Agrammatic Comprehension of Simple Active Sentences With Moved Constituents: Hebrew OSV and OVS Structures

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This study examines agrammatic comprehension of object-subject-verb (OSV) and object-verb-subject (OVS) structures in Hebrew. These structures are syntactically identical to the basic order subject-verb-object (SVO) sentence except for the movement of the object to the beginning of the sentence, and thus enable empirical examination of syntactic movement in agrammatic comprehension. Seven individuals with agrammatism, 7 individuals with conduction aphasia, and 7 individuals without language impairment, all native speakers of Hebrew, performed a sentence–picture matching task. The task compared OSV and OVS sentences to SVO sentences and to subject and object relatives. Individuals with agrammatism performed more poorly than those in either of the other groups. Their comprehension of SVO sentences was significantly above chance, but comprehension of OSV and OVS sentences was at chance and was poorer than comprehension of SVO sentences. These results show that agrammatic comprehension of structures that involve movement of a noun phrase is impaired even when the structure is a simple active sentence, in line with the Trace Deletion Hypothesis (TDH; Y. Grodzinsky, 1990, 1995a, 2000). A modification is suggested to accommodate the TDH with the VP Internal Subject Hypothesis, according to which individuals with agrammatism use an "Avoid Movement" strategy in comprehension.

KEY WORDS: agrammatism, comprehension, Hebrew, syntax, conduction aphasia

Individuals with agrammatic aphasia suffer from a deficit with regard to sentence comprehension that has been found to be selective. They understand simple active sentences, subject relatives, subject clefts, and subject questions, but they fail to understand reversible verbal passives, object relatives, object clefts, and object questions (Caramazza & Zurif, 1976; Grodzinsky, 1989, 2000; Schwartz, Saffran, & Marin, 1980; see Grodzinsky, Piñango, Zurif, & Drai, 1999, for a review). The question of what these structures have in common that makes them hard for agrammatic comprehension and what distinguishes them from the structures that are comprehended correctly has intrigued many researchers over the years, and several accounts that are different in nature have been suggested. Some accounts, like the Trace Deletion Hypothesis (TDH; Grodzinsky, 1990, 1995a, 2000), propose a *selective syntactic* deficit; other accounts contend that agrammatism entails a

complete loss of syntax and that sentence comprehension is achieved by *linear assignment* of roles (Caplan, 1983; Caplan & Futter, 1986); yet other researchers (e.g., Caplan, Baker, & Dehaut, 1985; Miyake, Carpenter, & Just, 1994) ascribe the deficit to *capacity limitations* and base their accounts on nonsyntactic complexity matrices.

In this paper, we report a study that examined, for the first time, agrammatic comprehension of two derived structures in Hebrew: Object-Subject-Verb and Object-Verb-Subject structures (OSV and OVS). Within the generative theoretical framework, these structures are analyzed as simple active sentences that are created from the basic Subject-Verb-Object order (SVO) by moving the object to the beginning of the sentence, forming a focalization or topicalization structure (Shlonsky, 1997). These structures are pure movement structures in that they involve movement of a noun phrase (NP), but do not include any addition of words or change of words or morphemes compared to the SVO counterpart. This makes them an interesting test case for the description of agrammatic comprehension and allows for empirical examination of several aspects of the TDH and its comparison to other accounts. Before we proceed with the predictions each theory holds for these structures, we will briefly describe the structures and their formation.

OSV and OVS Sentences in Hebrew

In Modern Hebrew the basic word order is, just like in English, SVO, namely Subject, Verb, Object (Shlonsky, 1997) (see Example 1).

(1) ha-safta mecayeret et ha-yalda ha-zo
the-grandmother draws ACC the-girl this
S V O
"The grandmother draws this girl"

It is also possible, however, to move the object to the beginning of the sentence and to create a structure in which the object precedes the logical subject, mainly in order to focus on the object. Two such focalization structures are possible in Hebrew (Shlonsky, 1997).[1] The first structure, OSV (Example 2), involves the movement of the object (with its object case marker) to the beginning of the sentence (to spec-CP). The second structure, OVS (Example 3), involves two movements. It includes, in addition to the object movement, a movement of the verb to the second sentential position, following the object and preceding the subject (to C). This type of verb movement is optional and generally does not change the sentence meaning; Shlonsky (1987, 1997; Shlonsky & Doron, 1992) terms it "Triggered Inversion." Examples for the OSV and OVS counterparts of Example 1 are given in Examples 4 and 5, respectively.

(2) S V **O→O** S V __

(3) S V **O→O** S V __ **→O** S **V** __ **→O V** S __ __

(4) et ha-yalda ha-zo$_1$ ha-safta mecayeret t_1
ACC the-girl this the-grandmother draws
O S V
This girl, the grandmother draws (meaning *the grandmother draws this girl*)

(5) et ha-yalda ha-zo $_1$ mecayeret $_v$ ha-safta t_v t_1
ACC the-girl this draws the-grandmother
O V S
This girl, draws the grandmother (again meaning *the grandmother draws this girl*)

According to transformational grammar, when constituents move they leave a trace behind (marked "*t*" in Examples 4 and 5) that enables the interpretation of the sentence in the following way: The verb assigns the thematic role (such as the *agent* of the action, for the NP performing the action, or the *theme* of the action, for the NP that receives the action or is affected by it) to the trace of the moved element, and the thematic role is transferred from the trace to the moved constituent via a chain that consists of the trace and its antecedent (the moved NP).

Thus, in order to correctly interpret a sentence with moved elements, several operations are necessary: the formation of a trace, the assignment of a thematic role to the trace, and the linking of the trace to the moved constituent. Therefore, the comprehension of OSV and

[1] This structure in Hebrew can be either topicalization or focalization. Some syntactic properties of this structure speak in favor of focalization, but some pragmatic properties suggest the structure can be used as both topicalization and focalization. For example, this structure cannot take a resumptive pronoun in the open sentence after the moved constituent, and according to Cinque (1990) and Rizzi (1997), this is a property of focalization structures. Another syntactic property of focus that applies to this structure is that the moved element can be quantificational: "et kuuulam cyarti mataishehu" (*everybody, I have drawn once*). Furthermore, when a constituent moves with its accusative marker, this is an instance of focalization rather than topicalization. However, pragmatically these structures can serve a focalization function, with the focused NP as the new information: "et hagvina HAZO, (velo et hashnyia) ani tamid kona" (*THIS cheese, and not the other one, I always buy*). In the case of focalization use, the intonation involves lengthening the stressed syllable of the focused element, and possibly also a short pause before the verb.

(footnote continued)

But these structures can also serve a topicalization function—it is possible that the part after the moved constituent, rather than the moved constituent itself, would include the new information "et haxayal haze harofe MECAYER (velo mecalem)" (*this soldier the doctor draws, and not photographs*) or "et haxayal haze harofe mecayer, veet haxayel hahu hu mecalem" (*this soldier the doctor draws, and the other soldier he photographs*), thus giving it the pragmatics of topic-comment. In the following, we will arbitrarily term the structure "focalization," based on its syntactic properties.

OVS structures requires an intact functioning of these operations.

Predictions of Different Accounts

According to the TDH (Grodzinsky, 1990, 1995a), individuals with agrammatic aphasia have a deficit in interpreting sentences that involve a movement of a referential NP. Thus, in the agrammatic representation, whenever an NP (like the theme in passive sentences) moves outside of its thematic position, its trace is deleted, and it can no longer receive the thematic role from the verb via the trace. When an NP remains roleless, it receives a thematic role by a nonstructural strategy that assigns the role of an agent to the first NP in the clause. Whenever the roleless NP is indeed an agent, the sentence is interpreted correctly (though not by the normal procedure). However, trouble begins when the NP without the role is not an agent but rather, for example, a theme. In this case, the theme receives an inappropriate agent role. If the sentence includes a real agent in addition to the NP that mistakenly received an agent role from the first-NP strategy, the hearer has to choose who the agent is and is forced to guess. This hypothesis was used to explain the guessing response of individuals with agrammatism in interpreting passive and object relative sentences, among other structures, because in these structures the first NP is a theme (Grodzinsky, 1995a, 2000).

For the focalization structures OSV and OVS, the TDH predicts a *chance-level* performance as well. Because the object moves and cannot receive its thematic role through a chain, it receives an agent role from the first-NP strategy, whereas the logical subject keeps its agent role because it has not moved. A patient with agrammatic aphasia who is left with two agents, and is forced to guess who the real agent is, would perform at chance level in tasks like sentence–picture matching.

Other theories of the deficit in agrammatic comprehension make different predictions regarding the OSV and OVS constructions. A theory that claims that individuals with agrammatic aphasia lack syntax altogether, and that they assign thematic roles only based on lexical category and linear order (such as the early work of Caplan in Caplan, 1983; Caplan & Futter, 1986), predicts below-chance performance on OSV and OVS structures. This is because the order of the arguments is reversed and is noncanonical, and therefore the logical object is bound to receive an agent role and the subject a theme role (but see Piñango, 2000, for a different type of canonicity approach that predicts chance performance in these sentences). A similar prediction can be derived from "piggybacking" suggestions like the ones made by Dick et al. (2001) and MacDonald and Christiansen (2002). These authors suggest that comprehension is especially impaired in nonfrequent structures, and this is why comprehension of structures like object cleft, which are very infrequent, is impaired. Subject clefts, on the other hand, which are also infrequent, are understood correctly because they are similar in all but three words to the frequent active SVO sentences, and individuals with aphasia "tend to fall back on the dominant word order when judging agent-patient relations" (Dick et al., 2001, p. 20). That is, structures that are infrequent but similar to frequent structures with respect to word order are interpreted like their frequent counterparts. It remains to be seen, of course, what the metric is that determines which constructions are "infrequent" and which are "similar" in such an account, except by simple intuition. Nevertheless, consider what this means for the Hebrew OVS structure for example (ACC-the-soldier draws the-doctor), which is much less frequent than the simple SVO (the-soldier draws ACC-the-doctor). An account that assumes piggyback will have to predict that the OVS sentence, which is similar to the SVO sentence in all but the position of one grammatical morpheme (the case marker), will be interpreted as SVO; individuals with agrammatism will thus systematically reverse the thematic order and perform below chance.

The last type of account we will examine here is the complexity or Capacity Constraint theories (Caplan et al., 1985; Haarmann, Just, & Carpenter, 1997; Miyake et al., 1994). These theories predict a better fate for OSV and OVS structures because they are "less taxing" by their criteria. According to Caplan et al. (1985), for example, comprehension of sentences in aphasia is dictated by factors such as the number of verbs (or thematic grids) within a sentence, whether or not the maintenance of the first NP is necessary while another set of thematic roles is computed, and whether there is an NP that plays two different thematic roles. According to these factors, OSV and OVS sentences are not complex—they include only one verb and only one thematic grid; the first NP receives its thematic role together with or before the second (when the verb is encountered), and each NP plays only one role. In addition, they are simple, short, and do not include additional function words compared to SVO. Thus, they are predicted to be comprehended at a high level of performance—certainly better than object relative sentences, which are complex according to these criteria. Note that these theories predict a relative ordering of structures with respect to their performance, but not an absolute estimate of performance. Thus, this study compared the agrammatic comprehension of SVO, OSV, and OVS structures and subject and object relative clauses.

Method

Participants

Twenty-one individuals participated in this study: 7 individuals with agrammatic aphasia, and two control groups—7 individuals with conduction aphasia and 7 individuals without language impairment.

The 7 individuals with agrammatic aphasia were 4 women and 3 men. They were all native speakers of Hebrew, tested with the Hebrew versions of the Western Aphasia Battery (WAB; Kertesz, 1982; Hebrew version by Soroker, 1997) and the Psycholinguistic Assessments of Language Processing in Aphasia (PALPA; Kay, Lesser, & Coltheart, 1992; Hebrew version by Gil & Edelstein, 2001). They were diagnosed with Broca's aphasia and further with Broca's aphasia with agrammatism by experienced speech-language pathologists, based on their spontaneous speech production and an extensive test battery of morphosyntactic abilities in production (BAFLA; Friedmann, 1998). All had characteristic agrammatic speech: short, nonfluent, with ungrammatical utterances, tense inflection errors, use of mainly simple sentences, and ungrammatical production of complex sentences and Wh-questions. BAFLA morphosyntactic tests, which were administered to all patients with agrammatic aphasia before the study, showed that all were impaired in the production of embedding and Wh-questions (8%–35% correct on elicitation tasks). Five of them were also severely impaired in tense inflection, scoring 26%–52% correct on tense inflection completion tasks. Two others (AL, RN) were more mildly impaired and showed relatively good abilities in verb inflections (above 90% correct).

Based on the BAFLA results, an assessment of sentence production based on the syntactic tree was performed (see Friedmann, 2001, for more detailed description of degrees of severity based on pruning sites in the syntactic tree). Five of these individuals were diagnosed as suffering impairment at the level of both the Tense Phrase (TP) and Complementizer Phrase (CP), and the two milder patients as impaired only at CP. All participants were premorbidly right-handed, suffered from right hemiplegia, and had a single lesion in the left hemisphere. Tested with the Behavioral Inattention Test neglect battery (BIT; Wilson, Cockburn, & Halligan, 1987), none of them suffered from hemispatial neglect. None of them had reported developmental language disorders. Six of them had experienced left hemisphere CVA (one of them, MK, had a relatively large infarct which extended, in addition to frontal areas, also to parietal and temporal areas) and one had left hemisphere infarct following head trauma (participant AL). Six of the participants had 12–17 years of education (M = 13.1); 1 was still in high school at the time of his head trauma. All were in stable condition, 9–72 months postonset (M = 41). Age range was 18–67 years (M = 36).

Seven individuals with fluent aphasia participated in the study as an aphasic control group. They were diagnosed either with conduction aphasia or phonological-anomic aphasia by the Hebrew versions of the WAB and the PALPA. The subcategorization of the anomic participants as suffering from a deficit at the phonological level was based on their phonological paraphasias in picture naming and spontaneous speech and by their normal performance on semantic tasks (semantic verbal fluency, categorization, odd out, and Pyramids and Palm Trees test; for details on the participants and tests, see Biran & Friedmann, 2002). The fluent aphasia group included 2 women and 5 men; 6 of them had experienced a CVA, and 1 had aphasia following head trauma (participant AK). All of them were right-handed and native speakers of Hebrew. They had 12–16 years of education (M = 13.1), were 2–24 months postonset (M = 9), and ranged in age from 25–62 years (M = 47).

Seven individuals with no history of speech, language, or hearing impairment participated in the experiment as a non-brain-damaged control group. They were native speakers of Hebrew, each matched to a participant in the group with agrammatic aphasia by age, gender, and education.

Procedure

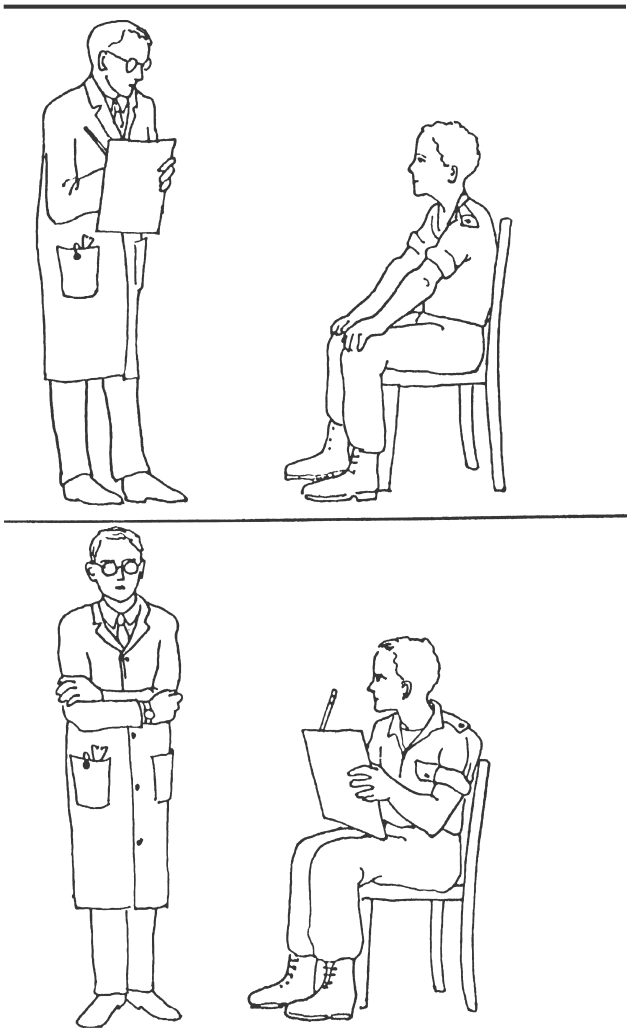
Comprehension was assessed using a binary sentence–picture matching task. The participant heard a semantically reversible sentence, read by a native speaker of Hebrew, and was required to point to the picture that correctly described the sentence, selecting from two pictures presented one above the other on the same page. In one picture, the roles matched the sentence; in the other picture, the roles were reversed (Figure 1).

There was no time limit and no limit on the number of repetitions of each sentence. Before the test, each participant was presented with the pictures and was asked to point to the figures by name ("Show me the nurse"). All participants performed well on this pretest.

Material

A total of 150 reversible Hebrew sentences were tested for each participant. Ninety of the sentences were simple sentences, with or without movement (30 SVO sentences, 30 OSV sentences, and 30 OVS sentences). To allow for a comparison between simple focalization structures and the embedded relative clauses, and to examine whether the patients with agrammatism in this study behave in the pattern known from the literature

Figure 1. A picture pair used in the binary sentence–picture matching task.



on other, more heavily tested, structures, relative sentences were tested as well. Sixty of these sentences were tested for each participant—30 subject relatives and 30 object relatives. All verbs were agentive transitives. Because in Hebrew the verb agrees with the subject in gender and number (and person), in order to preclude an agreement cue on the verb, the figures in every picture were always of the same gender and number (a nurse and a female soldier, a little boy and a grandfather, etc.).

The following are sentence examples (the first three sentences all mean "The doctor draws this soldier"):

SVO: ha-rofe mecayer et ha-xayal ha-ze
the-doctor draws ACC the-soldier the-this
S V O
"The doctor draws this soldier"

OSV: et ha-xayal ha-ze ha-rofe mecayer
ACC the-soldier the-this the-doctor draws
O S V
"This soldier, the doctor draws"

OVS: et ha-xayal ha-ze mecayer ha-rofe
ACC the-soldier the-this draws the-doctor
O V S
"This soldier, draws the doctor"

Subject relative:
ze ha-rofe she-mecayer et ha-xayal
this the-doctor that-draws ACC the-soldier
"This is the doctor that draws the soldier"

Object relative:
ze ha-xayal she-ha-rofe mecayer
this the-soldier that-the-doctor draws
"This is the soldier that the doctor draws"

Sentences were randomly ordered and presented in five sessions of 30 sentences each (6 sentences of each type per session). In each session, the participant saw 30 picture pairs; in each session every picture pair was assigned to a different structure, so that over the five sessions each picture pair appeared with all five sentence types. The correct picture in each pair was randomized both within a session (in each session 15 sentences matched the upper picture and 15 matched the lower picture) and between sessions (the matching picture in each pair was sometimes the upper, sometimes the lower).

Results

Overall, a two-way, 3 (groups) × 5 (sentence types) ANOVA with repeated measures on sentence types yielded a significant main effect for group, $F(2, 18) = 64.01$, $p < .0001$, $\eta_p^2 = .88$; a significant main effect for sentence type, $F(4, 72) = 26.35$, $p < .0001$, $\eta_p^2 = .59$; and a significant interaction between them, $F(8, 72) = 21.89$, $p < .0001$, $\eta_p^2 = .71$.

Agrammatic Group

SVO, OSV, and OVS

As shown in Figure 2, whereas the comprehension of active SVO sentences in the agrammatic group was significantly above chance (one sample t test compared to 50%, $t(6) = 13.79$, $p < .0001$; an alpha level of .05 and a Bonferroni correction was used for all statistical tests), the comprehension of both focalization structures, OSV and OVS, was at chance (not significantly different from chance using one sample t test, $t(6) = 1.08$, $p = .32$ for OSV and $t(6) = 1.57$, $p = .16$ for OVS). Each of the 7

Figure 2. Agrammatic aphasia group—Comprehension of SVO, OSV, and OVS structures.

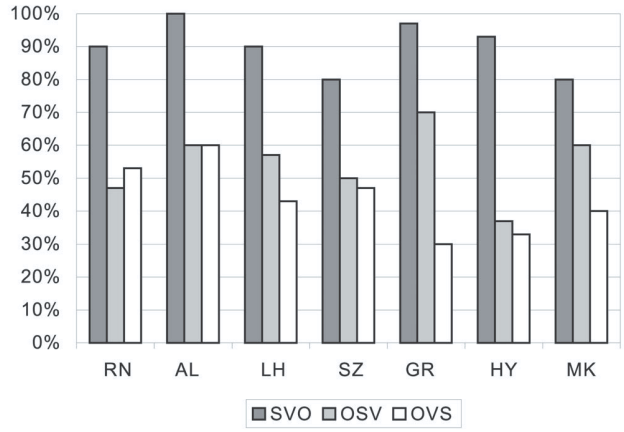
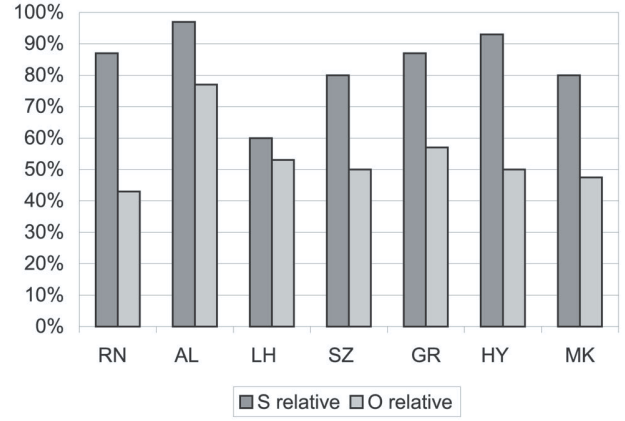


Figure 3. Agrammatic aphasia group—Comprehension of subject and object relative sentences.



individual participants presented the same pattern: SVO structures significantly above chance and focalization structures not significantly different from chance, using the binomial test (except for participant GR in focalization).

One-way repeated-measures ANOVA for the five sentence types yielded a main effect of sentence type, $F(4, 24) = 33.96$, $p < .0001$, $\eta_p^2 = .85$. SVO sentences were significantly better than the focalization structures, in the comparison of SVO to OSV [paired t test, $t(6) = 7.93$, $p = .0001$, $d = 3.84$; all Cohen's d for paired samples were calculated based on original standard deviation and mean to avoid an overestimate of the actual effect size] and in the comparison of SVO to OVS, $t(6) = 9.69$, $p < .0001$, $d = 4.97$. No significant difference was found between the two focalization structures, $t(6) = 1.82$, $p = .11$. Again, for each individual participant, comprehension of SVO was significantly better than comprehension of OVS and significantly better than comprehension of OSV (using Fisher's exact test, $p < .015$ for each participant except MK on the comparison SVO-OSV).

Relative Clauses

As shown in Figure 3, subject relatives were comprehended significantly above chance for the group [single sample t test, $t(6) = 7.27$, $p = .0001$]. Object relatives were at chance for the group [single sample t test, $t(6) = .95$, $p = .38$]. This pattern also held for each individual participant (using the binomial test, all participants except LH were above chance on subject relatives, and all participants except AL were at chance on object relatives). The performance on subject relatives was significantly better than that on object relatives for the group [paired t test, $t(6) = 6.04$, $p = .0005$, $d = 2.54$] and for each individual participant (using Fisher's exact test, $p < .03$ for all participants except LH).[2] No significant difference was found between focalization structures and object relatives [paired t test, $t(6) = 1.52$, $p = .18$].

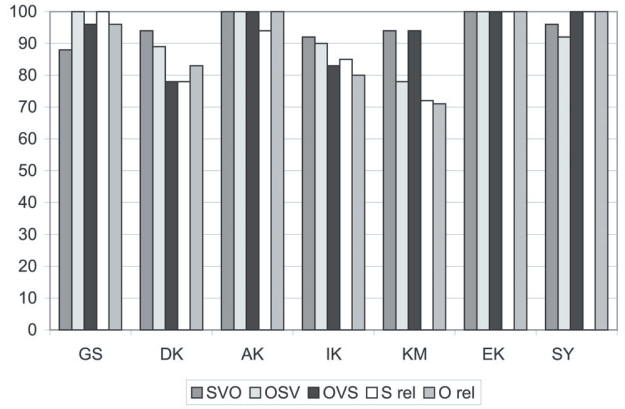
This pattern, in which subject relative clauses are comprehended above chance and are significantly better than object relatives, which are comprehended at chance level, corroborates many reports in the literature of agrammatic comprehension of relative clauses (Grodzinsky, 1989; see Grodzinsky et al., 1999, for a review) and further supports our diagnosis of agrammatic aphasia.

Control Groups

The participants in the conduction aphasia control group performed at a relatively high level on all sentence types, with a group average of between 90% and 95% correct per sentence type (see Figure 4 for individual results). All sentence types were comprehended significantly above chance for the group (using single sample t test, $p < .0001$, for each sentence type compared to chance) and for each individual participant (using the binomial test). One-way repeated-measures ANOVA for the five sentence types yielded no main effect of sentence type, $F(4, 24) = .88$, $p = .49$. The performance on SVO did not differ from OSV, $t(6) = .68$, $p = .52$, or from OVS, $t(6) = .61$, $p = .57$ (average performance was 95%, 93%, and 93%, respectively), and there was no significant difference between subject and object relatives [average performance was 90% for both, $t(6) = .09$, $p = .93$].

[2] Three of the individuals with agrammatism presented here participated in an additional study that included 160 subject and object relatives per participant (Friedmann & Gvion, 2003). Their results in the other study were very similar to the ones reported here.

Figure 4. Conduction aphasia group—Comprehension of SVO, OSV, and OVS structures and subject and object relatives.



These results, generated from a group of aphasic patients without agrammatism, suggest that it is not a general frequency or complexity effect that made the patients with agrammatism fail on OSV and OVS but rather a specific deficit that is related to the syntactic characteristics of these structures.

The control participants without language impairment performed between 97% and 100% correct on all conditions, thus affirming that the test materials could be reasonably comprehended in the absence of brain damage.

Discussion

Although OSV and OVS are simple active sentences, the individuals with agrammatic aphasia in this experiment comprehended both of them at chance. Comprehension of active SVO sentences, on the other hand, was significantly above chance. Given that the only syntactic difference between the focalization structures and the SVO structure is that the focalization structures involve movement of an NP; these results provide strong support for the claim that movement is impaired in agrammatic comprehension.

Furthermore, these results show that although the individuals with agrammatism are sensitive to the existence of the accusative case markers (because if they weren't sensitive to case markers, then in OSV and OVS structures they would perform below chance), they cannot use the case markers to assign thematic roles to moved constituents. That the existence of a case marker cannot compensate for the deficit in comprehension or assist in sentence interpretation was also found in Serbo-Croatian (Smith & Mimica, 1984), Japanese (Hagiwara & Caplan, 1990, who did not test individuals with agrammatic aphasia specifically), and German (Burchert, De Bleser, & Sonntag, 2001). Interestingly, the sensitivity to case markers in comprehension also manifests in production, where case markers are intact (see De Bleser, Bayer, & Luzzatti, 1996; Ruigendijk & Friedmann, 2002; Ruigendijk, van Zonneveld, & Bastiaanse, 1999).

These results have three main theoretical implications. First, the chance performance on the focalization structures shows that comprehension of sentences that involve movement of an NP is impaired in agrammatism even in short and simple active sentences. These findings thus support movement deficit accounts for agrammatism and posit a problem for accounts that ascribe the agrammatic deficit in comprehension to lack of syntax and linear assignment of thematic roles, as they predict below-chance performance. Similarly, they show that explanations that concern themselves with surface similarities of constructions (e.g., Dick et al., 2001) won't suffice, as they also predict below-chance performance due to the surface similarity of SVO and OVS structures. These findings are also inconsistent with complexity theories, because complexity theories expect better performance on focalization structures than on relative clauses, contrary to the findings of this study.

Second, OSV and OVS differ with respect to the verb movement to the second position in the sentence (Shlonsky, 1987, 1997; Shlonsky & Doron, 1992), which occurs in OVS but not in OSV sentences. The lack of significant difference between OSV and OVS suggests that given a movement of an argument, verb movement does not have an additive contribution to the impairment. The nonadditive nature of verb movement does not support any sort of general complexity or resource capacity account that relies critically on the purported additive nature of syntactic operations (e.g., Caplan et al., 1985; Haarmann et al., 1997; see also Shapiro, Gordon, Hack, & Killackey, 1993, for evidence against an additive complexity account) and might be taken as a corroboration for the claim that verb movement is not impaired in agrammatic comprehension (Grodzinsky, 1995a).

Third, according to current syntactic theories such as the VP Internal Subject Hypothesis (VPISH; Koopman & Sportiche, 1988) and the Minimalist Program (Chomsky, 1995), the logical subject is base generated within the verb phrase (VP) and always moves outside the VP, even in simple active sentences (for inflection and case-checking purposes). Taken within these theories, the chance performance on these structures posits a challenge for the TDH, because if the subject moves as well, not only the moved object but also the subject cannot receive its thematic role directly from the verb. All arguments can only receive their roles from the strategy that gives the first NP an agent role and the second a theme role. Thus, whenever the agent is second and the theme first (as is the case in OSV and OVS as well

as in other structures such as object relatives), the TDH currently predicts a reversed interpretation, because the agent cannot keep its thematic role as well. In a sentence–picture matching task, performance will manifest as below chance, rather than at chance. Thus, if we want to keep the VPISH,[3] which has proven useful in other domains of psycholinguistics such as language acquisition (see Déprez & Pierce, 1993, 1994; Friedemann, 1993/1994, 2000; Pierce, 1992), the TDH requires a modification of some sort to account for the chance performance on OSV and OVS structures (see Grodzinsky, 1995b, 2000; Hickok, Zurif, & Canseco-Gonzalez, 1993; Mauner, Fromkin, & Cornell, 1993, for discussions of this point).

Avoid Movement

A type of modification we would like to suggest is that individuals with agrammatic aphasia use an "Avoid Movement" strategy during the process of structure building in comprehension. Given the deficit in movement of phrases and in chain formation, individuals with agrammatism avoid movement of phrases as much as possible and prefer to assign the argument its base-generated position rather than move it and risk losing its trace. We suggest that movement does not occur in agrammatic processing unless word order forces it to occur. Thus, when an individual with agrammatic aphasia hears an OSV structure, for example, she has to move the object to the beginning of the sentence because word order forces her to do so. But she can, and therefore would, leave the subject within the VP, and the subject will receive its thematic role directly from the verb. This will result in guessing rather than in role reversal. With the addition of this "avoid movement" policy to the TDH, the TDH can account for the chance performance in a wide range of structures for which it currently predicts a below-chance performance, such as OSV and OVS structures in Hebrew, as well as object relatives, object clefts, and object questions. In these structures, the movement of the object, which is forced by word order, prevents thematic role assignment to the object; and the object receives the agent role by the first-NP strategy. The subject, on the other hand, is not forced to move by word order and therefore retains its agent role, which is assigned to it directly by the verb. The chance performance observed for these constructions is therefore derived from the TDH + Avoid Movement.

For the interpretation of passives, Avoid Movement predicts that the passive subject (the logical object) will have to move to a position before the verb, and at this point the predictions converge with the predictions of the TDH—chance performance in full passives (like *the girl is kissed by the grandmother*, and possibly below chance in truncated passives like *the girl is kissed*). In adjectival passives (like *the page is torn*), TDH and Avoid Movement dissociate. Avoid Movement predicts that the subject will not move from spec-VP, and therefore adjectival passives should be interpreted correctly (as was found by Grodzinsky, Pierce, & Marakovitz, 1991), whereas the TDH predicts below-chance performance because the subject moves from the VP, cannot receive its theme role, and receives an agent role from the first-NP strategy. Note that another prediction of Avoid Movement is that verbal passives will be interpreted as adjectival passives, a prediction we are currently testing in Hebrew. For passives in which the logical object is in postverbal position (e.g., was-combed the-girl), Avoid Movement predicts that performance will be above chance because the object does not move. This pattern has been found by Beretta, Piñango, Patterson, & Harford (1999) for Venezuelan Spanish, but there the SV passives were also above chance, a finding that the TDH with (or without) Avoid Movement fails to explain.

In simple active SVO structures and in subject questions, our explanation for the above-chance performance differs from that of the TDH. We suggest that as word order does not force the subject to move in either SVO or subject questions, the subject doesn't move, and therefore it gets its correct thematic role directly from the verb rather than from the first-NP strategy. Above-chance performance in subject relatives and subject clefts should still be accounted for by the first-NP strategy, because the subject is forced to move or form a long-distance dependency.[4]

[3] Another approach, which was taken by Schaeffer (2000), for example, is to adjust or eliminate the VPISH rather than the TDH.

[4] A different possible type of modification would be to restrict impairment only to nonlocal movement (of NP), defining "nonlocal movement" as a movement of an argument over another argument of the same verb. Thus, objects that move over subjects will lose their traces, because they move nonlocally, but subjects that do not cross any other argument, even if they do move, will retain their trace and thus also their agent thematic role. This will account for the chance (rather than below chance) performance on object relatives, object clefts, and object questions, as well as in Hebrew OVS and OSV structures. It will also account for a finding that was not previously accounted for by the TDH, Piñango's (2000) finding of above-chance performance on unaccusative sentences such as *the girl spun because of the boy*, in which the subject is thought to move from a postverbal position. Given that *the girl* is the only argument of *spin*, it does not cross as it moves another argument of *spin*; namely, it performs a local movement as we defined it, and it therefore gets to keep its Theme thematic role. The impaired comprehension of passive will be explained by the nonlocal movement of the logical object over the passive morphology (to which the external argument is assigned; see Baker, Johnson, & Roberts, 1989). The good comprehension of adjectival passives (Grodzinsky et al., 1991) will be explained by saying the passive subject does not move over another argument or over the passive morphology, but is rather base generated in spec-VP. In line with the TDH, head movement (such as verb movement to C in the current experiment) should be unimpaired, as only nonlocal movement of arguments is impaired.

Our results have general implications for the behavioral treatment of comprehension disorders in aphasia. Linguistic-theory-based accounts of the deficit in agrammatism—such as the one supported in this paper—have forged a productive set of treatment studies from Thompson, Shapiro, and colleagues (see Thompson & Shapiro, 1995; Thompson, Shapiro, & Roberts, 1993; Thompson, Shapiro, Tait, Jacobs, & Schneider, 1996, for details and Friedmann, Wenkert-Olenik, & Gil, 2000, for similar treatment of production deficit). These treatment studies have indicated that training of various syntactic structures is effective and may result in significant improvement in the comprehension or production of the treated structures in tests, and frequently also in conversation. Furthermore, they also suggest that training of a structure that includes movement of a certain type generalizes to other structures of the same type. Thus, this previous work suggests that training movement of displaced arguments that underlie OVS and OSV constructions should result in comprehension improvement for those patients with aphasia who evince such a comprehension deficit, and furthermore, that treating OSV sentences might also improve the comprehension not only of OSV and OVS structures but also of relative clauses and Wh-questions, being derived by the same type of syntactic movement.

To conclude, our data suggest that even though focalization sentences in Hebrew are simple active sentences, their comprehension is impaired in agrammatism. Linear order strategies, resource capacity accounts, and surface similarity accounts do not shed light on the present data set. Instead, an explanation involving movement of NPs—one that is concerned with the linguistic details of such movement—is indeed necessary to explain agrammatic comprehension patterns.

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References

Baker, M., Johnson, K., & Roberts, J. (1989). Passive arguments raised. *Linguistic Inquiry*, *20*, 219–251.

Beretta, A., Piñango, M., Patterson, J., & Harford, C. (1999). Recruiting comparative crosslinguistic evidence to address competing accounts of agrammatic aphasia. *Brain and Language*, *67,* 149–168.

Biran, M., & Friedmann, N. (2002). The effect of semantic and phonological cueing on the naming of aphasics with deficits in different levels of lexical processing. *Israeli Journal of Language, Speech and Hearing Disorders, 24,* 21–40. [In Hebrew]

Burchert, F., De Bleser, R., & Sonntag, K. (2001). Does case make the difference? Agrammatic comprehension of case-inflected sentences in German. *Cortex, 37*, 700–703.

Caplan, D. (1983). Syntactic competence in agrammatism—A lexical hypothesis. In M. Studdert-Kennedy (Ed.), *Psychobiology of language* (pp. 177–187). Cambridge, MA: MIT Press.

Caplan, D., Baker, C., & Dehaut, F. (1985). Syntactic determinants of sentence comprehension in aphasia. *Cognition, 21,* 117–175.

Caplan, D., & Futter, C. (1986). Assignment of thematic roles by an agrammatic aphasic patient. *Brain and Language, 27*, 117–134.

Caramazza, A., & Zurif, E. B. (1976). Dissociation of algorithmic and heuristic processes in language comprehension: Evidence from aphasia. *Brain and Language, 3,* 572–582.

Chomsky, N. (1995). *The minimalist program*. Cambridge, MA: MIT Press.

Cinque, G. (1990). *Types of A'-dependencies*. Cambridge, MA: MIT Press.

De Bleser, R., Bayer, J., & Luzzatti, C. (1996). Linguistic theory and morphosyntactic impairments in German and Italian aphasics. *Journal of Neurolinguistics, 9*, 176–185.

Déprez, V., & Pierce, A. (1993). Negation and functional projections in early grammar. *Linguistic Inquiry*, *24*, 25–68.

Déprez, V., & Pierce, A. (1994). Crosslinguistic evidence for functional projections in early child grammar. In T. Hoekstra & B. T. Schwartz (Eds.), *Language acquisition studies in generative grammar* (pp. 57–84). Amsterdam: John Benjamins.

Dick, E., Bates, E., Wulfeck, B., Utman, J. A., Dronkers, N., & Gernsbacher, M. A. (2001). Language deficits, localization, and grammar: Evidence for a distributive model of language breakdown in aphasics and normals. *Psychological Review*, *108*, 759–788.

Friedemann, M.-A. (1993/1994). The underlying position of external arguments in French: A study in adult and child grammar. *Language Acquisition, 3*, 209–255.

Friedemann, M.-A. (2000). Early French postverbal subjects. In M.-A. Friedemann & L. Rizzi (Eds.), *The acquisition of syntax: Studies in comparative developmental linguistics* (pp. 63–83). Geneva, Switzerland: Longman Linguistics Library Series.

Friedmann, N. (1998). *BAFLA—Friedmann's Battery for Agrammatism*. Tel Aviv, Israel: Tel Aviv University.

Friedmann, N. (2001). Agrammatism and the psychological reality of the syntactic tree. *Journal of Psycholinguistic Research, 30*, 71–90.

Friedmann, N., & Gvion, A. (2003). Sentence comprehension and working memory limitation in aphasia: A dissociation between semantic and phonological encoding. *Brain and Language*.

Friedmann, N., Wenkert-Olenik, D., & Gil, M. (2000). From theory to practice: Treatment of agrammatic production in Hebrew based on the Tree Pruning Hypothesis. *Journal of Neurolinguistics*, *13*, 250–254.

Gil, M., & Edelstein, C. (2001). *Hebrew version of the PALPA*. Ra'anana, Israel: Loewenstein Hospital Rehabilitation Center.

Grodzinsky, Y. (1989). Agrammatic comprehension of relative clauses. *Brain and Language, 37*, 480–499.

Grodzinsky, Y. (1990). *Theoretical perspectives on language deficits*. Cambridge, MA: MIT Press.

Grodzinsky, Y. (1995a). A restrictive theory of trace deletion in agrammatism. *Brain and Language, 50*, 27–51.

Grodzinsky, Y. (1995b). Trace deletion, theta-roles, and cognitive strategies. *Brain and Language*, *51*, 467–497.

Grodzinsky, Y. (2000). The neurology of syntax: Language use without Broca's area. *Behavioral and Brain Sciences, 23,* 1–71.

Grodzinsky, Y., Pierce, A., & Marakovitz, S. (1991). Neuropsychological reasons for a transformational analysis of verbal passive. *Natural Language and Linguistic Theory*, *9*, 431–453.

Grodzinsky, Y., Piñango, M., Zurif, E., & Drai, D. (1999). The critical role of group studies in neuropsychology: Comprehension regularities in Broca's aphasia. *Brain and Language*, *67*, 134–147.

Haarmann, H. J., Just, M. A., & Carpenter, P. A. (1997). Aphasic sentence comprehension as a resource deficit: A computational approach. *Brain and Language*, *59,* 76–120.

Hagiwara, H., & Caplan, D. (1990). Syntactic comprehension in Japanese aphasics: Effects of category and thematic role order. *Brain and Language, 38*, 159–170.

Hickok, G., Zurif, E., & Canseco-Gonzalez, E. (1993). Structural description of agrammatic comprehension. *Brain and Language*, *45*, 371–395.

Kay, J., Lesser, R., & Coltheart, M. (1992). *PALPA: Psycholinguistic Assessments of Language Processing in Aphasia.* Philadelphia: Psychology Press.

Kertesz, A. (1982). *Western Aphasia Battery*. Orlando, FL: Grune & Stratton.

Koopman, H., & Sportiche, D. (1988*).* The position of subjects. *Lingua, 85*, 211–258.

MacDonald, M. C., & Christiansen, M. H. (2002). Reassessing working memory: A comment on Just & Carpenter (1992) and Waters & Caplan (1996). *Psychological Review, 109*, 35–54.

Mauner, G., Fromkin, V., & Cornell, T. L. (1993). Comprehension and acceptability judgments in agrammatism: Disruptions in the syntax of referential dependency. *Brain and Language*, *45*, 340–370.

Miyake, A., Carpenter, P. A., & Just, M. A. (1994). A capacity approach to syntactic comprehension disorders: Making normal adults perform like aphasic patients. *Cognitive Neuropsychology*, *11,* 671–717.

Pierce, A. E. (1992). *Language acquisition and syntactic theory*: *A comparative analysis of French and English child grammars.* Dordrecht, The Netherlands: Kluwer.

Piñango, M. M. (2000). Syntactic displacement in Broca's agrammatic aphasia. In R. Bastiaanse & Y. Grodzinsky (Eds.), *Grammatical disorders in aphasia: A neurolinguistic perspective* (pp. 75–87). London: Whurr.

Rizzi, L. (1997). The fine structure of the left periphery. In L. Haegeman (Ed.), *Elements of grammar: A handbook of generative syntax* (pp. 281–337). Dordrecht, The Netherlands: Kluwer.

Ruigendijk, E., & Friedmann, N. (2002). Not all grammatical words are impaired in agrammatism: Evidence from case production in Hebrew and Dutch. *The Israeli Journal of Language, Speech and Hearing Disorders, 24,* 41–54. [In Hebrew]

Ruigendijk, E., van Zonneveld, R., & Bastiaanse, R. (1999). Case assignment in agrammatism. *Journal of Speech, Language, and Hearing Research, 42*, 962–971.

Schaeffer, J. (2000). Aphasia research and theoretical linguistics guiding each other. *Behavioral and Brain Sciences*, *23*, 50–51.

Schwartz, M., Saffran, E., & Marin, O. (1980). The word-order problem in agrammatism: I. Comprehension. *Brain and Language, 10,* 249–262.

Shapiro, L. P., Gordon, B., Hack, N., & Killackey, J. (1993). Verb-argument structure processing in complex sentences in Broca's and Wernicke's aphasia. *Brain and Language, 45,* 423–447.

Shlonsky, U. (1987). *Null and displaced subjects*. Doctoral dissertation, Massachusetts Institute of Technology, Cambridge.

Shlonsky, U. (1997). *Clause structure and word order in Hebrew and Arabic*. New York: Oxford University Press.

Shlonsky, U., & Doron, E. (1992). Verb second in Hebrew. In D. Bates (Ed.), *The proceedings of the tenth West Coast Conference on Formal Linguistics* (pp. 431–446). Stanford, CA: Stanford University, Center for the Study of Language and Information.

Smith, S. D., & Mimica, I. (1984). Agrammatism in a case-inflected language: Comprehension of agent-object relations. *Brain and Language, 21*, 274–290.

Soroker, N. (1997). *Hebrew Western Aphasia Battery*. Ra'anana, Israel: Loewenstein Hospital Rehabilitation Center.

Thompson, C. K., & Shapiro, L. P. (1995). Training sentence production in agrammatism: Implications for normal and disordered language. *Brain and Language*, *50*, 201–224.

Thompson, C. K., Shapiro, L. P., & Roberts, M. (1993). Treatment of sentence production deficits in aphasia: A linguistic-specific approach to Wh-interrogative training and generalization. *Aphasiology, 7*, 111–133.

Thompson, C. K., Shapiro, L. P., Tait, M. E., Jacobs, B. J., & Schneider, S. L. (1996). Training Wh-question production in agrammatic aphasia: Analysis of argument and adjunct movement. *Brain and Language*, *52*, 175–228.

Wilson, B., Cockburn, C., & Halligan, P. (1987). *The Behavioral Inattention Test*. Suffolk, England: Thames Valley Test Company.

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