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Semantic Aspects of Verb Production in Various Discourse Tasks in People With Nonfluent Aphasia

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ABSTRACT

Purpose: The purpose of this study was to investigate how people with nonfluent aphasia produce semantically weighted verbs compared to people without aphasia, as well as how a discourse elicitation task affects verb production in people with nonfluent aphasia and people without aphasia.
Method: This study included 30 people with nonfluent aphasia and 32 age-matched people without aphasia from AphasiaBank. Language samples of five different discourse tasks were obtained and coded for heavy, light, and *be*-copular verbs. The number of verbs per utterance and the proportion of heavy, light, and *be*-copular verbs were compared between groups and between tasks.
Results: People with nonfluent aphasia showed a similar proportion of heavy verbs but reduced verbs per utterance and proportion of light verbs compared to people without aphasia. With regard to discourse task effects, we found a trend for a higher proportion of heavy verbs in sequential picture descriptions, and a higher proportion of *be*-copular verbs and lower proportion of heavy verbs for a recount compared to other tasks in people without aphasia. The discourse task effects were minimally found in people with nonfluent aphasia.
Conclusions: Our results suggest that people with nonfluent aphasia present with relatively preserved heavy verb production but with impaired production of light verbs in discourse. In addition, it appears that discourse tasks do not significantly influence the type of verbs produced by people with nonfluent aphasia possibly due to the floor effects and wide range of individual variability. This study is a preliminary effort to evaluate methodological factors that impact verb production; future studies are needed to develop a framework for clinical decision making when selecting a discourse elicitation task for people with aphasia.

People with nonfluent aphasia often present with more difficulty retrieving verbs than nouns (Bastiaanse & Jonkers, 1998; Benetello et al., 2016; Berndt et al., 2002). One possible explanation for this phenomenon is that verb production requires semantic skills to understand the meaning, as well as morphosyntactic skills to manage various morphological variations for subject–verb agreement, carrying tense and mood information, and so forth. Although it is known that people with nonfluent aphasia have relatively preserved semantic skills (Goodglass et al., 2001), their limited morphosyntactic skills often reduce opportunities to use various types and forms of verbs (Barde et al., 2006; Cho-Reyes & Thompson, 2012; Thompson et al., 2013).

The current literature classifies verbs as heavy or light based on their semantic weights (i.e., how they carry specific meanings) and morphosyntactic demands required to construct a sentence. Heavy verbs are defined as verbs that provide semantically specific representations of the event schema (e.g., *bake*) carrying many semantic features of the meaning; therefore, producing this type of verb

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requires strong semantic skills (Gordon, 2008). On the other hand, light verbs are defined as providing semantically simple and vague representations (e.g., *do, make*; Jespersen, 2013; Kegl, 1995). They often require a sequential ordering of words to convey the full meanings (e.g., *make it happen*), which increases their morphosyntactic complexity. A balance of various types of verbs and the ability to select appropriate verbs based on the goals of communication is critical for natural communication and an important issue to evaluate in people with aphasia. Production of heavy verbs can enrich language by providing specific meanings and allow for the use of diverse lexical items (Thordadottir & Weismer, 2001). In addition, evaluating heavy verb production with its appropriate argument structures can provide insight on the semantic skills of the speaker, because the more semantically specific verbs restrict the argument features to appropriately fill the thematic role (Jackendoff, 1991; Morean, 2017; e.g., *bake* is appropriate for a *cupcake* but not a *chair*, whereas *make* can be appropriate for both *cupcake* and *chair*). On the other hand, frequent use of light verbs may indicate limited lexical diversity of verbs. Light verbs include a limited set of high-frequency verbs that have less specified semantic meanings. Overreliance on light verbs could indicate difficulty with specific verb retrieval, and repetitive use of light verbs can result in semantic simplification of the language context (Thordadottir & Weismer, 2001). However, because light verbs require variations of the noun phrase to compensate for the verb's reduced semantic specification, the appropriate use of light verbs could indicate the ability of complex morphosyntactic skills (Gordon, 2008). Therefore, a balance of the two types of verbs is critical for natural conversation, and evaluating each type of verb production can provide clinically useful information about the semantic and syntactic skills of people with aphasia.

The discrepancy between the semantic and morphosyntactic requirements of heavy and light verb production can impact people with nonfluent aphasia when producing these two types of verbs. Some studies suggest that people with nonfluent aphasia can produce heavy verbs but have difficulty with light verb production (Bencini & Roland, 1996; Gordon, 2008; Gordon & Dell, 2003). For example, Gordon (2008) showed that people with nonfluent aphasia used more heavy verbs than people with fluent aphasia in discourse samples elicited by picture description. However, inconsistent results have also been reported when the language task was structured and controlled for verb selections (Barde et al., 2006; Breedin et al., 1998; Morean, 2017). Morean (2017) presented a prerecorded story with either light or heavy verbs and asked a participant to complete a sentence using the verb presented in the story. They found people with nonfluent aphasia performed worse than controls but similar to participants with fluent aphasia in their ability to produce heavy and light verbs. Within the group of nonfluent aphasia, no difference between light and heavy verb production was reported. Barde et al. (2006) used a similar story completion task and showed that people with nonfluent aphasia produced fewer light verbs compared to fluent aphasia but produced heavy verbs similarly to fluent aphasia. In addition, within the group of nonfluent aphasia, there was no difference in production of heavy and light verbs. Breedin et al. (1998) reported a tendency for better production of heavy verbs than light verbs when people with nonfluent aphasia complete a sentence using previously prompted verbs, but the findings were not statistically significant. The inconsistency in the past literature is likely related to the language tasks used to elicit verb production. For example, sentence completion requires different cognitive processes, such as memory to recall the verb (Breedin et al., 1998), whereas verb production in spontaneous retrieval is associated with other demands (e.g., sentence construction, topic maintenance).

Evaluating verb production skills in discourse is a functional goal for people with nonfluent aphasia in order to understand their verb production patterns. However, to our knowledge, Gordon (2008) is the only study that has evaluated heavy and light verb production in the connected speech of people with nonfluent aphasia. There are two other studies that measured heavy and light verb production in connected speech from picture description samples (Dipper et al., 2018) and quality-of-life interview recounts (Cruice et al., 2014; Dipper et al., 2018). However, their participants displayed all types of aphasia and were not limited to nonfluent aphasia. In addition, Gordon compared nonfluent aphasia to fluent aphasia but not to people without aphasia and had a small sample size (eight people in each group). Therefore, it was the first aim of this study to replicate Gordon's study with a larger sample size of people with nonfluent aphasia and compare their heavy and light verb production to people without aphasia.

Clinically, various discourse elicitation tasks are being used to obtain language samples from people with aphasia, such as asking about personal episodes or opinions, requesting the generation of a story based on a picture or familiar story (e.g., fairytale story or TV show). With varying topics and instructions, each discourse may be associated with different types and levels of cognitive–linguistic demands for speakers. For example, presenting a visual stimulus can constrain lexical diversity (Shadden et al., 1991) but also provide a visual cue to facilitate producing the specific verb (Dell et al., 1997; Doyle et al., 1995; Howard et al., 2006). In addition, the presence of a picture stimulus can provide a scaffold of a story and

reduce the load of working memory, planning, and organization for a speaker who has limited resources for their speech production such as people with aphasia (Fergadiotis & Wright, 2011). Therefore, they may benefit from a picture stimulus to produce more content and diverse lexical items (Fergadiotis et al., 2011). The task instructions can also affect the language performance of speakers. Evidence suggests that when speakers are asked to describe a picture scene versus generating a story about the picture, they tend to produce less diverse lexical items and less diverse types of verb tense (Olness, 2006; Wright & Capilouto, 2009), simpler story grammar (Armstrong, 2000, 2005), and simpler syntactic structure (e.g., "there is a girl," "it is a kite"). Lastly, the familiarity of the topic and complexity of the story grammar can also impact the demands of the discourse task (Richardson et al., 2021). Stimuli that require many episodes and/or the integration of many characters require greater organization and ability to understand/convey the relationships of the characters. Therefore, a higher level of executive functioning skills and working memory would be required (Cahana-Amitay & Jenkins, 2018). Typically, a recount or storytelling task involves complex episodes and memory demands and, therefore, are considered more demanding for speakers compared to picture descriptions (Fergadiotis & Wright, 2011).

People with nonfluent aphasia, who have reduced cognitive–linguistic skills, may be sensitive to the increased cognitive–linguistic demands associated with a discourse task. Dipper et al. (2018) investigated this task-related issue by comparing two discourse types (picture description vs. recounts) and suggested no task effects on heavy and light verb production. However, their study included people with all subtypes of aphasia. If people with nonfluent aphasia have difficulty with light verb production due to their limited morphosyntactic skills, this difficulty could become more apparent in tasks that are more cognitively linguistically demanding, such as storytelling. Therefore, the second aim of this study was to determine whether the heavy and light verb production of people with nonfluent aphasia is differently affected by various discourse tasks compared to people without aphasia.

In summary, the purpose of the study was to investigate how people with nonfluent aphasia produce different types of verbs. To accomplish this, we specifically aimed to evaluate (a) how people with nonfluent aphasia produce heavy and light verbs compared to people without aphasia and (b) how various discourse tasks affect the heavy and light verb production of people with nonfluent aphasia compared to people without aphasia. Our specific hypotheses were

(a) people with nonfluent aphasia would produce a similar proportion of heavy verbs but lower proportion of light verbs than people without aphasia on all discourse tasks, and

(b) people with nonfluent aphasia would show a greater reduction of light verb production on cognitive–linguistically demanding tasks (e.g., storytelling) than less demanding tasks (e.g., picture description) compared to people without aphasia.

Method

Participants

In total, 30 people with nonfluent aphasia (29 Broca's and one transcortical motor) and 32 people without aphasia who were matched for age, $t(60) = 1.851$, $p = .069$, and years of education, $t(60) = 1.976$, $p = .053$, were selected from AphasiaBank (MacWhinney et al., 2011). We purposely selected participants with moderate to severe nonfluent aphasia based on the Aphasia Quotient (AQ) from the Western Aphasia Battery–Revised (Kertesz, 2007) in order to obtain analyzable language samples at a discourse level and to minimize potential variability by excluding the two extreme ends of the Western Aphasia Battery–Aphasia Quotient (WAB-AQ; mild and very severe). All people without aphasia, except for five participants whose MMSE scores were not provided in AphasiaBank, scored at or above the median score on the Mini-Mental State Examination (MMSE) based on their age and years of education (based on Crum et al., 1993, p. 2389). All people without aphasia whose MMSE scores are available received 28 or higher MMSE. Those whose MMSE scores were not available were categorized as the group without aphasia based on their report of no history of stroke, head injury, or neurological condition, no diagnosis of communication disorders, no depression, and good general health condition. All participants were monolingual native English speakers with adequate vision and hearing. See Table 1 for a summary of demographic information.

Discourse Language Samples

We included five discourse samples that are commonly used in research and clinic to maximize ecological validity: Event recount, Window and Umbrella sequential picture descriptions, Cat single-picture description (Nicholas & Brookshire, 1993), and Cinderella storytelling. The transcript of each discourse sample was obtained from AphasiaBank (MacWhinney et al., 2011). The Event prompt was, "Tell me a story about something important that happened to you in your life." For Window, Umbrella, and Cat tasks, each participant was provided with a visual stimulus and asked to tell a story with a beginning,

Table 1. Demographic summary of two groups of participants.

Variable	People with nonfluent aphasia	People without aphasia
Sex	19 men and 11 women	16 men and 16 women
Age (years)	59.82 ± 9.46	64.65 ± 10.97
Years of education	14.57 ± 2.13	15.72 ± 2.44
WAB-AQ	55.53 ± 10.90 (range: 32.4–72.2)	—
MMSE	—	29.67 ± 0.62 (range: 28–30)

Note. Em dashes indicate data not available. WAB-AQ = Western Aphasia Battery–Aphasia Quotient; MMSE = Mini-Mental State Examination.

middle, and end. For the Cinderella task, the wordless picture book of Cinderella was provided to participants (and removed prior to telling the story), and they were then asked to generate the story from their memory. Full descriptions of the task instructions and detailed guidelines for AphasiaBank transcriptions are provided at aphasia.talkbank.org.

Verb Coding

All transcriptions were downloaded as chat files from AphasiaBank and copied into a spreadsheet. Each utterance was parsed according to the guidelines established by AphasiaBank. According to the manual, AphasiaBank requires that utterances be parsed based on a hierarchy of indices: syntax, intonation, pause, and semantics following the guidelines described by Saffran et al. (1989). The researchers then identified all verbs including finite (main verbs in an independent clause) and nonfinite verbs (not main verbs in an independent clause, e.g., "I like swimming," "I want to go") in each task. Of the verbs, we excluded the ones that were (a) automatic speech (e.g., "you know"), (b) unrelated to the task (e.g., "I don't know what it is"), (c) incomplete as only the auxiliary verb was produced without a main verb (e.g., "I would (go) home"), (d) immediately repeated (e.g., "this is is"), and (e) self-interrupted or revised (e.g., "she is was"). We included all other verbs regardless of whether they were grammatically and/or semantically correct and counted how many total verbs were produced.

All included verbs were classified into three categories based on semantic weight: heavy verb (providing specific semantic representations), light verb (providing vague and nonspecific semantic representation), and *be*-copular (providing no semantic representations, linking verbs). Similar to other studies (Gordon, 2008; Kintz & Wright, 2022), the following nine verbs were categorized as light: *come*, *do*, *get*, *give*, *go*, *have*, *make*, *put*, and *take*. However, unlike previous studies, we classified *be*-copular verbs separately from light verbs because *be*-copular verbs contain even less semantic specification than light verbs because they function to connect a subject to its predicate(s). All other verbs were categorized as heavy verbs.

Verb Coding Reliability

Two undergraduate students were trained by the first author on the criteria for verb inclusion/exclusion and semantic classification. Of the 62 participants, 10 (16%) participants' transcriptions (all five discourse tasks) were randomly selected to assess interrater reliability. Item-by-item agreement comparison was conducted by comparing the first author's coding with each of the undergraduate raters. The average agreement was 98.42% for verb inclusion/exclusion coding and 88.11% for semantic classification. The raters and the first author discussed the disagreed upon coding and reached a consensus. The transcripts from a random selection of six (9.7%) participants were recoded at least 3 months after the initial coding to evaluate intrarater reliability. They reported 98.53% for verb inclusion/exclusion coding and 99.78% for semantic classification.

Analysis

The number of total verbs, heavy verbs, light verbs, *be*-copular verbs, and total utterances in each task was counted. Four measures were then calculated using these values. Proportion of heavy verbs was calculated by dividing the number of heavy verbs by the number of total verbs in each task. Proportion of light verbs was calculated by dividing the number of light verbs by the number of total verbs in each task. Proportion of *be*-copular verbs was calculated by dividing the number of *be*-copular verbs by the number of total verbs in each task. Verbs per utterance was calculated by dividing the number of total verbs by the number of total utterances in each task.

Because the dependent variables did not meet the assumption of normal distribution, we transformed the data of each dependent variable using the log transform function. Transformed values were calculated using the formula $Y = \log(x + 1)$ and then analyzed using a generalized linear mixed model (GLMM) for each measure using IBM SPSS Statistics (ver. 29). Group and task were included as a fixed effect, and individual participants were included as a random effect. Multiple comparisons with pairwise contrasts were adjusted by Bonferroni corrections. It should be noted that the transformation improved

the data distribution but not all variables were normally distributed based on the Kolmogorov–Smirnov (K-S) tests, even after the transformation. Curran-Everett (2018) argued that the log transformation may not improve skewness of the data but improve theoretical distribution to be normal. Furthermore, Schielzeth et al. (2020) evaluated violations of distribution assumption in linear mixed models and reported that skewed data of fixed and random effects caused minimal bias on the results. However, they also pointed out that this violation may increase prediction errors; therefore, we suggest that this be taken into account during interpretation.

Additional analyses were conducted to contextualize how verb production of people with nonfluent aphasia can be further explained in context with their overall language characteristics. The number of utterances were compared between groups using Mann–Whitney *U* because the data were not normally distributed. Spearman's correlations were conducted to investigate whether the WAB-AQ was correlated with the variables.

Results

Verbs per Utterance

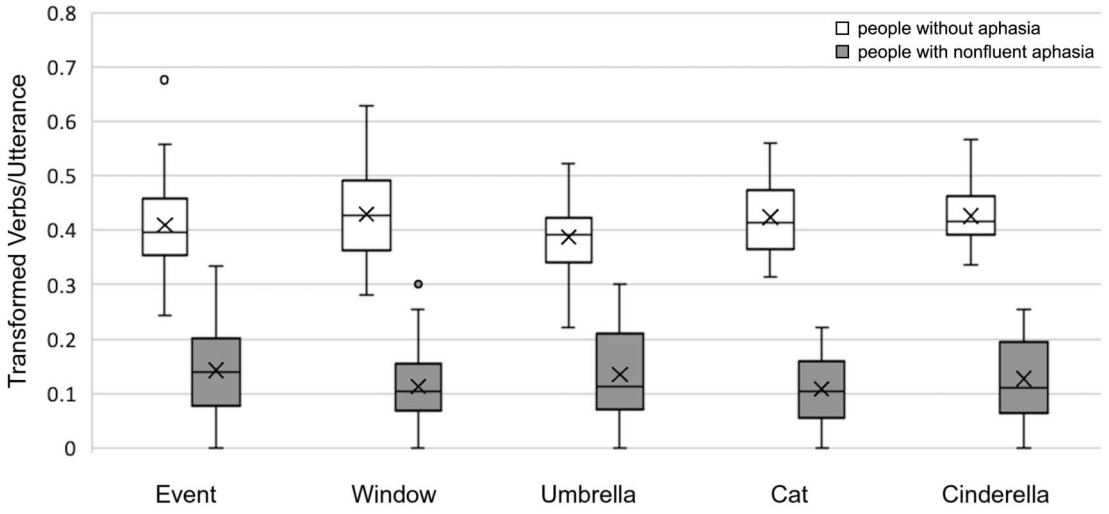
We found a significant group effect, $F(1, 300) = 37.947$, $p = .000$, where people without aphasia produced significantly more verbs per utterance than people with nonfluent aphasia. Although the task effects were not significant, $F(4, 300) = 1.306$, $p = .268$, the interaction between group and task was significant, $F(4, 300) = 4.228$, $p = .002$. Between groups, people without aphasia produced more verbs per utterance than people with nonfluent aphasia, and this difference was shown in all tasks ($p = .000$ for all tasks). See Table 2 and Figure 1. In people without aphasia, the verbs per utterance for Umbrella were fewer than all other tasks. In people with nonfluent aphasia, no task was significantly different from others (see Table 3). In addition, the average number of utterances in each group were reported in Table 4.

Table 2. Means and standard deviations of verb measures in discourse tasks in people without aphasia and people without nonfluent aphasia.

Measure	Task	People without aphasia		People with nonfluent aphasia		Adjusted *p* value
		Raw	Transformed	Raw	Transformed	
Verbs/Utt	Event	1.615 ± .566	.409 ± .084	.414 ± .273	.143 ± .081	.000
	Window	1.737 ± .534	.429 ± .083	.317 ± .244	.113 ± .077	.000
	Umbrella	1.468 ± .380	.387 ± .066	.392 ± .294	.135 ± .087	.000
	Cat	1.688 ± .447	.424 ± .070	.298 ± .209	.108 ± .069	.000
	Cinderella	1.687 ± .326	.426 ± .050	.359 ± .230	.127 ± .073	.000
	Total	1.639 ± .463	.415 ± .073	.330 ± .246	.125 ± .078	.000
%Heavy	Event	.499 ± .170	.173 ± .051	.495 ± .330	.164 ± .097	.173
	Window	.664 ± .158	.219 ± .041	.644 ± .329	.206 ± .096	.094
	Umbrella	.596 ± .129	.202 ± .036	.615 ± .360	.196 ± .106	.155
	Cat	.590 ± .111	.200 ± .031	.540 ± .289	.180 ± .086	.027
	Cinderella	.557 ± .070	.192 ± .020	.572 ± .311	.188 ± .088	.203
	Total	.581 ± .141	.197 ± .040	.574 ± .337	.187 ± .094	.003
%Light	Event	.255 ± .100	.097 ± .035	.153 ± .158	.058 ± .056	< .001
	Window	.194 ± .114	.075 ± .040	.083 ± .139	.031 ± .052	< .001
	Umbrella	.308 ± .136	.114 ± .045	.150 ± .219	.054 ± .076	< .001
	Cat	.272 ± .119	.103 ± .041	.153 ± .195	.056 ± .070	< .001
	Cinderella	.288 ± .057	.110 ± .020	.210 ± .196	.077 ± .069	< .001
	Total	.263 ± .114	.100 ± .039	.172 ± .232	.056 ± .066	.000
%Be	Event	.246 ± .140	.093 ± .047	.352 ± .327	.119 ± .103	.433
	Window	.142 ± .102	.056 ± .038	.273 ± .281	.096 ± .091	.074
	Umbrella	.096 ± .074	.039 ± .029	.235 ± .320	.080 ± .099	.057
	Cat	.138 ± .104	.055 ± .039	.308 ± .279	.107 ± .091	.017
	Cinderella	.156 ± .060	.062 ± .022	.218 ± .228	.079 ± .077	.686
	Total	.156 ± .110	.061 ± .040	.254 ± .287	.096 ± .093	.005

Note. *p* values were adjusted with Bonferroni correction. Adjusted *p* values were calculated based on transformed data. Verbs/Utt = verbs per utterance; %Heavy = proportion of heavy verbs; %Light = proportion of light verbs; %Be = proportion of *be*-copular verbs.

Figure 1. Transformed verbs per utterance box plots in discourse tasks in people without aphasia and people without nonfluent aphasia.



Proportion of Heavy Verbs

There were no significant group effects, $F(1, 289) = 0.010$, $p = .920$, or interaction between group and task, $F(4, 289) = 0.221$, $p = .926$. We found significant task effects, $F(4, 289) = 4.836$, $p < .001$. In people without aphasia, proportion of heavy verbs was higher for Window than Event and Cinderella. In people with nonfluent aphasia, proportion of heavy verbs was higher for Window and Umbrella than Event. See Figure 2, and Tables 2 and 3.

Proportion of Light Verbs

There were significant group effects, $F(1, 289) = 24.000$, $p < .001$, and task effects, $F(4, 289) = 6.736$, $p < .001$. However, the interaction between group and task

Table 3. Verb measure comparisons between discourse tasks in each group.

Group	Task	Comparison	Verbs/Utt	%Heavy	%Light	%Be
People without aphasia	Event	vs. Window	$p = .806$	$p = .009$	$p = .287$	$p = .083$
		vs. Umbrella	$p = .791$	$p = .349$	$p = .662$	$p = .002$
		vs. Cat	$p = 1.000$	$p = .381$	$p = 1.000$	$p = .070$
		vs. Cinderella	$p = 1.000$	$p = 1.000$	$p = 1.000$	$p = .238$
	Window	vs. Umbrella	$p = .022$	$p = 1.000$	$p = .003$	$p = 1.000$
		vs. Cat	$p = 1.000$	$p = 1.000$	$p = .092$	$p = 1.000$
		vs. Cinderella	$p = 1.000$	$p = .381$	$p = .014$	$p = 1.000$
	Umbrella	vs. Cat	$p = .062$	$p = 1.000$	$p = 1.000$	$p = 1.000$
		vs. Cinderella	$p = .041$	$p = 1.000$	$p = 1.000$	$p = .603$
	Cat	vs. Cinderella	$p = 1.000$	$p = 1.000$	$p = 1.000$	$p = 1.000$
People with nonfluent aphasia	Event	vs. Window	$p = .286$	$p = .073$	$p = .110$	$p = 1.000$
		vs. Umbrella	$p = 1.000$	$p = .519$	$p = 1.000$	$p = .164$
		vs. Cat	$p = .132$	$p = 1.000$	$p = 1.000$	$p = 1.000$
		vs. Cinderella	$p = 1.000$	$p = 1.000$	$p = .293$	$p = .164$
	Window	vs. Umbrella	$p = .767$	$p = 1.000$	$p = .137$	$p = 1.000$
		vs. Cat	$p = 1.000$	$p = .666$	$p = .164$	$p = 1.000$
		vs. Cinderella	$p = 1.000$	$p = 1.000$	$p = .000$	$p = 1.000$
	Umbrella	vs. Cat	$p = .425$	$p = 1.000$	$p = 1.000$	$p = .935$
		vs. Cinderella	$p = 1.000$	$p = 1.000$	$p = .274$	$p = 1.000$
	Cat	vs. Cinderella	$p = .992$	$p = 1.000$	$p = .274$	$p = .935$

Note. p values were adjusted with Bonferroni correction. Adjusted p values were calculated based on transformed data. Verbs/Utt = verbs per utterance; %Heavy = proportion of heavy verbs; %Light = proportion of light verbs; %Be = proportion of *be*-copular verbs.

Table 4. Average and standard deviations of the number of utterances in each group.

Task	People without aphasia	People with nonfluent aphasia	*p* value
Event	28.71 ± 28.232	20.30 ± 11.210	.531
Window	8.75 ± 3.312	15.30 ± 9.990	< .001
Umbrella	15.31 ± 5.306	17.07 ± 8.403	.626
Cat	11.69 ± 4.306	17.73 ± 9.706	.008
Cinderella	49.72 ± 22.676	35.80 ± 20.840	.021
Total	22.86 ± 22.268	21.24 ± 14.712	.212

was not significant, $F(4, 289) = 0.707$, $p = .588$. Overall, people without aphasia had a higher proportion of light verbs than people with nonfluent aphasia, and this difference was shown on all tasks ($p = .006$ in Event, $p = .002$ in Window, $p < .001$ in Umbrella, $p = .002$ in Cat, $p = .035$ in Cinderella). In people without aphasia, proportion of light verbs in Window was significantly lower than in Umbrella, Cat, and Cinderella. In people without nonfluent aphasia, proportion of light verbs in Window was significantly lower than in all other tasks. See Figure 3, and Tables 2 and 3.

Proportion of Be-Copular Verbs

There were significant group effects, $F(1, 289) = 14.373$, $p < .001$, and task effects, $F(4, 289) = 4.252$, $p = .002$. The interaction between group and task was not significant, $F(4, 289) = 0.660$, $p = .621$. Overall, people with nonfluent aphasia showed a higher proportion of *be*-copular verbs than people without aphasia. Specifically, people with nonfluent aphasia had a higher proportion of *be*-copular verbs in Window ($p = .015$), Umbrella ($p = .009$), and Cat ($p = .002$) than people without aphasia. Within group, people without aphasia showed a higher proportion of *be*-copular verbs in Event than in all other tasks. People with nonfluent aphasia showed a higher proportion of *be*-copular verbs in Event than Umbrella and Cinderella. See Figure 4, and Tables 2 and 3.

Correlations Between WAB-AQ and Verb Measures

The WAB-AQ of people with nonfluent aphasia was significantly positively correlated with the proportion of heavy verbs ($r = .278$, $p < .001$) and negatively correlated with the proportion of *be*-copular verbs ($r = -.230$, $p = .006$). Verbs per utterance ($r = .087$, $p = .290$) and proportion of light verbs ($r = -.107$, $p = .210$) did not show correlation with WAB-AQ.

Discussion

This study replicated the previously reported findings on verb production difficulty of people with nonfluent aphasia (Bastiaanse & Jonkers, 1998; Benetello et al., 2016; Berndt et al., 2002) by showing that they produced fewer verbs per utterance than people without aphasia.

Figure 2. Transformed proportion of heavy verb box plots in discourse tasks in people without aphasia and people without nonfluent aphasia.

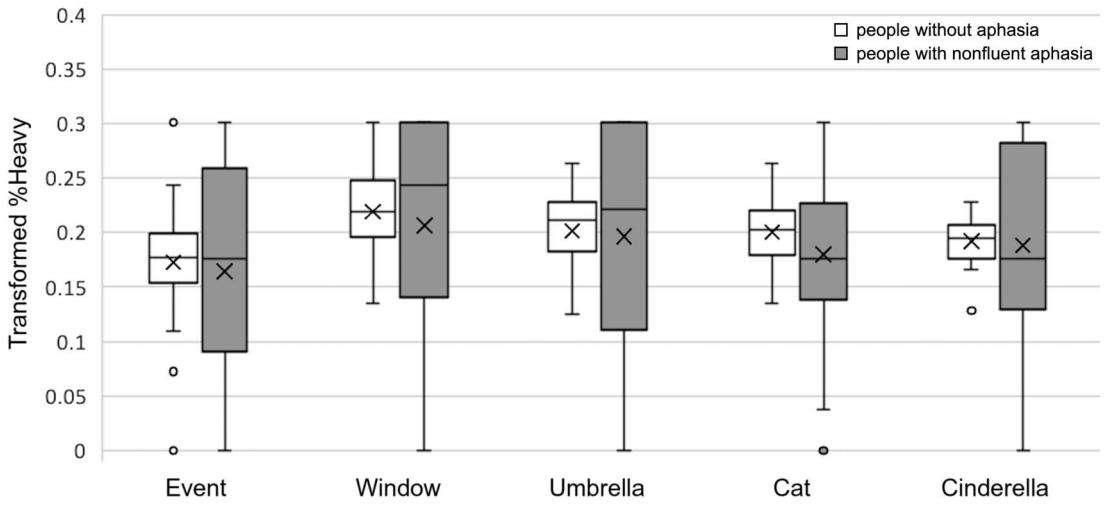
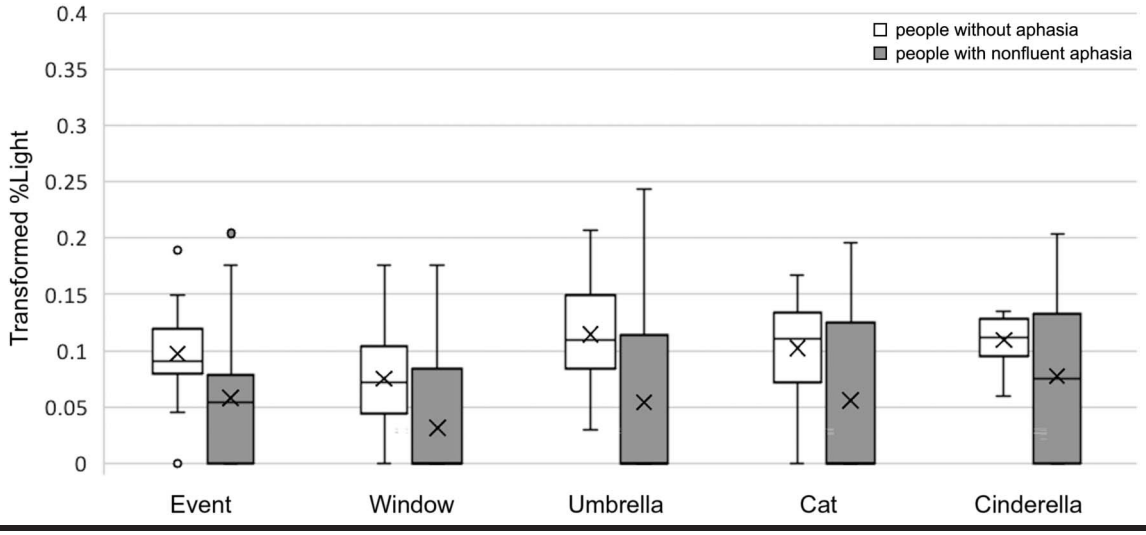


Figure 3. Transformed proportion of light verb box plots in discourse tasks in people without aphasia and people without nonfluent aphasia.

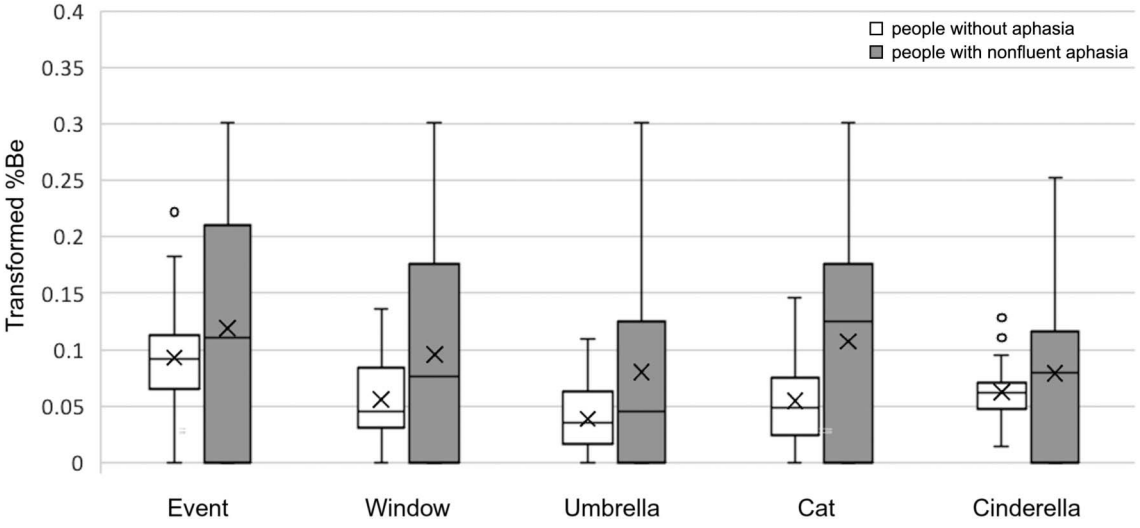


Furthermore, the results supported our first hypothesis that people with nonfluent aphasia have a preserved ability to produce heavy verbs (except for Cat) when compared to people without aphasia but have impaired ability to produce light verbs. In addition, we also showed that people with nonfluent aphasia have a tendency to overrely on *be*-copular verbs in picture descriptions. The second hypothesis was not supported because verb productions in people with nonfluent aphasia were only minimally varied between tasks possibly due to their overall difficulty with verb production. People without aphasia did appear to be affected by the task stimulus. We discuss evidence from our results and possible explanations below.

Verb Production With Various Semantic Weights in People With Nonfluent Aphasia

The findings showed that people with nonfluent aphasia produce a similar proportion of heavy verbs in most discourse tasks but a significantly reduced proportion of light verbs than people without aphasia. This suggests that people with nonfluent aphasias have relatively preserved semantic skills required to produce semantically weighted verbs (heavy verbs) and impaired morphosyntactic skills needed to produce light verbs. This finding is consistent with the work of Gordon (2008), who showed better heavy verb production and reduced light verb

Figure 4. Transformed proportion of *be*-copular verb box plots in discourse tasks in people without aphasia and people without nonfluent aphasia.



production in people with nonfluent aphasia than in people with fluent aphasia. Other studies also showed reduced light verb production in people with nonfluent aphasia (Barde et al., 2006; Bencini & Roland, 1996; Morean, 2017); however, these studies did not show the advantage of heavy verb production in people with nonfluent aphasia.

Our findings suggest a potential methodological issue that could have contributed to the inconsistency of these findings across studies. Our findings are in line with the work of Gordon (2008), where the same language task (discourse) was used, but are inconsistent with the studies that used a sentence completion task (Barde et al., 2006; Breedin et al., 1998; Morean, 2017). Sentence completion tasks require participants to recall heavy and light verbs presented in the prompted stimuli. Recalling a verb from the presented story requires a speaker's memory skills, which may affect the performance of heavy and light verb production and could result in different patterns of findings when verb production is compared in discourse tasks (Breedin et al., 1998). In addition, recall processing, similar to repetition, is more reliant on phonological processing than semantic processing (Martin & Saffran, 1990; Pilkington et al., 2019). Although Morean (2017) did not instruct participants to use the same word presented in a story to decrease the repetition-type task demands, it is likely that this preactivated phonological processing was an advantage for people with semantic impairments (such as people with fluent aphasia) when producing heavy verbs. Therefore, the two groups of people with fluent and nonfluent aphasia produced a similar number of heavy verbs in the works of Barde et al. (2006) and Morean (2017). In contrast, on discourse tasks, speakers spontaneously retrieve and produce verbs, which requires strong semantic activations. Therefore, it is possible that people with semantic impairment would have more difficulty producing heavy verbs in a discourse task.

One interesting finding although not surprising, which has not been previously reported, was the overreliance on *be*-copular verbs in people with nonfluent aphasia in the single-picture description task, Cat. Although the two sequential picture descriptions also showed the same trend, the difference was not statistically significant. The lack of significance could be related to reduced power due to the number of comparisons in the study (p values of .074 and .057). Descriptions of a picture tend to elicit simple descriptive utterances, listing the picture elements (e.g., "This is a girl"; Ulatowska et al., 1981, 1983). Our study suggests that people with limited language skills, such as people with nonfluent aphasia, are more susceptible to this tendency and more affected by the task stimuli (e.g., the presence of picture) than people without aphasia (Fergadiotis & Wright, 2011; Stark, 2019).

It is clinically relevant to note that the WAB-AQ was positively correlated with the proportion of heavy verbs (the higher the AQ was, the more frequently heavy verbs were produced) and negatively correlated with the proportion of *be*-copular verbs (the lower the AQ, the more frequently *be*-copular verbs were produced). This finding supports that people with nonfluent aphasia participants with less overall aphasia severity are more successful using semantically specific verbs in discourse, whereas those with more severe nonfluent aphasia are more likely to overrely on the *be*-copular.

Verb Production of People With Nonfluent Aphasia in Various Discourse Tasks

The evidence of discourse task effects on verb production in this study was not robust. The statistical differences of verb production between tasks were rather sporadically shown; therefore, we recommend caution when interpreting the verb production trends reported here. In general, more evidence of discourse task effects on the semantic weight of verb production was observed in people without aphasia than people with nonfluent aphasia. Although not all comparisons were statistically supported, the general trend showed a higher proportion of heavy verbs in sequential picture descriptions (Window and Umbrella) and lower proportions of heavy verbs and higher proportions of *be*-copular verbs in Event recount in people without aphasia. The tendency for a high proportion of heavy verbs in sequential picture descriptions (especially for Window) could be related to the stimulus, which presents a sequence of pictures to generate a story. Therefore, it is possible that speakers receive a visual cue from the depicted actions, which facilitates the production of semantically weighted verbs (Dell et al., 1997; Doyle et al., 1998; Howard et al., 2006). Thus, more opportunities to produce heavy verbs reversely reduced the opportunities to produce light verbs. However, it is unclear why this advantage was only statistically significant in Window but not Umbrella although the same trend was shown. Possibly, it is related to the specific events and actions in a story that require or facilitate specific types of verbs.

A higher proportion of *be*-copular verbs were observed in the Event task compared to other tasks. We can assume that, due to the maximum flexibility of verb selection for a recount task, speakers may tend to use easy and frequent verbs. In addition, anecdotally, speakers tend to describe their emotions and feelings while telling their own personal stories compared to other tasks. These emotional words typically take the form of adjectives, and, therefore, more opportunities for *be*-copular verbs are present.

The two trends that were shown in people without aphasia were also observed in people with nonfluent

aphasia in the descriptive data, but not statistically supported. The minimum evidence of discourse task effect for people with nonfluent aphasia could be due to their limited verb production skills in general (Bastiaanse & Jonkers, 1998; Benetello et al., 2016; Berndt et al., 2002) and/or the wide range of variation in verb production skills in this group. This study showed that people with nonfluent aphasia produced a very small number of verbs (approximately one verb per three utterances in raw data) on all discourse tasks. This overall reduction of verb production may hinder the opportunity to reveal task effects.

The only significant difference found in the group with nonfluent aphasia was a higher proportion of light verbs in Cinderella than Window. This was the opposite of our second hypothesis (less frequent light verb production in a cognitively demanding task such as Cinderella). This hypothesis was based on previous work suggesting reduced lexical diversity in cognitively demanding tasks (e.g., Cinderella) due to additional resource demands that could impact the performance of people with aphasia (Fergadiotis & Wright, 2011). We do not have a clear explanation for this unexpected result. One possibility could be related to the events and actions elicited by a specific task. There could be more actions in Cinderella and fewer for Window that yield light verbs during story generation. In fact, people without aphasia also showed the same results (i.e., a higher proportion of light verbs in Cinderella than Window). Since this study is presenting preliminary evidence to explore potential differences in verb production across discourse tasks, future studies are needed for an in-depth investigation into the contributing factors influencing heavy, light, and *be*-copular verb production in people with aphasia.

Future Directions and Clinical Implication

This study is innovative because it provides preliminary evidence of the dissociation between heavy and light verb production in people with nonfluent aphasia across various discourse tasks. We replicated previous research that suggested relatively preserved heavy verb production but impaired light verb production in people with nonfluent aphasia compared to people without aphasia. The participants with nonfluent aphasia in this study demonstrated a strength in their ability to produce heavy verbs in discourse. This is a valuable skill in that it can increase the specificity of language output and the overall communicative success. However, limited light verb production and overreliance on *be*-copular verbs reflect their impaired morphosyntactic skills. The results suggest that strength-based intervention approaches could capitalize on the heavy verb production and reinforce placing heavy verbs into a subject–verb–object structure in treatment when morphosyntactic skills are impaired. In addition, targeting heavy verb production can be a viable option for those relying on *be*-copular given the evidence of success with heavy verb production in people with nonfluent aphasia.

These suggestions are based on evidence from discourse-level spontaneous speech samples. As we discussed, these findings could differ based on methodological differences in verb elicitation (e.g., discourse vs. sentence completion). Therefore, future studies should explore the specific impacts of language tasks on verb production. In addition, the various discourse tasks included in this study were not controlled for specific cognitive–linguistic demands because secondary data from the AphasiaBank data set was used. Therefore, it is difficult to determine how specific characteristics of a task (e.g., presence or absence of a picture, story topic, complexity of story grammar) impacted heavy and light verb production. Instead, this study should be considered a preliminary attempt to explore heavy and light verb production in various discourse tasks. Our future directions are to control the methodologies of the discourse tasks to better determine how each factor and task characteristic contribute to heavy and light verb production. Previous evidence, including this study, suggests that different discourse tasks impact language performance in areas such as lexical diversity (Gordon, 2008; Stark, 2019; Stark & Fukuyama, 2020), gesture use (Stark & Cofoid, 2022), and sentence complexity (Ulatowska et al., 1981, 1983). This methodological issue should be thoroughly evaluated to accurately assess the language skills of people with aphasia. Based on the scientific evidence, we encourage researchers and clinicians to select a discourse task based on their needs and goals or to use multiple discourse tasks. Verb production is one of the major areas to evaluate and improve in people with nonfluent aphasia. Therefore, a thorough understanding of their verb production skills in functional speech (discourse) is a critical goal for this population. It would also be clinically important to include other types of aphasia (e.g., fluent aphasia) to compare their heavy and light verb production in various discourse tasks since it may be different from people with nonfluent aphasia.

Our study discussed a potential internal factor (aphasia severity) and external factors (presence of picture, flexibility of lexical selection, and amount of verbal opportunity) that may affect the production of semantically varied verb types. Thorough understanding of more factors will elucidate the tasks and stimuli that are required for specific clinical goals and to select appropriate assessment materials. At this point, strong clinical suggestions are not warranted based on findings from this study; however, the goal for future work on this issue is to propose benefits and/or drawbacks to selecting certain discourse tasks to evaluate particular language behaviors in people with aphasia.

Data Availability Statement

The data sets generated during and/or analyzed during this study are available in the AphasiaBank repository (https://aphasia.talkbank.org/).

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