Differences in Sentence Comprehension Tasks between Children with Williams Syndrome and Specific Language Impairment

Evidence from Greek[1]

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1. Introduction

Recently, language development in developmental disorders such as Williams syndrome (WS) and Specific Language Impairment (SLI) has received great attention by psycholinguists. Specifically, the question of whether linguistic abilities of children with SLI and Williams syndrome show any similarities or differences has motivated a number of studies (cf. Clahsen and Almazan 1998; Reilly et al. to appear). The reason for the particular interest that the above question received is the unusual profiles of individuals with WS and SLI. On the one hand, individuals with Williams syndrome, i.e. a rare neurodevelopmental disorder, exhibit a relative sparing of language abilities (Clahsen and Temple 2003; Clahsen and Almazan, 1998; Pléh et al. 2003; Volterra et al. 1996) despite mental retardation. On the other hand, language development in children with SLI is characterized by severe problems whereas their cognitive, motor, and social development falls within the normal range (cf. Stark and Tallal 1981). This unusual dissociation between linguistic and other cognitive abilities in WS and SLI raises at least two questions: The first is whether language abilities in both SLI and WS can be described in terms of selective deficits or sparing; the second is whether the grammatical profile of SLI children can extend to children with WS. Different answers are provided by two contrasting accounts of developmental disorders. According to Karmiloff-Smith and colleagues (Karmiloff-Smith 1998; Thomas et al. 2001; Thomas and Karmiloff-Smith to appear), language development in developmental disorders reflects the abnormal development of the entire cognitive system. A background assumption behind this line of reasoning is that atypical development cannot produce selective deficits while the rest of the system develops normally; in other words, there should be no evidence for 'residual normality' in developmental disorders (Thomas and Karmiloff-Smith to appear). If this is the case, then linguistic performance on the surface regardless of whether it is good or bad should result from abnormal functions in the underlying mechanisms. Besides, due to the ultimate abnormal functional architecture in developmental disorders, i.e. SLI and WS, it is predicted that (i) the linguistic behavior of impaired individuals will not be observed in

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unimpaired children (ii) sharp distinction between aspects of linguistic performance of children with SLI and WS will not be exhibited. On the other hand, according to Clahsen and Temple (2003), the impaired/unimpaired linguistic performance can reflect selective deficits/selective sparing in language development in developmental disorders; hence, residual normality holds. If this is the case, then some linguistic abilities are expected to be unimpaired while other cognitive abilities are severely impaired. In particular, grammatical abilities are expected to be spared in WS and consequently different than those in SLI.

Adopting a comparative perspective to the grammatical profile of WS and SLI children, this study aims to investigate aspects of syntactic comprehension in Greek children with SLI and WS. First, it examines the performance of SLI and WS children on the interpretation of sentences with different syntactic properties. Second, it compares the performance of the WS and SLI children to that of mental age (MA) controls and language age (LA) controls respectively. Third, it provides a direct comparison between the WS and SLI performance. The implications for the current debate on residual normality in developmental disorders are briefly discussed.

2. The experiment

2.1 Subjects

The performance of four groups of subjects is presented here: one group of WS children, one mental age control group of normally developing children, one group of SLI children and one language age control group of normally developing children. Information on the selection processes and details on the profiles of these groups are presented below.

2.1.1 WS subjects and mental age (MA) control group

5 Greek children who were independently diagnosed with WS by multidisciplinary teams in Greek hospitals in Thessaloniki participated in this study. The diagnosis has been confirmed on the basis of the fluorescent in situ hybridization (FISH) technique, i.e. a specialized chromosome analysis utilizing specially prepared elastin probes. WS children's mental age was derived from the verbal and non-verbal IQ scores calculated on the basis of the Greek version of WISC-III test (Georgas et al. 1997). One control group of 10 normally developing children whose chronological ages were similar to the mental ages of the WS children participated in the experiment; specifically, each WS child was matched to two control children on the basis of mental age. The control children constitute the mental age (MA) control group. In Table 1, chronological age (CA) and mental age (MA) of the WS children and CA of the control group are presented.

	CA MEAN RANGE (S.D.)	MA MEAN RANGE (S.D.)
WS group	10.1 7;9-15 (2.94)	5 3;4-7;2 (1.88)
MA group	5 3;3-7;3 (1.7)	

Table 1. WS children and MA controls: Chronological age (CA) and mental age (MA)

2.1.2 SLI subjects and language age (LA) control group

8 SLI children[2] participated in this experiment. All children were selected from child centers in Greece and met the exclusion criteria proposed by Stark & Tallal (1981), i.e. normal non-verbal IQ performance, normal hearing acuity, absence of motor impairment, absence of autistic symptoms, absence of otitis media history, neurological impairment and psychoemotional disorders.

The linguistic abilities of the SLI children were assessed on the basis of the Diagnostic Verbal IQ test for Greek children (Stavrakaki and Tsimpli 1999). These SLI children performed significantly better on that part of the test examining the lexical abilities than examining grammatical (morphosyntactic) abilities [t $(7)=-9.192$ $p<.001$]; hence, they were characterized as SLI children with grammatical deficits (cf. van der Lely 1999). A control group of 16 normally developing children participated in the experiment. The matching procedure between SLI and normally developing children was as follows. Each SLI child was matched to two control children on the basis of individual raw scores from the Diagnostic Verbal IQ (DVIQ) test for Greek children (Stavrakaki and Tsimpli 1999). Therefore, the normally developing children constituted the language age control group for the SLI children. Details on groups' chronological age and raw scores from the DVIQ test can be found in Table 2.

	CA MEAN RANGE (S.D.)	RAW SCORES MEAN RANGE (S.D.)
SLI group	8;1 6;1-10 (1.47)	82.875 64-98 (12.510
LA group	4.4 3;6-5;6 (0.73)	81.18 63-100 (11.44)

Table 2. SLI children and LA controls: Chronological age (CA) and raw scores from the DVIQ test

There was no exact matching between children with SLI and WS; with respect to chronological age, the WS children are older than SLI children, whereas with

[2] For more details on linguistic abilities of these SLI children, see Stavrakaki (2001, 2002a, 2002b).

respect to mental age, the WS children ranged between 3;4 to 7;2 whereas the SLI children performed normally (in accordance with their chronological age).

2.2 Experimental material and procedure

2.2.1 Design and materials

The test sentences consisted of 6 sentence types with different syntactic properties. In particular, the experimental material included simple transitive structures with SVO word order as well as structures formed by A-bar movement i.e. subject and object wh-questions, subject and object-clefts, and A-movement, i.e. passive sentences. There were 14 exemplars for each sentence type except for wh-questions. Concerning SLI children and LA controls, 4 stories for each question type were invented; concerning WS children and MA controls, 8 stories for each question type were used. Examples of the sentence types are presented below:

Simple transitive sentences with SVO word order
(1) O elefantas kiniga ton pithiko
the elephant-nom chases the monkey-acc
"The elephant is chasing the monkey"

Subject-clefts
(2) O skilos ine pu kinighai tin katsika
the dog-nom is that chases the goat-acc
"It is the dog that is chasing the goat"

Object clefts
(3) O pithikos ine pu htipai o elefantas
the monkey-nom is that hits the elephant-nom
"It is the monkey that the elephant is hitting"

Who-subject questions
(4) Pjos kinijise ton elefanta?
who-nom chased the elephant-acc
"Who chased the elephant? "

Who-object questions
(5) Pjon klotsise i katsika?
who-acc kicked the goat-nom
"Who did the goat kick? "

Passive sentences
(6) O pithikos sproxtete apo tin tigri
the monkey-nom push-3s-passive by the tiger
"The monkey is pushed by the tiger"

2.2.2 Procedure

An acting out task was employed for all sentences except for wh-questions. This task requires the subject to manipulate toy animals in such a way so as to demonstrate the thematic roles of nouns in verbally presented sentences. Before beginning the task, the children were asked to identify all animals by pointing to them in turn when they were named by the experimenter. They were also encouraged to play with the toys in order to be familiar with them. Finally, the children were instructed to do what the experimenter said.

A somewhat different method, which is nevertheless based on a toy manipulation task, was used for who-questions. The children were told that they should help the puppet to understand what was going on in the story by telling the puppet the answer. Three figurines were placed on the table. For example, one dog, one elephant, and one fox. The experimenter told the child a story in which the fox was chasing the dog and after that the dog was chasing the elephant. At the same time, she showed that the fox was chasing the dog and the dog was chasing the elephant. At the end, the child should help the puppet to answer the following question: ‘Who chased the dog?’

3. Results

All groups’ correct performance on the test sentences is presented in Table 3 below:

	Transitive sentences (SVO) Mean Range (S.D.)	Who-subject questions Mean Range (S.D.)	Subject-clefts Mean Range (S.D.)	Who-object questions Mean Range (S.D.)	Object-clefts Mean Range (S.D.)	Passive sentences Mean Range (S.D.)
SLI group	100 100-100 (.0)	90.62 75-100 (12.93)	100 100-100 (.0)	65.63 50-75 (12.9)	12.5 0-28.57 (9.15)	18.75 7.14-35.7 (8.4)
LA group	100 100-100 (.0)	100 100-100 (.0)	100 100-100 (.0)	87.5 100-100 (12.9)	36.6 0-100 (32.1)	57.6 14.3-100 (34.5)
WS group	100 100-100 (.0)	90 75-100 (13.69)	100 100-100 (.0)	92.5 75-100 (11.18)	55.7 0-100 (51.6)	65.7 0-100 (42)
MA group	100 100-100 (.0)	100 100-100 (.0)	100 100-100 (.0)	97.5 75-100 (7.9)	50.7 0-100 (39.4)	52.8 14.3-100 (37.2)

Table 3. The correct performance (%) of all groups on the tested structures

As shown in Table 3, the normally developing children, i.e. MA and LA controls, showed ceiling performance on all structures with SVO word order, i.e. simple transitive sentences with SVO word order, subject clefts and subject wh-questions. They have also showed near-ceiling performance on who-object questions, while their performance dropped on object-clefts and passive sentences. As far as the WS children are concerned, they showed ceiling and near-ceiling performance on all structures with SVO word order and near-ceiling performance on who-object questions. Noticeably, their performance was slightly better on object than on subject questions; however, this difference was not significant [Wilcoxon test Z=-.447 p=.655]. Similarly to typically developing children, the WS children's performance dropped on object-clefts and passive sentences. Ceiling and near-ceiling performance on all structures with SVO word order was also exhibited by SLI children whose performance dropped significantly on object who-questions and dramatically on object-clefts and passive sentences. Despite quantitative differences between groups, it should be noted that all groups' performance dropped on object-clefts and passive sentences. Therefore, the same structures were difficult for all groups.

In sum, all groups' performance was high on structures with SVO word order. However, while both typically developing children and WS children showed a high level of performance on object-questions, the SLI children's performance dropped significantly. Noticeably, all groups' performance dropped on object-clefts and passive sentences, but the SLI performance's drop was greater than that of the other groups. Interestingly, the WS children's performance was higher than that of typically developing children, i.e. MA and LA controls, on passive sentences, although this difference failed to reach significance [Mann-Whitney U test, p=.533 and p=.676 for comparisons between WS children and MA controls as well as between WS children and LA controls respectively].

To identify whether the SLI and WS children showed the same developmental trajectories as typically developing children, individual data analysis and error analysis were carried out. The former will show whether the attested performance is relatively homogenous or not, whereas the latter will indicate whether there are any qualitative differences between the groups' performance. Consider the SLI children's performance on the structures where no ceiling performance was attested, as shown in Table 4:

	RAW SCORES (LA TEST)	WHO-S	WHO-O	OBJECT-CLEFTS	PASSIVES
Nikos	83	100	50	14.28	7.14
Marios	94	100	75	0	21.42
Agni	91	100	75	14.28	21.42
Antonis	74	100	75	28.57	14.28
Manolis	98	100	75	0	21.42
Linos	90	75	75	14.28	35.71
Maria	69	75	50	14.28	14.28
Akis	64	75	50	14.28	14.28

Table 4. The SLI children's raw scores on the LA test and their correct performance (%) on subject and object questions, object-clefts, and passive sentences.

Noticeably, all children with SLI had problems with object wh-questions and especially with object clefts and passives. In Table 5, the WS children's performance on all structures where no ceiling performance was found is presented.

	MA	SUBJECT QUESTIONS	OBJECT QUESTIONS	OBJECT CLEFTS	PASSIVES
Lazaros	3;4	75	75	0	78.5
Nasos	3;4	75	100	78.5	0
Eleni	4;2	100	87.5	0	50
Giorgos	6;9	100	100	100	100
Filio	7;2	100	100	100	100

Table 5. The WS children's mental age (MA) and their performance (%) on subject and object questions, object-clefts, and passive sentences

As shown in Table 5, there were only two children whose performance was ceiling as predicted by their mental age (6;9 and 7;2 respectively); however, the younger children whose mental age ranged from 3;4 to 4;2 showed heterogeneous performance. It should be noted that their performance is within the normal range since such variation has been attested in the performance of younger children with typical development (see range of correct performance of MA and LA controls on object-clefts and passives in Table 3). Moreover, further comparisons between the 3 younger WS children's performance and their 6 mental age controls showed no significant differences between groups' performance on the test structures except for subject wh-questions [Mann-Whitney U test p=.033]. The correct performance of the 3 younger WS children and their mental age controls is presented in Table 6 below.

	transitive sentences (SVO) Mean Range (S.D.)	who-subject questions Mean Range (S.D.)	Subject clefts Mean Range (S.D.)	who-object questions Mean Range (S.D.)	object-clefts Mean Range (S.D.)	passive sentences Mean Range (S.D.)
WS group	100 100-100 (.0)	83.33 75-100 (14.43)	100 100-100 (.0)	87.5 75-100 (12.5)	26.16 0-78.5 (45.32)	42.83 0-78.5 (39.73)
MA group	100 100-100 (.0)	100 100-100 (.0)	100 100-100 (.0)	95.83 75-100 (10.2)	30.95 0-100 (36.6)	26.18 14.28-50 (18.44)

Table 6. The correct performance (%) of the 3 younger WS children's compared to that of the mental age controls

Error analysis indicated that normally developing children and children with WS showed similar pattern of performance. For the purposes of error analysis, both

LA and MA controls have been included in the category 'normally developing children' (NDC); therefore, 26 children were included in this category. The proportion of error types out of the total number of errors in the interpretation of object questions, object clefts, and passive sentences by normally developing children (MA and LA controls) and WS children is presented in Table 7.

	OBJECT QUESTIONS		OBJECT CLEFTS		PASSIVE SENTENCES	
	NDC N=10	WS N=3	NDC N=211	WS N=31	NDC N=163	WS N=24
Reversal of theta-roles	70	33.33	100	100	92.025	95.83
Reciprocal interpretation					7.975	4.16
Case error	30	33.33				
Gender error		33.33				

Table 7. Normally developing children (NDC) and WS children: The proportion (%) of error types out of the total number (N) of errors produced by children

With respect to the interpretation of object-questions both groups produced reversal of theta-role errors as well as case errors. Recall that children were required to tell the puppet the answer in the wh-question comprehension task. Some children produced case errors when they gave the answer, i.e. they produced the correct DP marked for incorrect case, i.e. nominative instead of accusative. It should be noted that this is a production and not comprehension error but it was included in the error types produced since it does not constitute the adult response. One WS child made a gender error, i.e. she produced the correct DP marked in incorrect gender. Although this error type was not produced at all by normally developing children, it cannot indicate qualitative differences between WS children's performance and that of controls, since it was attested once. Moreover, both normally developing and WS children produced the same error types while they were interpreting passive sentences. Specifically, they produced reversal of theta-roles errors and reciprocal interpretation errors; the latter are possible in Greek due to the fact that both passive and reciprocal constructions share the same suffix. Furthermore, WS children and normally developing children produced reversal of theta-role errors in the interpretation of object-clefts. However, WS children produced some reversal of theta-role errors in the interpretation of subject wh-questions, whereas normally developing children did not. Although WS children's performance seems to be deviant to some extent, it should be noted that their performance on subject-questions is still high and the overall comparison between all WS children's performance and that of normal controls did not reach significance (see Table 3). By contrast, the only error type that SLI children produced in wh-questions, object clefts and passives was reversal of theta-roles. This error type confirms SLI children's difficulties with interpreting complex syntactic structures, since SLI children could not identify theta-roles in structures where such identification is dependent on syntactic processes.

4. Discussion

In this study, I have investigated the linguistic ability of comprehending sentences in Greek children with WS, SLI, and normal development. The aims were to determine whether there were any similarities and/or differences between the performance of individuals with WS, SLI and normal development. Furthermore, I was interested in determining whether the performance of children with WS on sentence comprehension can be described in terms of residual normality or not.

On the one hand, the SLI children performed at ceiling on all structures with SVO word order regardless of whether they are base-generated, e.g. the transitive sentences with SVO word order, or formed by A-bar movement, e.g. who-subject questions and subject clefts. Therefore, the SLI children used the default SVO word order strategy to interpret these structures. However, the SLI performance drops significantly on the interpretation of who-object questions, object clefts, and passive sentences, as syntactic interpretation of these structures requires knowledge of syntactic movement, i.e. the A-bar and A-movement. It should be noted that the drop of SLI performance on object-clefts and passive sentences is greater than that on object-questions. Therefore, although all structures that require syntactic interpretation and include long-distance dependencies cause problems to SLI children (cf. van der Lely 1998, 1999), the specific syntactic characteristics of these structures play an important role in SLI comprehension, since the SLI children do not show the same level of performance on the interpretation of object clefts, object wh-questions, and passives. To be more specific, I suggest that the specific binding requirements of operators in wh-questions and clefts affect the SLI performance. In particular, the formation of wh-questions in Greek requires overt raising of a wh-operator to clause initial position, thus creating an A-bar chain with the wh-operator in Spec-CP binding a variable in the base position (Browing 1987; Chomsky 1986) whereas the formation of clefts requires a relative operator moved to an A-bar position which needs to be co-indexed with its variable and with the head NP; hence the linking status of the relative operator (Wexler 1991). Although all structures with A-bar movement are difficult to understand, the 'double' co-indexation of the relative operator with its variable and the head NP is more demanding than the 'single' co-indexation of the wh-operator with its variable.

On the other hand, A-bar movement in who-object questions does not prevent LA controls from showing a high level of correct performance on these questions. Therefore, normally developing children exhibit knowledge of the syntactic operations that take place in wh-question formation. However, their performance drops on the interpretation of object-clefts and passive sentences. It might be the case that the same restrictions that hold for SLI children's interpretation of object clefts are operative in normal grammar; in other words, the drop of normal performance on object-clefts and passives might be related to the linking status of operator in object-clefts (cf. Guasti and Shlonsky 1995) and A-chains in passive structures (cf. Borer and Wexler 1987).

Noticeably, the WS children's performance was close to that of normally developing children. In particular, the WS children showed a very high level of performance not only on the structures with SVO word order but also on who-object questions. The drop of their performance on object clefts and passive sentences does not result in below chance performance, as is the case with the SLI children but it is within the normal range. Crucially, the performance of the WS children is not significantly different than that of the MA controls on all tested structures although it is better than MA controls' performance on passive sentences. However, when the younger WS children's performance was compared to that of their mental age controls, it was found that the younger WS children performed significantly lower than normal controls on who subject-questions. This significance might be due to the ceiling level of performance that the normal controls showed. It should be noted that the WS children performed better than their mental controls on object questions and passive sentences. Noticeably, a recent study on Greek WS children's ability to produce wh-questions (Stavrakaki to appear) indicated that two out of three children showed ceiling performance on both subject and object wh-questions whereas one child performed better on the production of who-object than of who-subject questions. This preference for grammatical processes and rules (required for object wh-questions and passive sentences) over simple heuristic strategies (e.g. use of the SVO word order strategy for sentence interpretation) is compatible with the profile of WS children as referred in the literature. Specifically, WS children overuse grammatical rules of past tense formation in English (Clahsen and Almazan 1998) as shown by the overgeneralization of the regular suffix both to existing regular forms and to novel words rhyming with existing irregulars. Except for overusing grammatical rules excessively, the WS children of this study did not show any differences from normally developing children in both quantitative and qualitative terms, as shown by their level of correct performance and error types produced.

In sum, normally developing children and WS children indicated knowledge of complex syntactic structures such as wh-questions; the drop of WS and normal performance on object clefts and passives is rather related to the specific acquisition requirements of these structures. By contrast, SLI performance is characterized by severe problems with interpreting complex syntactic structures, i.e. object questions, clefts, and passive sentences. It is suggested that the syntactic properties of these structures, i.e. the specific binding requirements of operators in wh-questions, clefts as well as A-chains in passive sentences, contribute to the drop of SLI performance. In conclusion, the results of the present study indicate that children with SLI and WS show distinct linguistic profiles; they are also taken to support the view that -as far as the reception of syntax is concerned- WS children show normal abilities; in this respect, residual normality holds for children with WS (cf. Clahsen et al. to appear; Temple and Clahsen to appear).

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