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Agrammatic aphasic production and comprehension of unaccusative verbs in sentence contexts

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Abstract

This study examined the Argument Structure Complexity Hypothesis (ASCH, [J. Neuroling. 16 (2003) 151]), by investigating agrammatic aphasic comprehension and elicited production of two types of intransitive verbs (i.e. unergatives and unaccusatives) in sentence contexts. The ASCH attributes production difficulty frequently observed in agrammatic aphasia to the argument structure entries of verbs, stating that verbs with a more complex argument structure (in terms of the number and type of arguments) are more difficult for agrammatic aphasic patients to produce than those with a less complex argument structure. Results showed that eight agrammatic aphasic subjects had production difficulty with unaccusative verb sentences, as compared to unergatives, in the face of near-normal comprehension of both sentence types. These findings support the ASCH that predicts production difficulty with sentences involving unaccusatives with more complex argument structures. Error patterns observed also indicated successful lemma access in that the full array of verb argument structures were produced during sentence attempts, suggesting that complex argument structures hinder appropriate processing after the lemma level.

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Keywords: Agrammatism; Verb production deficits; Unaccusative verbs; Unergative verbs; Argument structures; Locus of verb deficits

Agrammatic aphasia has been characterized by slow, effortful and non-fluent speech, usually accompanied by a marked reduction in phrase length and syntactic complexity.

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Difficulty producing closed-class words and functional morphemes such as inflections is a common characteristic, although some open-class words also present problems to individuals with agrammatic aphasia. Recent studies have shown that verb production is selectively affected, as compared to relatively well-preserved noun production, in individuals with agrammatic aphasia (Berndt, Mitchum, Haendiges, & Sandson, 1997; Kim & Thompson, 2000; Miceli, Silveri, Nocentini, & Caramazza, 1988; Miceli, Silveri, Villa, & Caramazza, 1984; Thompson et al., 1995; Zingerser & Berndt, 1990). Studies examining this verb production deficit in detail have further shown that certain types of verbs are more impaired than others (Kim & Thompson, 2000; Thompson, 2003; Thompson, Lange, Schneider, & Shapiro, 1997). For example, Thompson, Shapiro, Li, and Schendel (1994), Thompson and colleagues (1997) and Thompson (2003) showed that the number and type of arguments associated with a verb influence the difficulty of verb production. They found that verb production difficulty increases as the number of arguments is increased, with one-place verbs such as *laugh* as in *Chris laughed* being easier to produce than two-place verbs such as *hit* as in *Chris hit the ball*, which in turn are easier than three-place verbs such as *give* as in *Chris gave Mary the ball*. This verb deficit pattern has also been found in other languages including Hungarian (Kiss, 1999) and German (De Bleser and Kauschke, 2003) as well as in some English-speaking patients (Kemmerer and Tranel, 2000).¹

Another factor that could influence verb production in agrammatic patients is the thematic roles of verb arguments. It is generally assumed that thematic roles map onto syntactic positions in systematic ways (Baker, 1988; Fillmore, 1968; Perlmutter & Postal, 1984). For instance, the agent role is typically related to the subject position and the theme role to the object position. However, there are many verbs that take a non-agent role (e.g. theme) as the subject. English unaccusative verbs such *boil* and *melt* are examples. It has been observed that these verbs present production difficulty for agrammatic aphasic patients (Beretta & Campbell, 2001; Grodzinsky, 1995; Kegl, 1995; Thompson, 2003). Kegl (1995), for example, reported one agrammatic subject produced no unaccusative verbs, but some instances of unergative verbs (e.g. *go* and *cry*) in spontaneous speech samples. Further, Thompson (2003) found in an experimental study using a constrained production task that eight agrammatic subjects had difficulty naming unaccusative verbs, while performing near-normally on naming unergatives (60 versus 96.6% correct on average).

Kegl (1995) suggested that difficulty with unaccusatives is due to the argument structure properties of unaccusative verbs, which lack an external argument and thus require syntactic movement of an internal argument to the subject position. According to Kegl's Syntactically Enriched Verb Entry Hypothesis (SEVEH), any construction lacking an external argument and involving syntactic movement of an argument at s-structure induces production difficulty for agrammatic aphasic patients, even though the lexical entry and d-structure representation of the verbs are intact. Thompson subsequently proposed the Argument Structure Complexity Hypothesis (ASCH), as in (1) below to accommodate both her and Kegl's unaccusative verb data as well as data showing that the number of arguments affects production. The ASCH suggests that rather than

¹ Only three of Kemmerer and Tranel's patients showed this pattern.

the configurational discrepancy between d-structure and s-structure, the information contained within the verb's lexical representation underlies verb deficits in aphasia.

(1) The ASCH

- (a) Verbs whose argument structures entail greater syntactic complexity are more difficult for agrammatic aphasics to produce.
- (b) Complexity encompasses both the number and type of arguments associated with a verb, information contained within the verb's lexical entry.

The two types of intransitive verbs—unergatives such as *run* and unaccusatives such as *fall*—are syntactically different (Burzio, 1986; Perlmutter, 1978). Although both have the same number of arguments (i.e. a single argument), critically, the argument type is different, as seen in (2). The single argument of unergatives is an external argument, which is a d-structure subject, whereas the single argument of unaccusatives is an internal argument, which is a d-structure object. This difference in the type of argument affects the subsequent syntactic derivation of sentences built around the two types of intransitives.

(2)

	(a) Unergatives	(b) Unaccusatives
Argument structure:	x	⟨y⟩
d-structure	[_{IP} [_{VP} NP V]]	[_{IP} [_{VP} V NP]]

Given the VP-internal subject hypothesis (Koopman & Sportiche, 1991), which has been widely accepted since the late GB period, the single argument of both types of verbs undergoes movement from a VP-internal position to Spec of IP at s-structure. The external argument of unergative verbs moves from Spec of VP to Spec of IP to receive Case from the head of IP, as shown in (3a). The argument of unaccusative verbs also involves movement from the VP-internal position to Spec of IP because, lacking an external argument, unaccusative verbs fail to assign Accusative Case to their internal argument in the object position. Burzio's Generalization states that 'all and only the verbs that can assign a theta-role to the subject can assign Case to an object' (Burzio, 1986: 178). In this case, however, the movement of a post-verbal argument to Spec of IP transits via Spec of VP, leaving a longer chain between the original and moved positions, as shown in (3b).

(3) a. Unergatives: [_{IP} The man_i [_{VP} t_i snored]].

b. Unaccusatives: [_{IP} The man_i [_{VP} t_i fell t_i]].

A longer chain makes syntactic derivation more complex (Collins, 1995). In sum, the argument structure of unaccusative verbs, lacking an external argument, entails greater syntactic complexity than that of unergatives in that the type of argument associated with unaccusatives triggers a more complex syntactic derivation.

The selective verb production deficits seen in agrammatic aphasia provide some insight with regard to the locus of the deficit per models of sentence production (Bock, 1995; Bock & Levelt, 1994). According to these models, once a message is formulated by

a speaker, lexical selection occurs first at the functional processing level. At a later positional level, selected lexical entries are inserted into sentence frames. Importantly, lexical selection involves lemma selection, which for verbs entails accessing not only the verb, but also its associated grammatical information, including argument structure properties. Based on their data, Kim and Thompson (2000) suggested that verb production difficulty in agrammatic aphasia may be attributed, at least in part, to problems with lemma selection. However, given Thompson's (2003) data showing that unaccusative verbs which involve argument movement are more difficult to produce than unergatives in spite of the fact that the two verb types have the same number of arguments, post lemma level deficits are implicated. That is, mechanisms involved in positional-level computations (e.g. movement operations, phrase structure building) must be impaired.

The purpose of the present study was to investigate agrammatic aphasic subjects' comprehension and production of unaccusative and unergative verbs in sentences and to further consider the locus of verb deficits based on Bock and Levelt's model of sentence production. While previous studies have examined comprehension and production of single verbs using naming tasks, here we studied verbs in sentences which include arguments as well. Thus, results from this study were expected to reveal how agrammatic aphasic subjects would realize argument structures of different types of intransitive verbs in sentences. Aphasic subjects were predicted to have more difficulty producing sentences involving unaccusatives, which are more complex in terms of their argument structure representation than those involving unergatives.

1. Method

1.1. Subjects

Aphasic subjects. Eight English-speaking agrammatic aphasic subjects (two females and six males; mean age = 58.8 years) participated in the study. They were recruited from the subject pool of the Northwestern University Aphasia and Neurolinguistics Research Laboratory. All subjects were right-handed, with the exception of two males, and had at least a high-school education (mean = 17 years). None of the subjects had a history of prior neurological disease, drug or alcohol abuse, psychiatric disorders, developmental speech/language disorders, or learning disabilities. CT scans, which were available for six of the eight subjects, revealed that they had suffered a single, left hemisphere, thromboembolic stroke in the distribution of the middle cerebral artery; subject 4 also had a small old infarct in the right frontoparietal area. All subjects were between two and twelve years post-stroke at the time of the study, and had received varying amount and type of language treatment prior to the study. However, none had received treatment focused explicitly on verb argument structures. Testing of visual and hearing acuity showed abilities adequate for test performance.

Language testing. The diagnosis of aphasia was based on administration of the *Western Aphasia Battery* (WAB; Kertesz, 1982) and the *Northwestern Sentence Comprehension Test* (NSCT; Thompson, unpublished). Aphasia quotients (AQs) derived from the WAB ranged from 62.2 to 82.3 (mean = 76.5), with auditory-verbal comprehension, while

Table 1
Language testing scores

	S1	S2	S3	S4	S5	S6	S7	S8	Mean
<i>Western Aphasia Battery</i>									
Aphasia quotient	76.8	69.3	77.5	62.2	82.3	80	82.1	81.6	76.5
Fluency	4	5	5	5	5	5	6	6	5.1
Auditory comprehension	10	7.9	9.5	6.8	9.8	9.4	9.9	7.9	8.9
Repetition	6.9	7.9	7.4	5.4	7.0	10	8.3	9.0	7.7
Naming	8.5	5.9	7.9	6.9	9.4	7.6	7.9	8.9	7.9
<i>Northwestern sentence comprehension test (percentage correct)</i>									
Subject relatives	85	40	95		70	90	80	80	77.1
Object relatives	85	65	80		40	65	95	70	71.4
Actives	90	55	80		80	85	100	80	81.4
Passives	100	45	85		65	70	90	45	71.4

impaired, superior to verbal expressive ability. Results from the NSCT revealed that comprehension of object relatives and passives was more disrupted than comprehension of subject relatives and actives. The sentence production priming task in which production was elicited by modeling target sentence types with a non-target sentence indicated good production of actives, but poor production of passive and subject-raising structures. A summary of these results is reported in Table 1.

Control subjects. Five normal native speakers of English (one male and four females) also participated in the study to provide a baseline of normal performance. They were undergraduate students at Northwestern University (mean age = 19.7 years). None had a history of neurological, psychiatric, or developmental speech, language, or hearing problems.

1.2. Materials

Twenty-two sentences involving intransitive verbs (10 unaccusatives and 12 unergatives) were used for sentence production and comprehension tasks. Verbs were selected based on their written frequency of occurrence (mean frequency = 89 per million, range 23–239 for unaccusatives; mean frequency = 92 per million, range 1–431 for unergatives) (Francis & Kucera, 1982). These verbs were all monosyllabic and did not have a listing of noun usage greater than 25% of their frequency, with the exception of *fall* (unaccusative) and *run* (unergative). The target sentences are listed in Appendix A.

For each of the 22 sentences, black-and-white line drawings (8.5 × 11 inches) were prepared. Two sample stimuli involving each sentence type are shown in Appendix B. Norms for describing the pictured sentences were obtained from a group of five normal participants, who were tested individually. All of these participants (one male and four females) were native speakers of English and graduate students at Northwestern University. Only pictures that elicited target sentences without any difficulty from all normal subjects were used in the experiment. The same stimuli were used for both the comprehension and production tasks. For the production task, however, target verbs were printed below each picture.

1.3. Procedures

For comprehension and production tasks, three practice items were provided to establish that subjects understood each task. Since both tasks employed the same targets and pictures, the production task preceded the comprehension task.

All responses were scored as correct or incorrect on line. Those from both the production and comprehension sessions were tape-recorded, transcribed and analyzed by the examiner. Self-corrections occurring within the given time frame (10 seconds for comprehension, 30 seconds for production) were accepted. The two tasks were completed in two sessions both occurring within a 1–3 week period.

Elicited production task. In the production task, picture stimuli were presented one at a time in random order. For each picture, subjects were instructed to describe the picture using a complete sentence with the given verb. Only responses in which both the verb and nouns were produced in correct order were accepted as correct responses. Any verb form produced was counted as a correct response (e.g. *Dog barking*, *Dog bark*, and *Dog barks* were counted as a correct).

Comprehension task. The sentence comprehension task involved a truth-value judgment. In this task, subjects were presented with one picture at a time, which was accompanied by a spoken test sentence. They were then asked to indicate whether the sentence correctly described the picture by responding ‘Yes’ or ‘No’. All test sentences were grammatical; their truth-value depended on the situation depicted in the pictures and lexical substitution was used to create foil sentences. Transitive active sentences were also used as foils for unaccusative intransitive sentences.

1.4. Reliability

An independent research assistant scored all participant responses for both the comprehension and production tasks. Point-to-point agreement between the primary examiner and the independent scorer was 99% for both tasks.

1.5. Data analysis

Percentage correct comprehension and production of sentences involving each verb type was calculated for each subject. Group means were then computed for each sentence type. Differences between tasks, between sentence types, and between groups were analyzed using a series of repeated measures analyses of variance (ANOVAs) and paired-samples *t*-tests. An alpha level of $p < 0.05$ was set for all statistical tests.

2. Results

Mean percentage correct performance of subjects on comprehension and production tasks is shown in Table 2. A repeated measures three-way ANOVA revealed significant differences between the two tasks and between the two sentence types: subjects performed better on the comprehension task than on the production task ($F(1, 11) = 11.562$,

Table 2
Mean percentage correct (SD) comprehension and production tasks

	Aphasic subjects		Normal subjects	
	Unaccusatives	Unergatives	Unaccusatives	Unergatives
Comprehension	95(5.35)	95.9(11.67)	100	100
Production	73.8(23.87)	98(3.84)	96(5.48)	100

$p = 0.006$). They also showed better performance on unergative sentences than on unaccusatives ($F(1, 11) = 11.957$, $p = 0.005$). There were also significant interaction effects between subject groups and tasks ($F(1, 11) = 14.963$, $p = 0.048$) and between subject groups and sentence types ($F(1, 11) = 6.278$, $p = 0.029$), reflecting the fact that tasks and sentence types had an effect only on aphasic subjects. Normal subjects were not affected by those factors, performing equally well on both sentence types in both tasks.

2.1. Production

Mean percentage correct production by sentence type is shown in Fig. 1. Aphasic subjects produced unergative sentences significantly better than unaccusative sentences ($t(7) = -2.708$, $p = 0.030$): mean percentage correct production of the former was 98% (SD = 3.84; range = 91.7–100%), while mean percentage correct production of the latter was 73.8% (SD = 23.87; range 20–100%). Errors with unaccusatives mostly involved incorrect word order of the verb and argument. For instance, *Boil water* was produced for the picture of a pot of water boiling on a stove and *Bounce the ball* for the picture of a ball bouncing on the floor. Normal subjects had no difficulty producing either type of sentences, although they showed a slightly better performance on unergative sentences than on unaccusative sentences (100 versus 96% correct on average). The normal subjects'

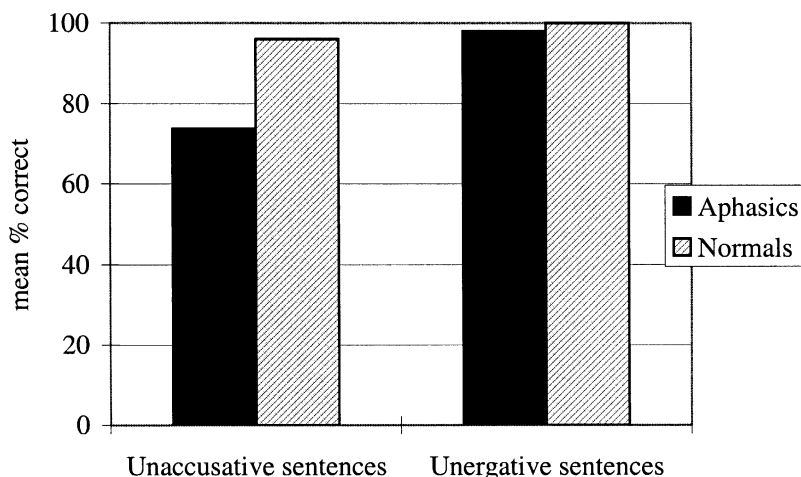


Fig. 1. Percentage correct production of unaccusative and unergative sentences by aphasic and normal subjects.

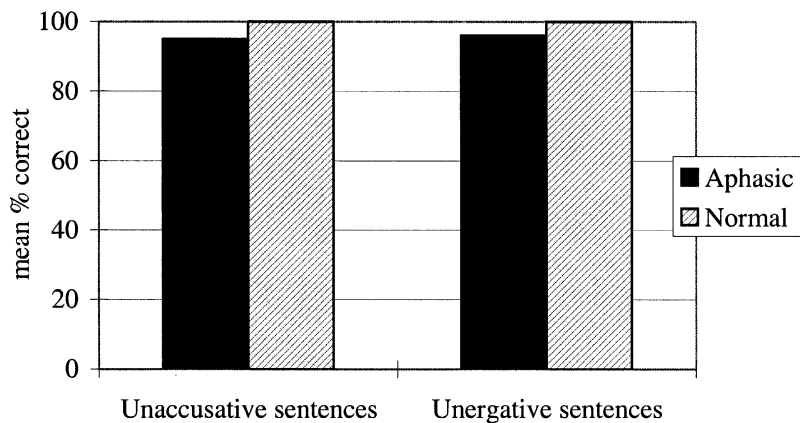


Fig. 2. Percentage correct comprehension of unaccusative and unergative sentences by aphasic and normal subjects.

errors largely consisted of production of adjectival passive sentences instead of targeted unaccusative sentences (e.g. *The egg is broken* instead of *The egg broke*). A repeated measures two-way ANOVA revealed a significant difference between the two subject groups ($F(1, 11) = 5.219, p = 0.043$).

2.2. Comprehension

In the comprehension task, aphasic subjects performed relatively well on sentences involving both unaccusative and unergative verbs, as shown in Fig. 2. Mean comprehension of unaccusative sentences was 95% (SD = 5.35), ranging from 90 to 100%, and comprehension of unergative sentences ranged from 70 to 100% with a mean of 95.9% (SD = 11.67). A paired-samples *t*-test showed no significant difference between these two types of sentences ($t(7) = -0.228, p = 0.826$). These results were not significantly different from those obtained from normal subjects ($F(1, 11) = 1.901, p = 0.195$).

3. Discussion

Results from this study examining production of intransitive verbs in sentences were consistent with previous studies by Kegl (1995) and Thompson (2003) showing that unaccusative intransitive verbs are selectively disrupted in agrammatic aphasic subjects. Specifically, as with single verbs, sentences involving unaccusative verbs presented production difficulty for agrammatic aphasic subjects, while those involving unergatives did not. This finding supports Kegl's Syntactically Enriched Verb Entry Hypothesis (SEVEH), which predicts difficulty with production of any construction that lacks an external argument and thus requires syntactic movement of the d-structure object to the subject position at s-structure. As discussed earlier, unaccusative verbs, unlike

unergatives, involve syntactic movement of an internal argument from the post-verbal position to the subject position, and therefore there is a mismatch between argument positions at d-structure and s-structure.²

The ASCH also correctly predicts our agrammatical subjects' better production of unaccusative as compared to unergative sentences. As discussed earlier, the argument structure of unaccusative verbs is more complex than that of unergatives in terms of the type of arguments. Although both types of verbs involve subject movement from the VP-internal position to Spec of IP, unaccusatives involve additional movement of the internal argument: with no external argument, the internal argument must move from a post-verbal position to Spec of IP via Spec of VP, leaving a longer chain between the original and the moved positions. Consequently, under ASCH, sentences involving unaccusatives are more complex than those with unergative verbs and are, therefore, more difficult to produce.

The SEVEH, however, does not account for the effect of the number of arguments associated with the verb on sentence production noted in our studies. As previously noted, we have found in a number of studies (Kim & Thompson, 2000; Thompson et al., 1995, 1997) that production difficulty increases as the number of arguments associated with the verb increases. In addition, in a recent study investigating psychological (psych) verb production (notably, in the same agrammatical individuals who participated in the present study), we found that *frighten*-type psych-verbs are more difficult to produce than unaccusatives (*mean* = 49% correct for *frighten*-type psych-verbs; versus *mean* = 74% correct production of unaccusatives) ($t(7) = 3.648, p = 0.008$) (see Thompson and Lee, in preparation). As shown in (4), the argument structure of *frighten*-type verbs, like unaccusatives, lacks an external argument and thus Accusative Case cannot be assigned (Burzio, 1986). Therefore, *frighten*-type psych-verbs involve movement of a post-verbal argument in the object position to Spec of IP (Belletti & Rizzi, 1988), yielding a mismatch between d-structure and s-structure configurations.³ The crucial difference, then, between unaccusatives and *frighten*-type psych-verbs is that the latter has a greater number of arguments.

² Kegl claims that the SEVEH is compatible with the VP-internal subject hypothesis, according to which both unaccusative and unergative verbs involve syntactic movement of their single argument from the VP internal position to the subject position (i.e. Spec of IP). As shown below, however, there is no permutation in the structural arrangements of the verb and argument between d-structure and s-structure of unergative verbs although the argument is displaced from the lexically specified VP-internal position. Accordingly, the SEVEH still predicts that agrammatical aphasic individuals have production difficulty only with unaccusative verbs which display the configurational discrepancy between d-structure and s-structure.

	(a) Unergative verbs	(b) Unaccusative verbs
d-structure	[_{IP} [_{VP} NP V]]	[_{IP} [_{VP} V NP]]
s-structure	[_{IP} NP[_{VP} e V]]	[_{IP} NP[_{VP} V e]]

³ Recent theories have shown that both *frighten*-type and *fear*-type psych-verbs have an external argument. Pesetzky (1995), for example, argues that both types behave syntactically alike, not being different from agentive transitive verbs in that the external argument maps onto the subject and the internal argument onto the object. Accordingly, neither type involves argument movement as shown in Belletti and Rizzi (1988). The difference between the two types lies in the thematic role of their external argument: an experiencer for *fear*-type and a causer for *frighten*-type. However, it is worth noting that in these theories, *frighten*-type verbs involve extra syntactic processing to assign the causer role to the subject. In other words, *frighten*-type psych verbs can still be considered syntactically more complex than *fear*-type verbs.

- (4) a. Unaccusative verbs: ⟨y⟩ [_{VP} V NP]
 b. *Frighten*-type psych-verbs: ⟨y, z⟩ [_{VP} V NP NP]

On Kegl's theory, unaccusatives and *frighten*-type psych-verbs should be similarly impaired because very similar syntactic movement is required for both. Our data show, however, that this is not the case. The ASCH, which states that agrammatic aphasic individuals have more difficulty with verbs that have more complex argument structures in terms of both the number and the type of arguments, predicts the noted discrepancy between these two verb types.

The difficulty that agrammatic subjects encountered with unaccusative sentences was observed only in production; their comprehension was near normal for both types of sentences as noted in previous studies (Kim & Thompson, 2000; Piñango, 2000; Thompson, 2003).⁴ These findings suggest that the argument structure representation of unaccusative verbs as well as other verbs is unimpaired in agrammatism and normally accessed in comprehension. The observed dissociation between production and comprehension, then, raises the question of what underlies these patients' impoverished production of unaccusative sentences. Kim and Thompson (2000) suggested that access to intact entries at the lemma level (per Bock and Levelt's (1994) model) is impaired. Their agrammatic aphasic individuals performed near-normally on grammaticality judgment and comprehension tasks, but had difficulty categorizing verbs by argument structure and verbs with more arguments were more impaired than those with fewer in production tasks. If the verbs' lexical entry is not completely available during production attempts, then details relevant to the syntactic properties of the verb, such as subcategorization information, would be unavailable and function assignment could not proceed normally. In sentence production, the consequence would be production of fewer arguments than required by the verb and/or incorrect thematic role assignment to the selected argument structure elements.

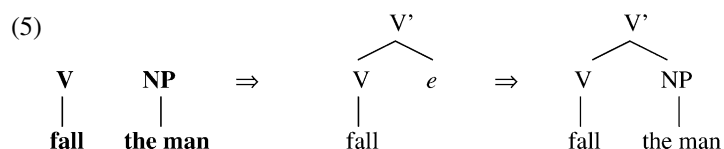
However, the error data derived from the present study indicated that our agrammatic aphasic subjects made predominantly word order errors for unaccusative sentences (e.g. *Bounce the ball* for *The ball bounced*), indicating successful access to the argument structure of the verbs. Further, proper function assignment can also be inferred since in English, arguments assigned a theme role are typically placed in the object position (Baker, 1988); a theme-marked argument in the object position (e.g. *Bounced ball_{THEME}*), even if ungrammatical, indicates that the process of function assignment is not disrupted. Another possibility, then, is that syntactic operations occurring at the post lemma level are disrupted. The verb and verb argument structures were accessed at the lemma level, but the necessary movement of the post-verbal argument of unaccusatives to the subject position failed to operate after the lemma level. Although sentence production models do not specify exactly where syntactic operations such as argument movement occur, Thompson and Faroqi-Shah (2002), based on acquisition and generalization patterns noted when training agrammatic

⁴ We note that the unaccusative verbs that we tested for comprehension are optionally transitive (e.g. the boy bounces the ball). Comprehension of the transitive form was very high (*mean* = 93%; range 86–100%).

patients to produce noncanonical sentences, suggested that argument movement in deriving grammatical surface structures is part of post lemma level processing that helps to derive sentence frames.

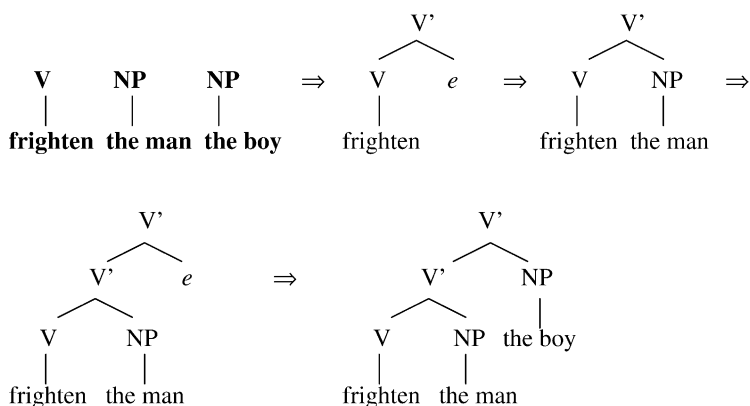
We note, however, that some unaccusatives such as *bounce* and *boil* are optional two-place verbs, which can take either a single (internal) argument, or an external argument and an internal argument, as in *The man bounced the ball*. Unaccusatives are, therefore, more complex than unergatives, not only because their argument structure entry triggers more complex syntactic movement, but also because there are two entries, rather than just one (V Theme; Agent V Theme). Given this, it is possible that the unaccusative verb effect noted here and in previous studies is related to the number of possible argument structure arrangements. It is also possible that the V NP error pattern noted in our patients may reflect subjects' unsuccessful attempts to produce the transitive form of the verb (which is the more frequently occurring of the two forms), a pattern suggesting a lemma level deficit. Considering, however, that the stimulus pictures for unaccusatives only showed one object in the absence of an actor, we excluded this possibility. Our subjects were instructed to describe stimulus pictures only using the verb label and the names of the objects depicted in the pictures. In fact, our subjects never dropped the agent subject when describing pictures showing two people as in *The artist chased the thief*. Further, if the lemma access were impaired, our subjects would be expected to drop either the agent subject as in *Bounced the ball* or the theme object as in *The boy bounced*, which did not occur in our data set: only V NP errors were noted. In addition, we note that neither *frighten*-type and *fear*-type psych-verbs are optional verbs; that is, the lexical entries for both psych-verb types entail two, and only two arguments. Indeed, our psych-verb data show a discrepancy between production of the two types of psych-verbs, with *frighten*-type verbs, which trigger more complex syntactic operations, presenting more difficulty for production than *fear*-type verbs. We, therefore, conclude that the unaccusative effect noted here cannot be fully explained by their optional argument structure status.

We suggest that a unitary deficit underlies both unaccusative and *frighten*-type psych-verb production deficits. Because psych-verbs have more arguments than unaccusatives, the former involve a more complex phrase structure building process at the post lemma processing level, and are therefore more difficult to produce than unaccusatives. In the GB approach, phrase structures are built up in a bottom-up way. Hence, when a verb lemma is selected from the lexicon, its argument structure is also activated as shown below. In building the phrase structure of a verb with one argument, the verb is first projected to V', which has two daughters, the head V and an empty position (*e*). Next, the empty position is replaced by an NP tree.



If the verb has two internal arguments, another projection of V' is added and its empty position is filled with an additional NP.⁵

(6)



Thus, it can be assumed that *frighten*-type psych-verbs with two arguments are more complex than unaccusative verbs with a single argument in phrase structure building.

The verb production difficulty hierarchy based on the number of arguments found by Thompson and colleagues can also be explained by the degree of complexity involved in the phrase structure building process. In particular, since all the verbs used in their study had an external argument and involved no movement of a post-verbal argument (i.e. ditransitives, transitives, and intransitives), the verb retrieval deficits are not likely to be related to the movement operations. Rather, as shown in their observation that some subjects produced a sentence during single verb production attempts and also when categorizing verbs by type, even single verb production appears to activate the verbs' argument structures and may involve phrase structure building processes.

In sum, our data suggest that the verb and its argument structure influence sentence production in agrammatic aphasia. Agrammatic aphasic subjects' sentence production can be disrupted when the verbs' argument structures are complex in terms of the number and type of arguments, as the ASCH claims. The number of arguments associated with the selected verb lemma affects the phrase structure building process: a greater number of arguments require more steps in building the planned phrase frames. The type of arguments also affects subsequent syntactic operations: lack of an external argument triggers movement of an internal argument from a post verbal position to Spec of IP through Spec of VP, entailing a syntactically longer chain than verbs with an external argument encoded in their lexical entry. Given that both phrase structure building and movement operations occur once lexical selection has been accomplished, we suggest that sentence production in agrammatic aphasia is disrupted at levels of processing subsequent to lemma access.

⁵ Recent theories propose a different tree structure for *frighten*-type psych-verbs within the minimalist framework (Pesetzky, 1995). In this paper, however, we will adopt Belletti and Rizzi's (1988) analysis, where the subject of *frighten*-type psych-verbs is base-generated in the object position, putting aside further discussion of this matter.

4. Conclusion

Results of this study provide further evidence that agrammatic aphasic subjects have selective impairment in production of verbs, and that the complexity of the verbs' argument structure accounts for the impoverished sentence production observed in these subjects. Unaccusative verbs have a more complex argument structure than unergative verbs in terms of the type of argument, and thus present agrammatic subjects with more difficulty in sentence production. This difficulty, however, does not appear to be due to impaired representation of the verbs' argument structure, or an inability to access this representation at the lemma level of processing. Considering the near-normal comprehension of unaccusative sentences and error patterns, the lexical-syntactic representation of the verbs appears to be not only intact but also accessed in production. We thus suggest that disruption at the post lemma level of processing is responsible for the impoverished sentence production in agrammatic subjects. We conclude that complex argument structures of unaccusative verbs hinder appropriate processing at levels of production following the lemma level, presenting difficulty for agrammatic subjects.

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Appendix A. List of target sentences

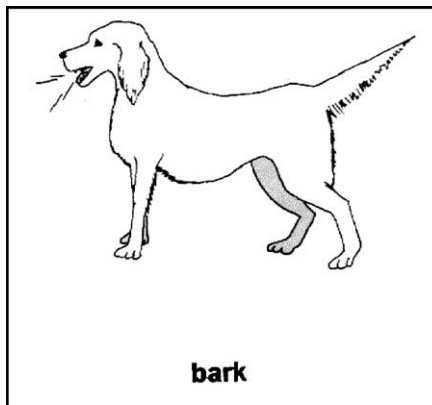
Unaccusative sentences⁶

1. The boat is sinking.
2. The egg is breaking.
3. The ball is rolling.
4. The snowman is melting.
5. The man is falling.
6. The tube is floating.
7. The book is dropping.
8. The car is crashing.
9. The ball is bouncing.
10. The water is boiling.

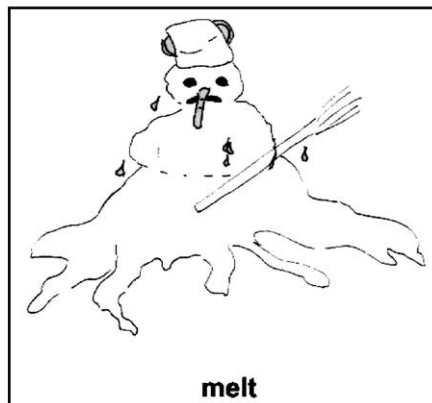
⁶ Haegeman (1994: 335–336) claims that the verbs that have an accusative counterpart are not unaccusative verbs (e.g. *The boat sank* and *They sank the boat*). She refers to those verbs such as *sink*, *break*, and *drop* as ergatives, following suggestions by Belletti (1988: 4, 14). In this paper, however, we classify all verbs whose single argument is assigned the theme role as unaccusatives, based on Burzio (1986), Levin and Rappaport-Hovav (1995) and Perlmutter (1978).

Unergative sentences

1. The dog is barking.
2. The girl is winking.
3. The man is snoring.
4. The girl is sitting.
5. The man is swimming.
6. The boy is running.
7. The boy is praying.
8. The boy is jumping.
9. The man is laughing.
10. The boy is crying.
11. The baby is crawling.
12. The man is sneezing.

Appendix B. Sample stimuli (for Production task)

Unergative



Unaccusative

References

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