

RESEARCH

The head the construct: Construct state nominals as a novel window to syntactic movement difficulties in hearing impairment

Naama Friedmann¹, Ronit Szterman¹, Adriana Belletti^{2,3} and Luigi Rizzi^{2,3}¹ Language and Brain Lab, Tel Aviv University, Tel Aviv 69978, IL² DISPOC, University of Siena, 53100 Siena, IT³ Département de linguistique, University of Geneva, 1211 Genève, CHCorresponding author: Naama Friedmann (naamafr@tau.ac.il)

Children with hearing-impairment often show difficulties related to different kinds of syntactic movement. According to current syntactic analyses, Hebrew construct state nominals (CSN) involve syntactic movement, in which the noun moves to the determiner position. This kind of movement has never been tested in individuals with hearing-impairment. In this study we examined how Hebrew-speaking hearing-impaired children produce definite CSNs. A well-functioning movement of N to D prevents an overt determiner before the head of the definite CSN, and therefore we took the (incorrect) addition of a determiner before the head noun as an indication of a difficulty in moving the N to D.

The participants were 32 children with hearing-impairment aged 9;1–12;2 whose performance was compared to 18 hearing children aged 8;10–10;7. We tested their oral reading of 63 CSNs in texts. The results showed that the children with hearing-impairment had a remarkable difficulty in reading the CSNs. The most noticeable error they made was that they incorrectly added a determiner before the head of the definite CSN, in addition to the determiner preceding the complement of the noun. The hearing control children virtually never made this error.

Since the D position before the head should not be available if the noun had moved to D, we concluded that they could not properly move the noun to D. This illustrates, for the first time, a deficit in N-to-D movement in this population. The difficulty in N-to-D movement in the nominal domain is consistent with these children's difficulties in other movement-derived structures in the clausal domain such as object A-bar movement and V-to-C movement. More broadly, these results support a movement analysis of CSN.

Keywords: construct state nominals; hearing impairment; syntactic movement; determiner; Hebrew

1 Introduction

More and more evidence accumulates indicating that children with hearing impairment who communicate exclusively in spoken language, and who did not receive sufficient language input during the critical period for first language acquisition (neither oral nor signed) show syntactic difficulties. An especially vulnerable construct is syntactic movement. Studies in various languages showed that many of these children have a deficit understanding and producing certain sentences derived by A-bar movement, including relative clauses, Wh questions, and topicalized sentences (English: Quigley, Smith & Wilbur 1974a; Quigley, Wilbur & Montanelli 1974b; Berent 1988; 1996; de Villiers 1988; de Villiers, de Villiers & Hoban 1994; Hebrew: Szterman & Friedmann 2003; 2007; 2014a; b; 2015; Friedmann & Szterman 2006; 2011; Friedmann et al. 2010; Arabic: Haddad-Hanna

& Friedmann 2009; 2014; Friedmann et al. 2010; Friedmann & Haddad-Hanna 2014; French: Delage & Tuller 2007; and Italian: Volpato & Adani 2009).

Some of these children also show difficulties in the production of verb movement to C in Hebrew (Szterman & Friedmann 2015; 2017), a deficit that may relate to difficulties in head movement, but may also be the result of a structural difficulty in the syntactic tree: a deficit in properly constructing the CP layer (Szterman & Friedmann 2014b). Other studies report considerable difficulties with accusative clitics (Tuller & Jakubowicz 2004; Delage & Tuller 2007; Volpato 2008), which may be related to a difficulty in clitic movement, which has been assumed to include a step of head movement (Belletti 1999, and references cited there).

In the current study we use a novel window from which we can look at movement abilities in this population: the production of construct state nominals (henceforth: CSN). In turn, we hope to draw from the performance of these individuals novel neuropsychological evidence bearing on the formal analysis of the CSN. CSNs are common and productive in Hebrew (Danon 2017), even for pre-school children (e.g., Berman 1978; Ravid 1997; Berman 2009), and are the focus of considerable interest for linguists who worked on understanding their syntactic properties (Borer 1988; 1999; Ritter 1988; Siloni 1996; 1997; Shlonsky 2004; Danon 2008; 2012; 2017; see Doron & Meir 2013, for a summary). One line of analysis of CSNs in Hebrew claims that it crucially involves the movement of the N head to D (Ritter 1988; Siloni 1996; 1997; Borer 1999).¹

Such movement analysis (see Figure 1) is able to explain the surface manifestation in the complementarity between D and N in the CSN: a definite article can introduce the complement of the head noun of a CSN, whereby the CSN is interpreted as definite, but not the head noun itself. This is because the head noun occupies, after the movement, the position in D.² This analysis generates a prediction: if a person with syntactic difficulties does not move the N to D, possibly as a consequence of a more general difficulty with head movement, D remains available to be realized as a determiner (along the lines of Longobardi's 1994a analysis of the syntax of proper names; See also Siloni's 2001 discussion of Longobardi's 1994b related work). Therefore, in this study we analyzed the hearing-impaired children's incorrect production of definite articles before heads of CSNs, as an indicator of their (head) movement ability.

Another relevant feature of CSN for examining the movement of N to D is that the CSN head in Hebrew often undergoes a morpho-phonological change that marks it as the head of a construct state. The morpho-phonological change is ascribed to the change in stress position: the head and its complement constitute a prosodic word with one primary

¹ Another line, pursued by Cinque (2000) and Shlonsky (2004), assumes phrasal movement of the N projection, the NP. This line of inquiry must somehow express the fact that this kind of "phrasal" movement is special in that it involves a smaller structure than familiar cases of phrasal movement: it only affects a constituent including the nominal head, not its complements. Once the system formally differentiates two kinds of phrasal movement along these lines, the analysis of head movement schematized in Figure 1 can be recast as referring to the kind of "small phrasal movement". In this way, our analysis can be made consistent with frameworks excluding classical head movement (or drastically limiting it, Kayne 1998; Koopman & Szabolcsi 2000) and only admitting movement of phrasal constituents of different sizes.

² This movement, as characterized in the text, is reminiscent of "head movement *qua* substitution" in the typology of Rizzi and Roberts (1989), with the moved head inconsistent with an overt filler of the host head position (as in V to C, inconsistent with overt complementizers in various kinds of V2 phenomena). This differs from cases of "head-movement *qua* adjunction", operative when the host head is an affix (at work in the formation of inflected verbal forms, N to D movement with a suffixal article, as in Rumanian, and, arguably, in cases of cliticization). Notice that in the "small phrasal movement" analysis mentioned in footnote 1 the incompatibility of the head noun of the CSN with the determiner does not follow from the fact that both elements compete for the same position: the complementarity would rather be akin to "doubly filled C effects" by which in certain projections either the head or the Spec, but not both, can be overtly realized. Anyway, in both analyses the non-occurrence of D in the CSN is a consequence of movement of the N (or N projection).

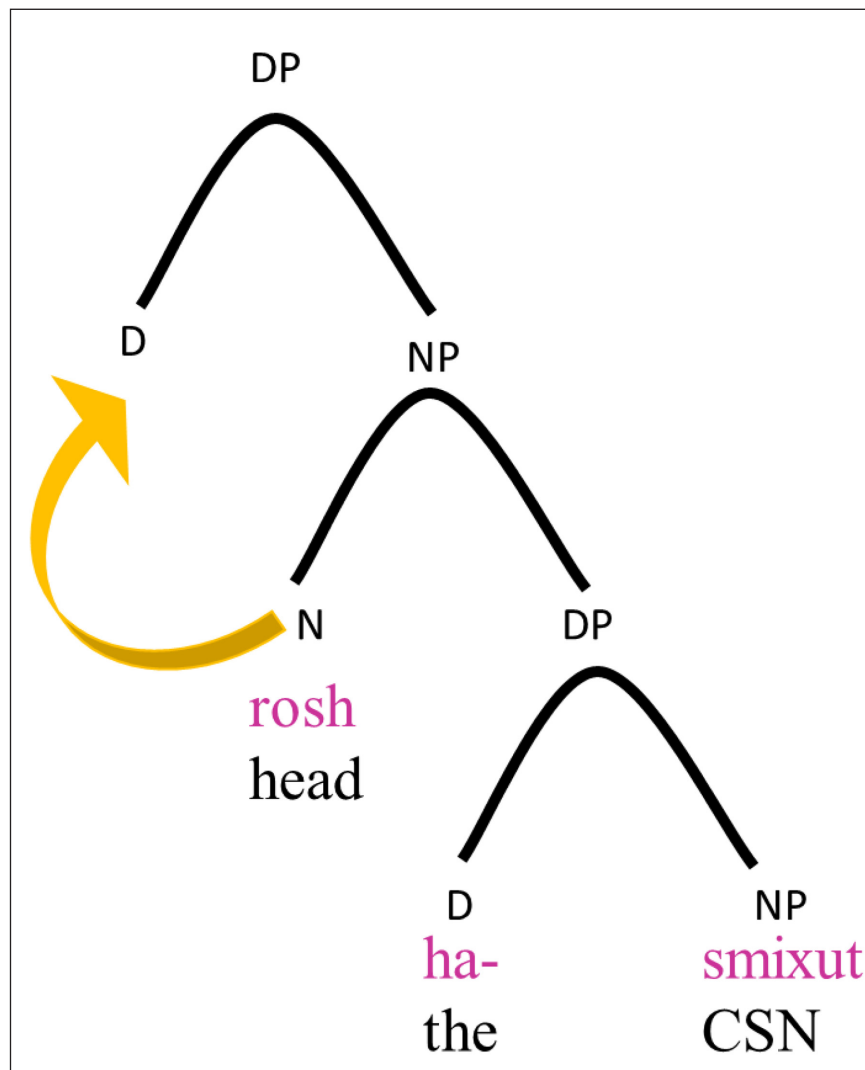


Figure 1: The syntactic structure of Hebrew CSNs, exemplified with the CSN *rosh ha-smixut* ('head the-CSN', 'the head of the CSN').

stress, which is on the complement (Siloni 2001; Doron & Meir 2013). Some nouns do not undergo the morpho-phonological change, for phonological reasons, and in these cases, the free and construct forms of the noun are identical. The morpho-phonological changes include changes such as vowel deletions and reductions, which are often unmarked orthographically (e.g., *bayit*, 'house', in the free form becomes *beit* as a head of CSN, both spelled identically), and changes in the suffixes (specifically, the feminine singular suffix *-a* and the masculine plural suffix *-im* in the free form become *-at* and *-ey* respectively in the construct state), which also show in the orthography. Thus, many nouns in Hebrew have two forms: the construct form, which is used in the head of construct state nominals, and the absolute or free form, which is used in any other context.

We assume that the morpho-phonological change is a PF outcome of the N to D movement (arguably connected to the fact that the final landing site of the noun is a functional position, D). If this is the case, failure to produce the morpho-phonological change may indicate that moving the noun to D failed (or that the PF reading of the structure failed).

Thus, assuming that the derivation of CSN involves N-to-D movement, and the hearing impaired population has a problem with movement, then, if the participants with hearing impairment to have difficulties in N-to-D movement in CSN, this should be manifested in incorrect production of a determiner before the head of the definite CSN (because the N

has not moved there and therefore the D position is available), and in failure to produce the morpho-phonological change on the head, which marks it as a CSN head rather than a free N.

2 Experiment

2.1 Participants

The participants were 32 Hebrew-speaking children with hearing impairment. They were 16 boys and 16 girls, aged 9;1–12;2 years ($M = 10;6$, $SD = 0;9$) in 4th to or 5th grade with moderate to severe hearing loss. All of them were monolingual speakers of Hebrew and were trained in oral language exclusively, without sign language. At the time of testing, they were studying in primary schools in regular classes with hearing children, with inclusive schooling using oral education, and each of them received additional support from a special teacher of the deaf, 2–4 hours a week. All the participants consistently wore binaural hearing aids (15 children) or used cochlear implants (17 children, 4 of them used two cochlear implants). All the participants passed a hearing screening test in which they were asked to repeat 10 sentences that included sibilants and were read to them by the experimenter with her lips concealed. During the hearing screening test, as in the rest of their everyday routine and during the testing for the current study, they were wearing their hearing aids/implants. (See Appendix for background information on the participants.)

A control group of hearing children included 18 typically developing children (4 boys and 14 girls) in 4th and 5th grade aged 8;10–10;7 ($M = 9;11$, $SD = 0;5$), from similar schools as the hearing impaired children, in the same area in the center of Israel.

2.2 Procedure

We assessed the status of CSN in these children by examining their reading aloud of paragraphs that included CSNs. The participants were asked to read the paragraphs aloud, and their reading was transcribed while they read. We also recorded their reading so we could complete and correct the transcription after the session.

2.3 Materials

Each participant read 10 paragraphs, 5–8 sentences per paragraph, with a total of 831 words. Five of the paragraphs included sentences with A-bar constructions (wh-questions, relative-clauses, and topicalized constructions involving A-bar movement) and sentences in which the verb appears as the second element, before the subject (involving V-to-C movement). The other 5 paragraphs did not include any sentence with these structures. The 10 paragraphs included a total of 63 CSNs, all of which were grammatical, so in particular none of them contained a determiner before the head noun.

We examined the participants' tendency to (incorrectly) add a determiner before the head noun in two contexts. One in which it is orthographically obvious that the head noun is not preceded by any determiner, the other in which it is not transparent, and the reader needs to decide whether the head should be read with or without a definite marker according to the syntactic structure. For this we used a special property of the Hebrew orthography. Some of the Hebrew prepositions are orthographically bound to the following NP, and are fused with the definite article *ha-*. For example, the preposition *be-* ('in') before the definite determiner *ha-* ('the') becomes *ba-* ('in-the'). The preposition *le-* ('to') before the definite determiner *ha-* ('the') becomes *la-* ('to-the'). The crucial point for this task is that this phonological change is not reflected in the written word, because of the underspecification of vowels in the Hebrew orthography. Thus, whereas the pronunciation of *be-* and *ba-* is clearly distinct, their spelling is identical, both with the letter bet, ב. The same is true for the preposition *le* ('to' preceding an indefinite) and *la* ('to the'), both spelled with the letter lamed, ל.

For example, the word $\gamma\upsilon$ (*ec*, ‘tree’), can be preceded by the definite article *ha-* (creating *ha-ec*), or when it is indefinite it appears without the definite article (*ec*) (Hebrew has no indefinite article). When the head noun appears after the bound preposition marked with the letter \beth (*b*), creating the word $\gamma\upsilon\beth$ (*bec*),³ it can be read either without the determiner, as *be-ec* (‘in-tree’), or with the determiner, as *ba-ec* (‘in-the-tree’). Hence, when these prepositions precede the head of a CSN, to pronounce them correctly, the reader has to choose whether the head is preceded by the definite determiner or not. As we explained above, when the word *ec* appears as the head of a CSN, it is never preceded by the definite article, and therefore the construct head + the preposition *b-* will always have to be read as *be-ec*. Thus, the way participants read the homographic preposition letter would indicate whether they add a determiner before the head noun or not.

The texts included a total of 63 CSNs per participant. Of these, 46 CSNs were of the crucial condition: definite CSNs, so that their complement was preceded by a definite article: 37 of the definite CSNs were such that if there were a definite article preceding the head noun, it would have been written before the head noun (but as explained above, because these are CSN heads they would not appear with a determiner). Of these 37 CSNs, 28 were with bare head nouns, and 9 started with the bound preposition *me-* or the bound complementizer *še-*,⁴ which precede the determiner *ha-*, and in which the determiner is not fused with them but remains phonologically and orthographically present. Nine other CSNs started with a homographic bound preposition (*b-*, *l-*) with which the determiner fuses and does not appear orthographically, so that both a definite and an indefinite noun after these prepositions look identical. (See Table 1 for the various definite CSN conditions).

The heads of 19 of the 46 definite CSNs included a morpho-phonological change that identified the head as the head of a CSN, all of which were orthographically marked for the change, and in the other 27 CSNs the head was morphologically and orthographically identical to the free form.

Additional 16 CSNs in the text were indefinite (i.e., their complement appeared without a definite article). Four of these CSNs were double CSNs (of the structure head-head-complement); for 7 of the 16 indefinite CSNs the morpho-phonological change of the head was marked orthographically, and the 9 others were not.

3 Results

The children with hearing impairment made a total of 72 errors of adding a definite determiner to the head of a definite CSN. Namely, even though they were reading aloud, and there was no definite determiner before the head noun, they still read a definite determiner before the head noun (in addition to the determiner preceding the complement), as shown in example (1). Whereas Hebrew speakers sometimes place the determiner before certain lexicalized CSNs **instead of** before the complement, the children with hearing impairment produced a determiner **both** before the head and before the complement (and for non-lexicalized CSNs), something that hearing Hebrew speakers almost never do.⁵

³ Recall that Hebrew is written right-to-left, so the letter \beth preceding the noun appears to its right in the Hebrew orthographic convention, and in the example in text.

⁴ *Me-* is the preposition ‘from’, and *še-* is the complementizer ‘that’. Both of them are prefixed to the following word, and both appear orthographically as a single letter preceding the head noun. Unlike *be-* and *le-*, the determiner *ha-* does appear after *me-* and *še-*, preceding the noun (so, for example, *from-the-boy* will be *me-ha-yeled*, keeping the determiner *ha-* overt and orthographically specified). Therefore, if *me-* and *še-* appear before the head noun and there is no determiner appearing in the complex word, this indicates that there was no determiner in that position.

⁵ Researchers distinguish between two types of construct state nominals: the ones that are productive and syntactically and semantically transparent, which they call “construct states”, and the ones that are syntac-

Table 1: Types of definite construct state nominals that were included in the various conditions.

Condition	# of items	Hebrew target	Form of the definite free head	Transliteration	Phonological transcription	Gloss	Translation
Types of preceding element							
Bare head	28	חבורת הילדים	החבורה xborh	xbort hildim	xavurat ha-yeladim	group the-children	the children's group
A bound preposition (b-, l-) that fuses with the determiner (so the determiner is not orthographically marked for definiteness)	9	לכלוב הקופים	לכלוב lqlob	lqlob hkopim	le-kluv ha-kofim	to-cage the-monkeys	to the monkeys' cage
A bound complementizer or preposition (še-, me-) that does not fuse with the determiner	9	שילדי החבורה	שהילדים šhildim	šildi hxborh	She-yaldey ha-xavura	that-children the-gang	that the gang's children
Types of morpho-phonological change on the head							
Orthographically-marked morpho-phonological change on the head: letter omission	12	תושבי השכונה	התושבים htošbim	tošbi hšqonh	toshavei ha-shxuna	residents the-neighborhood	the neighborhood's residents
Orthographically-marked morpho-phonological change on the head: letter substitution	7	קבוצת המטיילים	הקבוצה hkboch	kboct hmtilim	kvucat ha-metaylim	group the-hikers	the hikers' group
No change on the head noun	27	תושב השכונה	התושב htošb	tošb hšqonh	toshav ha-shxuna	resident the-neighborhood	the neighborhood's resident

Almost all of these determiner additions (71 of the 72) occurred in the definite CSNs (in which the complement appeared with a definite determiner). Only one determiner addition occurred in the indefinite CSN condition. This means that once the children identified the CSN as definite they marked it with a determiner before both the head noun and the complement.

An additional indication that these children can compute the definiteness of the CSN is that they never omitted the object cases marker *et* before the definite CSNs. The object case marker only appears before definite object DPs, and therefore, the fact that they produced it before the definite CSNs means that they correctly interpreted them as definite.

(1) **Target sentence:**

xavurat ha-kofim hiftiaa et kvucat ha-metaylim.
gang(construct form) the-monkeys surprised ACC group(construct) the-hikers
'The monkeys' gang surprised the hikers' group.'

Participants 18 and 20 read it:

ha-xavurat ha-kofim hiftiaa et ha-kvucat ha-metaylim.
the-gang(construct) the-monkeys surprised ACC **the**-group(construct) the-hikers

They made comparable rates of determiner additions in the bare definite CSN not introduced by a preposition (47 determiner additions, an average of 5.2% of the CSNs of this type) and in the CSNs that started with a preposition that fuses with the determiner (19 determiner additions, average of 5.9%, $t(31) = 1.04$, $p = .30$).

Even when the CSN was preceded by a bound complementizer or preposition which forms an orthographic and phonological word with the construct noun, they added (six) determiners before the noun. Interestingly, in these cases, they placed it between the complementizer/preposition and the noun (i.e., in the correct syntactic position for a determiner, if a determiner were allowed before the construct head noun, see example 2), and never before the complementizer or the preposition preceding the whole CSN. This clearly suggests that they were inserting the determiner in the D position, not just in the initial position before the whole CSN.

(2) **Target sentence:**

ha-kabaim še-tošavey ha-šxuna hizminu la-aruxa samxu.
the-fire-fighters that-residents the-neighborhood invited for-dinner rejoiced
'The fire fighters that the neighborhood's residents invited for dinner were happy.'

Participants 17 and 20 read it:

ha-kabaim še-**ha**-tošavey ha-šxuna hizminu la-aruxa samxu.
the-fire-fighters that-**the**-residents the-neighborhood invited for-dinner rejoiced

tically and semantically opaque, which are termed "compound constructs", or simply "compounds" (Borer 1988; 1999; 2008; Doron & Meir 2013; Siloni 2001). As mentioned above, in real construct state nominals, the definiteness of the nominal is expressed by the determiner of the complement of the noun. In contrast, in lexicalized compounds (e.g., *beged-yam*, cloth-sea, meaning swimming-suit), Hebrew speakers often interpret the compound as a word rather than as a CSN and then express its definiteness with a determiner introducing the whole lexicalized phrase, with no determiner appearing inside it (e.g., *ha-beged-yam*, 'the-cloth-sea', 'the swimming-suit'). This is very different from what the hearing-impaired children did here, as they produced the determiner both before the head and before the complement in the CSN (e.g., *ha-beged ha-yam*, 'the-cloth the-sea', 'the swimming the-suit'). This is something that no hearing Hebrew speaker does, for any type of CSN.

These errors of adding a definite determiner to the head came mainly from 10 hearing impaired participants who made 3 or more such errors (ranging between 3 and 11 definite determiner additions to the head of the CSN for each of these 10 participants) in reading the CSNs.

The performance of these 10 children with hearing impairment was significantly poorer than that of the control group of hearing children, who made very few errors in reading the CSNs: only two of the hearing children made any error at all in reading the head of the CSN, each of these two made a single error of adding a definite determiner to the head. This difference between the error rates in the (whole) hearing impaired group (ranging between 0–24%, see Table 2) and the control group ($M = 0.2\%$, $SD = 0.7$) was significant, $t(48) = 3.10$, $p = .001$.

Table 2 summarizes the number of definite article additions to the head of the CSN for each of the participants with hearing impairment (and the average and SD of these errors in the control hearing group).

In a total of 19 CSNs, the children with hearing impairment read the construct head as if it was a free noun (see Table 2). In contrast, there was only one instance of incorrect reading of the head in the control group, and even this could not be decisively classified as changing a construct form to a free form.⁶ This difference between the groups was significant, $t(48) = 2.66$, $p = .005$. This between-groups difference can also be seen in that 14 of the 32 hearing-impaired children but only 1 of the 18 hearing control children read the head noun as a free noun (44% vs. 6% respectively, $\chi^2 = 8$, $p = .005$). In one additional case, a participant added a possessive clitic to the head, again a form that is not grammatical in the head of a CSN. Finally, there was only a single error of insertion of the genitive marker/preposition *šel* ('of') to introduce the complement of the head noun. In all other cases, even when the children pronounced the head in the free form, they did not add the genitive marker *šel*, which is always required in genitive phrases with a free form head.

Given that hearing typically-developing children in the same age almost never made errors on the head of the CSN in this task (as shown in Figure 2), the pattern of errors of definite determiner addition and reading of the head as a free noun can be taken as an indication for the difficulty the hearing-impaired children have in moving N to D.

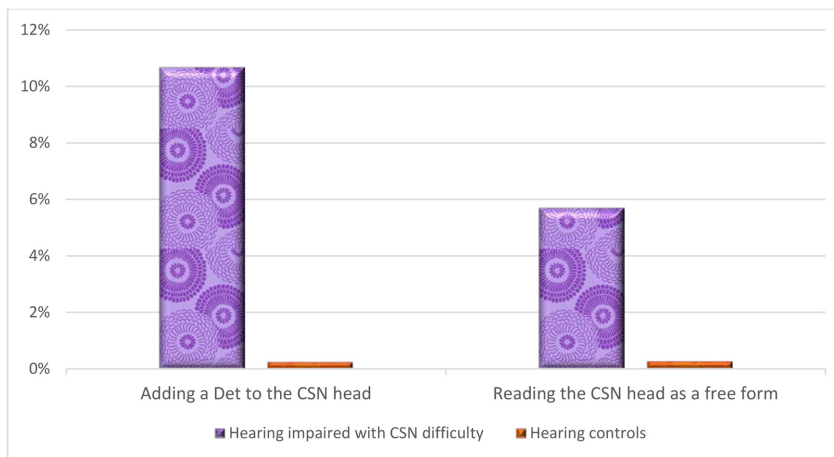


Figure 2: The performance of the children with hearing impairment who showed impaired reading of the CSN (the first group in Table 3) in comparison with the hearing control group: rate of adding a determiner before the CSN head (in addition to a determiner before the complement), and rate of failing to make the morpho-phonological change on the head that identifies it as a head.

⁶ This girl read the plural head as a singular (which has identical free and construct forms). Another hearing girl read the CSN as a noun-adjective phrase.

Table 2: Definite article additions to the head of the CSN for each HI participant; last line presents the average and SD in the control hearing group.

Participant	Total definite determiner addition to the head	Definite determiner addition to the		Reading the head as a free noun
		head + preposition (out of 9)	bare head (out of 37)	
17	11	1	10	3
20	9	3	6	1
1	8	5	3	1
19	7	2	5	1
15	5	1	4	1
14	4	0	4	0
18	4	0	4	0
5	3	2	1	0
16	3	0	3	1
2	3	2	1	0
9	1	0	1	3
22	1	0	1	2
13	2	1	1	1
4	2	1	1	1
6	2	0	2	0
8	2	0	2	0
25	2	1	1	0
7	1	0	1	0
26	1	0	1	0
3	1	0	1	0
21	0	0	0	1
31	0	0	0	1
10	0	0	0	1
23	0	0	0	1
11	0	0	0	0
12	0	0	0	0
24	0	0	0	0
27	0	0	0	0
28	0	0	0	0
29	0	0	0	0
30	0	0	0	0
32	0	0	0	0
Hearing controls M (SD)	0.11 (0.33)	0	0.11 (0.33)	0.05 (0.24)

Dark shaded cells – 3 or more determiner additions on the head of the CSN, or two or more reading of the construct head as a free noun. Lightly shaded – marginal impairment.

3.1 The relation between errors in CSNs and other movement-related syntactic difficulties

We further examined whether the participants who had difficulties with N to D movement in CSN could understand and produce structures with verb movement to C, and whether they could understand and produce structures with object A-bar-movement (the relevant data on the performance of these participants on these movement-derived structures are taken from Szterman & Friedmann 2017).⁷

The results, summarized in Table 3, indicate that all the 12 children with hearing impairment who had significant difficulties with the reading of CSNs arguably as a consequence of a deficit in N to D movement – who made three or more additions of a determiner before the head of a CSN or two or more reading the head as a free noun – were also impaired in V to C movement and in object A-bar dependencies. The 8 children who showed intact reading of CSN, with no addition of a determiner before the head, and with no change of the construct form to free form, all showed good V to C movement and object A-bar movement abilities. Twelve other children did make one or two errors in reading the CSN heads, so we could not safely classify them as having a deficit in CSN or not, some of these children also had difficulties in V to C or in object A-bar structures, and some did not.

4 Discussion

In this study we used a new window through which we could examine syntactic movement in individuals with hearing impairment. We used CSN, a structure that involves movement of the noun to D (in the form of head movement, Ritter 1988; Siloni 1996; 1997; Borer 1999; or of a “small phrasal movement” in the sense of footnote 2, Cinque 2000; Shlonsky 2004). When this N to D movement is intact, the D position is filled by the noun, so a determiner cannot appear before the head noun. Therefore, we took the addition of a determiner before the head of CSN, which creates an ungrammatical structure in Hebrew, to indicate impaired N to D movement.

We tested this by asking children with hearing impairment to read aloud paragraphs that included CSNs, and examined whether they incorrectly added a determiner before the head noun of definite CSNs, in addition to the determiner preceding the complement. The results were unequivocal – whereas hearing typically developing children almost never added a determiner on the head noun of the CSN, in addition to the determiner preceding the complement, many of the hearing-impaired children did. Even when there was clearly no determiner before the head, and they were reading the CSN, they added a determiner before the head noun, in addition to the determiner before the complement. This happened even when they pronounced the noun in the construct form. In other cases they failed to make the morpho-phonological change that marks the head noun as a construct head even though it was orthographically marked as such, which we take as another indication for a failure of N to D movement.

These two types of errors – the addition of the determiner to the head and the lack of morpho-phonological change of the head – were the most important findings of this study: they indicate that these children did not move N to D.

The finding that the children with hearing impairment added determiners in specific syntactic positions is also informative about the nature of their impairment. One could think that they do not hear phonologically weak elements and therefore ignore them. The fact that they actually added the phonologically weak article indicates that this was not the case. Moreover, the finding that they added the article in a position immediately

⁷ The inclusion criterion for the Friedmann and Szterman (2017) study was similar to the criterion for the current study, having moderate to severe hearing impairment from birth, training only in spoken language, and wearing hearing aids or cochlear implants. The participants were not pre-selected on the basis of their syntactic abilities.

Table 3: The performance of the participants in object A-bar and V-C movements.

Participant	Total definite determiner addition to the head	Reading the head as a free noun	V-C	Object A-bar movement
Children with impairment in CSN				
17	11	3	impaired	Impaired
20	9	1	impaired	Impaired
1	8	1	impaired	Impaired
19	7	1	impaired	Impaired
15	5	1	impaired	Impaired
14	4	0	impaired	Impaired
18	4	0	impaired	Impaired
5	3	0	impaired	Impaired
16	3	1	impaired	Impaired
2	3	0	impaired	Impaired
9	1	3	impaired	Impaired
22	1	2	impaired	Impaired
Children with marginal or mild difficulty in CSN				
13	2	1	Marginally impaired	Impaired
4	2	1	✓	✓
6	2	0	✓	Impaired
8	2	0	impaired	✓
25	2	0	impaired	✓
7	1	0	✓ ^a	✓
26	1	0	impaired	Impaired
3	1	0	✓	✓
21	0	1	✓	impaired
31	0	1	✓	impaired
10	0	1	impaired	✓
23	0	1	✓	✓
Children with intact reading of CSN				
11	0	0	✓	✓
12	0	0	✓	✓
24	0	0	✓	✓
27	0	0	✓	✓
28	0	0	✓	✓
29	0	0	✓	✓
30	0	0	✓	✓
32	0	0	✓	✓

Shaded cells – impaired reading of the CSNs: 3 or more determiners added on the head of the CSN, or 2 or more readings of the construct head in its free form.

✓ – unimpaired performance; impaired – failed in two or more out of 4 tests of this structure.

^aThis only reflects her performance in tasks in which the sentences were presented to her in writing.

preceding the noun (and not, for example, before the preposition or the complementizer) suggests that they were sensitive to the basic positional properties of such a weak element.

Additionally, it is not the case that they followed a superficial generalization according to which a determiner should appear before every noun: as we reported above, each of the 32 children with hearing impairment read 16 indefinite CSNs in the texts, and there was only a single case in which they added a determiner before the indefinite CSN head. Moreover, such a generalization would not account for their errors of reading the construct form as a free form. By contrast, a selective deficit in N-to-D movement accounts for all these findings.

These considerations suggest that it is not the structure of the functional layer of D *per se* that is impaired in these participants, but rather that the factors involved in triggering movement or the computation of movement are impaired.⁸

In earlier studies (Szterman & Friedmann 2014b; 2017), these children were also tested on the manifestation of other syntactic abilities involving movement dependencies, including V to C movement, as an instance of head movement, and phrasal A-bar movement to the left periphery. This allowed us to evaluate the relations between difficulties in the various movement types. Here, we could detect a clear connection between the addition of a determiner before the head of the CSN and other syntactic difficulties: the hearing-impaired children who had a deficit in N to D and added a determiner before the head noun or pronounced it as a free noun, also showed impairments in V to C and in object A-bar movement in other tasks of sentence comprehension, repetition, and production. Those who read the CSN correctly also showed normal V to C and object A-bar movement abilities. Whereas this does not allow us to use these data to shed light on the exact nature of N to D movement in construct states (i.e., whether it is an instance of head movement or of “small phrasal movement”), it definitely indicates that the distribution of determiners in construct states is syntactic in nature. As such, difficulties with determiners on the CSN may be taken as an indicator of problems in syntactic movement.

These results also shed light on the formal analysis of linguistic constructs. The finding that individuals who have impairments in syntactic movement also show difficulties with CSNs support movement accounts for the derivation of CSN.

Abbreviations

CSN = construct state nominal, N = noun, D = determiner, NP = noun phrase, DP = determiner phrase, V = verb, C = complementizer, PF = phonological form, ACC = accusative case, M = mean, SD = standard deviation, HI = hearing impaired.

Additional File

The additional file for this article can be found as follows:

- **Appendix.** Background information on the hearing impaired participants.
DOI: <https://doi.org/10.5334/gjgl.674.s1>

Acknowledgements

Adriana Belletti and Luigi Rizzi’s research presented here was funded in part by the ERC Advanced Grant n. 340297 SynCart. Naama Friedmann and Ronit Szterman’s research was supported by the Israel Science Foundation (grant no. 1066/14, Friedmann), by the

⁸ The finding that the children did not add *šel* even when they pronounced the head as free, may suggest that the (genitive) Case assignment capacity of the functional D head of the construct was also preserved for them even in the lack of N to D. This follows standard analyses of CSNs under which the complement DP receives genitive case from the construct head noun, whereas the free head, not being a case assigner, requires the addition of the genitive case assigning preposition *šel*. This is consistent with the idea that they are computing the construct, and its definiteness (see discussion immediately preceding example 1), but only fail to perform the N-to-D movement operation.

Human Frontiers Science Program (RGP0057/201, Friedmann), by the Branco-Weiss Chair for Child Development and Education, and by the Australian Research Council Centre of Excellence for Cognition and its Disorders (CCD), Macquarie University (CE110001021).

Competing Interests

The authors have no competing interests to declare.

References

- Belletti, Adriana. 1999. Italian/Romance Clitics: Structure and Derivation. In Henk Van Riemsdijk (ed.), *Clitics in the Languages of Europe*, 543–579. Berlin: Mouton De Gruyter. ISBN: 3110157519
- Berent, Gerald P. 1988. An assessment of syntactic capabilities. In Michael Strong (ed.), *Language learning and deafness*, 133–161. Cambridge: Cambridge University Press. DOI: <https://doi.org/10.1017/CBO9781139524483.008>
- Berent, Gerald P. 1996. Learnability constraints on deaf learners' acquisition of English wh-questions. *Journal of Speech and Hearing Research* 39. 625–643. DOI: <https://doi.org/10.1044/jshr.3903.625>
- Berman, Ruth Aronson. 1978. Modern Hebrew structure. Tel Aviv: University Publishing Projects.
- Berman, Ruth Aronson. 2009. Children's acquisition of compound constructions. In Rochelle Lieber & Pavol Štekauer (eds.), *Handbook of compounding*, 298–322. Oxford University Press.
- Borer, Hagit. 1988. On the morphological parallelism between compounds and constructs. *Yearbook of Morphology* 1. 45–65.
- Borer, Hagit. 1999. Deconstructing the construct. In *Beyond principles and parameters*, 43–89. Springer, Dordrecht. DOI: https://doi.org/10.1007/978-94-011-4822-1_3
- Borer, Hagit. 2008. Compounds: The view from Hebrew. In *The Oxford handbook of compounds*, 491–511.
- Cinque, Guglielmo. 2000. On Greenberg's universal 20 and the Semitic DP. *University of Venice Working Papers in Linguistics* 10. 45–61.
- Danon, Gabi. 2008. Definiteness spreading in the Hebrew construct state. *Lingua* 118(7). 872–906. DOI: <https://doi.org/10.1016/j.lingua.2007.05.012>
- Danon, Gabi. 2012. Two structures for numeral-noun constructions. *Lingua* 122(12). 1282–1307. DOI: <https://doi.org/10.1016/j.lingua.2012.07.003>
- Danon, Gabi. 2017. Imagine no possession: John Lennon in the construct state. *A paper presented at the 33rd IATL meeting*. Israel.
- de Villiers, Jill G., Peter A. de Villiers & Esme Hoban. 1994. The central problem of functional categories in the English syntax of oral deaf children. In Helen Tager-Flusberg (ed.), *Constraints on language acquisition: Studies of atypical children*, 9–47. Hillsdale, NJ: Erlbaum.
- de Villiers, Peter A. 1988. Assessing English syntax in hearing-impaired children: Elicited production in pragmatically motivated situations. In Richard R. Kretschmer & Laura W. Kretschmer (eds.), *Communication assessment of hearing-impaired children: From conversation to classroom* (The journal of Academy of Rehabilitative Audiology 21), 41–72.
- Delage, Hélène & Laurice Tuller. 2007. Language development and mild-to-moderate hearing loss: Does language normalize with age? *Journal of Speech, Language, and Hearing Research* 50. 1300–1313. DOI: [https://doi.org/10.1044/1092-4388\(2007/091\)](https://doi.org/10.1044/1092-4388(2007/091))
- Doron, Edit & Irit Meir. 2013. Construct state: Modern Hebrew. In *The encyclopedia of Hebrew language and linguistics* 1. 581–589.

- Friedmann, Naama & Manar Haddad-Hanna. 2014. The comprehension of sentences derived by syntactic movement in Palestinian Arabic speakers with hearing impairment. *Applied Psycholinguistics* 35(3). 473–513. DOI: <https://doi.org/10.1017/S0142716412000483>
- Friedmann, Naama & Ronit Szterman. 2006. Syntactic movement in orally-trained children with hearing impairment. *Journal of Deaf Studies and Deaf Education* 11. 56–75. DOI: <https://doi.org/10.1093/deafed/enj002>
- Friedmann, Naama & Ronit Szterman. 2011. The comprehension and production of Wh questions in children with hearing impairment. *Journal of Deaf Studies and Deaf Education* 16. 212–235. DOI: <https://doi.org/10.1093/deafed/enq052>
- Friedmann, Naama, Ronit Szterman & Manar Haddad-Hanna. 2010. The comprehension of relative clauses and Wh-questions in Hebrew and Palestinian Arabic hearing impairment. In Ana Castro, João Costa, Maria Lobo & Fernanda Pratas (eds.), *Language acquisition and development: Generative approaches to language acquisition 2009*. Cambridge: Cambridge Scholars Press/CSP.
- Haddad-Hanna, Manar & Naama Friedmann. 2009. The comprehension of syntactic structures by Palestinian Arabic-speaking individuals with hearing impairment. *Language and Brain* 9. 79–104.
- Haddad-Hanna, Manar & Naama Friedmann. 2014. The comprehension and production of sentences with syntactic movement in Palestinian Arabic-speaking individuals with hearing impairment. In Tova Most & Dalia Ringwald-Frimermen (eds.), *Rehabilitation and Education of Children and adults hard of hearing and deaf: Theoretical and implementation aspects*, 295–351. Tel Aviv: Mofet institute.
- Kayne, Richard S. 1998. Overt vs. covert movements. *Syntax* 1(2). 128–191. DOI: <https://doi.org/10.1111/1467-9612.00006>
- Koopman, Hilda Judith & Anna Szabolcsi. 2000. *Verbal complexes* (No. 34). Cambridge, MA: MIT Press.
- Longobardi, Giuseppe. 1994a. Reference and Proper Names. *Linguistic Inquiry* 25. 609–665.
- Longobardi, Giuseppe. 1994b. A case of construct state in Romance. In Roberto Ajello & Saverio Sani (eds.), *Scritti linguistici e filologici in onore di Tristano Bolelli*. Pisa: Pacini.
- Quigley, Stephen Patrick, N. L. Smith & Ronnie Bring Wilbur. 1974a. Comprehension of relativized sentences by deaf students. *Journal of Speech and Hearing Research* 17. 325–341. DOI: <https://doi.org/10.1044/jshr.1703.325>
- Quigley, Stephen Patrick, Ronnie B. Wilbur & Dale S. Montanelli. 1974b. Question formation in the language of deaf students. *Journal of Speech and Hearing Research* 17. 699–713. DOI: <https://doi.org/10.1044/jshr.1704.699>
- Ravid, Dorit. 1997. Between syntax and the lexicon: The parallel between N-N compounds and N-A strings in acquisition. In Antonella Sorace, Caroline Heycock, & Richard Shillcock (eds.), *Proceedings of the GALA 1997 Conference on Language Acquisition*, 138–141. Edinburgh: University of Edinburgh.
- Ritter, Elizabeth. 1988. A head-movement approach to construct-state noun phrases. *Linguistics* 26(6). 909–930. DOI: <https://doi.org/10.1515/ling.1988.26.6.909>
- Rizzi, Luigi & Ian Roberts. 1989. Complex inversion in French. *Probus* 1(1). 1–30. DOI: <https://doi.org/10.1515/prbs.1989.1.1.1>
- Shlonsky, Ur. 2004. The form of Semitic noun phrases. *Lingua* 114(12). 1465–1526. DOI: <https://doi.org/10.1016/j.lingua.2003.09.019>
- Siloni, Tal. 1996. Hebrew noun phrases: Generalized noun raising. In *Parameters and functional heads*, 239–267.
- Siloni, Tal. 1997. *Noun phrases and nominalizations: The syntax of DPs* 40. Springer Science & Business Media. DOI: <https://doi.org/10.1007/978-94-015-8863-8>

- Siloni, Tal. 2001. Construct states at the PF interface. In *Linguistic variation yearbook* 1(1). 229–266.
- Szterman, Ronit & Naama Friedmann. 2003. The deficit in comprehension of movement-derived sentences in children with hearing impairment. *Lir'ot et Hakolot* 2. 20–29.
- Szterman, Ronit & Naama Friedmann. 2007. How do children with hearing impairment produce relative clauses? *Israeli Journal of Language, Speech, and Hearing Disorders* 28. 58–71.
- Szterman, Ronit & Naama Friedmann. 2014a. The syntactic abilities of children with hearing impairment in school ages and its influence on reading comprehension. In Tova Most & Dalia Ringwald-Frimermen (eds.), *Rehabilitation and Education and of Children and adults hard of hearing and deaf: Theoretical and implementational aspects*, 239–294. Tel Aviv: Mofet institute.
- Szterman, Ronit & Naama Friedmann. 2014b. Relative clause reading in hearing impairment: Different profiles of syntactic impairment. *Frontiers in Psychology: Language Sciences* 5(1229). 1–16. DOI: <https://doi.org/10.3389/fpsyg.2014.01229>
- Szterman, Ronit & Naama Friedmann. 2015. Insights into the syntactic deficit of children with hearing impairment from a sentence repetition task. In Cornelia Hamann & Esther Ruigendijk (eds.), *Language acquisition and development: Generative approaches to language acquisition*, 492–505. Newcastle: Cambridge Scholars Publishing.
- Szterman, Ronit & Naama Friedmann. 2017. Comprehension and production of sentences with verb movement to C in children with hearing impairment. *Language and Brain* 12. 53–87.
- Tuller, Laurice & Celia Jakubowicz. 2004. Développement de la morphosyntaxe du français chez des enfants sourds moyens. *Le Langage et l'homme* 39(2). 191–207.
- Volpato, Francesca. 2008. Clitic pronouns and past participle agreement in Italian in three hearing impaired bilinguals Italian/LIS. *Rivista di Linguistica* 20(2). 308–345.
- Volpato, Francesca & Flavia Adani. 2009. The subject/object relative clause asymmetry in Italian hearing-impaired children: Evidence from a comprehension task. In *Proceedings of the XXXV Incontro di Grammatica Generativa*.

How to cite this article: Friedmann, Naama, Ronit Szterman, Adriana Belletti and Luigi Rizzi. 2018. The head the construct: Construct state nominals as a novel window to syntactic movement difficulties in hearing impairment. *Glossa: a journal of general linguistics* 3(1): 134.1–15, DOI: <https://doi.org/10.5334/gjgl.674>

Submitted: 07 April 2018 **Accepted:** 29 September 2018 **Published:** 14 December 2018

Copyright: © 2018 The Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC-BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited. See <http://creativecommons.org/licenses/by/4.0/>.

]u[*Glossa: a journal of general linguistics* is a peer-reviewed open access journal published by Ubiquity Press.

OPEN ACCESS 