Spring 5-2-2021

Light and Heavy Verb Usage by People with Non-Fluent Aphasia

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by
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A thesis submitted to the faculty of The University of Mississippi in partial fulfillment of the requirements of the Sally McDonnell Barksdale Honors College.

Oxford
May 2021

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ABSTRACT
CHASE SOPHIA KOZAK: Light and Heavy Verb Usage by People with Non-Fluent Aphasia
(Under the direction of Hyejin Park)

The purpose of the study was to investigate the discourse elicitation task effect and whether it affects the production of verbs with different semantic weight (light verbs with vague semantic representations, e.g., 'do', or heavy verbs with specific semantic representations, e.g., 'deliver'). Thirty people with non-fluent aphasia and twenty people without aphasia were included. The light and heavy verb ratios over the total number of verbs were calculated for two discourse elicitation tasks: sequential picture description and storytelling. The results for the healthy control group showed that they produced a significant higher heavy verb ratio in sequential picture description than in storytelling and that they produced a significantly higher light verb ratio in storytelling than in sequential picture description. The results for the people with non-fluent aphasia showed that they produced a significantly higher heavy verb ratio in storytelling than in sequential picture description and that there was no significant difference between the light verb ratios for the two tasks.

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LIST OF ABBREVIATIONS

PWA	People with Aphasia
PWOA	People without Aphasia
PWNFA	People with Non-Fluent Aphasia
AQ	Aphasia Quotient
WAB-R	Western Aphasia Battery-Revised

Introduction

People who have had a stroke often experience symptoms in varying parts of cognition, including communication (Barker-Collo et al., 2010). Of all acute stroke patients, 21-38% have acquired aphasia as a result (Berthier, 2005), making it one of the most common post-stroke symptoms (Pedersen et al., 2004). Aphasia is a language impairment resulting from acquired brain damage to the language dominant hemisphere, typically the left hemisphere, (Berthier, 2005) that affects the ability to interpret and formulate language (Darley, 1982).

A person with aphasia can have difficulty in all aspects of communication, including verbal expression, reading, auditory comprehension of language, and writing (Rohde et al., 2018). Aphasia can be categorized into two groups based on how fluent the patient's speech is: fluent aphasia and non-fluent aphasia.

Fluent aphasia typically follows posterior brain lesions in the left hemisphere (Kertesz, 1981) and accounts for approximately 53% of aphasia cases (Pedersen et al., 2004). There are four subtypes of fluent aphasia: Wernicke's, transcortical sensory, conduction, and anomic aphasia (Pedersen et al., 2004). All subtypes have fast rates of speech but differ on repetition abilities and on language comprehension skills (Coppens & Patterson, 2018). The speech of a patient with fluent aphasia is largely characterized by meaningless speech, a combination of words that don't convey a clear message or speech that includes made up words (Coppens & Patterson, 2018). Their speech also includes lots of repetitions of parts of words, whole words, or phrases (Bose & Buchanan, 2007). Patients also are not typically able to recognize when their

speech is meaningless, so they don't attempt to fix it (Cappa et al., 1994). Some also have difficulty with auditory comprehension which can contribute to their inability to recognize their own incorrect speech (Robson et al., 2012) and writing (Cappa et al., 1987). Fluent aphasia is most commonly associated with one subtype, Wernicke's aphasia, (Coppens & Patterson, 2018) but anomic aphasia is the most common type of fluent aphasia and accounts for around 27% of all cases, whereas Wernicke's only accounts for around 15% of those cases (Pedersen et al., 2004).

Non-fluent aphasia is typically associated with lesions of the Broca's area of the brain which resides in the posterior frontal lobe, usually in the left hemisphere (Grodzinsky, 2000). However, there are other lesion sites that can lead to the diagnosis (Caplan et al., 2007). Of all aphasia cases, around 47% of them can be categorized as non-fluent (Pedersen et al., 2004). Similarly, to fluent aphasia, there are four subtypes in the non-fluent category: global, Broca's, mixed transcortical, and transcortical motor aphasia (Pedersen et al., 2004). Although each subtype varies in specific characteristics, generally this type of aphasia is characterized by difficulties in planning and producing speech, as well as difficulties in syntactic processing (Gunawardena et al., 2010) and a slower rate of speech (Dede & Salis, 2019). This slow rate of speech is paired with decreased lexical abilities and word retrieval that affects their sentence production and ability to convey thoughts (Coppens & Patterson, 2018), making their speech sound more effortful (Dede & Salis, 2019). Typically, a person with non-fluent aphasia is aware of their language abilities and their language comprehension abilities are not impaired (Coppens & Patterson, 2018). The most well-known subtype of non-fluent aphasia is Broca's aphasia, making up for about 12% of all aphasia cases, but global aphasia is the most common non-fluent aphasia, making up for about 32% of all aphasia cases (Pedersen et al., 2004).

Another prominent characteristic of non-fluent aphasia is agrammatism, which indicates the decrease of a person's syntactic skills (Barde et al., 2006). The symptoms of agrammatism include limited abilities to structure sentences, verb retrieval and usage, and difficulties with morphological skills (Coppens & Patterson, 2018). Agrammatism often affects verb usage because verb forms change to reflect the syntactic information in sentence structures (e.g., adding -s to indicate third person singular, adding -ing to indicate progressive tense) (Čech & Mačutek, 2011). Because of this, people with non-fluent aphasia struggle with verb production more than noun production (Berndt et al., 1997).

Semantic Aspects of Verbs

Depending on how much a verb conveys semantic representation of the action, verbs can be categorized as "heavy" or as "light" verbs. Light verbs provide a vague representation of an action because it holds little semantic information (Kegl, 1995). For example, 'take' provides a vague mental image of the action itself and provides different images for 'take a bus', 'take a book', and 'take a shower'. Therefore, light verbs, such as 'take', are easier to use in varying contexts and more frequently produced than more specific heavy verbs (Morean, 2017). Furthermore, because this type of verb carries semantic information in combination with other words, syntactic and morphological skills are required to form correct sentence structure (Morean, 2017; Gordon & Dell, 2002). On the other hand, heavy verbs provide a more specific representation of an action than light verbs because they have more semantic weight (Kegl, 1995) and provide specific semantic features. For example, 'run' provides a more accurate and specific representation than 'go', which also represents a person moving from one place to another and is classified as a light verb. Because of this, heavy verbs include a light verb in their semantic meaning (Kegl, 1995). For instance, there are many specific actions, such as 'bake',

‘build’, and ‘cook’, that have the light verb ‘make’ as a component of its meaning. Thus, heavy verbs rely less on the syntactic elements of discourse than light verbs do because they’re able to portray the action accurately on their own but rely more than light verbs on semantic features to provide the semantic representation of the action without surrounding words (Gordon & Dell, 2002).

Previous studies that evaluated how people with aphasia produce heavy and light verbs reported inconsistent results. There are far more heavy verbs than there are light verbs, so both people with aphasia and people without aphasia will always produce more heavy verbs than light verbs. It’s also known that because of the slow rate of speech that people with non-fluent aphasia have, they will produce less verbs overall (i.e., light and heavy) than someone without aphasia (Dede & Salis, 2019). With this in mind, literature suggests that people with non-fluent aphasia (PWNFA) produce verbs with a higher ratio of heavy verbs to total verbs than people without aphasia (PWOA) because of the presence of agrammatism (Barde et al., 2006; Breedin et al., 1998). It is suggested that this is the case because light verbs rely heavily on grammar, which is affected by agrammatism for PWNFA, whereas heavy verbs are not as affected (Barde et al., 2006; Gordon & Dell, 2002). It has also been suggested that verb retrieval is more difficult for light verbs since they can occur in so many different contexts (Breedin & Martin, 1996; Coppens & Patterson, 2018), and that it is easier for someone with non-fluent aphasia to retrieve a verb that is specific to the action they want to represent (Coppens & Patterson, 2018). However, there is no general agreement, and some research studies have reported no significant differences between heavy and light verb production of PWNFA and PWOA other than a total decrease of verbs (both heavy and light) in PWNFA (Marcotte et al., 2014; Morean, 2017).

Verb Retrievals in Various Discourse Elicitation Tasks

Discourse is connected speech about a specific topic that is longer than one sentence and is commonly used by clinicians and researchers to determine a person's functional communication abilities (Olness, 2006). It's used to assess communication abilities because it can allow for the evaluation of the syntactic, semantic, and morphological skills of a patient (Olness, 2006). Discourse analysis has been shown to be more successful than standard assessment measures in predicting the functional and social communication skills of a patient because it allows the clinician to mimic natural, everyday speak (Larfeuil & Le Dorze, 1997; Ross & Wertz, 1999). In addition, it can also be a better measure of the outcomes and efficacy of treatment efforts of people with aphasia (PWA) (Larfeuil & Le Dorze, 1997; Ross & Wertz, 1999). Overall, successful discourse during daily communication efforts is essential to a person's quality of life (Best et al., 2008; Cruice et al., 2006), which is the ultimate goal for PWA.

Because of the advantages of discourse analysis, varying discourse elicitation tasks are used in clinical settings, as well as within research settings. The varying discourse elicitation tasks include single picture description, sequential picture description, storytelling tasks, and recount tasks. All these tasks change the context of the discourse gathered, and verb retrieval and production depend on this change (Fergadiotis & Wright, 2011; Olness, 2006). For example, single picture description tasks require participants to come up with a story about what is happening in a picture provided to them by the clinician. In contrast, during sequential picture description tasks, participants are required to portray what is happening in a series of pictures. In the storytelling tasks, participants are either asked to tell a story of their choice or to hear/read a story provided for them and tell it back afterward. Recount elicitation tasks require a participant to answer a series of interview-styled questions about their lives.

Each of these different elicitation tasks require varying cognitive skills that could significantly influence different aspects of language and verb production. For example, storytelling and recount tasks depend heavily on a person's memory skills, whereas single and sequential picture description tasks do not because the picture stimulus is provided during the task. However, the effects of different aspects of certain elicitation tasks are not fully discussed, although, it is suggested that different types of discourse impacts verb production (Olness, 2001). Fergadiotis and Wright (2011) stated that the demands of certain elicitation techniques might affect PWA more than PWOA. Barde et al. (2006) and Morean (2017) also stated that the inconsistency of verb production of PWA is due to the variability of discourse elicitation tasks. Barde, Schwartz, and Boronat (2006) used a list of verb pairs, one with more (i.e., heavy verbs) and one with less (i.e., light verbs) semantic weight, and had participants listen to a story and then answer questions about it using words they remembered from the story. This study produced results that found that the group without aphasia did not show a significant difference in accuracy while producing heavy or light verbs (Barde et al., 2006). The study also found that the group of people with non-fluent aphasia was significantly less accurate during the production of light verbs compared to the production of heavy verbs (Barde et al., 2006). In another study, participants were asked to describe ten different pictures and the verbs produced in their responses were classified based on a predetermined list of eleven light verbs, all other verbs produced that were not on the study's light verb list were classified as heavy verbs (Gordon, 2008). This study produced similar results to Barde, Schwartz, and Boronat (2006) and found that PWNFA produced a lower ratio of light verbs to total verbs and produced a higher ratio of heavy verbs to total verbs (Gordon, 2008). They suggested that using more specific verbs is an adaptive strategy used by people with slower rates of speech, a characteristic across all subtypes

of non-fluent aphasia (Gordon, 2008). Although these two studies have had similar outcomes, their results have not been effectively compared in terms of discourse elicitation task effects on these verb ratios.

This current study compared light verb and heavy verb production across two elicitation tasks: sequential picture description and storytelling. Both tasks were similar in that (1) they facilitated participants to generate a story based on the story sequences and (2) the story that was generally targeted for response was controlled across participants. However, in the sequential picture descriptions, participants continuously relied on the visual stimulus provided by the examiner while responding to their questions. In contrast, during storytelling, the visual stimulus of the picture book that was provided by the examiner was taken away once the speakers began generating their story and responding to their questions, and speakers needed to recall the story from their memory without the help of a visual stimulus in front of them. Therefore, the storytelling task required more memory demands compared to the sequential picture description which is more cognitively taxing for an individual. Speakers also had more freedom when constructing the story in storytelling tasks than they did for the picture description. These different aspects of cognitive demands in each task may have affected participant's word retrieval abilities and their production of heavy and light verbs. We hypothesized that both PWNFA and healthy controls would produce higher heavy verb ratios for the sequential picture descriptions than the storytelling task because (1) the higher memory demand in storytelling interferes with the speakers semantic-lexical processing and keep them from producing specific speech, and (2) the presence of a visual stimulus in sequential picture descriptions facilitate the semantic-lexical processing to retrieve semantically specific verbs. We also hypothesized that PWNFA would show no significant differences between the light verb ratios between the

storytelling task and the sequential picture description task because the presence of agrammatism in PWNFA would decrease their overall ability to produce these types of verbs across all tasks.

Methodology

Participants

This study obtained IRB approval from the University of Mississippi (Protocol number #20x-067). Thirty people with non-fluent aphasia (18 males and 12 females) were randomly selected from AphasiaBank. AphasiaBank (Forbes et al., 2012) is a password protected database that houses videos of speech samples and demographic information of participants, with and without fluent or non-fluent aphasia, performing several discourse elicitation tasks where a protocol is provided for the examiner. The inclusion criteria for the PWNFA were: (1) being classified as moderate or moderate-severe non-fluent aphasia based on the Aphasia Quotient (AQ) scores of the Western Aphasia Battery-Revised (WAB-R) (Kertesz, 2007), (2) being a monolingual, native English speaker, and (3) being right-handed, with normal vision and hearing. The mean age of the participants with aphasia was 59.89 ± 9.40 years old, and their mean number of total years of education was 14.50 ± 2.11 years. In total, 29 people with Broca's aphasia and one person with transcortical motor aphasia were included.

In addition, twenty healthy adult controls (12 males and 8 females) were selected from AphasiaBank (Forbes et al., 2012). They were matched with the experimental group in regard to age and the total years of education. The inclusion criteria of the control group were: (1) passing the cognitive screening tested by the Mini-Mental State Examination (Folstein et al., 1975), (2) being an English monolingual speaker, (3) having no history of developmental and neurogenic

disorders, and (4) normal vision and hearing. The mean age of this group was 65.04 ± 10.05 years old and their mean of total years of education was 15.50 ± 2.46 years.

Materials

This study included two discourse elicitation tasks: (1) sequential picture description and (2) storytelling. Sequential picture description tasks require participants to describe a series of images and the 'broken window' series off of AphasiaBank was used, which includes a series of four pictures of a boy playing with a ball outside and breaking a window (see Appendix A for the picture stimulus). According to the instructions used to obtain language samples in AphasiaBank, the examiner was told to present the picture series and then say:

"*Take a little time to look at these pictures. They tell a story. Take a look at all of them, and then I'll ask you to tell me the story with a beginning, a middle, and an end. You can look at the pictures as you tell the story*."

If the participant gave the examiner no response within ten seconds, they were told:

"*Take a look at this picture (point to the first picture) and tell me what you think is happening*."

If still no response was given and the participant needed more prompting, the examiner was required to point to each picture in the sequence and say:

"*And what happens here*?" and "*Can you tell me anything about this picture*?"

The storytelling elicitation task required the participants to tell a popular fairytale, *Cinderella*, from memory and include a clear beginning, middle, and end to the story. According to the instructions used to obtain language samples in AphasiaBank, the examiner gave them a copy of the wordless picture book, then said:

"*I'm going to ask you to tell a story. Have you ever heard the story of Cinderella*?"

If the participant said they have not, the examiner was to give them a story they had heard of. While letting the participant look through the picture book, the examiner was told to say: "*Do you remember much about it? These pictures might remind you of how it goes. Take a look at the pictures and then I'll put the book away and ask you to tell me the story in your own words*."

After the examiner took the book away, they said:

"*Now tell me as much of the story of Cinderella as you can. You can use any details you know about the story, as well as the pictures you just looked at*."

If the participant needed more prompting, the examiner would say, "*What happened next*?" or "*Go on*."

The video-recorded sessions with each participant performing these tasks, as well as their written transcripts, were provided on AphasiaBank along with the specific demographic information for the specific participant of each session.

Analysis

The transcripts of participants provided by AphasiaBank were organized on an Excel spreadsheet for verb coding. All verbs produced by the participants were coded through two steps. First, verbs were excluded from the final total verb count if the participant repeated them in an attempt to finish a phrase, the verbs were interrupted to change what they were saying, or they were auxiliary verbs that are used to change tense or for grammatical purposes. Verbs produced in automatic speech (e.g., "you know") and in speech that was unrelated to the task (e.g., "I don't know the name of this.") were also not included.

After the process of determining which produced verbs would be included, secondly, those verbs were then classified as either be-copular, supplementary, light, or heavy verbs. Verbs

were coded as light verbs if they did not provide a specific representation of the meaning. There were nine verbs that were counted as light verbs in this study: 'do,' 'get,' 'take,' 'give,' 'make,' 'have,' 'put,' 'go,' and 'come.' Heavy verbs were coded as such if they provided a specific representation of the meaning (e.g., start, pull, drink).

After all verbs were coded, (1) the total number of light verbs to the total number of verbs ratio (so called light-verb ratio) and (2) the total number of heavy verbs to the total number of verbs ratio (so called heavy-verb ratio) were calculated. This was done in each task for each participant group.

Inter-rater Reliability

For this study, there were two people coding the provided transcripts and determining if the verbs produced would be included in our final count and if the verbs were light verbs or heavy verbs. The inter-rater reliability was calculated between the author and advisor using 20% of the transcripts, chosen randomly. The two raters' agreement on verb inclusion (i.e., if each verb met the previously discussed inclusion criteria for the total number of verbs) and the agreement of verb coding (i.e., whether the included verbs were then coded as heavy verbs, light verbs, or be-copular verbs and supplementary verbs that were not used to calculate any ratios) was then calculated. Verb inclusion reliability was 98.42% and verb coding agreement was 88.11%.

Statistical Analysis

The independent variables in this study were the type of discourse elicitation task, and the dependent variables were the heavy-verb ratio and light-verb ratios. These ratios were calculated by dividing the total number of heavy or light verbs produced by the total number of verbs that were produced in each task. Two (tasks) by two (verb types) repeated measures ANOVA with

Bonferroni post-hoc tests were conducted in each participant group separately. The IBM SPSS (Statistical Package for the Social Sciences) software, version 26, was used to run the analysis.

Results

Control Group

There was a significant main effect of verb type, F (1, 19) = 76.434, p = 0.000 and interaction between task and verb type, F (1, 19) = 12.033, p = 0.003, but no main effect of task, F (1, 19) = 0.005, p = 0.945). The mean of the light-verb ratio for the sequential picture task (mean = 0.198 ± 0.022) was significantly less than the storytelling task (mean = 0.295 ± 0.011, p = 0.001). The mean of the heavy-verb ratio for the sequential picture task (mean = 0.587 ± 0.037) was significantly higher than the storytelling task (mean = 0.492 ± 0.022; p = 0.025). This is displayed in Figure 1.

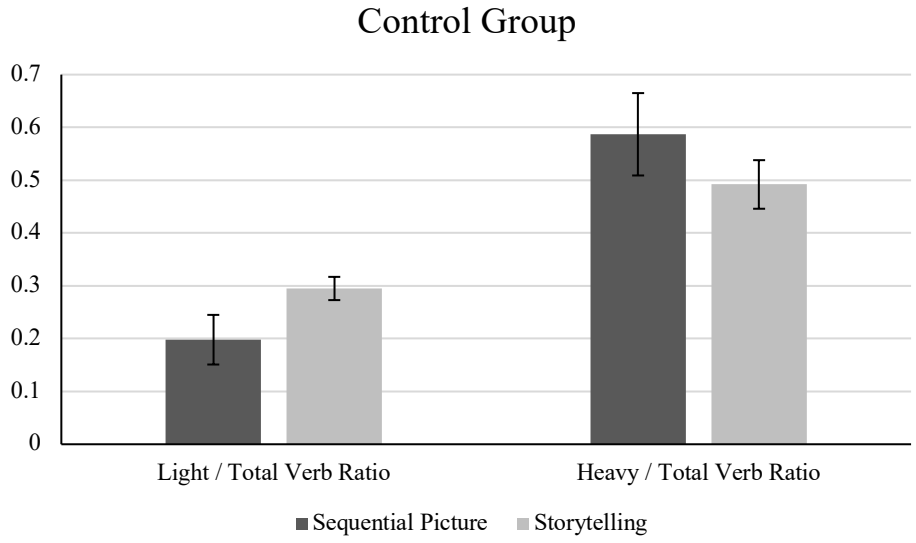

Figure 1. Mean light verb and heavy verb ratios of people without aphasia in sequential picture description and storytelling tasks.

PWNFA Group

There was a significant main effect of task type, F (1, 19) = 10.035, p = 0.005, but no main effect of verb type F (1, 19) = 0.044, p = 0.836, and interaction, F (1, 19) = 2.007, p = 0.173. The mean of the light-verb ratio for the sequential picture task (mean = 0.132 ± 0.118) was not significantly different from the storytelling task (mean = 0.168 ± 0.206). The mean of the heavy-verb ratio for the sequential picture task (mean = 0.085 ± 0.147, p = 0.446) was significantly smaller than the storytelling task (mean = 0.227 ± 0.195, p = 0.008). This is displayed in Figure 2.

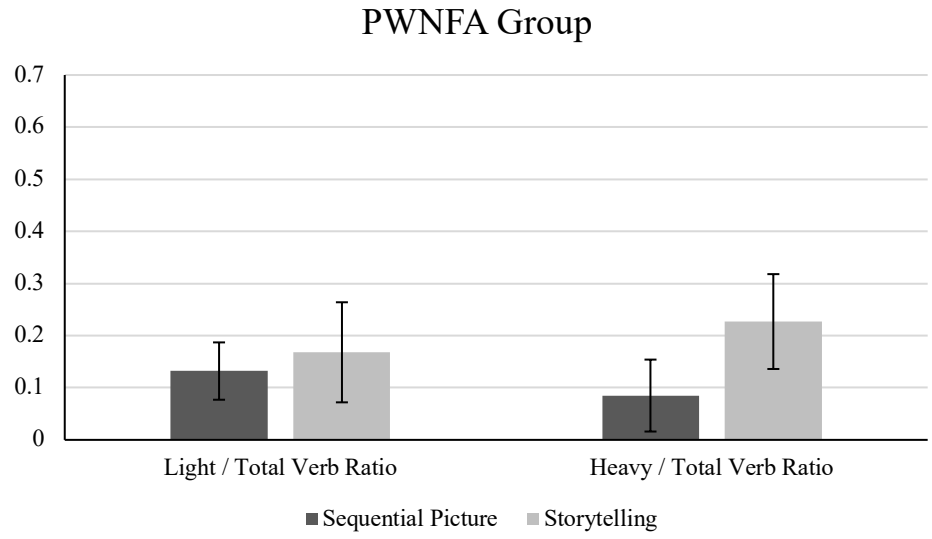

Figure 2. Mean light verb and heavy verb ratios of people with non-fluent aphasia in sequential picture description and storytelling tasks.

Discussion

This study aimed to find the impact that discourse elicitation tasks have on the semantic weight of verb production. We hypothesized that both healthy controls and PWNFA would produce a higher heavy verb ratio in sequential picture descriptions than in the storytelling tasks. We also hypothesized that there would be no significant difference for PWNFA in the light verb ratio for the different tasks.

The hypothesis for the heavy verb ratios was supported by the healthy controls, but not by PWNFA. We found that the PWNFA produced a significantly higher heavy verb ratio in the storytelling task than in the sequential picture task, which is the opposite of our hypothesis. A possible explanation for the results is that the lack of visual stimulus requires PWNFA to be more specific in their verbs. That is, they need to use more heavy verbs to successfully convey their meanings without extra aids (visual stimuli) (Gordon & Dell, 2003) because of their awareness of their expression deficits. Without the help of a picture to convey their message, PWNFA may try to use specific verbs with more semantic features, which is their relative strength, instead of using light verbs (Gordon & Dell, 2003).

The hypothesis for the light verb ratios was supported by the PWNFA group. We found no significant difference between the two discourse elicitation tasks. Task effects were minimal between the two tasks in PWNFA due to (1) their agrammatism and (2) light verb production being related to syntactic and morphological skills. On the other hand, the healthy controls produced a higher light verb ratio in storytelling than in sequential picture description. This may

be because the storytelling task requires participants to rely on memory, which compromised the use of semantically rich verbs.

Limitations and Future Directions

One systematic limitation of the study is the relativity of the definitions of heavy verbs and light verbs. Although, similar to Gordon (2008), we defined light verbs with a list of nine verbs and classified all other non-auxiliary or be-copular verbs as heavy verbs, some of the heavy verbs are still considered heavier or lighter than others. For example, 'speak' delivers lighter semantic meaning that 'whisper' but it is still heavier than 'do'. However, it is difficult in spontaneous speech to determine the semantic weight relative to another verb. This is why most previous studies, which have compared production of light and heavy verbs, have used controlled stimuli (e.g., sentence repetition, completing sentences with only two verbs given as options) for easy semantic weight comparison rather than discourse, or researchers ask that participants use only verbs heard in the task previously if discourse is used (Barde et al., 2006; Morean, 2017). For a better understanding of the task effect on semantic aspects of verb production in discourses, an improved method to classify light and heavy verbs would be needed (e.g., based on the number of semantic features). In addition, future studies could expand the study by including people with fluent aphasia for a full understanding of discourse elicitation task effect on semantic weight of verb production. These studies should also consider using more discourse elicitation tasks to compare the variety of discourse elicitation tasks used in clinical settings.

Clinical Significance of the Study

The current study showed partial evidence of task effects of heavy and light verb production during discourse elicitation in people with and without non-fluent aphasia. As

researchers and clinicians assess the language abilities of people with aphasia through discourse analysis, this study suggests being aware of the potential bias of the task used when evaluating language skills in people with aphasia. Also, this study suggested the task effect on the semantic weight of verb production; however, a potential task effect may influence speaker's abilities in word retrieval, grammatical skills, and functional communication skills. This bias should be taken into consideration when evaluating and planning treatment goals. With more evidence from future studies, our ultimate goal is to suggest a specific task for different clinical interests. For example, with more evidence, we may be able to suggest using one task over another when measuring PWA's ability to name semantically specific nouns or verbs, or their cognitive abilities and cognitive functioning. The preliminary evidence from the current study, in combination with results from future studies, could provide better outlines of suggestions in regard to possible useful tasks to evaluate heavy and light verb productions in people with aphasia.

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Appendix A. Picture Stimulus of Broken Window Given by AphasiaBank for Sequential Picture Description