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Morphosyntax in down's syndrome: is the extended optional infinitive hypothesis an option?

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This paper examines the question of whether language impairment in Down's syndrome (DS) can be characterized in terms of the same linguistic markers that were identified for Specific Language Impairment (SLI). The specific proposal we will assess is that English-speaking adolescents with DS are more impaired in tense-related grammatical morphemes than in non-tense-related morphemes, a dissociation that has been argued to explain the linguistic profile of individuals with SLI. We tested 8 adolescents with DS and various groups of unimpaired children matched for mental age to the DS participants in four elicitation tasks examining the past tense, noun plurals, and comparative adjectives. We found that non-tense related morphemes are affected in a similar way to tense-related morphemes in DS indicating that the linguistic impairment in DS is broader than in SLI and not restricted to the finiteness cluster.

Introduction

Down's syndrome (DS) is a congenital neurodevelopmental disorder resulting from the triplication of (part of) chromosome 21, with an approximate incidence of 1 in 800 live births (Lubec, 2002). Many previous studies of the linguistic capacities of people with DS have described the frequent omission of grammatical morphemes (Bol and Kuiken, 1990; Chapman et al., 1998; Eadie et al., 2002; Laws and Bishop, 2003; O'Neill and Henry, 2002), but the precise nature and extent of these omissions has thus far not been clearly delineated. In particular the omission of tense-related morphemes has been robustly observed (Fowler et al., 1994; Chapman et al., 1998; Laws and Bishop, 2003), but the status of non-tense related morphemes is less clear (see e.g. Fowler et al., 1994 for evidence that the possessive *-s* morpheme is underused in DS but Chapman et al., 1998 for evidence that this same morpheme is relatively unimpaired). Several studies (e.g. Tager-Flusberg, 2003; Laws and Bishop, 2003) have drawn tentative parallels between the linguistic abilities of people with DS and those with a second disorder: Specific Language Impairment (SLI). One particular

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account of SLI, known as the Extended Optional Infinitive (EOI) hypothesis (Rice et al., 1995), has also been considered as a potential explanation for the DS linguistic profile (see e.g. O'Neill and Henry, 2002). It is this proposal that will be further assessed in this paper.

The EOI hypothesis is based on the work of Wexler (1994) who observed that young typically developing children go through a stage of early language development in which they sometimes fail to mark finiteness on verbs in matrix clauses, a period of development he termed the Optional Infinitive (OI) Stage. Finiteness markers such as past tense *-ed*, 3rd person singular *-s* and auxiliary forms are omitted in obligatory contexts. One of the principle observations, however, is that finiteness omissions co-occur with fully specified forms (hence the term *optional*) in which children display knowledge of the relevant grammatical properties: for example, they use inflectional forms appropriate to the context (e.g. past tense forms in past tense contexts). Children with SLI, it has been shown, pass through a similar but extended stage of development during which they treat tense marking of verbs in main clauses as optional (Rice et al., 1995). Essentially the EOI hypothesis predicts that morphemes within the finiteness cluster are subject to optional omission, while those outside the finiteness cluster (e.g. nominal and adjectival inflections) should remain unaffected. Given that tense-related morphemes are subject to omission in DS (e.g. Chapman et al., 1998; Laws and Bishop, 2003), it has been proposed (O'Neill and Henry, 2002) that the EOI account might be considered as a possible explanation for the DS linguistic deficit, but this has not been extensively tested to date. O'Neill and Henry's study was conducted with just three subjects with DS and while the authors argued that non-tense-related morphemes were used less accurately by DS than unimpaired subjects, their results also clearly showed increased difficulty with tense-related over non-tense-related morphemes. However the small scale nature of their investigation precluded the use of statistical analyses, and further assessment of the EOI hypothesis as an explanation of the DS grammatical deficit is undoubtedly necessary.

In the SLI literature, the robustness of the EOI hypothesis has been tested by comparing performance on tense-related morphemes (e.g. past tense *-ed* in English) to performance on non-tense-related morphemes (e.g. plural *-s* in English). If a dissociation occurs, such that performance on tense-related morphemes is poor, while performance on non-tense related morphemes is good, support for the EOI hypothesis is strengthened. Rice and Wexler (1996) reported such results for 37 children with SLI who produced similar levels of accuracy in the use of plural *-s*, participle *-ing* and the prepositions *in* and *on* as both age-matched and language-matched controls. We adopt a similar approach here with respect to DS, by testing performance on regular and irregular past tense forms against the use of regular and irregular plurals and the use of the comparative adjective markers *-er* and periphrastic *more*.

Materials and Methodology

We conducted a total of four elicitation tasks. In Experiment 1 we tested the use of existing regular and irregular past tense verbs, adopting the procedure and materials from Ullman (1993) and Ullman et al. (1997). Also included in the experimental materials were novel verbs which rhymed with existing irregulars (e.g. *crive* by analogy to *drive*), and were thus predicted to take irregular forms, and novel non-rhymes (e.g. *trab*) which should take *-ed*. An example of the materials used is given in (1):

1. Past Tense 1: existing irregular condition
   Every day I swim a mile. Just like every day, yesterday I _____ *a mile.*

In Experiment 2 the distinction between existing irregular verbs and homophonous denominal verbs was tested using the materials and procedure from Kim et al. (1994). Verbs derived from nouns in English do not have canonical lexical entries as verbs, but rather involve category-changing affixation. When such forms are inflected for past tense, access to lexical entries of verbs is blocked and the default suffixation of *-ed* is required. Example sentences are shown in (2a) and (b):

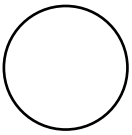
2a. Past Tense 2: denominal verb condition
   This is a ring. I am going to ring your finger. (Experimenter puts the ring on the child's finger).
   I just ____ *your finger.*

2b. Past Tense 2: verb root condition
   I like to ring this bell. I am going to ring this bell. (Experimenter rings the bell).
   I just _____ *the bell.*

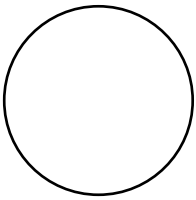
In Experiment 3 we tested the production of existing regular and irregular plurals, using a procedure involving a puppet adopted from Gordon (1985). The procedure involved first checking whether the child knew the singular form of the noun by presenting a single example of a real or toy example of an item and asking "What is this?". To elicit the plural form the experimenter then said that the greedy alligator liked to eat lots of these things, produced several more examples, and asked: "So here we have lots of _____?"

In Experiment 4 the formation of comparative adjectives was tested. In this experiment adjectives requiring *-er* suffixation, adjectives forming their comparatives with periphrastic *more* and adjectives permitting either comparative form were tested by presenting sentences with corresponding pictures. The procedure and materials were adopted from Dalalakis (1994). An example is given in (3) below:

3. Comparative Adjectives: *-er* condition



This circle is big.



This circle is even _____.

If the EOI hypothesis were to hold for the DS participants, we would expect to see higher levels of unmarked verb forms than produced by the MA-matched controls in the two past tense tasks. However, since the EOI hypothesis restricts the deficit to the finiteness domain and therefore only finiteness-related morphemes are optionally omitted, we would expect to see low levels of unmarked forms in both the plural and the comparative adjective tasks. Since one premise of the EOI hypothesis is that when the finiteness features are used their morphosyntactic properties are respected, we predict that there will be no DS-CTR differences in the use of regular and irregular forms once the uninflected forms are discarded, even if the DS subjects are in an EOI stage. Given these predictions, a two-step analysis was therefore conducted; in the first step, the percentages of uninflected forms produced by the two groups in each task were compared, while in the second step the uninflected forms were discarded and the percentages of correctly marked forms were compared.

Subjects

We tested 8 adolescents with DS (chronological age (CA): 12;0 to 14;3, mean: 13;0; mental age (MA): 5;4 to 6;10; mean: 5;11), and various groups of unimpaired children matched for MA, whose details are given in Table 1 below. Wexler (1994) and Ingham (1998) suggest that typically developing children emerge from the OI stage of language development by around the middle of their third year and therefore our control (CTR) children should be well beyond the OI stage. If the EOI hypothesis is a likely explanation of the DS linguistic deficit, clear DS-CTR differences should emerge.

Table 1: Control subject details for the four experimental tasks

	Group size	**Age range**	**Mean**
Past Tense 1	35	4;11 - 6;11	5;11
Past Tense 2	12	4;10 - 6;11	5;11
Plurals	16	4;11 - 6;5	5;8
Comparatives	33	4;11 - 6;9	5;10

Results

Table 2 shows the results from all four tasks. The percentages of unmarked forms produced by the DS and CTR groups are shown in the first two columns of figures, while the percentages of correctly inflected forms produced in each condition are shown in the final two columns of the table. Recall that for the latter figures all unmarked forms were discarded. Statistically significant DS-CTR differences (determined by non-parametric Mann-Whitney tests) are indicated by asterisks by the DS scores.

Table 2: Results from the four experimental tasks: % unmarked forms and % correct forms in each condition (s.d.s shown in parentheses) * Mann-Whitney tests reveal a significant DS-CTR difference ($p < 0.05$)

	% Unmarked Forms		**% Expected Forms**	
	DS	**CTR**	**DS**	**CTR**
Past Tense 1				
Regular	80.5 (32.8)*	15.5 (12.2)	100 (0.0)	100 (0.0)
Irregular	75.5 (31.2)*	22.4 (17.2)	49.1 (46.3)	52.5 (25.6)
Past Tense 2				
Verb Root	53.4 (28.3)*	1.0 (3.6)	100 (0.0)	89.2 (14.7)
Denominal	78.9 (33.2)*	21.1 (19.9)	57.5 (34.9)	71.4 (16.8)
Plurals				
Regular	16.6 (17.3)*	0.3 (0.9)	100 (0.0)	100 (0.0)
Irregular	31.5 (22.0)*	12.3 (8.73)	69.9 (17.5)	68.2 (20.1)
Comparatives				
-er	55.6 (35.8)*	2.7 (9.8)	72.2 (44.3)	91.8 (24.5)
more	60.4 (45.4)	35.7 (36.6)	66.7 (47.1)	41.3 (40.7)
either	56.3 (35.8)*	17.7 (21.3)	100 (0.0)	100 (0.0)

We consider first the production of unmarked forms in the two past tense tasks. In the *Past Tense 1* task, the existing and novel verbs were collapsed into single regular and irregular categories since there were no statistically significant differences between the two verb types[1]. Table 2 shows that the percentage of unmarked forms in both the regular and irregular conditions was significantly higher for the DS than for the CTR group. Once the unmarked forms were disregarded the DS subjects correctly used the *-ed* morpheme at ceiling level, and used irregular forms at a similar level to the controls. The relatively low level of correct irregular marking is due principally to the over-application of the past tense *-ed* suffix to the novel irregular verbs (70% and 62.5% *-ed* use in the CTR and DS groups respectively for the novel irregular verbs).

[1] CTR: Existing Regular Stem ~ Novel Regular Stem: $Z = 0.288$, p = n.s
Existing Irregular Stem ~ Novel Irregular Stem: $Z = 1.095$, p = n.s
DS: Existing Regular Stem ~ Novel Regular Stem: $Z = 0.405$, p = n.s
Existing Irregular Stem ~ Novel Irregular Stem: $Z = 0.845$, p = n.s

A similar pattern is seen in the *Past Tense 2* task in which past tense forms of denominal verbs and homophonous irregular verb root forms were required. The DS group produced significantly more unmarked forms in both conditions than the MA-matched controls, but once these forms were scaled out of the equation there were no statistically significant DS-CTR differences in the production of expected forms.

The results are parallel for the non-tense related morphemes. The DS group produced significantly more unmarked regular and irregular plurals than the CTR group, but there were no DS-CTR differences in the percentage use of expected forms once the uninflected forms were scaled out. Similarly in the comparative adjective task the DS group used significantly more uninflected forms in two of the three conditions than the CTR group, while there were no statistically significant differences in the use of expected forms once the unmarked forms were discarded.

Discussion

Looking first at the percentages of unmarked forms in the two past tense tasks, the predictions of the EOI hypothesis were fulfilled. We had expected to see, if the DS subjects were in an EOI stage, significantly higher rates of uninflected verb forms from the DS subjects than from the controls, but no differences in the use of either regularly or irregularly inflected forms once the unmarked forms were scaled out of the equation. Confirming these predictions, in both past tense experiments the DS group produced significantly more unmarked verb forms than the control groups. Furthermore, once the unmarked forms had been scaled out of the equation, there was no significant DS-CTR difference in the use of correct *-ed* forms for regular or denominal verbs, nor in the correct production of irregular forms for irregular verbs. Due consideration of the past tense data given, the predictions of the EOI hypothesis stand, and it remains in contention as a reasonable account of the linguistic profile of individuals with DS.

However, the data from the plural and comparative adjective tasks reveal that these non-tense related morphemes are affected in a similar way to the tense-related morphemes. Although the percentage of unmarked plural forms is lower than the percentage of unmarked past tense forms (and is compatible with regular plural data from Fowler et al., 1994), the percentage of unmarked regular and irregular plural forms produced by the subjects with DS was statistically significantly higher than the percentage of unmarked forms produced by the MA-matched controls. Taken together with the high number of unmarked comparative adjectives, there is incontrovertible evidence that the grammatical morpheme difficulties extend beyond the finiteness cluster. As such the EOI hypothesis, restricted as it is to the finiteness cluster, does not offer a complete account of the DS linguistic profile.

It could be argued that the results from the past tense and plural tasks indicate that the DS subjects have a morphological deficit manifested as a difficulty with bound morphology. The regular and irregular past tense exhibit themselves as bound morphemes in English as do regular and irregular plural forms. Table 2 shows that all of these are produced at low levels by the DS group. However, the results from the task on comparative adjectives provide evidence against the argument for a difficulty with bound morphology. While it is true that the DS group produces low rates of the bound comparative morpheme *-er*, it is also true that they experience similar levels of difficulty in the production of the free comparative morpheme *more*. Thus a morphological account does not hold given the results shown in Table 2.

Further evidence against a morphological account of DS grammatical difficulties comes from the fact that there were no statistically significant DS-CTR differences in the use of regularly or of irregularly inflected forms. Once uninflected forms were ignored, the DS group used the correct forms of verbs, nouns and adjectives at similar levels to the MA-matched controls, and in some cases at higher levels of accuracy.

We propose, instead, that a syntactic account along the lines of the EOI hypothesis, but extended to other functional categories, is more feasible. The central characteristic of the EOI stage is an optionally underspecified Tense feature. That is, where the Tense feature should be marked [+ Tense] in main clauses, the syntactic representation in DS allows the underspecification of the Tense node as [± Tense]. We suggest that similar representations can also be found in the Number node (NumP) which is the locus of the number feature [± Plural] (Ritter, 1991). In cases where the number feature should be marked [+ Plural] the DS representation is underspecified as [α Plural], accounting for the apparently optional use of plural inflection as seen in Table 2 by this group. Syntactic representations of the comparative construction essentially posit a Degree feature within a Degree Phrase (DegP) which requires checking by a comparative marker, in English either *-er* or *more* (see e.g. Corver, 1997). Where the degree feature should be specified as [+ Degree], requiring the insertion of the comparative or superlative markers, the evidence from Table 2 suggests that the syntactic representation in DS subjects exhibits itself as [α Degree]. In this way the marking of the adjective through the use of either the *-er* suffix or periphrastic more is optional.

Conclusion

The principal aim of this paper was to assess the proposal that the EOI hypothesis can explain the linguistic profile of individuals with DS. The EOI hypothesis was originally offered as an explanation of the linguistic deficit of children with SLI (Rice et al., 1995), but recent studies have suggested that *'language impairment in DS shares the same primary linguistic markers identified for SLI'* (Tager-Flusberg, 2003: 314).

We observed that the principal response type given by subjects with DS in elicitation tasks of past tense, plurals and comparative adjectives was an unmarked stem. The increased rates of uninflected forms given by the DS subjects in the plural and comparative adjective tasks over the rates seen in the control children provided evidence that the EOI hypothesis, which restricts the deficits to the finiteness cluster, cannot encompass the full extent of the DS deficit. We therefore argued in favour of a broader-reaching deficit, similar in spirit to the EOI hypothesis. We assert that our results indicate that, in addition to the Tense feature, the Number feature and Degree feature are underspecified in DS. We concede that further research is necessary to assess the full extent of the syntactic underspecification in DS. We have investigated just three functional categories, and investigations of other functional categories are now recommended.

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