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PREDICTION OF ATTENTION ON WORD FINDING TREATMENT OUTCOMES AFTER STROKE

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ABSTRACT

Deficits in word finding are a ubiquitous characteristic of aphasia from left hemisphere stroke or other brain injury. Although it is often overlooked in aphasia treatment, attention is important to study because it is needed for accurate word generation, and is therefore important for both word finding and word finding therapy. The purpose of this paper is to determine if attention can predict outcomes for word finding therapy by comparing patient performance on subtests of the Cognitive Linguistic Quick Test – including the attention subcomponent – and the effect size of abstract word training conducted by Sandberg and Kiran (2014). Correlations and regressions of the CLQT scores and treatment Effect Sizes were conducted in SPSS software to determine if attention predicts word finding treatment outcomes. It was determined that attention is not predictive of treatment outcomes in this sample. However, it was found that memory and executive functioning are correlated with treatment outcomes. Composite severity was the only CLQT variable to be both correlated with and predictive of word finding treatment outcomes. This research on word finding treatment outcomes is important so that future clinicians may be able to predict responses to therapy and provide more effective aphasia treatment.

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Chapter 1

Introduction

Aphasia is an acquired language disorder or impairment in which language deficits are the recognized signs and symptoms resulting from injury to the brain (Hula & McNeil, 2008). Deficits in word finding are a ubiquitous characteristic of aphasia from left-hemisphere stroke or other brain injury. For example, a problem with word finding occurs when one wants to say the word "apple," but cannot produce the word because he or she is having trouble retrieving it from his or her mental lexicon. The person knows what an apple is and will try to compensate for the word finding deficit by producing circumlocutions – talking around the word. This paper is going to focus on therapy for word finding, specifically the therapy provided by Sandberg and Kiran in their 2014 study, "How justice can affect jury: Training abstract words promotes generalization to concrete words in patients with aphasia." One factor that may affect word finding therapy and is therefore important to study is attention. Since aphasia is a language impairment, attention is often overlooked by the focus on language deficits in aphasia research and therapy. However, there is a need to study attention as it relates to aphasia, word finding, and/or therapy. Attention applies to word finding therapy in two ways. First, there is an internal role of attention in the process of word finding itself and second, attention plays a role in the learning that occurs in therapy. Before specifying the specific attentional processes that are needed for word finding and therapy, attention must be defined. In addition, the relationship between aphasia and attention as they relate to therapy for word finding will be discussed.

Carr and Hinckley (2012) define attention as a set of mental functions different from other information processing such that it is executed by neural systems separate from the brain regions that process information that is given or denied attention. Thus, specialized attentional systems exist separately from other information-processing systems, such as sensory, memory, language, and motor, and these attentional systems regulate how information-processing operates in the brain.

Many researchers discuss attention in a plethora of different ways, however, I am going to use Sohlberg and Mateer's clinical model to discuss attention, as defined in their 2001 article regarding improvement and managing attentional problems (Sohlberg & Mateer, 2001). Villard and Kiran (2014) also used Sohlberg and Mateer's clinical model in their 2014 study. The clinical model has a hierarchical complexity to it, in which less complex types of attention are requirements for more complex types (Villard & Kiran, 2014). Sohlberg and Mateer (2001) state that their clinical model of attention was based upon the attentional difficulty symptoms reported or observed in individuals with traumatic brain injury. Their model provides a useful method to organize assessment and treatment. The five components of attention in their model include: focused, sustained, selective, alternating, and divided, and the components rank in order from least complex to most complex. While Sohlberg and Mateer (2001) discuss the components of attention as they relate to their clinical model, Murray (2002) and Crosson and Cohen (2012) also provide their own discussions of the attentional functions and components. I will be incorporating each of the researcher's information to provide a more comprehensive understanding of attention.

The two most basic functions of attention include arousal and vigilance (Murray, 2002). Crosson and Cohen (2012) define arousal as a physiological state underlying a general readiness to process information. Arousal is the underlying component of attention that is needed for the more complex attentional components. Arousal supports vigilance, and both are necessary for selective attention. Vigilance is also known as sustained attention (Murray, 2002). Murray (2002) refers to vigilance as the ability to maintain a consistent response that is measured by long, repetitive tasks. Sohlberg and Mateer (2001) equate the component of sustained attention with two subcomponents of vigilance and working memory. They describe sustained attention as the "ability to maintain a consistent behavioral response during continuous and repetitive activity" (Sohlberg & Mateer, 2001). This maintenance of a response during continuous and repetitive activity is what takes places in therapy. Vigilance or sustained attention becomes important because a patient will have to attend to the treatment for the entire length of the therapy session. Specifically, in Sandberg and Kiran's 2014 study, therapy is two hours per session, and so, the patient must utilize sustained attention to effectively complete the whole two hour therapy session.

According to Murray (2002), the two complex functions of attention are selective and divided attention. Divided attention will be defined later. Murray (2002) defines selective, or focused attention, as the ability to focus on and prioritize certain stimuli while hindering processing of competing stimuli. Selective attention includes selecting the appropriate word from one's internal semantic system that becomes active during word finding. Although Murray equates selective and focused attention, Sohlberg and Mateer (2001) state them as two separate entities in their clinical model. Focused is the very first component of the model, and it is defined as the ability to respond to specific stimuli, whereas selective is the third component and refers to the ability to maintain a behavioral response when presented with distracting stimuli. Crosson and Cohen (2012) break down selective attention into two separate intention and attention processes. Attention governs the processing of sensory information, and intention governs the action processing and the actions performed. In the word finding therapy used for this study, patients must ignore features irrelevant to the target words and inhibit any external distracting stimuli that may affect the therapy tasks.

The next complex component of attention in Sohlberg and Mateer's clinical model is alternating attention. Alternating attention refers to the ability to shift focus from one task to another, with different cognitive requirements, to specifically select and control which information to process. In the word finding therapy in this study, patients must move from sorting target words to selecting semantic features to answering yes/no questions, and finally, to generating the target word and a synonym and freely generating words.

Lastly, divided attention is the most complex component and function of attention. Murray (2002) and Sohlberg and Mateer (2001) both define divided attention as the ability to attend and respond to multiple stimuli or tasks simultaneously. For example, in the word finding therapy in this study, patients must perform a task and listen to feedback from the clinician.

There are two current models of attention that should be noted. These models include a capacity-limited system and a bottleneck model. There are two basic assumptions of attention as a capacity-limited system. These basic assumptions include: within our attentional system, one or more pools of quantitatively limited attentional resources exist, and although the attentional capacity is limited, it is possible to allocate resources flexibly and simultaneously to multiple activities (Murray, 1999). Moreover, task demands regulate how much attention is invested in a specific task, and Murray (1999) refers to task demands as the processing resources needed to ensure effective task execution. While attention allocation is regulated by task demands, Murray (1999) states that it is also regulated by novelty of the task, intent to attend to specific input, and arousal level, in which low and high arousal may have damaging effects. Consequently, failure of a task occurs if there is inadequate capacity for the task demands or if resources are misdirected or slowly organized (Murray, 1999). A major focus of the capacity-limited system model of attention is to explain the process of task resource competition and its outcome. If dual tasks are completed, and the tasks compete for the same resource pool, then a decline in performance for one or both of the tasks is anticipated. To account for this dual-task interference, Pashler has developed a bottleneck model of attention (Murray, 1999).

As summarized in Murray (1999), Pashler proposes that some operations rely on the same mechanism at the same time, which creates a “bottleneck”, and one of the operations must wait to be completed or suffer. According to Hula and McNeil (2008), within the bottleneck model, attention is a system in which specific forms of information are processed at the same time and, in some conditions, particular parts of competing tasks are processed consecutively. The central bottleneck (CB) model is a model of dual-task performance that states that performance limitations primarily occur from sequential processing of “central” stages of competing tasks (Hula & McNeil, 2008). According to the CB model, the three consecutive stages of processing per task include the precentral stage, the central stage, and the postcentral stage. While the precentral stage is concerned with perceptual stimulus encoding, the central stage includes selection of a response, and the postcentral stage includes the initiation and execution of a response (Hula & McNeil, 2008). Moreover, the CB model states that the precentral and postcentral stages can be processed at the same time for competing tasks. However, the central stages of competing tasks are only able to processes tasks sequentially.

Murray (1999) summarizes the differences of the bottleneck model and the capacity-limited model. Capacity theories relate limitations in attention to a lack of availability or to inefficient distribution of resources. However, Pashler's bottleneck theory or model attributes the limitations in attention to the specific central stage of processing. This central stage forces a switch from processes working at the same time to processes only operating one at a time (Murray, 1999). Limitations in attention during word finding therapy may be able to be attributed to both the bottleneck model and the capacity limited model.

Crosson and Cohen (2012) discuss some of the impairments in attention as they are related to aphasia. Deficits in attention due to aphasia lie on a spectrum from obvious to subtle. On the more obvious end of the spectrum lies a deficit in further information processing due to rapid information decay. Consequently, if the information is lost, comprehension is compromised. A more subtle attention deficit is an inability to select one information source when presented with multiple sources of information. Moreover, one would be distracted by irrelevant stimuli, thus compromising comprehension of the selected information source. (Crosson & Cohen, 2012).

Attention is driven by a top-down mechanism in which it is influenced by intention mechanisms. One's intention often determines what one must attend to, so if one's intention mechanisms are impaired, then attention deficits will also appear (Crosson & Cohen, 2012). Intentionality also influences more complex forms of attention, such as divided and alternating attention. Attending to two different sources of information or switching from one source to another results from what we intend to do. These complex types of attention are impaired in people with aphasia. Crosson and Cohen (2012) reference 1997 research by Murray, Holland, and Beeson that showed decline of performance in patients with aphasia during a task requiring suppression of divided attention and during dual-tasks requiring divided attention. They found no correlation between deterioration in performance and aphasia severity, suggesting a separate attention deficit coexisting with aphasia. The attentional mechanism of suppressing or requiring divided attention is important for both word finding and success in completing steps in therapy. One must to be able to effectively divide one's attention to complete multiple tasks, such as listening to the clinician while focusing on the therapy task.

To summarize, attention is important to study as it relates to word finding therapy because there is an internal attention process competing within a person that allows him or her to find specific words (Crosson & Cohen, 2012). Attention is needed for accurate word generation and, therefore, for word finding therapy. Additionally, when providing treatment to patients with aphasia from left hemisphere stroke, attention can have an effect on the success of the treatment (Villard & Kiran, 2014).

Therefore, the purpose of this paper is to directly measure the correlation of treatment outcomes and attentional ability to determine if attention can predict outcomes for word finding therapy. Specifically, I compare patient performance on subtests of the Cognitive Linguistic Quick Test – including the attention subcomponent – and the effect size of abstract word training conducted by Dr. Chaleece Sandberg and Dr. Swathi Kiran (Sandberg & Kiran, 2014). I hypothesize that pre-therapy attentional ability will positively correlate with word finding treatment effect size.

Villard and Kiran (2014) highlighted the importance of future studies investigating the role and effect of attention on language treatment outcomes. This research on language treatment outcomes is important so that future clinicians may be able to predict responses to treatment before therapy begins. Results of this project are expected to add to the body of work of predicting treatment outcomes for post-stroke aphasia therapy.

Chapter 2

Methods

The data were collected during a treatment study (Sandberg & Kiran, 2014) and this is a secondary analysis of data.

Participants

Twelve right-handed native English-speaking individuals with aphasia (seven male, five female) ranging from 47 to 75 years of age (*M* = 60, *SD* = 9) participated in Sandberg and Kiran's 2014 study. All 12 participants experienced a cerebrovascular accident in the distribution of the left middle cerebral artery. All were in the chronic recovery stage, at least six months post-stroke onset. All participants exhibited normal or corrected-to-normal hearing and visual acuity. While all had at least a high school education, most had received college degrees (Sandberg & Kiran, 2014). A table outlining all participant demographic information is provided below (Table 1).

The participants were given a battery of standardized language tests, including the Western Aphasia Battery (WAB-R), the Boston Naming Test (BNT), the Psycholinguistic Assessment of Language Processing in Aphasia (PALPA), The Pyramids and Palm Trees Test (PAPT), and the Cognitive Linguistic Quick Test (CLQT; Helm-Estabrooks, 2001). The WAB Aphasia Quotient scores are included in Table 1 and Table 2. AQ scores are used to rate the severity of a person's aphasia. Lower numbers mean higher aphasia severity and higher numbers mean lower aphasia severity. The severity scale for AQ is as follows: 0-25 is very severe, 26-50 is severe, 51-75 is moderate, and 76-100 is mild.

According to Sandberg and Kiran (2014), the CLQT was used to determine the relative contribution of cognitive deficits, such as attention and memory, to language dysfunction. The CLQT is made up of 10 tasks, including personal facts, symbol cancellation, confrontation naming, clock drawing, story retelling, symbol trails, generative naming, design memory, mazes, and design generation. Each task assesses various cognitive and language skills. For example, the symbol cancellation task assesses visual attention and perception, and the story retelling task helps to assess auditory memory and comprehension, working memory, and language output skills (Helm-Estabrooks, 2001). The 10 tasks of the CLQT encompass five cognitive domains — attention, memory, executive function, language, and visuospatial skills — and are scored according to them. After the CLQT is conducted, each of the five cognitive domains is rated for severity, according to participant age range. The severity ratings are totaled and then averaged to determine the composite severity rating. Clock drawing is the only task in which its severity is determined outside the realm of the five cognitive domains (Helm-Estabrooks, 2001). All of the participants' Pre Testing and Post Testing CLQT scores are shown in Table 2 below.

Table 1: Participant Demographic Information

Client ID	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12
Age	59	56	47	53	48	57	74	69	75	56	61	66
Sex	M	M	M	M	M	FM	FM	M	M	FM	FM	FM
Months Post Stroke	23	76	42	117	93	38	134	16	11	7	54	15
Lesion Region	Left MCA	Left ICA	Left ICA/MCA	Left ACA/ MCA	Left MCA	no med records	Left MCA	Left MCA	Left ACA/MCA /PCA (watershed)	Left MCA	Left MCA	Left ICA
WAB Aphasia Quotient	78.6	77.7	95.5	41.7	72.5	99.2	90.8	97.1	67.4	84.7	74.4	82.2
Aphasia Type	Anomic	Cond.	Anomic	Broca's	Broca's or Cond.	Anomic	Anomic	Anomic	TCM	Anomic	TCM	TCM

Note: M = Male, F= Female, WAB = Western Aphasia Battery, Cond.= Conduction, TCM= Transcortical Motor

Table 2: Participant Pre and Post Testing Scores

Client ID	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12
Pre-Testing												
WAB AQ	78.6	77.7	95.5	41.7	72.5	99.2	89.8	97.1	81.5	84.7	74.4	82.2
CLQT												
Attention	90%	93%	90%	83%	91%	92%	21%	89%	67%	89%	88%	49%
Memory	78%	82%	77%	50%	64%	96%	77%	81%	62%	82%	66%	40%
Executive Function	65%	78%	63%	60%	75%	65%	40%	58%	25%	65%	55%	35%
Language	70%	76%	68%	27%	65%	92%	78%	73%	54%	78%	51%	51%
Visuospatial Skills	91%	95%	91%	88%	94%	87%	30%	83%	59%	84%	90%	43%
Clock Drawing	92%	100%	100%	100%	77%	100%	54%	100%	69%	92%	85%	85%
Composite Severity	90%	90%	90%	65%	80%	100%	75%	85%	65%	95%	70%	35%
Post-Testing												
WAB AQ	82.8	82.6	96.3	50	69.8	96.7	93.4	96.6	81.1	93.9	69.1	
CLQT												
Attention	88%	90%	91%	85%	89%	87%	17%	87%	84%	93%	90%	
Memory	71%	84%	82%	68%	55%	89%	73%	88%	59%	88%	75%	
Executive Function	63%	100%	68%	55%	78%	78%	30%	55%	53%	70%	48%	
Language	65%	100%	76%	35%	62%	86%	72%	81%	57%	81%	57%	
Visuospatial Skills	87%	88%	91%	83%	90%	88%	28%	77%	79%	92%	88%	
Clock Drawing	100%	100%	100%	100%	77%	100%	77%	100%	85%	100%	85%	
Composite Severity	80%	100%	90%	70%	75%	100%	55%	90%	80%	100%	70%	
Target Abstract ES	12.07	17.53	13.79	1.15	12.07	5.82	5.75	9.24	4.60	13.86	3.46	0.00
Target Concrete ES	4.62	-0.79	1.73	-0.44	-0.67	7.01	4.62	3.46	2.31	1.73	2.31	0.45
Attention Diff	7.45	18.32	12.06	1.59	12.74	-1.19	1.13	5.78	2.29	12.13	1.15	0.45
All Abstract ES	7.33	9.56	13.86	0.00	12.12	2.84	8.66	6.35	4.60	10.39	4.60	0.00
All Concrete ES	5.77	-1.57	1.33	1.13	-0.55	1.10	0.29	0.44	4.04	5.67	0.44	0.00

Note: WAB = Western Aphasia Battery, AQ = Aphasia Quotient, ES = Effect Size, Diff = Difference

Treatment Protocol

In the original study (Sandberg & Kiran, 2014), each participant received 10 weeks of therapy twice per week for two hours per session. The following steps were practiced: 1) sort target words, half from the trained context-category and half from the control context-category, into their respective context-categories; 2) select semantic features that apply to the abstract target word being trained; 3) answer yes/no questions; 4) generate the target word being trained and a synonym; and 5) freely generate words in the trained context-category with specific feedback from the clinician. While steps one and five occurred only once per session, steps two and four were performed for each target abstract word. The participant generated features to be used for each target word in steps two and three during the first treatment session. For a more detailed description of the treatment protocol, see Sandberg and Kiran (2014).

Effect sizes (ESs) for both trained items and generalized items, or trained abstract words and untrained concrete words, respectively, were calculated for each participant to measure the efficacy of treatment at the individual level. To calculate the individual effect sizes, the mean of the baseline probe scores was subtracted from the mean of the post-treatment probe scores, and then divided by the standard deviation of the baseline probe scores (Sandberg & Kiran, 2014).

Data Analysis

All participants' pre-therapy and post-therapy CLQT scores and difference in attention scores, as well as effect sizes for target items and all acceptable responses in the trained category (abstract and concrete words) were imported into Excel. Pearson correlations were conducted in SPSS software. The CLQT scores included: attention, memory, executive function, language, visuospatial skills, clock drawing, and composite severity. A p-value of .05 was used for significance. Note: One patient (P12) did not finish therapy; therefore, the post-therapy scores are not available. Significant correlations between CLQT measures and effect sizes of concrete and abstract words in the trained categories were focused on. Based on the correlation results, regressions were conducted in SPSS software to determine the specific contributions of each measure to treatment outcomes. Effect size (ES) was the dependent variable (DV), and the independent variables (IV) were the CLQT measures that correlated with effect size. The IVs, or CLQT measures that were correlated with each other, were also included to account for any contribution they could be making. Regressions were also conducted to determine whether treatment affected CLQT scores. The regressions that were conducted are outlined in Table 3 below.

Table 3: Regressions Conducted in Data Analysis

Regression	DV	IV
1	Target Abstract ES	Composite Severity Pre
2	Target Concrete ES	Composite Severity Pre
3	Target Concrete ES	Memory Pre, Language Pre
4	Target Abstract ES	Clock Drawing Pre, EF Pre, Attn Pre, Visuospatial Skills Pre
5	Executive Function Post	Target Abstract ES, EF Pre
6	Executive Function Post	Target Abstract ES, Composite Severity Pre
7	Language Post	Target Abstract ES, EF Pre
8	Language Post	Target Abstract ES, Composite Severity Pre

Note: DV = dependent variable, IV = independent variable, ES = Effect Size, EF = Executive Function, Attn = Attention

Chapter 3

Results

Nine significant correlations were found: 1) Memory Pre and Target Concrete ES (r= .62, n=11 , p < .05); 2) Executive Functioning Pre and Target Abstract ES (r=.62, n=11, p < .05); 3) Composite Severity Pre and Target Abstract ES (r= .68, n=11, p < .05); 4) Language Post and Target Abstract ES (r= .71, n= 10, p < .05); 5) Executive Functioning Pre and Attention Difference (r= .66, n= 11, p < .05); 6) Executive Functioning Post and Target Abstract ES (r= .69, n=10, p < .05); 7) Language Pre and Memory Pre (r= .95, n= 11, p < .01); 8) Language Post and Memory Pre (r= .88, n= 10, p < .01); 9) Language Post and Memory Post (r= .70, n= 10, p <. 05). Figures 1, 2, 3, and 4 are found below and illustrate the correlations that are positive and the most relevant to the purpose of this paper.

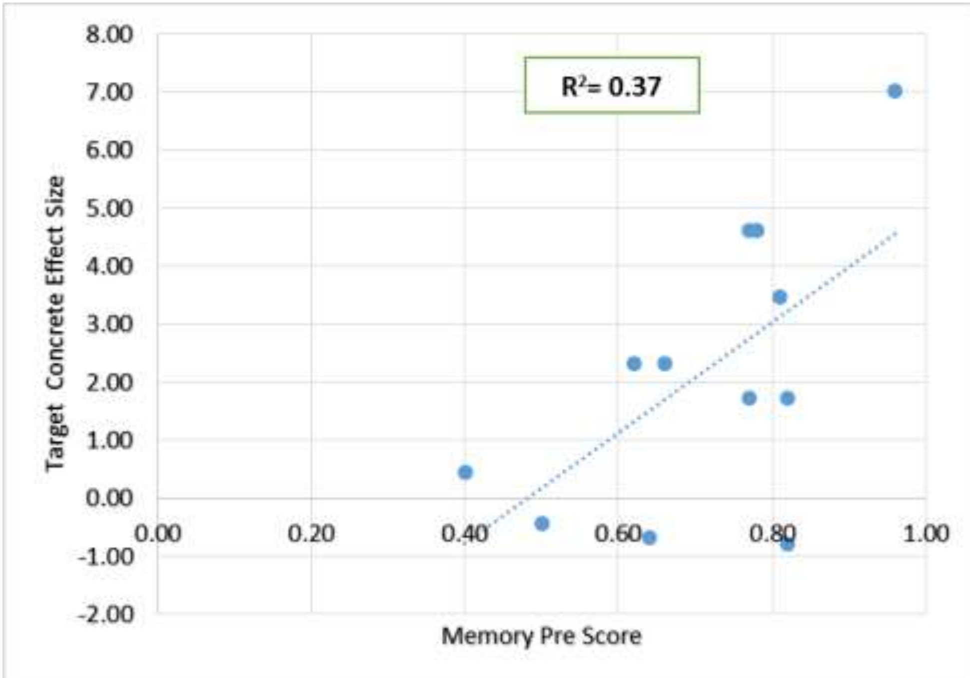

Figure 1: Memory Pre and Target Concrete Effect Size Correlation

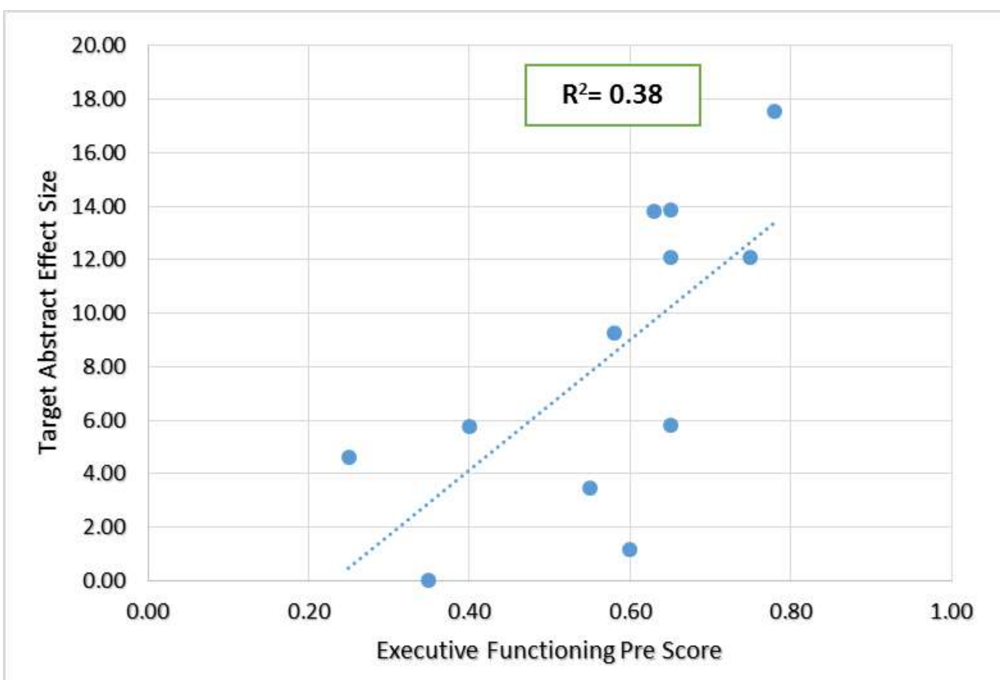

Figure 2: Executive Functioning Pre and Target Abstract Effect Size Correlation

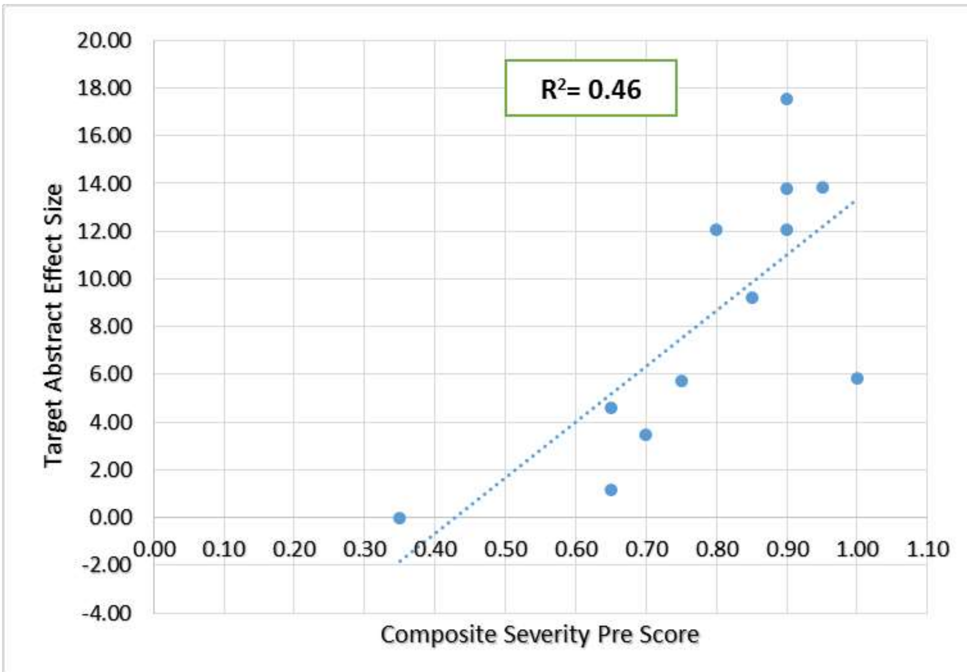

Figure 3: Composite Severity Pre and Target Abstract Effect Size Correlation

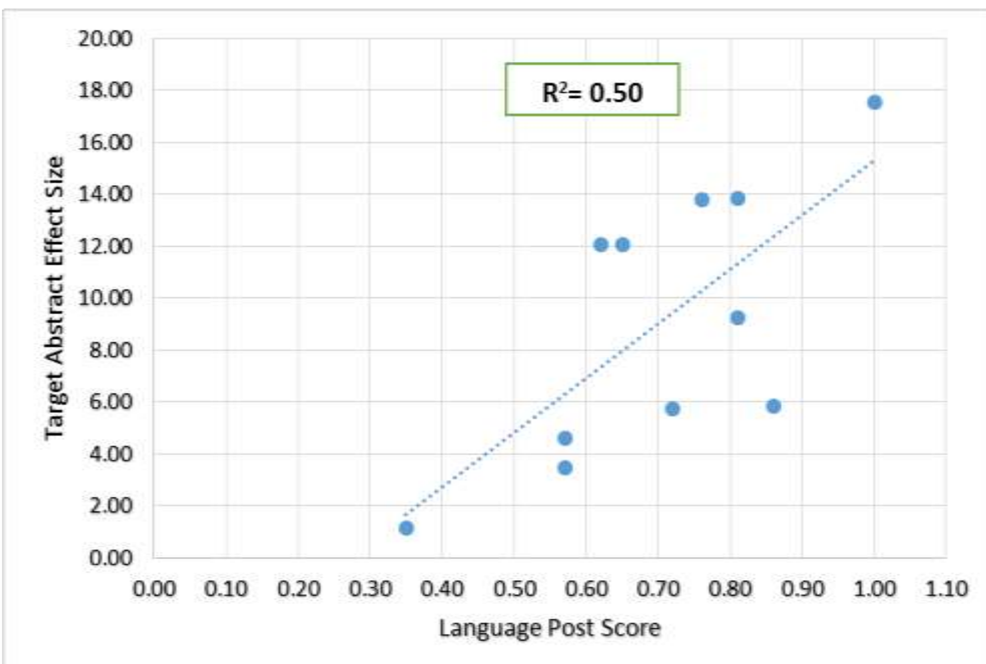

Figure 4: Language Post and Target Abstract Effect Size Correlation

In summary, attention is not correlated with effect size. The measures that correlated with Target Abstract ES are Executive Functioning Pre, Composite Severity Pre, Executive Functioning Post, and Language Post. Executive Functioning Pre is also correlated with the Attention Difference score. The only measure correlated with Target Concrete ES is Memory Pre. Three between-measure correlations were also found: Language Pre and Memory Pre, Language Post and Memory Pre, and Language Post and Memory Post.

Three of the eight regressions conducted were significant. Composite Severity Pre significantly predicted Target Abstract ES (R^2=.51, F(1,11)=12.43, p<.01). When combined, Target Abstract ES and Executive Functioning Pre significantly predicted Executive Functioning Post (R^2=.57, F(2,10)=7.67, p<.05). Also when combined, Target Abstract ES and Composite Severity Pre significantly predicted Language Post (R^2=.60, F(2,10)=8.49, p<.05). For the previous two regressions, none of the Independent Variables (Target Abstract ES, Executive Functioning Pre, and Composite Severity Pre) were significant on their own within the regressions. The remaining regressions were not significant (all *p*s > .05).

Chapter 4

Discussion

Attention was not correlated with treatment effect size, and therefore, not predictive of treatment outcomes for word finding therapy. Thus, my hypothesis was not supported. However, the correlations conducted that were significant show that other cognitive processes of memory and executive functioning contribute to treatment effect size.

Although both Executive Functioning Pre and Composite Severity Pre correlated with Target Abstract ES, when regressions were conducted, Composite Severity was the only CLQT measure that predicted and significantly contributed to Target Abstract ES ($\beta = .74$, $p<.01$). Since Composite Severity is essentially an average of the five cognitive domains of the CLQT (Helm-Estabrooks, 2001), this led me to infer that other cognitive processes could be taking place simultaneously during abstract word training, such as memory and executive functioning.

Since Memory Pre was the only CLQT measure correlated with Target Concrete ES, it can be inferred that memory contributed to the generalization of untrained concrete words in therapy. CLQT testing and the word finding therapy mainly utilize working memory. Van Dyke (2012) describes working memory as the space of active information in which information is being brought in and out of consciousness during cognitive tasks. Van Dyke (2012) also references a model of working memory by Alan Baddeley that describes a key component of working memory, the Central Executive. The Central Executive component is responsible for revising, altering, and hindering information. In therapy, a patient would have to keep a word in his or her working memory to be able to complete the tasks. If a patient has a higher level of working memory before treatment, he or she would most likely be able to complete the therapy tasks more effectively and have more success.

The regression of Memory Pre and Language Pre as the IVs and Target Concrete ES as the DV was conducted to determine the effect of Memory Pre on Target Concrete ES. It was necessary to take into account Language Pre in this regression since Language Pre and Memory Pre are correlated; however, the regression was insignificant, meaning the measures do not predict treatment outcomes. In addition, it makes sense that Language Post would be correlated with Target Abstract ES since direct training of abstract items would lead to an increase in language function.

The correlations of both Executive Functioning Pre and Executive Functioning Post with Target Abstract ES led me to infer that one's level of executive functioning prior to treatment predicts outcomes, while also increasing as a result of treatment. Overall, executive functioning encompasses a wide variety of cognitive processes in the brain, including planning, organization, problem-solving, metacognition, engaging in goal-directed behaviors, etc. (Ardila, 2012). The structured nature of the word finding therapy referenced in this paper may help with some of these functions. Therefore, it makes sense that executive functioning may both benefit abstract word training and also be benefited by the abstract word training. When a regression was conducted using Executive Functioning Post as the DV with Target Abstract ES and Executive Functioning Pre as the IVs, it was significant. The results of this regression show that executive functioning post-therapy scores were positively affected by success with abstract word training; however, Target Abstract ES was not significant on its own in the regression. This means that although Target Abstract ES is linked to Executive Functioning Post, it is not predictive on its own when other variables are in play, such as Executive Functioning Pre.

Since direct training of abstract items would lead to an increase in language function, it makes sense that Target Abstract ES is also correlated with Language Post. Moreover, it was also important to explore how treatment success affects Language scores on the CLQT. Therefore, a regression was conducted using Language Post as the DV with Target Abstract ES and Composite Severity Pre as the IVs, and the regression was significant. The results show that language post-therapy scores were positively affected by success with abstract word training, just as the executive functioning post-therapy scores. Also like executive functioning, Target Abstract ES was not significant on its own in the regression. Therefore, this means that while Target Abstract ES is linked to Language Post, it is not predictive on its own when other variables are in play, such as Composite Severity Pre.

Chapter 5

Conclusion

In conclusion, the only CLQT pre-measure that predicts word finding treatment outcomes is Composite Severity. Since Composite Severity is an average of the five cognitive domains of the CLQT — attention, memory, executive function, language, and visuospatial skills — each domain contributes to word finding treatment outcomes, but only when combined as a whole. When separate from the other domains and on its own, each domain does not predict treatment outcomes. With this data, it is not possible to tease apart which cognitive skill is most important for success in therapy.

Although not a primary focus of this project, I also found that treatment outcomes can affect post-therapy CLQT scores for Language and Executive Function. Future work should be conducted to explore this specific facet of the results further.

A few of the limitations of the study include: there were only 12 participants in the original Sandberg and Kiran (2014) study, and one participant (P12) did not finish therapy, so there is only post-testing scores available for 11 participants. Future work should explore further abstract word training and generalization in word finding therapy with a larger participant pool. With more participants, more concrete results could occur.

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