Spring 5-1-2021

Light and Heavy Verb Productions Between Single and Sequential Picture Description Tasks in People with and without Non-fluent Aphasia

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LIGHT AND HEAVY VERB PRODUCTIONS BETWEEN SINGLE AND SEQUENTIAL PICTURE DESCRIPTION TASKS IN PEOPLE WITH AND WITHOUT NON-FLUENT APHASIA

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

University, MS
April 2021

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DEDICATION

I would like to dedicate this work to my parents, Michael and Jennifer Hall. Without their unwavering support and belief in me, I would not be in the place I am today. Throughout my four years at the University of Mississippi, they have always encouraged me to put my best foot forward and take advantage of every opportunity I am given. Mom and Dad, thank you for you constant guidance, positivity, and support not only in these four years but my entire life.

ACKNOWLEDGEMENTS

I would first like to acknowledge Dr. Park for always pushing me to be the best researcher and student possible. She has done so much more than just advise my thesis. She has encouraged me to apply for opportunities that would cultivate and grow my interest in research and in neurogenic disorders. Not only have I gained skills as a researcher and writer, but also as a Speech-Language Pathologist. Thank you for everything.

Dr. Kornisch and Dr. Higdon, I would like to thank you as well for reading and guiding my thesis work. I know this is an extremely busy time, so taking the time out of your schedule to help undergraduate student researchers is greatly appreciated.

I would also like to thank Chase Kozack for her help and friendship throughout this entire process. We began this journey of our undergraduate thesis work together and she has continually uplifted and encouraged me. Not only has she been a positive presence throughout this experience, but she also contributed to collecting and analyzing the data for this project.

Carly Landgraf, Hannah Spurlock, Maliah Wilson, & Emily Culbertson should also be acknowledged for their help in the data analysis process for this project. I would like to extend a thank you to The Sally McDonnell Barksdale Honors College and Summer Undergraduate Research Fellowship department for their financial support in this project.

ABSTRACT

Background: Previous research has shown that persons with non-fluent aphasia (PWNFA) suffer from the inability to retrieve words, specifically more of a difficulty with verb productions. Various discourse elicitation tasks have shown to have differing effects on verb retrievals in this population. However, there is a lack of research on the relationship between single vs. sequential picture description tasks and the productions of heavy and light verbs in persons with non-fluent aphasia.

Purpose: The purpose of this study was to analyze the ratios of heavy and light verbs produced in both single picture description tasks and sequential picture description tasks in persons with aphasia.

Methods: Thirty persons with non-fluent aphasia and 20 healthy control group participant's verb productions were analyzed for the two discourse tasks (single and sequential picture description tasks). The heavy verb ratio and light verb ratio were then found by counting all of the verbs and coding them as light or heavy. Two by two repeated ANOVA tests and post-hoc Bonferroni tests were then conducted in each separate group.

Results: The results of this study found that the healthy control group produced a significantly higher light verb ratio in the single picture description task and non-significant results for the heavy verb ratio. On the other hand, the PWNFA group had an advantage with a higher heavy verb ration in the single picture description task. Additionally, there were no significant findings in the light verb ratios between tasks.

Discussion: Results indicated that visual stimuli in the single picture description task facilitate the semantic system in PWNFA. These findings have important implications for clinicians when

working on verb retrieval abilities with PWNFA. Thus, certain discourse elicitation tasks may be more beneficial for certain goals.

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TABLE OF ACRONYMS

AQ	aphasia quotient
MMSE	mini-mental state examination
PWA	persons with aphasia
PWNFA	persons with non-fluent aphasia
WAB	western aphasia battery test

Introduction

Aphasia is a language disorder acquired by a brain injury, most likely a stroke, in the language dominant hemisphere (Weisong et al., 2019). Common symptoms in people with aphasia (PWA) include anomia (word retrieval difficulty), slowed speech, and frequent pauses which can severely affect their flow of speech and, ultimately, the quality of life of an individual (Feyereisen et al., 1991; Goodglass & Kaplan, 1983; Kertesz, 2006; Best, Greenwood et al., 2008).

Within aphasia there are two main categories that affect the communication skills of an individual in different ways. Fluent aphasia describes individuals whose symptoms include uninterrupted runs of speech, empty speech output, and difficulty retrieving and producing nouns (Berndt et al., 1997; Cramazza & Hillis, 1991; Kim & Thompson, 2000; Luzzatti et al., 2002; Luzzatti et al., 2006; Miceli et al., 1984; Edwards, 2005; Feyereisen et al., 1991; Goodglass & Kaplan, 1983; Kertesz, 2006). These symptoms are normally caused by damage to the posterior regions of the left hemisphere of the brain rather than anterior lesion sites (Edwards, 2005; Feyereisen et al., 1991; Goodglass & Kaplan, 1983; Kertesz, 2006). Fluent aphasia can be further categorized into Wernicke's, transcortical sensory, conduction, or anomic aphasia depending on verbal comprehension and repetition abilities (Pedersen et al., 2004).

The other type of aphasia is non-fluent aphasia. Persons with non-fluent aphasia (PWNFA) usually have characteristics such as effortful speech, telegraphic speech (deliver mainly content words and miss function words) or sentence fragments, and verb retrieval difficulties (Gordon & Dell, 2003; Feyereisen et al., 1991; Goodglass & Kaplan, 1983; Kertesz,

2006). One of the most common indicators of non-fluent aphasia is agrammatism. This is defined as a decrease in syntactic complexity as well as a specific difficulty producing function words, especially verbs (Goodglass & Kaplan, 1983; Kolk & Heeschen, 1992; Rochon et al., 2000; Saffran et al., 1989). It has been shown through multiple studies and research that PWNFA have more difficulty retrieving and producing verbs over nouns and other types of speech (Berndt & Caramazza, 1980; Rochon, et al., 2000; Thompson & Bastiaanse, 2012; Gordon, 2006; Zingeser & Berndt, 1990). There are also four subdivisions of non-fluent aphasia: Broca's, global, transcortical motor, and transcortical mixed aphasia (Pedersen et al., 2004).

The Semantic Aspects of Verb Productions in PWNFA

Recent studies have determined that the verb carries important information regarding the topic and meaning within an individual's speech (Olness, 2007). However, when an individual suffers from non-fluent aphasia, their ability to retrieve verbs is greatly impacted due to the fact that verbs have a greater grammatical complexity than nouns, making the verb retrieval deficit more pronounced (Gordon & Dell, 2003). To date, there is little research done on the topic of the semantic aspects of verbs, with the majority focusing on morphological and syntactic features. One way to categorize verbs is to define them as heavy or light verbs based on how much semantic representation/contribution they provide. Heavy verbs provide full semantic contribution, which means they have a higher number of semantic features than light verbs (Breedin et al., 1998). These verbs, such as "fly" or "run", can offer specific and full meanings while standing alone (Breedin et al., 1998; Jesperson, 1965; Kegl, 1995). To explain further, the heavy verb, fly will describe that the object is moving, that it is going in a forward and upward direction, and that the object is in the sky. On the other hand, light verbs have minimal semantic contribution, and they often aid in specifying a heavy verb within the utterance (Jesperson, 1965;

Kegl, 1995; Breedin et al., 1998). Examples of such light verbs are “go,” “have,” or any other verbs that produce empty speech (Breedin et al., 1998; Jesperson, 1965; Kegl, 1995). The light verb go, simply describes that the object is moving and lacks any other semantic descriptors.

Several studies have investigated the retrieval deficits between these two semantically different types of verbs in aphasic patients (Breedin et al., 1998; Berndt et al., 1997; Kohn, 1989; Kegl, 1995). These studies showed inconsistent evidence within the ability for PWNFA to produce heavy and light verbs. Berndt, et al. (1997) found that PWNFA will substitute a light verb when they are unable to retrieve a different more specific verb. This was corroborated by Kohn (1989) and Kegl (1995). It has also been hypothesized in previous studies that a light verb advantage may be shown since light verbs are higher frequency verbs and less constrained (Breedin et al., 1998; Gordon & Dell, 2003).

More recently, Gordon & Dell (2003) designed multiple studies to look specifically at how the differences in light and heavy verbs related to individual’s differing behaviors. When they manipulated the experiment so that the heavy and light verbs had the same equal frequencies, a heavy verb advantage was shown. The researchers believed that these findings may be due to how difficult it can be to learn a light verb, since these verbs are less specific and can be seen in various different contexts (Gordon & Dell, 2003). When it becomes more difficult to learn a certain type of verb, retrieval abilities may be affected in PWNFA. These findings may have also been impacted by the frequency of light and heavy verbs in this study. Interestingly, the light and heavy verbs were used in a controlled setting and were equally likely to be produced; however, in natural language there is not a controlled frequency of these verbs (Gordon & Dell, 2003). In this way, Gordon & Dell (2003) hypothesized that when heavy verbs are less frequent, such as in natural language, the syntactic areas will have more responsibility

and activate their counterparts (i.e., light verbs) at a wider and more successful level. Therefore, a light verb advantage may be seen in natural language. In a different study by Barde et al. (2006), pairs of light and heavy verb counterparts were set up and then the researchers used these pairs in stories. The PWNFA were then asked questions which would prompt them to answer with one of the verb pairs. The PWNFA showed lower productions of light verbs compared to heavy verbs (Barde et al., 2006). This study supported that PWNFA have more difficulty producing verbs that have fewer semantic properties, such as light verbs compared to the heavy verbs. This occurred because the heavy verbs relied more on semantic features, which are relatively intact in this population. In contrast, light verbs relied on the syntactic input, which is impaired in this population (Barde et al., 2006; Morean, 2017). Barde et al. (2006) concluded that verb retrieval is heavily influenced by both syntactic and semantic processes; however, the extent of which is still unknown.

Heavy and Light Verbs in Discourse

Speech-language pathologists and researchers obtain connected speech samples (called discourse) to evaluate PWA's functional communication abilities by using various language tasks. It is especially important to use discourse analysis in aphasia assessment since it (1) is the most functional form of measured communication and (2) shows the relationship between words and sentences (Fergadiotis & Wright, 2011; Olness, 2007). Using discourse analysis also allows the researchers to observe the patients from a variety of analyses, all of which measure language in a way that is natural to their everyday speech (Olness, 2007).

A variety of tasks are used to obtain discourse language samples, such as single or sequential picture description, story retelling, procedure, and recount (recalling personal episodes). However, the nature of each task demands different cognitive skills and, therefore,

may influence the aspects of language production in PWNFA (Fergadiotis & Wright, 2011). In general, story retelling and recount tasks rely on an individual's memory skills since they ask the participant to tell a story from their memory, either about a popular story or a personal episode. Fergadiotis et al. (2011) found that storytelling and recount tasks elicited the most lexical diversity in healthy adults. It was speculated that these findings may be due to the richer vocabulary that is needed when telling a personal story; rather than the small vocabulary necessary when describing a task (Fergadiotis, et al., 2011). On the other hand, single and sequential picture description tasks provide individuals a picture prompt and they are asked to describe the image(s). Research has shown that the picture prompt within the single/sequential picture description tasks can lead to a higher amount of high-imageability and descriptive words (Bottenberg et al., 1987; Olness et al., 2002). Therefore, it can be inferred that pictures can influence the type of verb production demands put on a PWNFA and they can prime an individual to more easily retrieve verbs than in the tasks without visual stimuli (Olness, 2007; Fergadiotis & Wright, 2011).

The single and sequential picture description tasks have similarities in that the speakers are provided a picture prompt and asked to generate a story of the picture. The difference between the two tasks is that the single picture description task provides a single image of a scene, and the sequential picture description provides a series of images. Previous studies have shown that single picture description tasks, under traditional elicitation instructions, are likely to have less lexical diversity produced than sequential picture description tasks (Fergadiotis & Wright, 2011; Fergadiotis et al., 2011). Fergadiotis & Wright (2011) studied how different discourse elicitation tasks would impact the lexical diversity in PWA and a control group. The results showed that, similar to previous studies, the PWA had lower lexical diversity in the single

picture description task compared to the sequential picture description task. This may occur due to the ability to recall more diverse and specific vocabulary when using picture stimuli that contain a large number of events and/or characters (Fergadiotits & Wright, 2011). Furthermore, when the individual participates in the single picture description task, they may be more likely to "list" the events happening and repeat their verbs more often (Fergadiotis & Wright, 2011). In general, their study provided supportive evidence that sequential picture description tasks facilitate more diverse language samples than single picture description tasks (Fergaditotis & Wright, 2011).

The Current Study

If the discourse elicitation task affects lexical diversity and word retrieval processing, it may also influence the heavy and light verb productions. To date, no study has investigated how the nature of the discourse elicitation task differently affects heavy and light verb productions. Using heavy verbs may increase the semantic density of speaker's discourse, and using words with a more specific and descriptive meaning would increase the chance to successfully deliver a message to their communication partner.

The aim of the current study was to compare the ratio of heavy and light verbs produced by PWNFA and a control group in (1) single picture description tasks and (2) sequential picture description tasks. We hypothesized that, for both participant groups, the sequential picture description would elicit more heavy verbs and less light verbs than single picture descriptions.

Methodology

Participants

This study was approved by the University of Mississippi Institutional Review Board (protocol number: 20x-067). Thirty participants with moderate and moderate-severe non-fluent aphasia and twenty healthy older adults were randomly selected from the AphasiaBank participant pool (Forbes et al., 2012). AphasiaBank is a password protected database for research and teaching purposes, which provides demographic information, language samples, and test scores that are obtained by a range of various tasks from both persons with different types of aphasia and healthy participants (Forbes et al., 2012). AphasiaBank provides video and audio discourse samples that all follow a consistent protocol.

The inclusion criteria for people with non-fluent aphasia was: (1) normal vision and hearing, (2) diagnosis of non-fluent aphasia based on the Aphasia Quotient (AQ) scores of the Western Aphasia Battery–Revised (WAB; Kertesz, 2007), (3) moderate or moderate-severe severity level to exclude extreme outliers, and (4) English monolingual speaker. Twelve female and eighteen male participants were included. Their mean age was 59.89 ± 9.40 years with 14.5 ± 2.11 mean years of education. Overall, speech samples of twenty-nine people with Broca's aphasia and one person with transcortical motor aphasia were included in the current study.

In addition, twenty people without aphasia (12 males, 8 females) were included from the AphasiaBank control pool. The inclusion criteria for the control group were: (1) passing the cognition screening tested by the Mini-Mental State Examination (MMSE; Folstein et al., 1975), (2) normal vision and hearing, (3) no history of developmental or neurogenic disorders, and (4)

English monolingual speaker. The ages and years of education were matched between the two groups. The control group had a mean age of 65.04 ± 10.05 years old, $t(48)=1.847$, $p=.071$, and the mean years of education were 15.50 ± 2.46 years, $t(48) = 1.535$, $p=.131$.

Materials

Two discourse elicitation tasks were included in this study: (1) single picture description (cat rescue; Nicholas & Brookshire, 1993) and (2) sequential picture description (broken window). See Appendix A for the single picture stimuli and Appendix B for the sequential picture stimuli. According to the instruction manual provided by AphasiaBank, for the single picture description task the examiner gave the participant the picture and followed this script: "*Here is another picture. Look at everything that's happening and then tell me a story about what you see. Tell me the story with a beginning, a middle, and an end*." If the participant did not give a response in 10 seconds a second prompt was given, "*Take a look (point to picture) and tell me any part of the story*." If fewer than 2 utterances were spoken, the third prompt was given: "*Anything else you can tell me about the story*?" In the sequential picture description task the examiner presented the picture and gave the following directions, "*Now I'm going to show you these pictures. 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 no response was given to these instructions, the examiner said, "*Take a look at this picture (point to first picture) and tell me what you think is happening*." If needed, they would point to each picture sequentially, giving the prompt: "*And what happens here*?" These directions were followed by every examiner that uploaded their data to AphasiaBank. The obtained discourse samples were transcribed by the examiner as a chat file and provided via AphasiaBank database.

Analysis

In preparation of coding, the transcriptions provided by AphasiaBank were copied and pasted on an Excel spreadsheet. All verbs that were produced in each task were then counted. Repeated, revised, or interrupted verbs were excluded from the total verb count. Verbs produced in automatic speech (e.g., you know) and unrelated utterances to the task (e.g., that's it, I don't know the name) were also excluded from the analysis. Next, for the included verbs, we coded each of the verbs as light, heavy, or other (e.g., be-copular). The following were coded as light verbs: *do*, *make*, *get*, *take*, *give*, *have*, *put*, *go*, and *come*, since they present a vague representation of their meaning. Most verbs providing specific representation of the meaning were coded as heavy verbs (e.g., deliver, sleep, bake).

Interrater Reliability

The interrater reliability for verb inclusion and verb type decisions were checked between two raters, using randomly chosen 20% of the transcripts. The interrater reliability agreement was 98.42% for the verb inclusion and 88.11% for verb coding agreement.

Statistical Analysis

For each task, the light verb ratio was calculated by dividing the number of light verbs by the total number of verbs produced, and the heavy verb ratio was calculated by dividing the number of heavy verbs by the total number of verbs produced. The independent variables were the type of discourse elicitation task (single and sequential picture description tasks) and the type of verb (light and heavy verbs). The dependent variable was the ratios of light and heavy verbs. Two by two repeated-measures ANOVA with Bonferroni post-hoc tests were conducted for each group using IBM SPSS version 26.

Results

In the healthy control group, there was no main effect of task, $F(1,19) = 1.797$, $p = .176$. but significant main effect of verb type, $F(1,19) = 62.495$, $p = .000$. There was also a significant interaction between task and verb type, $F(1,19) = 5.331$, $p = .032$. The single picture description task had a significantly higher light verb ratio (mean = .276 ± .109) than the sequential picture description (mean = .198 ± .1, $p = .006$). In contrast, there was no significant difference in the heavy verb ratio between the two tasks (mean = .551 ± .101 in single picture description, mean = .587 ± .17 in sequential picture description, $p = .281$). See Figure 1.

PWNFA showed a significant main effect of task, $F(1,19) = 4.9$, $p = .039$. There was no significant main effect on verb type, $F(1,19) = 2.78$, $p = .604$, or interaction between task and verb type, $F(1,19) = .956$, $p = .34$. There was no significant difference of the light verb ratio between the single picture description task (mean = .163 ± .233) and the sequential picture description task (mean =.132 ± .118, $p = .398$). The heavy verb ratio between the two tasks was significant (mean = .168 ± .206 in single picture description and mean = .085 ± .147 in sequential picture description, $p = .039$). See Figure 2.

Figure 1. *Heavy vs Light verb ratio in the healthy control group*

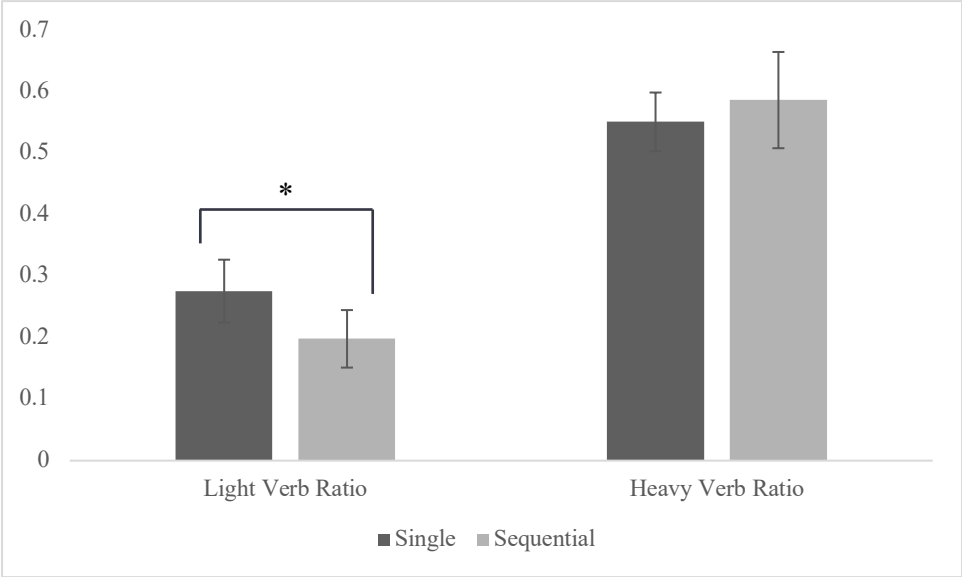
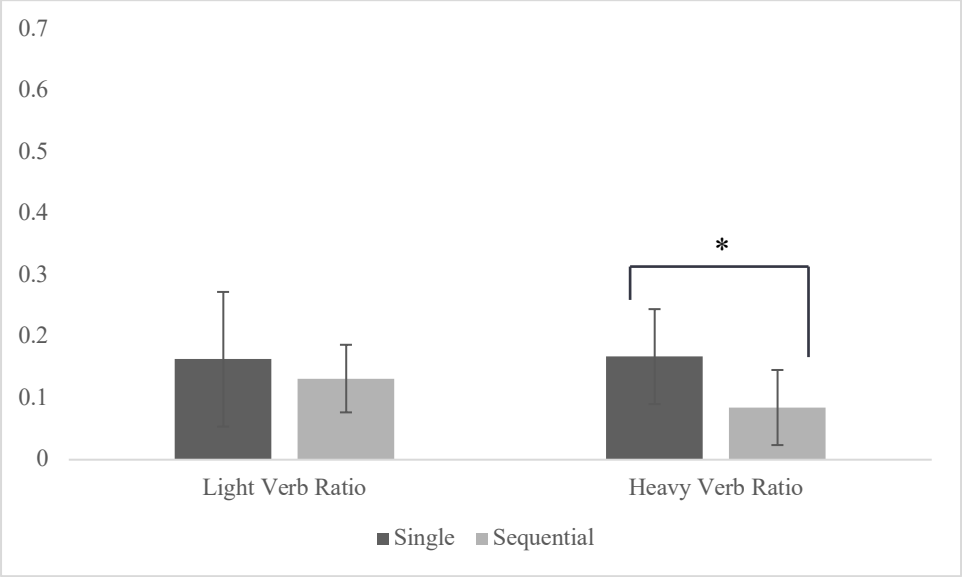


Figure 2. *Heavy vs. Light verb ratio PWNFA group*



Discussion

In this study, our aim was to compare heavy and light verb productions during single picture description tasks and sequential picture description tasks in PWNFA and healthy controls. We hypothesized higher heavy verb ratios and lower light verb ratios in sequential picture description tasks compared to single picture description tasks. This hypothesis is partially supported by the healthy control group showing a significantly higher light verb ratio in the single picture description task than the sequential picture description task. The results are in line with previous research in that single picture description tasks elicit less lexical diversity (Fergadiotis & Wright, 2011). The light verb ratios do not directly indicate less diversity of lexical retrieval. However, because we defined only nine verbs as light verbs in the current study, more productions of the nine verbs reduce the opportunities to produce various heavy verbs. It is interesting that the heavy verb ratios between the tasks were not statistically significant. It may be because the healthy control group, without communication impairments or significant difficulties in lexical retrievals, may have displayed the ceiling effect on heavy verb productions in both tasks. Barde et al. (2006) also reported that the control group did not show a significant difference of heavy and light productions due to the ceiling effect in a storytelling discourse task.

PWNFA showed the opposite pattern of our hypothesis and produced higher heavy verb ratios for the single picture description task than for the sequential picture description task, while the light verb ratios of the two tasks were not statistically different. The lack of a statistically significant finding in the light verb ratio between single picture description tasks and sequential

picture description tasks may be due to the agrammatism for PWNFA. Since light verbs compared to heavy verbs usually require more syntactic-morphological processing, which is one of the major deficits in PWNFA (Thompson, 2003), this may have caused the light verb productions to be low in both tasks. Thus, resulting in a floor effect. These results support previous studies (Gordon & Dell, 2003; Gordon, 2008) which suggested difficulties of light verb productions in PWNFA compared to people with fluent aphasia. Our results also showed a higher heavy verb ratio in single picture descriptions than in the sequential picture description. This is the opposite pattern of our hypothesis. This may be because of the semantic activations from the picture facilitated retrieval for specific verbs, since speakers tend to rely less on creating a story and more on descriptions in single picture descriptions. PWNFA with lexical retrieval difficulty heavily rely on picture descriptions and can use more descriptive words (Breedin et al., 1998). These verbs may have had an extra boost by direct semantic activation from the picture during the lexical processing, which may have resulted in facilitating lexical retrievals. In contrast, when speakers generate a story in the sequential picture descriptions, they may use extra verbs that are not illustrated in the pictures, which may not get the semantic activation advantages (Kintz et al., 2016).

Limitations

One limitation of this study is the subjective definitions of heavy and light verbs. Most studies (Barde et al., 2006) defined light and heavy verbs as pairs in controlled sentence stimuli. Since the terms to determine the semantic contribution of verbs in discourse samples are subjective, we defined these verbs in regard to their semantic representation and included nine specific verbs in the light verb category similar to Gordon (2008). Therefore, a better definition, possibly based on the exact number of semantic features of a verb, should be developed for

future studies. Moreover, our findings may also be affected by other factors, such as the participants' status and/or types of occupation that may have had an impact on their communication skills. Continuous communication interaction in a social manner may facilitate an individual's verb retrieval skills. However, because AphasiaBank does not provide specific information about this, future studies may investigate the occupational effect on lexical retrieval skills in PWA.

Clinical Implications

One of the implications of this study would be the application of these findings in evaluation and therapy. It must be noted that this is simply one preliminary study showing partial task effect; therefore, much research is still needed to confirm these results. However, it is the ultimate goal of this study and others like it to apply these results in real therapy settings. From our findings we believe that researchers and clinicians should both be aware of the task bias when assessing language skills in PWA. It may also be helpful for clinicians working with PWA to purposely choose a certain type of task based on their client's goals. For example, when working on naming skills in a PWNFA, it may be advantageous to use a single picture description task. When looking to elicit a larger variety of verb productions it may be most helpful to use sequential picture description tasks. Since we can see less retrieval abilities for light verbs in PWNFA, it may be important to clinically distinguish between heavy and light verbs to guide clinicians in assessment and intervention techniques. According to the findings of this study, it may be beneficial to pick a single picture description task if the PWNFA struggles with retrieving heavy verbs. Overall, these findings show the need for clinicians to focus on verb retrieval abilities, specifically light verbs more than heavy verbs in PWNFA since these will be highly impacted by the aphasia deficits.

Conclusion

Our study showed partial evidence of the discourse elicitation task effect on heavy and light verb productions in people with non-fluent aphasia and healthy controls. They showed the opposite patterns of using light and heavy verb ratios in single and sequential picture descriptions. The current study implicates a discourse elicitation task effect on language production; however, the current data is preliminary. More research is needed to fully understand these mechanisms.

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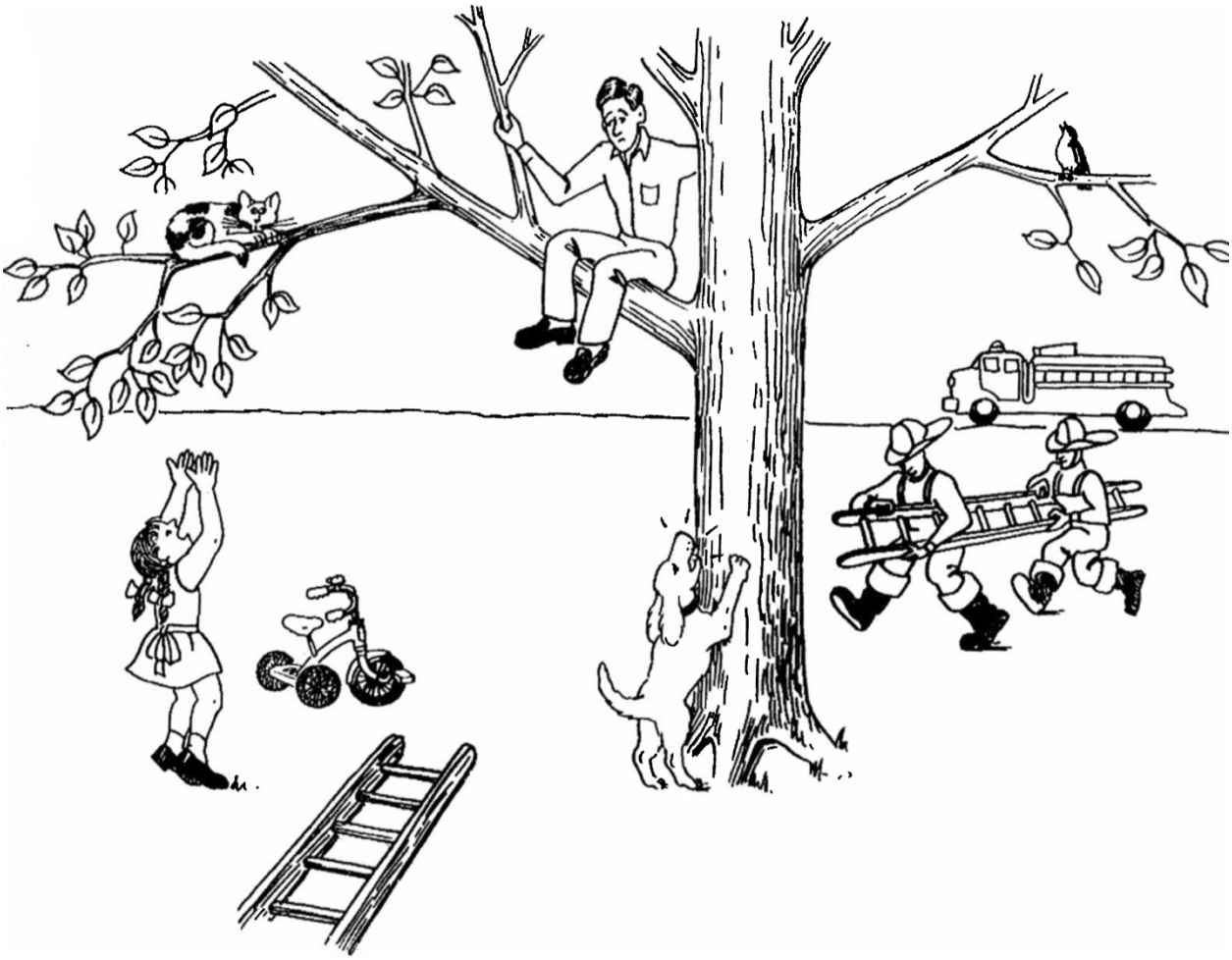
APPENDIX

Appendix A. Single Picture Description Task: Cat Rescue



Appendix B. Sequential Picture Description Task: Broken Window