, the only difficulties to be expected would concern the coreferential interpretation of pronouns, discussed above.

4. Experiment

4.1. Participants

Four girls with DS, aged between 17 and 21, participated in the study. Details of their performance on standardized language and cognitive abilities tests are given in Table 1. They had no known hearing impairments. Participant DS3 grew up in a bilingual home environment. The language surrounding her was predominantly English, so it is believed that her bilingual background did not adversely affect her scores on the standardized tests, or study tasks. Four TD children, aged between 5;11 and 7;10 years, were individually matched to participants with DS on verbal MA, as determined by their scores on a measure of receptive vocabulary, British Picture Vocabulary Scales (BPVS). A group of four adult control participants was also tested, matched to the participants with DS on the basis of their age, sex and exposure to a mono

[6] The distinction between the two types of anaphoric relation, binding and coreference, is best illustrated in examples involving VP deletion. Here the interpretation of the second conjunct depends on the interpretation of the first, giving rise to the ambiguity between the coreferential ('strict') reading and bound variable ('sloppy') reading:

(i) [Bill liked his cat] and [Charlie did too].
  (a) Bill λx (x liked a's cat) & Charles λx (x liked a's cat)
  (b) Bill λx (x liked x's cat) & Charles λx (x liked x's cat) (Reinhart, 1986)

(ia) represents the strict reading, where *his* is interpreted coreferentially: the value of *a* can be freely chosen, it can refer to anybody in the universe, including Bill. (ib) represents the sloppy reading: *his* is locally bound, so in the first conjunct it refers to Bill, and in the second conjunct, to Charles. It is argued that the two types of anaphoric relations are subject to constraints originating in distinct modules of the language faculty. In contrast to variable binding, regulated by a syntactic principle, e.g. Principle B, coreferential interpretation of pronouns is subject to a constraint outside syntax proper, one that operates at the semantics/discourse interface, e.g. Rule I.

[7] Rule I: 'NP *A* cannot corefer with NP *B* if replacing *A* with *C*, *C* a variable A-bound by *B*, yields an indistinguishable interpretation.'

[8] Principle P: 'Contraindexed NPs are noncorefential unless the context explicitly forces coreference.'

or bilingual home environment.[9] Their performance was at ceiling on the study task, confirming its validity.

Table 1
Scores on standardized language and IQ tests for participants with DS

	Age	BPVS AE (raw sc)	RWFV AE	TROG AE	WAIS Perf. IQ	Raven's CPM AE (raw sc)
DS1	17;9	8;1 (83)	7;3–7;5	4;9	65	7;8 (21)
DS2	17;2	6;6 (66)	5;7–7;9	5;3	55	6;6 (17)
DS3	19;3	7;0 (71)	>8.6	4;5	57	5;6 (15)
DS4	20;7	5;0 (51)	5;7–5;9	4;0	62	6;0 (16)

Note: AE = Age Equivalent; raw sc = raw score, BPVS = British Picture Vocabulary Score, RWFV = Renfrew Word Finding Vocabulary, TROG = Test for Reception of Grammar, WAIS Perf. = Performance scale of Wechsler Adult Intelligence Scales, Raven's CPM = Raven's Coloured Performance Matrices.

4.2. Materials and procedure

The task used in the study was the Picture Truth Value Judgement task, adapted from the 4th experiment by Chien and Wexler (1990), eliciting yes/no answers to questions accompanied by picture stimuli, e.g. *Is Cinderella washing herself?* Four different types of experimental questions were included (cf. Table 2): *name-reflexive* (NRM and NRX), *name-pronoun* (NPM and NPX), *quantifier-reflexive* (QRM and QRX) and *quantifier-pronoun* (QPM and QPX). The name-reflexive or name-pronoun conditions included a proper name in the subject (antecedent) position and a reflexive or a pronoun in the object position. The quantifier-reflexive and quantifier-pronoun conditions involved a quantified DP in the subject position, with the pronoun or a reflexive in the object position. Each condition was tested twice, in the match form (eliciting a 'yes' answer, e.g. NRM) and mismatch form (eliciting a 'no' answer, e.g. NRX) in order to control for a positive or negative bias, thus totaling to 8 experimental conditions, with 8 items in each.

Table 2
Examples of experimental and control questions

	Match	Mismatch	Example
Experimental conditions			
Name-reflexive	NRM	NRX	Is Snow White washing herself?
Name-pronoun	NPM	NPX	Is Snow White washing her?
Quantifier-reflexive	QRM	QRX	Is every bear washing himself?
Quantifier-pronoun	QPM	QPX	Is every bear washing him?
Control conditions			
Name-name	CNNM	CNNX	Is Snow White washing Cinderella?
Quantifier-name	CQNM	CQNX	Is every bear touching Peter Pan?
Name-name action	–	CNAX	Is Snow White drying Cinderella?
Attention	–	CAX	Is Father Christmas sleeping?

Note: 'Match' conditions (condition code ending with 'M') elicit a 'yes' answer; 'mismatch' conditions (condition code ending with 'X') elicit a 'no' answer. Number of items for each condition 8, except for CAX, 16. Total items: 120.

[9] The four young TD controls were all monolingual speakers of English. It was decided against matching the 19-year-old bilingual participant with DS, DS3, to any 6- or 7-year-old bilingual control, as the length of exposure to a bilingual environment for the two participants could not be matched.

Four control conditions, two match and two mismatch, aimed to uncover participants' knowledge of assignment of reference independently of pronominal elements (CNNM, CNNX, CQNM, CQNX) (see Table 2 for examples sentences). Two additional (mismatch only) conditions were used to control for the well-known attention deficits in individuals with DS (CAX, CNNX). Each experimental question was preceded by introducing the characters presented in the picture showing popular TV/cartoon characters: '*This is Cinderella. This is Snow White. Is Cinderella washing her*?' Each question contained one of three action verbs, *wash*, *dry* or *touch*.

4.3. Results

Except for their performance on control condition CQNX,[10] both participants with DS and TD children scored well on all control conditions, showing that they understood the requirements of the task.

As seen from Tables 3 and 4, the performance of participants with DS on the experimental conditions does not correspond at all with that of the control participants. On the experimental conditions involving pronouns, in a local relation with either a referential or quantified antecedent (NPM, NPX, QPM, QPX), the participants with DS performed near or at ceiling level. On the *name-pronoun* conditions, both match and mismatch (NPM and NPX), participants with DS were found to perform significantly better than the control participants ($p < 0.006$).[11] On all four conditions, participants with DS correctly rejected locally bound pronouns in the mismatch condition and accepted a referent distinct from the local subject for the pronoun in the match condition 100% of the time. DS3 scored 6 out of 8 on QPM, a score still close to being significantly above chance ($p = 0.1445$).[12]

Table 3
Individual and mean scores on experimental match conditions

	DS1	CS1	DS2	CS2	DS3	CS3	DS4	CS4	Mean DS (S.D.)	Mean CS (S.D.)
NPM	8	3	8	7	8	8	8	7	8 (0.00)	6.75 (2.22)
NRM	2	8	6	8	5	8	6	8	4.75 (1.89)	8 (0.00)
QPM	8	7	8	7	6	8	8	8	8 (1.00)	7.5 (0.58)
QRM	1	8	4	8	1	8	2	8	2 (1.41)	8 (0.00)

Notes: Maximum score of 8 for each condition; DS = participants with DS, CS = control participants; S.D. = standard deviation.

[10] DS1 and DS4 performed poorly on pronouns and reflexives bound by quantified NPs. This, however, cannot be correlated with their performance on all other experimental conditions involving quantifiers. DS1 and DS4 who scored poorly on CQNX still achieved faultless performance on the experimental conditions involving pronouns bound by quantified antecedents. Conversely, DS2 and DS3, whose performance was 100% correct on CQNX, reached only 50% and 12.5% correct on the match condition involving reflexives bound by a quantifier. The pattern shown by DS1 and DS4 resembles the pattern reported in typical acquisition where young children show difficulties interpreting universal quantifiers 'every', 'each' and 'all' in contexts where there is a mismatch between the number of agents and objects presented visually (Inhelder and Piaget, 1964; Philip, 1995; amongst others). CQNX involved such an asymmetry: this question was accompanied by a picture showing only 2 of the 3 characters involved in an action, e.g. two bears washing Peter Pan, with one bear standing by. All other control and experimental questions involving quantifiers showed all three characters involved in an action of washing/touching/drying, directed to another character, with no character left out (e.g. three bears washing Peter Pan).

[11] The p values were calculated by using Fisher Exact test procedure.

[12] The p values were obtained using a binomial distribution, on the assumption that participants were guessing in a random, unbiased way.

Table 4
Individual and mean scores on experimental mismatch conditions

	DS1	CS1	DS2	CS2	DS3	CS3	DS4	CS4	Mean DS (S.D.)	Mean CS (S.D.)
NPX	8	4	8	5	8	8	8	7	8 (0.00)	6 (1.83)
NRX	1	7	3	8	6	8	8	8	4.5 (3.11)	7.75 (0.50)
QPX	8	5	8	6	8	8	8	8	8 (0.00)	6.75 (1.50)
QRX	1	5	2	5	7	8	5	8	3.75 (2.75)	6.5 (1.73)

Notes: Maximum score of 8 for each condition; DS = participants with DS, CS = control participants; S.D. = standard deviation.

On conditions involving a reflexive pronoun, the pattern shown by the participants with DS is strikingly different: they performed significantly worse than the controls, both on the non-quantified conditions, *name-reflexive match* (NRM) and *name-reflexive mismatch* (NRX) ($p < 0.002$), and the quantified conditions, *quantifier-reflexive match* (QRM) ($p < 0.001$) and *quantifier-reflexive mismatch* (QRX) ($p < 0.005$). On the match conditions, the mean performance on NRM reached 59%, on the quantified version of this condition, QRM, it is 25%. The trend is not different on the mismatch conditions: 56% correct on NRX and 47% on QRX. No other between-subjects differences reached significance.

5. Discussion

The observed performance of the participants with DS reveals an extreme difficulty interpreting reflexive pronouns. Individual data show that each of the four participants performed below chance level on at least one (match or mismatch) or both conditions involving an anaphor bound by a quantified or a referential antecedent, indicating a systematic misinterpretation of these constructions. No consistent positive or negative bias was displayed, thus a low score on either match or mismatch condition can be interpreted as evidence for their failure to master this particular construction. This pattern is in striking contrast to these participants' near perfect performance on control conditions, or conditions involving pronouns. No similar pattern was present in the results shown by control participants in this study, either age-matched unimpaired adults or TD children matched to the participants with DS on a measure of receptive vocabulary. This pattern is not documented at any stage of typical language development either, as reported for English in Jakubowicz (1984), Chien and Wexler (1990) or other languages in studies which focused on typical acquisition of binding and is in fact directly opposite to the widely reported DPBE phenomenon in TD, where children are known to accept illicit coreference between a personal pronoun and a local referential antecedent, the pattern confirmed in data of two of the young controls in this study. Importantly, the identical pattern of difficulties comprehending reflexives but not pronouns has recently been replicated in a group of 8 English-speaking teenagers with DS (Ring and Clahsen, 2005) and 6 Serbo-Croatian-speaking young adults with DS (Perovic, 2004).

On the face of it, the observed pattern can be interpreted as revealing some deficiency in the grammar of DS which causes a 'delay' in the acquisition of a syntactic principle, e.g. Principle A of standard Binding Theory (BT) (revealing something that could be termed a ''Delay of Principle A Effect''), which states that 'anaphors must be bound'. Such an explanation would be in line with the delayed characterisation of linguistic development in this disorder. But note that if Principle A of standard BT were unavailable in the grammar of participants with DS, they would be expected to rule in all the sentences violating the principle, whilst not rejecting any

constructions with reflexives as ungrammatical. The fact that our participants did not show such a pattern – they said 'yes' to experimental questions of the mismatch condition as often as they said 'no' to questions of match conditions involving reflexives – rules such an explanation out.

The starting point in developing an explanation for the findings reported above will be the same problem faced by researchers accounting for the DPBE in typical language development. Recall that the typical acquisition data discussed in section 3 exposed the inability of standard BT to account for the distinction between binding and coreference. A number of concerns have been raised in the literature about this framework, mainly related to its inability to account for the rich variety of anaphoric elements and their distributional properties in a number of languages. The relevant part here is that in this framework, notions of locality and structure are of utmost importance: interpretive dependencies solely rely on structural conditions on coindexing of nominal expressions, with Binding Principles presupposing binding relations (see the definition in 1 earlier). However, the example in (4) presents a problem for such an approach. Here, the pragmatic context makes it possible for the two NPs to corefer without being in a binding relation. Yet in the normal case, such relations must also be blocked by Principle A.

(4) I know what Bill and Mary have in common. Mary adores Bill and *Bill* adores *him* too.

In the alternative framework of Binding Theory, as developed by Reinhart and Reuland (1993) (subsequently R&R), this problem does not arise: interpretive dependencies do not necessarily coincide with the syntactic relations that nominal expressions enter into with their antecedents. Their binding principles can have locality effects even if no binding relation is established. A hypothesis I shall explore here is that difficulties with the comprehension of anaphors demonstrated by the participants in the experimental task in fact reveal a deficit in establishing certain syntactic dependencies, and not with interpretive dependencies. The claim is that binding, as the expression of referential dependencies, is available in the grammar of individuals with DS, but binding relations are not. The Reflexivity model of R&R therefore provides tools to explore the apparent dissociation between binding principles and the syntactic relation of binding in DS. Independent evidence for the claim that these participants may have a deficiency in establishing binding relations comes from their inability to form A-dependencies in passive constructions. Before going into the analysis of the data, it is necessary to briefly outline some of the concepts of Reflexivity relevant to our discussion, although the reader is referred to original sources for a detailed introduction to this framework.

5.1. Reflexivity (Reinhart and Reuland, 1993)

R&R's version of Binding Theory argues for two types of conditions on A-binding: conditions on binding as conditions on reflexivity of predicates, and the condition on chain formation. Together they account for the distribution of pronominals and anaphors crosslinguistically. The standard Binding Principles A and B of Chomsky (1981) are thus replaced with the following conditions on reflexivity:

(5) Condition A: A reflexive marked syntactic predicate must be reflexive.
Condition B: A reflexive semantic predicate must be reflexive marked.

To be reflexive, a predicate must have two of its arguments co-valued. The reinterpreted binding conditions rely on the assumption that reflexivity of predicates must be linguistically licensed

('reflexive-marked'). Transitive predicates are reflexive-marked in the syntax with the aid of complex anaphor SELF, with Condition B ruling out the pronoun:

(6) John$_i$ hates himself$_i$/*him$_i$.

Intrinsically reflexive predicates are marked so in the lexicon: in English, they are intransitive (7),[13] whereas in Dutch and other languages that have a contrast between a complex and a simplex anaphor, inherently reflexive predicates overtly realise their internal θ-role in the form of a simplex anaphor *zich* (8).[14]

(7) John$_i$ behaves$_i$/*him.

(8) Jan$_i$ gedraagt zich$_i$/*zichzelf$_i$/*hem$_i$. (Dutch)
John behaves *zich*/himself/him

Since the predicate in (7) and (8) is inherently reflexive, there is no need to reflexive-mark it in syntax by the complex anaphor; the conditions on reflexivity are satisfied. The revised Chain Condition excludes pronouns from the same contexts (the Chain Condition is not discussed in much detail here as it does not play a large role in accounting for the data in the section below).[15] The important consequence of Binding Conditions, as stated in R&R, is that they account for the distribution of anaphors and (together with the revised chain theory) pronouns, without stating any restrictions on their structural domains.

5.2. Analysis of data in the framework of Reflexivity

The hypothesis presented above was that participants with DS will not be able to establish binding relations, but they will show knowledge of conditions on reflexivity as defined in (5). Applying R&R's framework to the present results, it is clear that these participants showed difficulties understanding constructions involving a transitive predicate reflexive-marked by the complex anaphor[16]:

(9) Snow White$_i$ is drying herself$_i$.

(10) Every bear$_i$ is drying himself$_i$.

[13] Some English verbs seem ambiguous between being inherently reflexive and purely transitive predicates (e.g. *shave*, *wash*). When inherently reflexive, they are intransitive and appear with one argument only (*John shaves*). When transitive, they can take an object distinct in reference from the subject (*John shaved Peter*), or become reflexivized just like any other pure transitive predicate, with their internal argument appearing in the form of a complex anaphor (*John$_i$ shaves himself$_i$*). Each occurrence of the predicate is listed separately in the lexicon (Everaert, 1986). In Dutch these verbs (e.g. *wash*) show up with the simplex anaphor *zich* when inherently reflexive and *zichzelf*, when not inherently reflexive transitive predicates.

[14] See Reinhart (1996), and Reinhart and Siloni (2005), for a more refined view of lexical versus syntactic reflexivization and the role of Dutch 'zich'.

[15] The definition of a chain in R&R is as follows: 'A maximal A-chain (a_1, . . ., a_n) contains exactly one link – a_1 – that is both [+R] and case-marked (fully specified for pronominal features, including structural Case).'

[16] It is important to note that some of the participants did not just provide incorrect answers to the experimental questions involving transitive predicates reflexive-marked by the *self* anaphor: DS2 often could not provide any answer (subsequently coded as incorrect), showing a great deal of hesitation and frustration as a result at leaving the anaphor uninterpreted.

This result can be interpreted as an inability to use the SELF anaphor as an argument of a reflexive predicate, perhaps because the participants with DS are not to be able to bind it in syntax. They may very well be aware of the special function of the anaphor, namely to impose reflexivization on the predicate, but they cannot establish the syntactic relation between the anaphor and its antecedent. The hypothesis predicts that participants with DS would, however, show knowledge of the conditions on reflexivity. This is indeed shown in their performance on experimental conditions involving a pronoun as one of the covalued arguments of a transitive predicate illustrated in (11) and (12). Here, the argument has not been reflexive-marked in syntax, in violation of Condition B (no syntactic dependency between the argument and the predicate is relevant here, the structure is ungrammatical due to the fact that the argument is not reflexive-marked):

(11) *Snow White$_i$ is drying her$_i$.

(12) *Every bear$_i$ is drying him$_i$.

As seen earlier, the participants with DS correctly rejected violations of Condition B in (11) and (12) nearly 100% of the time. Further support for the claim that individuals with DS do know conditions on reflexivity of predicates but may have difficulties computing the syntactic relation between an anaphor and its antecedent comes from the study that investigated the knowledge of binding in individuals with DS speakers of Serbo-Croatian (Perovic, 2004). Six adult subjects with DS in this study showed the same pattern of difficulty interpreting the reflexive pronoun, however, they were able to successfully interpret the reflexive clitic, therefore showing knowledge of Condition A in (5) above. Assuming that the reflexive clitic *se* in this language is not an anaphor but a lexical marker of inherent reflexivity in the sense of Reinhart (1996), this is exactly the expected result.[17]

Independent evidence for a specific deficiency in forming A-dependencies comes from reports on the production and comprehension of passives, known to be extremely problematic for the DS population (e.g. Bridges and Smith, 1984; Ring and Clahsen, 2005). Our results also support this claim: all four participants failed a passive comprehension task, a part of the battery of tests administered.[18]

6. Conclusions

The findings presented above constitute an argument in support of a selective grammatical deficit in DS, a population known to show limited attainment in morphosyntax. They also confirm

[17] According to Reinhart and Siloni (2005), the operation of reflexivization in Serbo-Croatian applies in the syntax, rather than the lexicon. However, in my dialect as well as dialects of my informants, reflexivization in SC does not apply as freely as in Romance and targets only a limited number of predicates. In that respect, SC behaves more like Dutch and Russian, the languages Reinhart & Siloni argue derive reflexives in the lexicon.

[18] The participants' comprehension of passives was tested on a picture matching task, kindly provided by Heather van der Lely who used it in her study investigating passives in SLI (van der Lely, 1996). All four participants with DS performed well on active declarative sentences, but had severe difficulties matching appropriate pictures to passive constructions, both truncated and non-truncated. This is in contrast to what has been reported for Williams syndrome, a population with similarly depressed cognitive abilities. For example, Clahsen and Almazan (1998) and Ring and Clahsen (2005) report a near perfect comprehension of passives on the same task for their participants with WS. (However, see Perovic and Wexler (2006), for findings that individuals with WS perform differently on passives of actional as opposed to non-actional/psychological verbs, showing a much poorer performance on the latter).

the proposed dissociation between the computational modules of the language faculty and those related to conceptual knowledge in DS. Our results are at odds with any proposal which states that the limited grammatical achievement in DS is related to a severe slowing down of linguistic development. As the pattern shown by the majority of participants with DS in our study has not been evidenced in typical populations, and there is no reason to assume that different maturational constraints apply in DS, this cannot be the full explanation for the observed pattern in our study. An account that invokes a selective grammatical deficit seems better able to describe the pattern of a deficiency in anaphoric binding, as recently confirmed in the data of English-speaking teenagers with DS (Ring and Clahsen, 2005) and Serbo-Croatian-speaking young adults with DS (Perovic, 2004).

Our findings also have important implications for the linguistic theory of binding, supporting the proposed fractionation of binding into syntactic and extra-syntactic components. Here, the interpretation of anaphoric elements is limited to syntax proper, whereas the coreferential interpretation of pronouns is governed by an extra-grammatical constraint, related to the general, non-linguistic system. While the literature on the acquisition of binding in typical development supports this fractionation in one direction, by documenting that TD children have difficulties in applying the extra-grammatical constraint, the data presented in this study run in the opposite direction: our participants with DS revealed an inability to interpret anaphoric elements, a task firmly in the realm of syntax proper. This outcome confirms that we can successfully test competing linguistic theories in the field of language disorders, and crucially, that the grammar proposed is psychologically and perhaps neurologically feasible. If the conclusions drawn here about UG and the organisation of grammar are correct, the present research shows that work on disordered populations can reveal facts about the language faculty that linguistic inquiry into typical populations cannot.

Acknowledgments

I thank Neil Smith, the best teacher I have ever had, for his unwavering support, kind words and most knowledgeable guidance. There are a number of other people who made my years at UCL a wonderful experience, but especially Ad Neleeman, my other ‘first’ supervisor, to whom I am grateful for all the help and encouragement. Thanks to all the participants for their patience and willingness to engage in all the tasks I presented them with, and two anonymous Lingua reviewers for helpful comments on an earlier version of this paper.

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