Binding Principles in Down syndrome[*]

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Abstract

In an experiment designed to tap into knowledge of Binding in individuals with Down syndrome (DS), it was found that subjects had specific difficulties assigning appropriate interpretation to reflexives, traditionally claimed to be governed by Principle A of standard Binding Theory, as opposed to pronouns, constrained by Principle B in the same framework. This pattern, not previously evidenced in the literature, is the reverse of the well known 'Delay of Principle B' effect confirmed in typical acquisition. The findings suggest that the process of acquisition of Binding in DS may be qualitatively different compared to typical linguistic development, rendering the traditional 'slow-but-normal' characterisation of language development in DS no longer tenable. Embracing the Reflexivity framework of Reinhart & Reuland (1993), I also argue that these findings reveal a specific syntactic deficit in the language of DS, related to the inability to establish a certain syntactic dependency, namely the binding relation between an anaphor and its antecedent.

1 Introduction

Research on Down syndrome (DS) has uncovered an unusual disparity between linguistic and cognitive development, with linguistic development significantly lagging behind. Further dissociations have been reported within the linguistic faculty itself, particularly between morphosyntax on the one hand, and lexical knowledge and pragmatics on the other. In an attempt to further elucidate the relationship between different linguistic modules in the selective language impairment in DS, this study of the language of four adolescent girls with DS focuses on Binding Principles. In standard Binding Theory, Binding Principle A governs the distribution and

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interpretation of reflexives, whereas Binding Principle B is concerned with pronouns. It is well known that typically developing children acquire Principle A early and with few difficulties, whilst their acquisition of Principle B is significantly delayed – the phenomenon known as Delay of Principle B Effect (DPBE). If language development in DS is, as traditionally thought, delayed, but essentially normal, then investigations of the availability of the Binding Principles in DS should demonstrate parallels to normal language development – with Principle A posing few problems but Principle B yielding interpretive difficulties until later stages of language development. The results of this study, however, point to a rather different pattern: in contrast to typically developing children, as compared to data from Chien & Wexler (1990), the subjects violated Principle A but obeyed Principle B.

In line with the 'delayed' characterisation of language in DS, it may be reasonable to claim that these findings are due to some kind of delay in the acquisition of a particular syntactic principle, thus revealing a 'Delay of Principle A Effect' in this population. However, on the basis of the accounts for the DPBE in typical children, I argue that a satisfactory account of these findings cannot be provided within the framework of standard Binding Theory. I argue that the pattern shown in DS is not caused by the unavailability of a Binding Principle but rather a specific deficiency in establishing binding relations. The proposed dissociation between binding, as the expression of referential dependencies, and the ability to establish the syntactic relation of binding in DS, can be accounted for within the framework of Reflexivity of Reinhart & Reuland (1993).

The comprehension pattern on pronouns, as opposed to reflexives, presented by the four girls with DS in this study has not been evidenced at any stage of typical language development, thus providing further evidence against the claim that language development in DS is severely delayed but essentially non-deviant.

2 Language in Down syndrome: Delay or deficiency?

A traditional characterisation of linguistic development in DS is that language in individuals with DS is essentially normal, but severely delayed. Comparisons of the linguistic development of DS children with that of typical children usually come to the conclusion that the two populations follow the same course of development (Chapman, 1995; Fowler, 1990). It has been argued that DS children acquire vocabulary, use the same range of grammatical morphemes and syntactic structures, induce grammatical rules and impose word order just like typically developing

children, albeit with a considerable delay (Fowler, 1990; Rutter & Buckley, 1994; Vicari et al, 2000).

However, this 'delayed' characterisation does not seem adequate to describe the course of linguistic development, and particularly the end linguistic achievement in DS. A delay in language development is characteristic of a whole range of aetiologies, and is usually one of the first signs of a language disorder. Interestingly, disparities between linguistic and non-linguistic abilities in DS seem to increase with chronological age. DS children up to 3 or 4 years of age have been found to have language skills consistent with their cognitive abilities. As they get older, however, their language skills do not increase at comparable rates to other cognitive skills (Miller, 1988; Chapman, 1995). Fowler et al. (1994) report the average mean length of utterance (MLU) for a group of DS adolescents to be around 3, but their mental age (MA) to be around 6 years.[1] Moreover, Down syndrome is found to be more detrimental to language development than other aetiologies (Miller, 1988; Rondal, 1993; Rondal & Comblain, 1994). In studies conducted with young adolescents and adults, individuals with DS show consistently poorer performance on linguistic measures than individuals with other types of intellectual disorders (Kernan & Sabsey, 1996; Marcell et al. 1995).

Disparity between language and cognition in DS is further reflected in the interaction of distinct linguistic modules. Inconsistent use and widespread omission of grammatical morphemes such as articles, auxiliaries, copulas, pronouns, conjunctions, prepositions, verbal and nominal inflection have been widely reported (Chapman et al. 1998; Fabretti et al, 1997; Rutter & Buckley, 1994; Vicari et al, 2000), and DS syntax is usually limited to only the simplest structures: constructions involving passives, subject/auxiliary inversion, possessive forms, negation, interrogatives are rarely used by either children or adults (Fowler, 1990; Rondal, 1995). Phonological development in this population is also fraught with difficulties, with processes such as final consonant deletion, consonant cluster reduction, substitution and omission greatly reducing the intelligibility of speech of both children and adults (Dodd, 1976).[2] In contrast, receptive vocabulary and pragmatics have been reported to be relatively less impaired, and, interestingly, rather consistent with general cognitive levels of this population (Chapman, 1995; Rondal & Comblain, 1996). Miller (1988) reports

[1] Note, however, that this population displays extreme variability in the levels of linguistic achievement, which cannot be accounted for by comparison with cognitive abilities (Miller, 1988; Fowler, 1990; Rondal, 1995). Cases of near-normal linguistic complexity have also been reported (Rondal, 1995).

[2] Reduced intelligibility and hearing defects, very often present in DS, have not been found to correlate with syntax, morphology or vocabulary (Chapman et al, 1998).

measures of receptive vocabulary as correlating with measures of mental age in children with DS at various stages of development,[3] in line with the argument that mental age measures successfully predict lexical development in both intellectually disabled and typically developing children. In other words, modules of the computational system (e.g. morphosyntax and phonology) appear more severely impaired in DS than more general, multi-modality processing systems (e.g. lexical knowledge and pragmatics).

The strikingly low ultimate level of linguistic attainment, comparable to normally developing 2-year-olds, and the known disparities in the development of computational vs. conceptual systems, suggest that the language of DS is more than just delayed. Recall that the argument for the 'delayed' characterisation of language in DS is essentially based on comparisons of linguistic patterns in DS with those found in typical acquisition, e.g. omissions of grammatical morphemes, problematic use of passive constructions.[4] However, parallels with typical development are expected if we assume that human language, impaired or not, is constrained by Universal Grammar. The same argument holds for language disorders in general: constraints postulated by UG will restrict the logical number of possible deficiencies whatever the linguistic impairment.

To determine whether linguistic impairment in DS is merely delayed, or also deficient in important respects, I investigate the end syntactic achievement of four adolescents with DS, in particular, their knowledge of Binding. Binding belongs to the core computational system of the language faculty and constitutes a major part in adult syntactic knowledge. However, recent developments in the theory have suggested an interesting interplay of syntactic and pragmatic factors that influence the process of the acquisition of this module, resulting in apparent delays in acquiring a Binding principle, thus making it particularly interesting with respect to the delay vs. deficiency argument regarding linguistic development in DS.

3 Binding Theory and Delay of Principle B Effect

[3] Receptive vocabulary has been reported to even exceed MA in some adolescents and adults with DS, as a result of educational experience (Facon et al, 1998). These findings further support the idea of dissociation between the computational and conceptual components of the language system in DS.

[4] Note that these problems are also characteristic of aphasia.

Principles A and B[5] of Binding Theory (Chomsky, 1981; 1986) regulate the distribution and interpretation of nominal expressions - anaphors and pronouns, respectively - within a particular sentence domain, therefore permitting and excluding the constructions in (2) and (3):

(1) Principle A: an anaphor must be locally bound. [6]
Principle B: a pronoun must be locally free.

(2) Mary_i is washing $\text{herself}_{i/*j}$
(3) Mary_i is washing $\text{her}_{*i/j}$

The theory of Universal Grammar (UG) entails that Binding Principles are innately specified. However, it comes as a surprise that in the process of acquisition children show distinctions between Principles A and B, obeying Principle A very early, from around age 4, but violating Principle B even after the age 5 or 6. Studies have shown that children would accept (4) as grammatical around 50% of the time:

(4) * Mary_i is washing her_i

This phenomenon, often referred to as 'Delay of Principle B Effect', is reported in a variety of languages: English (Jakubowicz, 1984; Chien & Wexler, 1990), Dutch (Philip & Coopmans, 1996), Russian (Avrutin & Wexler, 1992), Icelandic (Sigurjónsdóttir, 1992).[7]

To circumvent the empirical problem that children's apparent violations of Principle B pose to the central claim of UG, namely that knowledge of syntactic principles is innate, researchers have argued that children do have the knowledge of this particular syntactic principle but their performance on the tasks in studies reported is masked by other factors. Rather than attributing it to a violation of a syntactic principle, Chien & Wexler (1990) and Grodzinsky & Reinhart (1993) argue that children's error in (4) is

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[5] Principle C will not be discussed here.

[6] *a* binds *b* iff *a* and *b* are coindexed and *a* c-commands *b*. A precise definition of 'locally bound' need not concern us here.

[7] See Baauw (2000), McKee (1992) and Varlokosta (2001) for claims that DPBE does not occur in languages with rich inflectional morphology, and especially, clitic doubling: Spanish, Italian and Greek. In Spanish, however, DPBE may occur in ECM constructions (Baauw, 2000).

due to the immaturity of their pragmatic and/or general processing system, knowledge of which is not confined to syntax proper.

For the accounts to be discussed here, distinction between binding and coreference is crucial. In standard Binding Theory both binding and coreference are defined in terms of syntactic coindexation: NPs with identical indices are obligatorily coreferent, and NPs with distinct indices are obligatorily disjoint in reference. In contrast to standard Binding Theory, Reinhart (1983, 1986) argues that binding and coreference are governed by two distinct modules of grammar: Principle B applies to pronouns only when bound variable, and not when coreferential with referential antecedents. Assuming that definite description and proper names also can serve as variable binders, Grodzinsky & Reinhart (1993) claim that a sentence like (4) above could have more than one possible logical representation:[8]

(5) a. Mary is washing her.
b. Mary λx (x is washing a)
c. Mary λx (x is washing x)

In the set of possible referents for *her* in 5b can also be *Mary* herself, thus yielding a coreferential interpretation. In 5c, the pronoun is a variable bound by a lambda operator. Note that both 5b and 5c yield the same truth conditions. The ambiguity between coreferential and bound variable reading therefore exists whenever a pronoun has a referential NP as an antecedent. The bound variable interpretation will be ruled out by a syntactic principle, Principle B. Coreference, however, is not a syntactic notion,[9] and can be licit in appropriate pragmatic contexts:

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[8] The distinction between binding and coreference is best illustrated in the 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) a. [Bill liked his cat] and [Charlie did too].
b. Bill λx (x liked *a*'s cat) & Charles λx (x liked *a*'s cat)
c. Bill λx (x liked x's cat) & Charles λx (x liked x's cat)

(ib) entails 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*. (ic) entails sloppy reading: *his* is locally bound, so in the first conjunct it refers to *Bill*, and in the second conjunct, to *Charles*.

[9] Coreference, unlike binding, does not crucially involve structural conditions on coindexing. Note that in VP deletion constructions the bound variable (sloppy) reading is not available if there is no c-command:

(i) [Most of her friends adore Lucie] and [Zelda too]

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

The idea behind the accounts of the DPBE as proposed by Chien & Wexler (1990) and Grodzinsky & Reinhart (1993) is that, unlike adults, children are not able to rule out the coreference reading in illicit contexts such as (4). Due to the immaturity of children's pragmatic system (Principle P, Chien & Wexler, 1990),[10] or limitations on children's processing system that hinder coreference computation operations (Rule I, Grodzinsky & Reinhart 1993),[11] the constraint which blocks the coreference interpretation whenever it is semantically indistinguishable to the bound variable interpretation cannot be implemented in children's grammar, resulting in the guesswork performance on examples such as (4) above.[12]

The important issue that arises in the accounts of the DPBE presented here is the proposed fractionation of Binding Principles into linguistic and extralinguistic components. Processes involved in the interpretation of anaphoric elements are constrained to syntax proper. In contrast, coreferential interpretation involves processes that relate linguistic expressions to elements outside grammar. This division of labour between syntax and pragmatics in the interpretation of pronouns has interesting implications for our exploration of the linguistic deficit in Down syndrome. If binding is syntactically encoded, and it is assumed that the linguistic deficit in DS is syntactic in nature, the subjects may reveal difficulties with interpreting anaphoric elements whose distribution is constrained by syntactic principles. If the interpretation and distribution of pronouns are regulated by principles that belong to some system

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(Lucie λx (x's friends adore x)
but NOT Zelda's friends adore Zelda (Zelda (λx (x's friends adore x)))

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

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

[12] In contexts in which a coreferential interpretation is unavailable, i.e. when they need not call upon a pragmatic principle to resolve the ambiguity between the coreferential and bound variable interpretation, children do not show the DPBE (Chien & Wexler, 1990):

(i) *Every bear$_i$ is washing him$_i$

outside syntax proper, influenced by the maturation of general processing abilities,[13] the subjects should do better than typically developing children on tasks involving pronouns. However, this prediction runs against the 'delay' characterisation of the language in DS, discussed in previous sections. If children with DS go through identical stages of acquiring syntactic principles to typically developing children, even if these processes get arrested at distinct points in the development, it should be possible to identify at least some stages in the grammar of adults with DS that match the patterns of typical acquisition processes.

4 Experiment

4.1 Subjects

Four adolescent girls with DS, between 17 and 21 years of age, participated in our study. The aetiological subtype of DS is not confirmed, but is suspected to be standard trisomy.[14] All subjects were students at a Learning Support Unit at a further education college in Greater London. Their scores on standardised grammar and vocabulary tests are given in Table 1. Note the disparity between their scores on both receptive and expressive vocabulary and the test of comprehension of grammar, in line with the widely reported dissociations between grammar and vocabulary. Following the tradition in the literature, the subjects can be matched to two distinct control groups: on the basis of their grammar comprehension scores (TROG), or on the basis of their verbal mental age, as measured by the receptive vocabulary (BPVS).[15]

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[13] It is probable that Rule I and Principle P would yield different predictions with regard to their application in the grammar of DS. Principle P is a maturational pragmatic constraint and should be available to the individuals of DS, if their pragmatics is relatively unimpaired as it is claimed in the literature. However, no pragmatic framework from which this principle follows is provided for any clear predictions to be made. On the other hand, Rule I is an innate constraint that can also be interpreted as a general economy condition, in the sense of Reuland (1997). It however assumes maturity of general processing system, relying on working memory resources, an area well known to be problematic for individuals with DS. To resolve this issue is beyond the scope of this paper, and will not be of crucial importance for our discussion.

[14] Five girls originally participated in the study, however, the scores for one of them are excluded here as it appeared that she had a mosaic form of DS, rather than standard trisomy 21. Mosaic form is known to give rise to less severe cognitive and possibly linguistic impairments.

[15] Measures of receptive vocabulary have been found to highly correlate with measures of mental age.

Table 1

	Age in years	Receptive Vocabulary (BPVS) Age Equivalent	Expressive Vocabulary (RWFVT) Age Equivalent	Grammar Comprehension (TROG) Age Equivalent
LP	17;09	8;01	7;03-05	4;09
DA	17;02	6;06	5;07-09	5;03
MK	19;03	7;0	>8.6	4;05
SL	20;07	5;00	5;07-09	4;0

4.2 Materials and procedure

The task used in the study was the Picture truth value judgement task, adapted from Chien & Wexler (1990),[16] eliciting yes-no answers to experimental questions which matched or did not match the picture shown.[17] Following Chien & Wexler (1990), four experimental conditions were included: *name-reflexive, name-pronoun, quantifier-reflexive* and *quantifier-pronoun*, with eight questions for each condition.[18] In addition to control conditions used in Chien & Wexler (1990), *name-name* and *quantifier-name*, two extra control conditions were included: *name-name action* and *attention*, with eight questions for each, bar the *attention* control condition, which included 16 questions.[19] Examples of questions for each of the conditions are given in the Appendix A. Subjects were presented with a picture showing cartoon characters *drying, washing* or *touching* either themselves or other characters. A sentence

[16] I acknowledge the help of Heather van der Lely who kindly provided some of the pictures used in van der Lely & Stollwerck (1997).

[17] Mismatch conditions were included to control for a positive bias (opting for 'yes' answers even if unsure, in order to please the (adult) experimenter), well evidenced in the research on typical language acquisition.

[18] Chien & Wexler (1990) used six questions per condition.

[19] To control for the well known attention deficits in individuals with DS, two extra condition were added, mismatch only. *Name-name action* included a picture of characters performing action different to the action mentioned in the experimental question: a question such as *Is Peter Pan drying Mickey Mouse*? was accompanied by a picture depicting Peter Pan washing Mickey Mouse. *Attention* condition involved questions such as *Is Father Christmas sleeping*? accompanied by a picture depicting Father Christmas standing next to a bed.

introduced the characters (e.g. '*This is Cinderella. This is Snow White*.') followed by a question (e.g. '*Is Cinderella washing her*?). Their answers were coded onto an answer sheet, along with any other comments. In the four experimental sessions, each subject was presented with 30 pictures and 30 questions. To ensure that subjects understood the task, four trial questions were used at the beginning of each session. The sessions were conducted in an empty classroom at the girls' college.

5 Results

Table 2 presents the percentage of correct responses for the subjects with DS on each of the experimental condition.

Table 2

	LP	DA	MK	SL
Name-reflexive				
Match NRM	25.00%	75.00%	62.50%	75.00%
Mismatch NRX	12.50%	37.50%	75.00%	100%
Quantifier-reflexive[20]				
Match QRM	12.50%	50.00%	12.50%	25.00%
Mismatch QRX	12.50%	25.00%	87.50%	62.50%
6 Name-pronoun				
Match NPM	100%	100%	100%	100%
Mismatch NPX	100%	100%	100%	100%
Quantifier-pronoun				
Match QPM	100%	100%	75.00%	100%
Mismatch QPX	100%	100%	100%	100%

On conditions involving pronouns (NPM, NPX, QPM, QPX), the subjects performed at ceiling: LP, DA and SL 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. MK's performance was also 100% correct on conditions NPM, NPX and QPX, and with 75%, slightly worse, but still above chance ($p= 0.1445$)[21] on condition QPM.

[20] Two different quantifiers (*all* and *every*) were used in the experiment. However, since no significant differences were found in the subjects' performance, the results were collapsed for ease of reference.

[21] P values are obtained on the basis of the test of binomial distribution.

Their performance is strikingly different on conditions that involve reflexives. All subjects performed below chance on at least one (match or mismatch) condition, revealing a systematic misinterpretation of these constructions. LP performed below chance on all four conditions involving reflexives, match and mismatch ($p<0.05$ for NRM, $p=0.1445$ for NRX, QRM and QRX). DA attained above chance performance on NRM, but scored below chance on the mismatch type of the same condition, NRX ($p=0.3632$). Her performance on reflexives bound by quantified NPs is much poorer: at chance for QRM and below chance ($p=0.1445$) for QRX. MK and SK scored above chance on the conditions with reflexives bound by a reflexive antecedent, however, their performance on reflexives bound by a quantified antecedent is poorer: significantly below chance for the match type of this condition ($p<0.05$ for MK, $p=0.1445$ for SL), and (slightly) above chance for the mismatch type of that condition. Their performance on control conditions was at ceiling; see Appendix B for exact percentages.[22]

Scores on the same experimental task of typically developing children in various age groups, as reported in Chien & Wexler (1990), are given in Table 3 for comparison.

Table 3

	Group 1 (n=48) age: < 4[23]	**Group 2 (n=45) age: 4-5**	**Group 3 (n=44) age: 5-6**	**Group 4 (n=40) age: 6-7**
Name-reflexive				
Match NRM	79.51%	92.96%	96.97%	96.67%
Mismatch NRX	30.56%	67.04%	92.80%	99.17%
Quantifier-reflexive[24]				
Match QRM	77.43%	76.67%	89.39%	94.17%
Mismatch QRX	29.51%	40.74%	82.95%	84.58%
Name-pronoun				
Match NPM	91.67%	88.52%	90.15%	94.58%

[22] Two of the subjects, LP and SL showed very poor performance on the control condition involving quantified NPs, mismatch type (QNX). It would be beyond the scope of this paper to explore the possible answers to why these quantified structures were problematic for our subjects. It is, however, clear that this problem did not hinder their faultless performance on pronouns bound by quantified NPs.

[23] Data reported in Chien & Wexler (1990).

[24] Two quantifiers (*all* and *every*) were used in Chien & Wexler's study. No significant differences were found in the performance on the two quantifiers, so only the results for *every* are given here.

Mismatch	NPX	30.90%	39.26%	49.24%	76.67%
Quantifier-pronoun					
Match	QPM	88.54%	94.44%	97.93%	98.75%
Mismatch	QPX	46.88%	60.00%	83.71%	86.67%

The large disparity between the scores on match and mismatch type on each of the experimental conditions suggests the well known positive bias, thus scores in the mismatch conditions are more likely to be informative. The youngest children (Group 1) performed below chance, or at chance, on all the mismatch conditions. The difference in the performance on pronouns and reflexives when bound by a referential antecedent ('Delay of Principle B Effect') becomes apparent from the age of 4, and persists even at the age 6-7. Group 2 performed better on the condition NRX than on condition NPX. Group 3 had generally better scores on both conditions, but their performance on NPX still points to guesswork. The oldest children achieved highest scores on all conditions, except, again, the condition NPX. Note that children in Groups 2, 3 and 4 performed significantly better on pronouns when bound by a quantified NP (condition QPX), providing support for the argument that children have knowledge of the syntactic principle which rules out local binding of pronouns when the bound variable reading is available (see footnote 12).

Following the tradition in the literature, three subjects (LP, MK and SL) can be matched to controls in Group 2, on the basis of their scores on a test of grammar comprehension. On the same measure, DA can be matched to controls in Group 3. On the basis of their MA scores, as measured by the test on receptive vocabulary, the subjects could be matched to the eldest controls in Group 4. However, regardless of the matching method, none of the groups of controls exhibits the pattern evidenced in the subjects with DS.

6 Discussion

6.0 The experiment reported here revealed that four girls with DS performed significantly worse on anaphors as opposed to pronouns, revealing a pattern opposite to the well known 'Delay of Principle B Effect' (DPBE) discussed earlier. Such a

pattern is not documented at any stage of typical language development, as reported in Chien & Wexler (1990).[25] How can these findings be accounted for?

A simple explanation would be that our subjects are merely misanalysing anaphors as pronouns. Recall that one of the girls with Down syndrome, LP, rejected local and accepted non local binding of reflexives in 27 out of the 32 sentences (match and mismatch), seemingly treating reflexives as pronouns. A lexical learning explanation for the DPBE was also proposed for typically developing children: Jakubowicz (1984) argued that young children initially miscategorise pronouns, interpreting them as if they were reflexives. Note, however, that such an account only reformulates the problem it was initially faced with: we are still left with no explanation as to why children, or individuals with DS, would treat one type of lexical item as if it were another.[26]

Another possibility would be to argue for a specific deficiency in the grammar of individuals with DS, which causes a 'delay' in the acquisition of a syntactic principle such as Principle A of standard BT (revealing a "Delay of Principle A Effect"), in line with the 'slow but normal' characterisation of linguistic development in DS discussed earlier. This again appears to be a mere reformulation of the problem. It is not clear why individuals with such a grammar would obey one grammatical principle, and not the other, if both principles underlie the same grammatical knowledge of Binding Theory (BT). Recall that similar arguments were put forward in the accounts of the DPBE in typical language acquisition. Furthermore, if Principle A was unavailable in the grammar of DS, the subjects would be expected to rule in all the sentences violating the Principle, and not to reject any constructions with reflexives as ungrammatical. Our subjects' performance did not show such a pattern.

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 acquisition data discussed in section 3 exposed the inability of standard BT to account for the distinction between binding and coreference. In this framework, interpretive dependencies crucially rely on structural conditions on coindexing of nominal expressions, with Binding Principles presupposing binding relations. However, this claim cannot hold with respect to constructions such as (6), repeated here as (7), where pragmatic context makes it possible for the two

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[25] To my knowledge, the pattern shown in the subjects with DS here has not been exhibited in other types of language disorders. Note, however, the literature on aphasia has also revealed the DPBE.

[26] Baauw (2000), however, gives an analysis of DPBE in typical children in terms of incomplete feature acquisition, which forces children to misanalyse pronouns as if they were simplex anaphor, *zich*.

NPs to corefer without being in a binding relation. Yet in the normal case, such relations must also be blocked by principle A.

(7) 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 & Reuland (1993) (subsequently R&R), this problem does not arise: interpretive dependencies do not necessarily coincide with the syntactic relations nominal expressions enter into with their antecedents. Binding Principles, as given in R&R, 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 subjects in the experimental task in fact reveal a deficit in establishing certain syntactic dependencies, and not with interpretive dependencies. To put it differently, my claim will be that binding, as the expression of referential dependencies, is available in the grammar of individuals with DS, but binding relations are not.[27] The Reflexivity model 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 subjects may have a deficiency in establishing binding relations comes from their inability to form A-dependencies in passive constructions. Before giving the full analysis of the data, it is necessary to briefly outline some of the concepts of R&R's Reflexivity framework relevant to our discussion.

6.1 Reflexivity (Reinhart & Reuland, 1993)

The central notion of reflexivity refers to the idea that to be reflexive, a predicate must have two of its arguments covalued. The reinterpreted principles of Binding Theory rely on the assumption that reflexivity must be linguistically licensed ('reflexive-marked'), either in the lexicon[28] (with the head of the predicate being reflexive-

[27] It is more than likely that the linguistic impairment in DS is caused by an interplay of a variety of different factors. However, here we begin by assuming that only one particular problem is the cause of the deficiency, and assume that the rest of the grammar is as given by UG.

[28] Independent evidence that inherently reflexive predicates are marked so in the lexicon comes from Dutch nominalization (Reinhart & Reuland, 1993):

(i) Wassen is gezond.
washing (oneself) is healthy

marked) or in syntax (with one of its arguments being the complex anaphor *self*). The standard Binding Principles A and B of Chomsky (1981) are thus replaced with the following conditions on reflexivity:[29]

(8) Principle A: A reflexive marked syntactic predicate must be reflexive.[30]
Principle B: A reflexive semantic predicate must be reflexive marked.

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.

The complex anaphor *self* appears as an argument of a simple transitive verb that has become reflexivized, with Condition B ruling out both the simplex anaphor and the pronoun:

(9) a. John$_i$ hates himself$_i$/*z*ich$_i$/*him$_i$
b. Jan$_i$ haat zichzelf$_i$/*zich$_i$/*hem$_i$

Intrinsically reflexive predicates are marked so in the lexicon, as part of verb's functional semantics. In English, they are intransitive,[31] whereas in Dutch and other

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(ii) Haten is niet gezond.
hating (only someone else) is unhealthy

[29] Standard Principle C is subsumed under a distinct inferential module, along with the coreference effects of Principle B (Reinhart 1983).

[30] R&R make the following distinction between syntactic predicates and semantic predicates:
"The syntactic predicate formed of (a head) P is P, all its syntactic arguments and an external argument of P (subject). The syntactic arguments of P are the projections assigned θ-role or Case by P. The semantic predicate formed of P of P is P and all its arguments at the relevant semantic level." (p. 678)

[31] 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. 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.

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:

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

Since the predicate in (10), (11) 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 context.[32] However, in absence of the simplex anaphor, the anaphoric systems of some languages allow pronouns to appear as syntactic arguments of inherently reflexive verbs, in the same way as simplex anaphors do.[33] Frisian displays a pattern different from to Dutch:[34]

(12) Max$_i$ hâld him$_i$/*himsels$_i$[35]

Following the design of Chien & Wexler (1990), *wash* was one of the verbs used in the experiment. We assume that our subjects treated it as a transitive predicate, as no differences were found in their performance on this verb as opposed to *dry* and *touch*, verbs that have transitive entries only.

[32] Arguing that any sequence of coindexed elements meeting the restrictions on government and c-command is a chain, R&R claim that chains also have to satisfy the well-formedness condition: only the head of the chain must be referential, not the tail. Having referential content, pronouns are excluded from the tail position.

[33] Simplex anaphors have been found to parallel pronouns in a number of languages, most importantly, by allowing them to be locally bound. In Dutch, *zich* is used with inherently reflexive verbs only in third person, for first and second person locally bound pronouns are used (in blatant violation of Principle B in standard BT).
(i) Ik$_i$ was me$_i$
I wash me

[34] As expected, Frisian sides with English and Dutch in the case of transitive predicates, reflexive-marked in syntax, where only the complex anaphor *self* is allowed:
(i) Max$_i$ hatet himsels$_i$/*him$_i$
Max hates himself/him

[35] An explanation for why *zich* is generally preferred to pronouns in appearing with inherently reflexive predicates in languages like Frisian has been proposed in terms of economy effects (Reuland, 1997):

Max behaves him/*himself

The Reflexivity framework also copes with the long standing issue of complex anaphors occurring in non-local domains. In the following constructions, the anaphor is not a syntactic argument of the predicate, so the Condition A as given in (8) is not violated:

(13) $John_i$ pulled the blanket over $himself_i$/him_i.
(14) There were five tourists in the room apart from myself.
(15) Physicists like yourself are a godsend.

6.2 Analysis and predictions

The hypothesis presented above was that DS subjects will not be able to establish binding relations, but they will show knowledge of conditions on reflexivity as defined in (8). Applying R&R's framework to the present results, it is clear that these subjects showed difficulties understanding constructions involving a transitive predicate reflexive-marked by the complex anaphor:[36]

(16) Snow $White_i$ is drying $herself_i$.

Their poor performance on the reflexive structures supports the above hypothesis: DS subjects do not seem to be able to use the *self* anaphor as an argument of a reflexive predicate, because they are not able to bind it in syntax. They may very well be aware of the special function of the anaphor *self*, namely to impose reflexivization on the predicate, but they cannot establish the syntactic relation between the anaphor and its antecedent. Independent evidence for a specific deficiency in forming A-dependencies comes from reports on the production and comprehension of passives: passive constructions are known to be extremely problematic for the DS population (Fowler,

anaphoric binding is an option cheaper than variable binding. When the cheapest option is not available, the anaphoric system of a language will have to opt for the use of pronouns.

[36] It is important to note that some of the subjects did not just provide incorrect answers to the experimental questions involving transitive predicates reflexive-marked by the *self* anaphor: DA often could not provide any answer (subsequently coded as incorrect), showing a great deal of hesitation and frustration as a result. This seems to reveal the inability to bind the anaphor to the antecedent, with the anaphor remaining uninterpreted.

1990). The results reported here also support this claim: all four subjects failed the task on passives on the test of comprehension of grammar (TROG).

The hypothesis predicts that DS subjects 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 that has not been reflexive marked in syntax, in violation of Condition B, as stated in (8). The subjects correctly rejected violations of Condition B nearly 100% of the time:

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

If this analysis is on the right track, it should be possible to predict how a deficit in establishing syntactic dependencies could affect the general use of pronominals in reflexive and non-reflexive predicates in DS. The following predictions may be made:

(i) Production and comprehension of inherently reflexive verbs in English should pose no difficulty. These verbs are intransitive and no establishing of binding relation is needed (cf. *John shaves every day*).

(ii) Inherently reflexive verbs in languages like Frisian, where a pronoun is used as the argument of the predicate, would be used and comprehended without difficulty.

(iii) Transitive predicates reflexive-marked by the complex anaphor *self* should also pose difficulties in languages other than English.

(iv) Logophoric use of anaphors, in constructions such as (13), (14), (15) should not be problematic. In these constructions, no A-dependency is established.

(v) In languages that use a simplex anaphor with inherently reflexive verbs, such as Dutch, distinct patterns in the use and comprehension of these verbs may be expected. Being unable to establish syntactic dependencies, individuals with DS would show a poor comprehension of reflexive structures, in line with the data reported here. However, when using inherently reflexive predicates, they may resort to whatever is available in their anaphoric system to realise the syntactic argument of the inherently reflexive predicate, and use a locally bound pronoun in place of the anaphor, in line with the pattern evidenced in Frisian.

7 Conclusions

The data reported here provide evidence against the claim that language development in DS is severely delayed but essentially non-deviant. The comprehension pattern for anaphors as opposed to pronouns evidenced by the four girls with DS tested in this study is not confirmed in typically developing children at any stage of linguistic development. The DS subjects' performance on experimental conditions involving reflexives and pronouns differ from the performance of typical children in two crucial respects:

(i) Poor performance on experimental conditions involving anaphoric binding points to a syntactic deficit in the grammar of DS, related to the inability to form syntactic dependencies. In contrast, typical children are found to correctly reject locally bound anaphors at early ages of language acquisition.

(ii) Faultless performance by the DS subjects on conditions involving pronouns demonstrates knowledge of Binding Principles (as given in the Reflexivity framework of Reinhart & Reuland, 1993), as well as the pragmatic/general inferential constraint such as Principle P/Rule I (Chien & Wexler, 1990; Grodzinsky & Reinhart, 1993) which rules out illicit coreferential interpretations of pronouns. The latter constraint is argued to be unavailable to young children, forcing them to perform at chance level on constructions involving pronouns bound by referential antecedents.

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Appendix A: Example Sentences

Experimental conditions	match	items	mismatch	items	
1. name-reflexive	NRM	8	NRX	8	*Is Snow White washing herself?*
2. name-pronoun	NPM	8	NPX	8	*Is Snow White washing her?*
3. quantifier-reflexive	QRM	8	QRX	8	*Is every bear washing himself?*
4. quantifier-pronoun	QPM	8	QPX	8	*Is every bear washing him?*
Control conditions					
1. name-name	NNM	8	NNM	8	*Is Snow White washing Cinderella?*
2. quantifier-name	QNM	8	QNX	8	*Is every bear touching Peter Pan?*
3. name-name action	----	---	NAX	8	*Is Snow White drying Cinderella?*
4. attention	----	---	CAX	16	*Is Father Christmas sleeping?*

Appendix B: Performance on Control Conditions

Table 4

	LP	**DA**	**MK**	**SL**
Name-name				
Match NNM	100%	100%	100%	100%
Mismatch NNX	87.50%	100%	100%	100%
7.1 Quantifier name				
Match QNM	100%	100%	100%	100%
Mismatch QNX	25.00%	100%	100%	0
7.2 Name-name action				
Mismatch NAX	100%	87.50%	87.50%	87.50%
Attention (16 items)				
Mismatch ATTX	100%	100%	100%	93.75%