Summer 1-1-2017

Drawing Conclusions about Aphasia: An Examination of the Relationship between Word Retrieval, Drawing, and Semantics

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DRAWING CONCLUSIONS ABOUT APHASIA:

AN EXAMINATION OF THE RELATIONSHIP BETWEEN WORD RETRIEVAL, DRAWING, AND SEMANTICS

A Thesis

Submitted to John G. Rangos Sr. School of Health Sciences

Duquesne University

In partial fulfillment of the requirements for

the degree of Master of Science

By

Joanne Kinney

August 2017

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ABSTRACT

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Thesis supervised by Sarah Wallace, Ph.D.

The hallmark characteristic of aphasia, word retrieval impairment, can significantly affect a person's ability to communicate their needs and ideas. Treatment for these deficits typically focuses on either restorative or compensatory strategies. In aphasia therapy, clinicians have predominately used drawing as a compensatory strategy. Emerging evidence suggests that drawing may also have restorative effects on word retrieval impairments by providing an alternate route to accessing the semantic system (Farias, Davis, & Harrington, 2006). However, the current understanding of this theoretical relationship between the semantic system, drawing, and word retrieval abilities is limited. This study examined that relationship to further develop the field of speech-language pathology's theoretical understanding. Ten participants with chronic aphasia completed a series of specially sequenced tasks, which measured confrontation-naming accuracy before and after drawing and a semantic feature cueing (SFC) task for target nouns. Participants significantly improved their confrontation naming accuracy when they named targets after completing SFC then drawing. Additionally, there were moderate negative relationships between semantic content present in participant drawings and drawing quality with the amount of semantic features participants produced. These results have implications for future studies that further examine the relationship between word retrieval, drawing, and semantics in people with aphasia.

ACKNOWLEDGEMENT

This project has provided me with so many opportunities to learn and grow as a young researcher and clinician. I would like to thank a few people who helped me throughout the process.

Dr. Wallace has been a huge inspiration for me the past couple years and will continue to be one throughout my career. Thank you for all the time, effort, interest, and guidance you have put into this project.

I’d like to thank the Aging Research and Teaching Consortium for funding this project, and my committee for encouraging evidence-based, interdisciplinary work.

Lauren Matthews, thank you for all your help. You are a dedicated, prepared, and skilled clinician and researcher. I’d also like to thank the undergraduate student raters for all the time and effort they contributed.

I also would not have been able to complete this project without the participants and their friends and families. Thank you for all the time and energy you have given to contribute to the literature base.

The Department of Speech-Language Pathology, thank you for your constant support and dedication to education throughout my time at Duquesne. I know that I was given every opportunity to learn about and grow in the field of speech-language pathology through this program.

Finally, I want to thank all my friends and family who supported and encouraged me throughout my degrees and this project.

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LIST OF ABBREVIATIONS

Beery VMI: Beery-Buktenica Developmental Test of Visual-Motor Integration

CLQT: Cognitive Linguistic Quick Test

CLQT VS: Cognitive Linguistic Quick Test Visuospatial Skills

CNA: Confrontation naming accuracy

PALPA: Psycholinguistic Assessment of Language Processing in Aphasia

P&PTT: Pyramids and Palm Trees Test

SFC: Semantic feature cueing

WAB-R: Western Aphasia Battery Revised

WAB-R AQ: Western Aphasia Battery Revised Aphasia Quotient

CHAPTER 1

INTRODUCTION

Word Retrieval Impairment in Aphasia

About 795,000 people sustain cerebrovascular accidents each year in the United States (Center for Disease Control, 2015). About 30% of people who survive a cerebrovascular accident exhibit characteristics associated with the language disorder, aphasia (Flowers, Silver, Fang, Rochon, & Martino, 2013). People with aphasia have difficulty expressing their communicative intent verbally and graphically (e.g., writing) as well as understanding other people's speech and written language. The hallmark characteristic of aphasia is word retrieval impairments (i.e., deficits in naming). Word retrieval deficits range from mild to severe and can significantly interfere with a person's ability to functionally communicate.

Treatments for word retrieval deficits often focus on either restoring the person's language skills or improving the use of compensatory strategies (e.g., gesturing, drawing) to increase communicative effectiveness during communication breakdowns. Some restorative treatments for people with aphasia include Constraint-Induced Language Therapy (Pulvermüller, Neininger, Elbert, Rockstroh, Koebbel, & Taub, 2001), Melodic Intonation Therapy (Sparks & Holland, 1976), and Response Elaboration Training (Kearns, 1985). Some compensatory treatments include the use of Augmentative and Alternative Communication (Beukelman & Mirenda, 2013) and treatments that focus on accessing multiple communication modalities, such as Multimodal Communication Training (Purdy & Van Dyke, 2011) and Promoting Aphasics' Communicative Effectiveness (Davis, 2005).

Relationship between Word Retrieval and Semantics

Many restorative treatments are based on studies that examined the relationship between semantic abilities and word retrieval ability. Semantic abilities include understanding the meaning of words, a skill that is important for retrieving words. According to the two-step model of lexical access, during the process of word retrieval, while the target word is activated, other words, their phonemes, and their semantic features will be activated as well (Dell, Lawler, Harris, & Gordon, 2004). Semantic feature analysis is a semantic treatment often used with people with aphasia that uses semantic cues (e.g., group, function, location, physical properties) to increase word retrieval. For example, in a single subject design study, Boyle and Coelho (1995) examined the effects of a semantic feature treatment on word retrieval impairments in a person with Broca's aphasia. In this study, the participant completed treatment involving semantic feature analysis. Following the completion of the treatment, the participant demonstrated improved confrontation naming accuracy on both treated and untreated words. Additionally, a single subject design study by Davis and Stanton (2005) found that a person with borderline fluent aphasia and prominent word retrieval deficits improved naming ability in connected speech and in confrontation naming tasks after six weeks of semantic feature analysis treatment. This evidence suggests that treatment focused on increasing semantic abilities through strengthening of the connections between words and related semantic features can increase word retrieval abilities (e.g., increasing connections between the word "cat" and the feature "purrs"). This idea is based on the theory that when neural connections between related concepts are strengthened within the semantic system, access to words becomes automatic (Davis &

Stanton, 2005). According to this spreading-activation theory of semantic processing, words are semantically linked through a series of intersecting nodes and pathways. When these links are activated, they are evaluated by factors such as context and syntax to determine if they are appropriate. However, when concepts have been primed, activation is more automatic (Collins & Loftus, 1975).

Link between Restorative Treatments and Compensatory Strategies

Although treatment can focus on either restorative or compensatory treatments, evidence has shown that these strategies are not mutually exclusive. To increase speech and language abilities, treatment does not have to directly address natural speech through restorative treatments (Weissling & Prentice, 2010). In fact, Hux, Buechter, Wallace, and Weissling (2010) found that a person with aphasia who engaged in novel communication increased conversational turns and content units when using a shared augmentative and alternative communication device versus natural speech alone. This demonstrates that compensatory strategies do not only bypass some communication deficits, but also have the potential to enhance communication competence and restore some language abilities (Weissling & Prentice, 2010).

Recently researchers have started to investigate the link between restorative and compensatory aspects of treatment. That is, treatments that are compensatory in nature may also have a facilitative effect increasing word retrieval abilities. Traditionally, restorative strategies focus on achieving rehabilitation goals by improving areas of deficits, while compensatory strategies provide a way to work around deficits to achieve the same goals (e.g., increasing word retrieval for functional communication versus use of a letter board). Thus far, most researchers have focused these efforts to examine the combined restorative and compensatory effect of gestures. For example, a single-subject, crossover design study by Ferguson, Evans, and Raymer (2012) examined the effects of both intention (i.e., non-meaningful circular movement at the wrist) and pantomime (i.e., meaningful/symbolic movements) gesture treatment on word retrieval abilities in people with mild to severe word retrieval deficits. They found that two of the four participants improved confrontation naming accuracy when using pantomime and intention gestures. Additionally, a study by Lanyon and Rose (2009) examined the effects of spontaneously gestured arm and hand gestures during word retrieval difficulty in people with aphasia. In this study, the examiners transcribed 20 minute conversation samples from 18 people with aphasia including all arm and hand gestures. They found that gestures were produced more often in the instances of word retrieval difficulties and that these instances were resolved more often when a gesture was present. Although additional research is needed, these studies suggest that gestures may have a combined restorative and compensatory effect for some people with aphasia.

Drawing and Aphasia

Another compensatory strategy, drawing, has been hypothesized to have a similar combined restorative and compensatory effect (Farias, Davis, & Harrington, 2006). Traditionally, drawing has been used as a compensatory strategy with treatment aimed at improving the information present in drawings and the overall drawing clarity (Morgan & Helm-Estabrooks, 1987). In this way, drawing can be used to compensate for word retrieval errors, to add context or clarify information, and in combination with other intervention strategies (Lyon, 1995). In a study by Morgan and Helm-Estabrooks (1987), two participants, both with limited verbal output, were administered treatment, which focused on improving the semantic information and detail present in their drawings. During drawing treatment, the examiners showed the participants a picture and asked them to draw it from memory. If the drawing was not satisfactory, the examiners would provide the participants with verbal cues and clinician models until they produced a satisfactory drawing. A drawing was scored satisfactory when it was recognizable and contained details of critical semantic content. Following the treatment, both participants communicated information more effectively through the use of drawing alone and included more detail and semantic content in their drawings. This study highlights the important relationship between semantic content in drawings and successful communication.

To investigate the restorative effects of drawing, an initial study by Farias et al. (2006) examined the relationship between drawing and word retrieval accuracy in people with fluent and nonfluent aphasia. In this study, 22 people with mild to severe aphasia identified 30 pictures from the *Reading Comprehension Battery of Aphasia* under three conditions (i.e., on confrontation, while writing the word, and while drawing the picture) after completing a baseline confrontation naming task. Verbal responses were either scored correct if they contained the correct phonemic sequencing or coded with different error types (e.g., neologisms, unrelated lexical error, and perseveration). When compared to writing, the results showed that drawing significantly improved naming, and naming errors produced while participants were drawing were fewer in number and closer to the target (Farias et al., 2006). Their results, although limited in scope, suggested that word retrieval may be improved after drawing by offering an alternative route to accessing the semantic system. That is, the action of drawing a target concept may strengthen connections between the concept and the semantic features in the same way that a restorative semantic treatment might. Additionally, unlike the restorative semantic treatments, drawing, like gestures, would provide a “backup” compensatory strategy if word retrieval is not facilitated. In a similar study, Hough and Taylor (2013) examined the effects of a drawing protocol, which included a semantic feature analysis format, on confrontation naming ability in a person with aphasia. The participant constructed her drawings after being cued to draw semantic features (i.e. “What does it remind you of?”). By the end of the drawing treatment, the participant’s confrontational naming ability increased remarkably, as measured by improvements in confrontation naming accuracy. This study provides further initial support for the relationship between drawing, word retrieval, and the semantic system.

Semantic content present in drawings and drawing quality may also provide information about neural connections. Richards (1967) completed a study where he collected drawings of cats and kittens from 1,200 children ages 4 to 15 years to examine developmental changes and gender differences in drawings. The researchers scored the drawings on six measures, including number of colors used and number of background/extra objects included. The examiners found that up until the age of 11 years, girls used more colors than same aged boys. However, there was not a significant trend for color use based on age. Examiners also found a steady increase in background drawings (i.e., drawn objects in addition to the cats) until the age of 9 years. At 12 years, however, background drawings began to decrease. The author suggests that this decrease may be due to a realistic and critical attitude that arrives with puberty and depresses creative ability (Richards, 1967). This decrease in background drawings as children mature suggests that adults may not be accustomed to including this information in their drawings. However, elements such as color and background drawings can increase the communicative effectiveness of a drawing. Therefore, when people with aphasia are taught to use drawing for communicative purposes, they are encouraged to include elements such as colors and background drawings (Lyon, 1995).

Although previous research (e.g., Farias et al., 2006; Ferguson et al., 2012; Taylor & Hough, 2013) has provided evidence to suggest that compensatory strategies (i.e., gestures and drawing) can increase word retrieval, these studies have only provided a limited evaluation of the semantic system. Therefore, the connection between the potential restorative effect of these compensatory strategies and the semantic systems is not well understood. Evidence provided by Davis and Stanton (2005) highlights the important relationship between word retrieval and semantics, and Morgan and Helm-Estabrooks (1987) provide evidence to suggest a relationship between semantics and drawing. Understanding this relationship is important because if the action of drawing target words can activate semantic links within the brain, according to the spreading-activation theory of semantic processing, drawing may make word retrieval more automatic. This may be possible through drawing, as compared to other modalities, because during the act of drawing a person must consider various aspects of the item. These aspects are similar to the semantic features that are integral to many semantic interventions (Boyle, 2004; Davis & Stanton, 2005; Rider, Wright, & Marshall, 2008). For example, if a person is drawing the item *cat*, they may consider features such as the tail, fur, whiskers, collar, food dish, toy mouse, or a related-item like a dog. Although not through the spoken modality, consideration of these features may still activate semantic networks resulting in spreading-activation and increase retrieval of the target item. In this way, drawing may have a unique relationship with semantics as compared to the nonverbal modality of writing or gestures, which do not require the same degree of consideration of the related features.

Study Purpose and Research Questions

The purpose of the proposed study was to examine the relationship between drawing, verbal and nonverbal semantic abilities, and word retrieval to further develop the field's understanding and provide a framework for development of theoretically based intervention strategies that capitalize on a hypothesized, combined restorative and compensatory strategy. Three primary questions, each with three related sub-questions, were addressed in this study:

Confrontation Naming Accuracy

(a.) What is the effect of drawing on confrontation naming accuracy in people with aphasia?

b. Does drawing improve confrontation naming accuracy in people with aphasia more than semantic feature cueing (SFC)?

c. Does drawing with SFC improve confrontation naming accuracy in people with aphasia more than SFC alone?

d. Does drawing with SFC improve confrontation naming accuracy in people with aphasia more than drawing alone?

Semantic Content

(a.) What is the relationship between confrontation naming accuracy and semantic content present in drawings?

b. What is the relationship between semantic feature accuracy and semantic content?

c. What is the relationship between aphasia severity and semantic content?

d. What is the relationship between semantic abilities and semantic content?

Drawing Quality

(a.) What is the relationship between confrontation naming accuracy and drawing quality?

b. What is the relationship between semantic feature accuracy and drawing quality?

c. What is the relationship between aphasia severity and drawing quality?

d. What is the relationship between semantic abilities and drawing quality?

CHAPTER II

METHODS

Experimental Design

This study employed a within group, repeated measures design to examine the relationship between word retrieval, drawing, and semantics in people with aphasia. The primary dependent variables included word retrieval accuracy, drawing quality rated on a five-point scale, number of semantic features spoken independently, and the amount of semantic content included in drawings. The independent variables include aphasia severity as determined by the *Aphasia Quotient of the Western Aphasia Battery Revised* (WAB-R) (Kertesz, 2006) and semantic abilities as determined by the *Pyramids and Palm Trees Test* (P&PTT) (Howard & Patterson, 1992) and subtests from the *Psycholinguistic Assessment of Language Processing in Aphasia* (PALPA) (Kay, Lesser, & Coltheart, 1992).

Participants

Ten participants with mild to severe aphasia were recruited for this study. All participants were at least 6 months post stroke (*M* = 97.5; *SD* = 53.4), ranged from 44 to 76 years old (*M* = 61.3; *SD* = 11.5), and spoke American English as their first and primary language. Participant demographic information is illustrated in Table 1.

Table 1. Participant demographic information

P	Gender	Age (years)	Ed. Level (years)	Time Post Onset (months)	Currently Receiving Services	Post Stroke Dominant Hand	Employment Status	Previous Occupation
1	M	58	12	155	Y	L	Part Time	Maintenance
2	M	44	16	156	Y	L	Volunteer	Salesman
3	F	72	12	96	Y	L*	Unemployed	Teacher
4	M	47	16	66	Y	L	Unemployed	Chiropractor
5	M	54	16	73	Y	L	Unemployed	Accountant
6	M	53	12	131	Y	R*	Volunteer	Salesman
7	M	69	16	71	Y	L	Unemployed	Engineer
8	M	69	12	171	N	R*	Unemployed	Sheet Metal Worker
9	M	76	18	43	Y	R*	Unemployed	Researcher
10	M	71	12	13	Y	R*	Retired	Service Man

**Indicates same pre-stroke dominant hand.*

The WAB-R Aphasia Quotient determined aphasia severity profiles. Seven participants demonstrated a confrontation naming accuracy (CNA) of at least 30% but no better than 80%, as determined by a confrontational naming task of ten targets. Due to challenges with recruitment, two participants who demonstrated a CNA above 80% and one participant who demonstrated a CNA below 30% were included in the study. To ensure that participants included in the study had the physical capabilities to complete research procedures, individuals completed screenings for severe impairments in fine motor control and dexterity, vision impairment, and hearing impairment. Participants completed the 9-hole Pegboard Test and the *Beery-Buktenica Developmental Test of Visual-Motor Integration* (Beery VMI) (Beery & Beery, 2010) to screen fine motor control and dexterity, an informal symbol identification task to screen visual abilities, and hearing was informally assessed (i.e., self report). No participants were excluded from this study. Participants completed all screening tasks, formal assessments, and experimental tasks with their post-stroke dominant hand. Half the participants' post-stroke dominant hand was the same as their pre-stroke dominant hand, and half were different due to right-sided weakness. Participant performance on formal testing is illustrated in Table 2. Participants were recruited from the Duquesne University Speech-Language and Hearing Clinic and local support groups. The researcher and a second examiner (speech-language pathology student) distributed recruitment flyers at these locations (Appendix 1).

Table 2. Participant performance on formal testing

P	WAB-R AQ	Aphasia Type	Aphasia Severity	CLQT VD (105)	CLQT Clock Draw (13)	P& PTT (55)	PALPA Spoken Word (40)	PALPA Written Word (40)	Beery VMI	Beery VMI Severity
1	68.3	Broca's	Moderate	71	12	44	36	38	94	Average
2	65.5	Broca's	Moderate	97	7	43	36	32	87	Below Average
3	88.3	Anomic	Mild	77	13	50	39	40	80	Below Average
4	38	Broca's	Severe	87	10	46	34	34	97	Average
5	36.6	Broca's	Severe	76	5	50	37	36	100	Average
6	49.4	Conduction	Severe	77	9	45	30	35	80	Below Average
7	77.1	Anomic	Mild	76	9	47	38	39	98	Average
8	83.5	Anomic	Mild	84	10	51	39	40	88	Below Average
9	55.9	Conduction	Moderate	52	7	46	33	30	66	Very Low
10	50.4	Broca's	Severe	80	8	54	40	40	80	Below Average

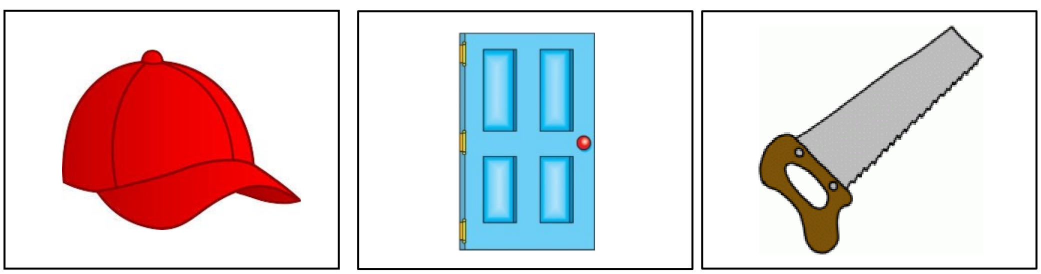
WAB-R AQ = Western Aphasia Battery-Revised Aphasia Quotient; CLQT VD = Cognitive Linguistic Quick Test Visual Domain; P&PTT =Pyramids and Palm Trees Test; PALPA=Psycholinguistic Assessments of Language Processing in Aphasia; Beery VMI= Beery-Buktenica Developmental Test of Visual-Motor Integration

Instrumentation

Materials for this study included formal assessment tools, 10 target concepts, and a semantic feature chart. The researcher used formal assessment tools to identify if participants were eligible for participation and describe participants' language and cognitive abilities. Testing included the WAB-R Aphasia Quotient portion, *Cognitive*

Linguistic Quick Test (CLQT) (Helm-Estabrooks, 2002) nonverbal subtests, PALPA spoken word and written word subtests, and the P&PTT. The WAB-R and CLQT described the type and severity of the participants' language impairments and nonverbal cognitive abilities. The PALPA and P&PTT provided detailed information about participants' verbal and nonverbal semantic abilities. The ten target concepts included concrete nouns selected based on their number of syllables (i.e., one syllable words), frequency of occurrence (i.e., high frequency words), naming reaction time, and potential complexity of drawings. The researcher ensured that the potential drawing for each concept was generally, equally complex by trialing the number of times a drawer would have to pick up their hand to complete each drawing. The researcher presented target concepts to participants as colored line drawings on 8 by 5 inch note cards and used a semantic feature chart for SFC. Examples of target concepts are shown in Figure 1.

Figure 1. Examples of target concepts used in study: (1a) hat, (1b) door, (1c) saw.



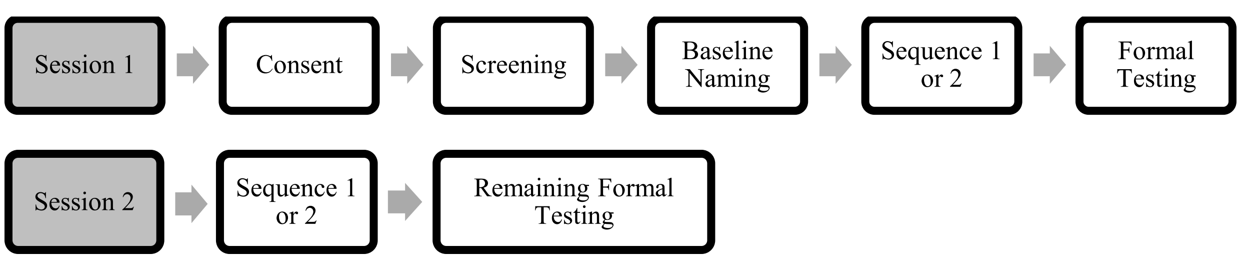
{a} {b} {c}

This study was conducted at the Duquesne University Speech-Language and Hearing Clinic and/or participants' homes. The Duquesne University Speech-Language Hearing Clinic provided a quiet environment for research sessions to occur. Parking, complete with a handicap-accessible entrance to the building, was available to participants. To assure reliability of data collected from the study, all sessions were recorded with a video camera on a tripod. All videos, scanned drawings, and study files were stored on a 2TB external drive, which was kept in a locked lab. Examiners were two speech-language pathology graduate students.

Procedures

Participants who provided informed consent completed study procedures during two sessions lasting 30 to 90 minutes each. Session schedules are shown in Figure 2. During the first session, participants completed screening tasks including a medical history interview, hearing and visual screening tasks, the 9-hole Pegboard Test, the Beery VMI, and a confrontation naming task. Then, the session continued with experimental tasks systematically sequenced to answer the research questions. Odd numbered participants were randomly assigned to complete Sequence 1 during the first session, and even numbered participants were randomly assigned to complete Sequence 2 during the first session. Then, the remaining sequence was completed during the second session. Formal assessments were completed after the first session following the experimental task. Depending on task timing and participants' schedules, any remaining formal tests were completed after the second session. The experimental task took between 15 to 30 minutes.

Figure 2. Session 1 and 2 schedule



Participants completed the experimental sequences on two separate days to limit the influence of order effects related to fatigue and practice effects. To limit the risk of history/maturation and mortality effects, participants completed the second session within 10 days of the first session.

Sequence one. First, the researcher showed the participant a line drawing of 1 of the 10 target concepts and asked for the name of the target word (Name1). Next, the participant was asked to describe four semantic features while utilizing the SFC chart (i.e., group, use, physical properties, and location) (Appendix 2). If the participant could not retrieve a feature, the researcher provided a written and spoken feature, and asked the participant to repeat the feature (SFC1). Following a review of the features, the participant was asked to name the target word again (Name2). Then, the examiner removed the picture and asked the participant to draw the target concept from memory (Draw1). Finally, the examiner presented the picture and asked the participant to name the word a third time (Name3). Sequence 1 is shown in Figure 3. This sequence was repeated for each of the 10 target concepts evaluated during this session.

Sequence two. Sequence two occurred on a different day (i.e., different session) than sequence one. Participants were shown 10 pictures individually and asked to name the target word (Name4). Next, the examiner removed the picture and asked the participant to draw the target concept from memory (Draw2). Then, the examiner presented the picture and asked the participant to name the word again (Name5). Next, the participant was asked to describe four semantic features (i.e., group, use, physical properties, and location) while utilizing the SFC chart (Appendix 2). If the participant could not retrieve a feature, the researcher provided a written and spoken feature, and asked the participant to repeat the feature (SFC2). Following a review of the features, the participant was asked to name the target word a third time (Name6). Sequence 2 is shown in Figure 4. This sequence was repeated for all 10 target concepts evaluated during this session.

Figure 3. Sequence 1

Name1 → SFC1 → Name2 → Draw1 → Name3

Fiqure 4. Sequence 2

Name4 → Draw2 → Name5 → SFC2 → Name6

Data Collection, Organization, and Analysis

All sessions were video recorded for later analysis. The researcher counted words accurately spoken with 15 seconds during the confrontation naming task as correct. Semantic features that were spoken within 15 seconds of the verbal cue were counted as correct. Any response that was an acceptable alternative to the target (e.g., “cap” for “hat”) or a close apraxic approximation of the target (e.g., “hac” for “hat”) was accepted as an accurate production. Finally, drawings were analyzed for quality and content. Twenty-five undergraduate speech-language pathology students (naïve judges) analyzed the quality of each drawing given a five-point scale (Appendix 3). All drawings were presented to the naïve judges as ten surveys on the course website, *Blackboard*©. Each naïve judge completed the surveys in a different, randomized order. Next, the researcher and a research assistant measured the number of semantic elements in each drawing to determine the amount of content present in each drawing.

To assess reliability, measures were taken to assure consistency of procedures across participants and trials. A second rater (speech-language pathology student) scored 20% of randomly selected session videos. The researcher and second rater were in 97% agreement and resolved discrepancies through discussion.

The researcher completed a descriptive analysis and employed t-tests and correlations to evaluate the three primary research questions and sub-questions. Specifically, the researcher calculated means, standard deviations, and t-tests for all questions related to question 1 (Q1a-Q1d). Additionally, research question 2 and question 3 (Q2a-Q3d) involved the calculation of multiple correlations with Microsoft Excel©. Table 3 shows the comparisons that were made for each question. Each task is referenced based on Figures 2 and 3 above (e.g., Name4 is the participant's first attempt at naming during sequence 2). The researcher also grouped participants by severity (i.e., mild, moderate, and severe aphasia as determined by the WAB-R) and calculated means, standard deviations, and t-tests for all questions related to question 1 (Q1a-Q1d). P-values less than 0.05 were considered significant.

Table 3. Comparisons for each research question

Question	Description
Q1a	Name4 compared to Name5 (i.e., naming before and after drawing)
Q1b	Name1 compared to Name2 (i.e., naming before and after SFC)
Q1c	Name3 compared to Name2 (i.e., naming after SFC + drawing and after SFC)
Q1d	Name6 compared to Name5 (i.e., naming after drawing + SFC and after drawing)
Q2a	Name1 compared to semantic content as determined by judge ratings
Q2b	Number of features produced independently compared to semantic content as determined by judge ratings
Q2c	Aphasia severity as determined by the WAB-R AQ compared to semantic content as determined by judge ratings
Q2d	Semantic abilities as determined by the P&PTT and PALPA subtests compared to semantic content as determined by judge ratings
Q3a	Name1 compared to drawing quality as determined by judge ratings
Q3b	Number of features produced independently compared to drawing quality as determined by judge ratings
Q3c	Aphasia severity as determined by the WAB-R AQ compared to drawing quality as determined by judge ratings
Q3d	Semantic abilities as determined by the P&PTT and PALPA subtests compared to drawing quality as determined by judge ratings

CHAPTER III

RESULTS

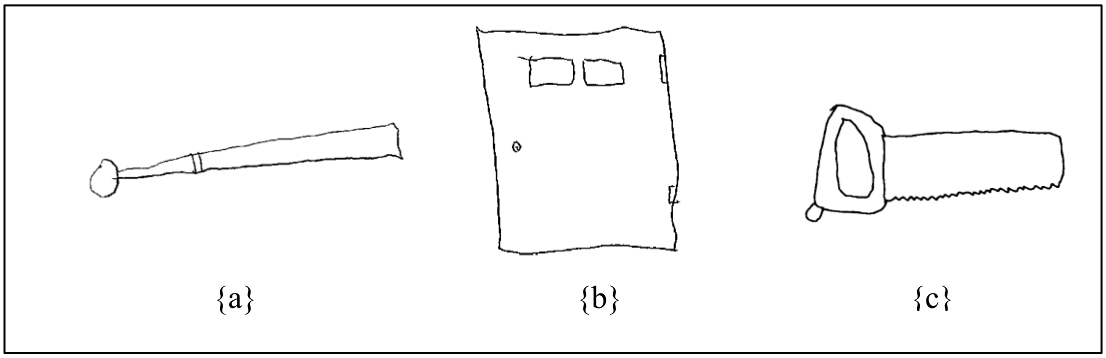
Confrontation Naming Accuracy

Means, standard deviations, and t-tests between all participants for each confrontation naming condition are presented in Table 4. Descriptive analyses show that participants' performance was somewhat consistent regardless of condition; however, small variations were noted. Overall, the confrontation naming accuracy mean increased after the participants completed a drawing task (i.e., drawing alone and drawing after SFC). Only one of these changes was supported by statistically significant results. When participants named targets after completing SFC then drawing, their scores significantly improved ($p = 0.003$). Figure 5 shows examples of drawings that resulted in confrontation naming accuracy improvement.

Table 4. Confrontation naming accuracy means, standard deviations, and t & p values

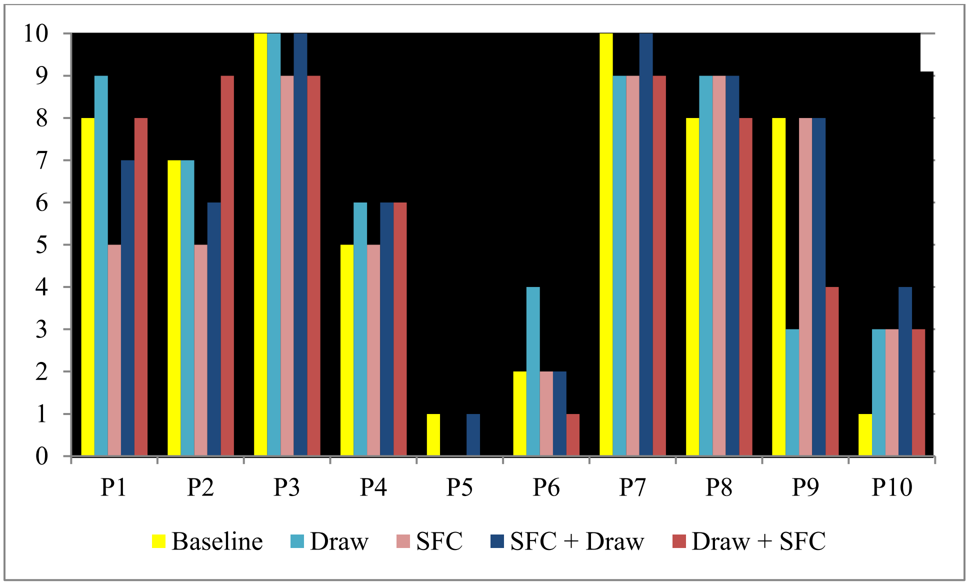
Drawing (Q1a)		SFC (Q1b)		SFC + drawing (Q1c)		Drawing + SFC (Q1d)	
Before drawing	After drawing	Before SFC	After SFC	After SFC	After SFC + drawing	After drawing	After drawing + SFC
$M = 5.8$ $SD = 3.8$	$M = 6$ $SD = 3.4$	$M = 6$ $SD = 3.5$	$M = 5.5$ $SD = 3.2$	$M = 5.5$ $SD = 3.2$	$M = 6.3$ $SD = 3.2$	$M = 6$ $SD = 3.4$	$M = 5.7$ $SD = 3.5$
$t = 0.480$ $p = 0.642$		$t = 1.103$ $p = 0.299$		$\boldsymbol{t = 4.000}$ $\boldsymbol{p = 0.003}$		$t = 0.709$ $p = 0.496$	

Figure 5. Drawings of a bat (4a), door (4b), and saw (4c) that resulted in confrontation naming accuracy improvement



Additionally, the naming accuracy mean decreased after participants generated semantic features (i.e., SFC alone and SFC after drawing). The following improvements in confrontation naming accuracy were noted: seven participants after drawing (P1, P2, P4, P6, P7, P8, P10), two after completing SFC (P8, P10), seven after completing SFC then drawing (P1, P2, P3, P4, P5, P7, P10), and two after drawing then completing SFC (P2, P8). The following decreases in confrontation naming accuracy were noted: two participants after drawing (P2, P7), six after completing SFC (P1, P2, P3, P5, P7, P10), and four after drawing then completing SFC (P1, P3, P6, P7). Figure 6 illustrates individual participant confrontation naming accuracy for those conditions: baseline (Name1), after drawing (Name5), after SFC (Name2), after SFC then drawing (Name3), after drawing then SFC (Name6).

Figure 6. Individual participant Confrontation Naming Accuracy for multiple conditions



Aphasia Severity. Grouping of participants by severity showed that participants with severe aphasia (P4, P5, P6, P10) demonstrated slight improvements in mean scores after drawing, completing SFC, and completing SFC then drawing. The moderate aphasia group (P1, P2, P9) mean scores slightly improved after completing SFC then drawing and drawing then completing SFC. Across all conditions, the mild aphasia group (P3, P7, P8) mean scores slightly improved most after completing SFC then drawing. Otherwise, the groups' mean scores slightly decreased. These changes across participant groups were not statistically significant. Table 5 shows the means, standard deviations, and t-tests for each confrontation naming condition, grouped by aphasia severity.

Table 5. Confrontation naming accuracy means, standard deviations, and t & p values by aphasia severity

Q1a	Before drawing	After drawing	T and P values
Mild	$M = 9.7$; $SD = 0.6$	$M = 9.3$; $SD = 0.6$	$t = 0.840$; $p = 0.422$
Moderate	$M = 7$; $SD = 1.7$	$M = 6.3$; $SD = 3.1$	$t = 0.655$; $p = 0.529$
Severe	$M = 2$; $SD = 2.2$	$M = 3.3$; $SD = 2.5$	$t = 1.976$; $p = 0.080$
Q1b	Before SFC	After SFC	
Mild	$M = 9.3$; $SD = 1.5$	$M = 9$; $SD = 0$	$t = 0.445$; $p = 0.667$
Moderate	$M = 7.7$; $SD = 0.6$	$M = 6$; $SD = 1.7$	$t = 1.39$; $p = 0.199$
Severe	$M = 2.3$; $SD = 1.9$	$M = 2.5$; $SD = 2.1$	$t = 0.373$; $p = 0.718$
Q1c	After SFC	After SFC + drawing	
Mild	$M = 9$; $SD = 0$	$M = 9.7$; $SD = 0.6$	$t = 1.44$; $p = 0.184$
Moderate	$M = 6$; $SD = 1.7$	$M = 7$; $SD = 1$	$t = 1.30$; $p = 0.225$
Severe	$M = 2.5$; $SD = 2.1$	$M = 3.3$; $SD = 2.2$	$t = 2.175$; $p = 0.056$
Q1d	After drawing	After drawing + SFC	
Mild	$M = 9.3$; $SD = 0.6$	$M = 8.7$; $SD = 0.6$	$t = 1.44$; $p = 0.184$
Moderate	$M = 6.3$; $SD = 3.1$	$M = 7$; $SD = 2.6$	$t = 0.655$; $p = 0.529$
Severe	$M = 3.3$; $SD = 2.5$	$M = 2.5$; $SD = 2.6$	$t = 0.901$; $p = 0.391$

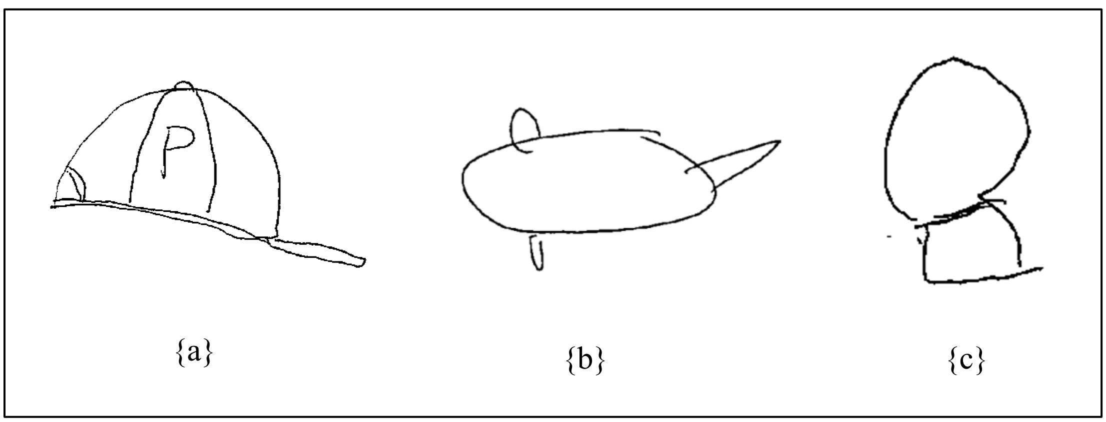
Semantic Content in Drawings

Relationships were determined by the following values based on Portney and Watkins (2000): above 0.75 good to excellent, 0.50 to 0.75 moderate to good, 0.25 to 0.50 fair to moderate, 0.00 to 0.25 little to no relationship. The amount of semantic content in participants' drawings had no relationship (negligible to no) with their baseline confrontation naming accuracy ($r = 0.03$) and scores on the PALPA written word subtest ($r = -0.09$). However, semantic content had a moderate negative relationship with the number of semantic features independently produced by participants ($r = -0.59$). There was also a fair negative relationship between semantic content and aphasia severity determined by the WAB-R AQ ($r = -0.34$), semantic abilities determined by P&PTT scores ($r = -0.44$), and semantic abilities determined by PALPA spoken word subtest scores ($r = -0.31$). Finally, semantic content had a fair positive relationship with participants' CLQT visuospatial skills (VS) domain score (r = 0.33). Table 6 shows correlations for semantic content present in participants' drawings. Figure 7 shows examples of participant drawings with different amounts of semantic content.

Table 6. Additional semantic content in drawings correlations

CNA	Semantic features	WAB-R AQ	P&PTT	PALPA written	PALPA spoken	CLQT VS domain
0.03	-0.59	-0.34	-0.44	-0.09	-0.31	0.33

Figure 7. Participant drawings of hats with different semantic content: (6a) P4 (severe aphasia; semantic content drawing score 4; P&PTT score 46; semantic feature mean 2.25), (6b) P3 (mild aphasia; semantic content drawing score 0; P&PTT score 55; semantic feature mean 8.25), (6c) P10 (moderate aphasia; semantic content drawing score 1; P&PTT score 54; semantic feature mean 7)



Drawing quality

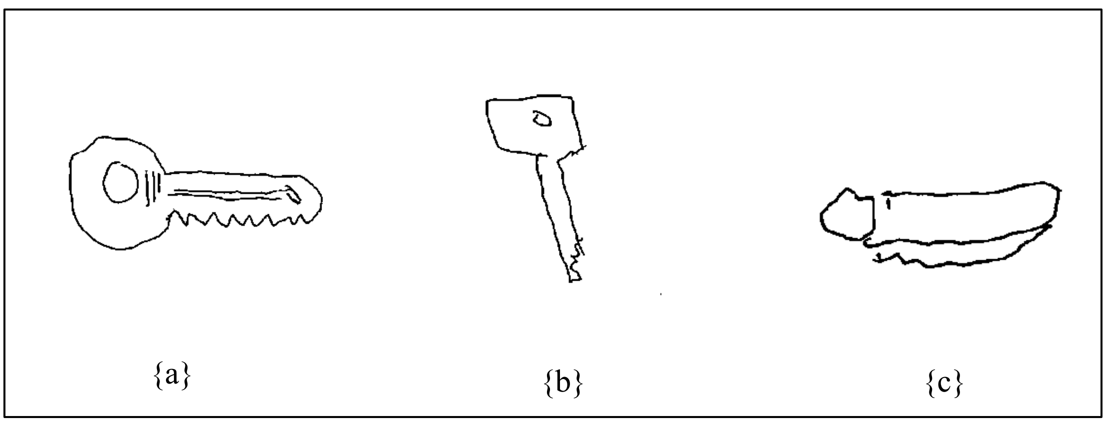
Drawing quality had no relationship (negligible to no) with participants' baseline confrontation naming accuracy (r = -0.03) and scores on the PALPA written (r = 0.07) and spoken (r = -0.10) subtests. However, drawing quality had a moderate negative relationship with semantic features independently produced (r = -0.66). There was also a fair negative relationship between drawing quality and aphasia severity as determined by

WAB-R AQ scores (*r* = -0.32) and semantic abilities determined by P&PTT scores (*r* = -0.33). Finally, drawing quality had a fair positive relationship with participants' CLQT VS domain score (*r* = 0.29). Table 7 shows correlations for drawing quality. Figure 8 shows differences in the quality of participant drawings.

Table 7. Drawing quality correlations

CNA	Semantic features	WAB-R AQ	P&PTT	PALPA written	PALPA spoken	CLQT VS domain
-0.03	-0.66	-0.32	-0.33	0.07	-0.10	0.29

Figure 8. Examples of participant drawings of keys with different quality: (7a) P4 (severe aphasia; drawing quality score 4.92; P&PTT score 46; semantic feature mean 2.25), (6b) P2 (moderate aphasia; drawing quality score 3.92; P&PTT score 43; semantic feature mean 3.75), (6c) P9 (moderate aphasia; drawing quality score 1.84; P&PTT score 46; semantic feature mean 5)



CHAPTER IV

DISCUSSION

Confrontation naming accuracy

This study investigated the effects of different drawing and semantic conditions on confrontation naming. Confrontation naming accuracy (CNA) significantly improved when a drawing task was added after a semantic feature cueing (SFC) task, suggesting that people with aphasia may benefit from a semantic treatment that incorporates drawing. Previous studies have shown that semantic treatments can improve lexical retrieval for people with aphasia (Boyle, 2004; Davis & Stanton, 2005; Rider, Wright, & Marshall, 2008). This may be due to the theory that as connections between target words and their semantic features become stronger, lexical retrieval is more automatic (Collins & Loftus, 1975). However, treatment effects may not generalize to untreated words and semantic cueing may be difficult to implement outside of therapy sessions, so modifications to these treatments should continue to be investigated (Boyle, 2004; Davis & Stanton, 2005; Rider et al., 2008).

In the current study, participants often decreased their CNA after SFC because they produced a perseverated semantic feature rather than the accurate name of the target concept (e.g., P3 said "kitchen" instead of "bowl" after completing SFC). Drawing, a nonverbal action, may decrease the language demands of this task for people with aphasia, as well as the amount of preservative errors, while still strengthening the connections between target words and their semantic features. Additionally, Hough and Taylor (2013) found that a treatment protocol that incorporated drawing and semantic features improved naming scores for a participant with aphasia. In this study, CNA did not significantly improve under other conditions such as drawing alone, SFC alone, or adding SFC after a drawing task. Under conditions where participants were only generating semantic features or generating semantic features after drawing, their CNA appeared to decline. It is possible that CNA did not significantly improve after naming alone because many participants included little or no additional semantic information in their drawings. CNA did not improve in conditions where participants were attempting to name target concepts immediately after completing SFC, because many participants were producing preservative errors, as mentioned above.

Changes in mean scores demonstrated that CNA after drawing conditions all slightly improved while CNA after SFC conditions all slightly decreased. These results are similar to the study by Farias et al. (2006), where participants significantly improved CNA after drawing conditions versus writing conditions. CNA scores improved more in drawing conditions than conditions where participants were generating semantic features and language demands were greater. Writing and generating verbal semantic features are both much more linguistically demanding than drawing.

The magnitude of change (range of change observed across participants) from no drawing to drawing conditions was rather small. One explanation for this relatively small change was that the researcher instructed participants to draw target concepts within an isolated, decontextualized task rather than instructing them to draw these concepts for communicative purposes. Participants' CNA may have improved more if the prompt for the drawing task had been different or if they were involved in a conversational task.

Improvements in CNA made following a drawing task may not have been due to a semantic activation as hypothesized. Motor movements used for drawing may have activated accurate word retrieval rather than semantic drawing. Previous studies have demonstrated neural activation in hand motor areas during language tasks in healthy adult participants that were not present when participants completed control, non-linguistic tasks (Flöel, Ellger, Breitenstein, & Knecht, 2003; Meister et al., 2003). This finding may suggest a relationship between lexical retrieval and hand movements where hand movements facilitate more efficient lexical retrieval. Additionally, the study by Ferguson et al. (2011) found that two participants with aphasia significantly improved verbal picture naming following the production of non-symbolic gestures and only showed some improvement following the production of symbolic gestures. This provides further evidence that motor movements of the hand, rather than the semantic activation from meaningful drawings could have resulted in improved CNA. Further, more efficient lexical retrieval may be facilitated by limb movements in general. A study by Meinzer et al. (2011) found that participants with aphasia accurately self-corrected semantic naming errors more while they were standing than while they were sitting. While this evidence does not prove that CNA improvements followings drawing were caused by motor cortex activation alone, it should be considered.

Overall, this study demonstrated that drawing with SFC improves CNA in people with aphasia more that SFC alone. Otherwise, drawing and SFC alone had a minimal effect on CNA in people with aphasia, and drawing with SFC after did not improve CNA in people with aphasia more than drawing alone.

Aphasia severity. When the results were grouped by severity, drawing with SFC showed slight improvements in CNA for people with severe aphasia more than SFC alone. That is, when participants with severe aphasia drew target concepts after completing SFC, their scores improved enough to approach significance. Also, participants with severe aphasia's mean CNA scores slightly improved after every condition, while participants with mild and moderate aphasia's mean CNA scores only slightly improved after completing SFC then drawing. This may be due to the higher amounts of additional semantic content the participants with severe aphasia included in their drawings. For example, the participant who included the most additional semantic content in his drawings, P4, had severe aphasia and improved his CNA after drawing for two target concepts. To contrast, one of the participants with the most mild aphasia, P3, included very little semantic content in her drawings and only improved naming after drawing once.

Semantic Content in Drawings and Drawing Quality

The researcher also examined the relationship between additional semantic content present in drawings and multiple cognitive/linguistic factors. The more semantic content present in a drawing, the more likely the participant demonstrated difficulty generating accurate semantic features and presented with lower scores on language and semantic formal assessments. These findings suggest that people with aphasia with higher language and semantic abilities may not be fully accessing their semantic system when they are drawing. The participants with lower language abilities may use drawing to compensate during daily interactions more than participants with higher language abilities (Lyons, 1995; Sacchett, Byng, Marshall, & Pound, 1999). Therefore, people with lower language abilities may include more semantic content in their drawings because they are used to drawing communicatively. Similarly, Braddock, Farmer, Deidrick, Iverson, and Maria (2006) examined the speech and gesture patterns of a group of participants with Joubert syndrome. They found that all of the participants used gestures while communicating; however, the more unintelligible participants' speech, the more gestures they used. This further indicated that people with more complex or severe communication needs are more likely than people with mild communication impairments to use compensatory strategies (e.g., drawing) in their daily interactions. If a person uses compensatory strategies frequently, it is likely that he or she will use these strategies more efficiently and skillfully.

Within the current study, the researcher also examined the relationship between drawing quality and multiple cognitive/linguistic factors. Relationships found between the amount of additional semantic content in drawings and other factors (i.e., amount of semantic features generated, language abilities, semantic abilities, and visuospatial abilities) were similar to the relationships found between drawing quality and those factors. Additional semantic content, in many cases, likely increases the communicative effect of drawings; therefore, the researcher anticipated this result. The study by Farias et al. (2006) also examined drawing quality and found that there was no significant relationship between drawing quality and picture naming abilities in participants with aphasia. They suggested that the detail in their participants' drawings did not contribute to improvements in naming, but that it was the action of drawing alone that led to these improvements. While the results from the current study also imply that drawing quality has little to no relationship with naming abilities, the participants who included the most semantic information in their drawings and had the highest drawing quality also demonstrated the most improvements in CNA after drawing.

Overall, the current study findings suggest that semantic content present in drawings has no relationship with CNA. Also, the results suggest that the more semantic content people with aphasia include in their drawings, the more likely it is that they will have difficulty generating semantic features and present with lower language and semantic abilities on formal testing. Drawing quality also has no relationship with CNA. However, drawing quality may provide evidence on a person with aphasia's ability to generate semantic features and their performance on formal assessments. Based on the results from this study, the better a person with aphasia draws, the more likely they will perform poorly on formal assessments for language and semantic abilities and have difficulty generating semantic features.

Limitations

This study aimed to examine the complex relationship between word retrieval, drawing, and semantics. Given the exploratory nature of this study, limitations were evident. In addition to small sample size, the range of aphasia severity present in the participant group and the day-to-day variability of this population may have interfered with the results. People with aphasia may have variable language abilities within an identical task in the same environment (McNeil, 1982), and this may have contributed to improved or decreased naming abilities rather than drawing or SFC conditions. Also, the participant's range in severity may have altered the significance of the results. Participants who were very severe may not have had the residual abilities to improve their CNA and participants who were mild did not have as many opportunities to improve because their baseline naming was so high. Furthermore, some of the participants may have been more or less familiar with the target high-frequency nouns as compared to other participants. Familiarity has been shown to affect word retrieval and might also affect drawing (Conley & Coelho, 2003). If participants are more familiar with a word, they may have stronger semantic representations of this word and therefore be able to access the word more automatically. Participants may have included a greater amount of semantic content in drawings of concepts that they were familiar with. There was also variability across drawing raters. A one-fact generalizability approach indicates that the raters used the scale differently. However, within themselves, they appear to be consistent. Although participants were required to complete the second study session within four to seven days of the first session, priming effects from the experimental tasks must also be considered. Specifically, participants were exposed to the same word list in the same order in both sessions, which may have affected CNA in their second session. Finally, because participants had the opportunity to generate their own semantic features, therefore, participants were not exposed to all the same ones. If participants were able to generate their own features, rather than being given the examiners predetermined feature, their description of the target concept may have been more familiar and contextualized than other participants' descriptions. This difference in semantic feature generation may have led to higher CNA following semantic feature generation.

Future Studies

Based on the key findings of this preliminary study, future studies should begin to examine the relationship between word retrieval, drawing, and semantics during a task wherein people with aphasia draw for a communicative purpose. Additionally, evidence from this study suggests that a treatment study aimed to teach participants with high semantic abilities to include more semantic information in their drawings may be beneficial. This could be achieved by extending and expanding on the current study and results from Hough and Taylor (2013) to integrate drawing into a semantic feature task. Also, a study wherein people with aphasia name target concepts after they draw a target for two conditions (i.e., after a semantic drawing and after a nonrelated drawing) may provide more evidence to understand the importance of semantic content in drawings to improve confrontation naming accuracy. Finally, future studies should address the current study's research questions with other people with language impairments and with a larger group of people with different types and severities of aphasia.

Conclusion

Word retrieval deficits can be frustrating and debilitating for people with aphasia. However, restorative (i.e., semantic treatments) and compensatory strategies may improve communicative effectiveness. Drawing, a strategy that has been predominantly used to compensate for word retrieval deficits in people with aphasia may have some restorative effects. In this study, the relationship between word retrieval, drawing, and semantics in aphasia was examined. The results from this study suggested that drawing after generating semantic features improves confrontation naming accuracy in people with aphasia. Additionally, people with mild and moderate aphasia may need training to include semantic content in their drawings to utilize this combined restorative-compensatory strategy. However, the results from this study were preliminary and this topic should be addressed by future studies.

References

Beery, K. E, & Buktenica, N. A., & Beery, N. A. (2010). *Beery-Buktenica Developmental Test of Visual-Motor Integration.* San Antonio, TX: The Psychological Corporation.

Beukelman, D. R., & Mirenda, P. (2013). *Augmentative & alternative communication: Supporting children and adults with complex communication needs.* Baltimore, MD: Brookes.

Boyle, M. (2004). Semantic feature analysis treatment for anomia in two fluent aphasia syndromes. *American Journal of Speech-Language Pathology, 13*, 236-249.

Braddock, B. A., Farmer, J. E., Deidrick, K., M., Iverson, J. M., & Maria, B. L. (2006). Oromotor and communication findings in joubert syndrome: Further evidence of multisystem apraxia. *Journal of Child Neurology, 21*(2), 160-163.

Centers for Disease Control and Prevention: CDC 24/7: Saving Lives, Protecting People (March 24, 2015). *Stroke.* Retrieved from http://www.cdc.gov/stroke/facts.htm

Collins, A. M., & Loftus, E. F. (1975). A spreading-activation theory of semantic processing. *Psychological Review, 82*, 407- 428.

Conley, A., & Coelho, C. A. (2003). Treatment of word retrieval impairment in chronic broca's aphasia. *Aphasiology, 17*(3), 203-211.

Davis, G. A. (2005). PACE revisited. *Aphasiology, 19*(1), 21-38.

Davis, L. A., & Stanton, S. T. (2005). Semantic feature analysis as a functional therapy tool. *Contemporary Issues in Communication Science and Disorders, 32*, 85-92.

Dell, G. S., Lawler, E. N., Harris, H. D., & Gordon, J. K. (2004). Models of errors of omission in aphasic naming. *Cognitive Neuropsychology, 21*, 125-145.

Farias, D., Davis, C., & Harrington, G. (2006). Drawing: Its contribution to naming in aphasia. *Brain and Language, 97*, 53-63.

Ferguson, N. F., Evans, K., & Raymer, A. M. (2012). A comparison of intention and pantomime gesture treatment for noun retrieval in people with aphasia. *American Journal of Speech-Language Pathology, 21*, 126-139.

Flöel, A., Ellger, T., Breitenstein, C., & Knecht, S. (2003). Language perception activates the hand motor cortex: Implications for motor theories of speech perception. *European Journal of Neuroscience, 18*, 704-708.

Flowers, H. L., Silver, F. L., Fang, J., Rochon, E., & Martino, R. (2013). The incidence, co-occurrence, and predictors of dysphagia, dysarthria, and aphasia after first-ever acute ischemic stroke. *Journal of Communication Disorders, 46*(3), 238-248.

Helm-Estabrooks, N. (2002). *Cognitive Linguistic Quick Test*. San Antonio, TX: The Psychological Corporation.

Howard, D., & Patterson, K. (1992). *The Pyramids and Palm Trees Test*. Bury St. Edmunds, UK: Thames Valley Test Company.

Hough, M. & Taylor, A. (2013, May 28). *Use of Drawing to Improve Word Retrieval in Chronic Nonfluent Aphasia*. Paper presented at the 43rd Clinical Aphasiology Conference: Tucson, AZ.

Hux, K., Buechter, M., Wallace, S., & Weissling, K. (2010). Using visual scene displays to create a shared communication space for a person with aphasia. *Aphasiology, 24*(5), 643-660.

Kay, J., Lesser, R., & Coltheart, M. (1992). *Psycholinguistic Assessments of Language Processing in Aphasia*. Hove: Erlbaum.

Kearns, K. P. (1985). Response elaboration training for patient initiated utterances. *Clinical Aphasiology,* 196-204.

Kertescz, A. (2006). *Western Aphasia Battery*. New York: The Psychological Corporation.

Lanyon, L., & Rose, M. L. (2009). Do the hands have it? The facilitation effects of arm and hand gesture on word retrieval in aphasia. *Aphasiology, 23*, 809-822.

Lyons, J. G. (1995). Communicative drawing: an augmentative mode of interaction. *Aphasiology, 9*, 84-94.

McNeil, M. R. (1982). The nature of aphasia in adults. *Speech, Language, and Hearing, 2*, 692-740).

Meinzer, M., Breistenstein, C., Westerhoff, U., Sommer, J., Rösser, N., Denise Rodriguez, A., Harnish, S., Knecht, S., & Flöel, A. (2011). Motor cortex preactivation by standing facilitates word retrieval in aphasia. *Neurorehabilitation and Neural repair, 25*(2), 178-187.

Meister, I. G., Boroojerdi, B., Foltys, H., Sparing, R., Huber, W., & Töpper, R. (2003). Motor cortex hand area and speech: Implications for the development of language. *Neuropsychologia, 41*, 401-406.

Morgan, A. & Helm-Estabrooks, N. (1987). Back to the drawing board: A treatment program for nonverbal, aphasic patients. *Clinical Aphasiology, 17*, 64-72.

Portney, L. G., & Watkins, M. P. (2000). Foundations of clinical research: Applications to practice. Upper Saddle River, NJ: Prentice Hall Incorporation.

Pulvermüller, F., Neininger, B., Elbert, T., Rockstroh, B., Koebbel, P., & Taub, E. (2001). Constraint-induced therapy of chronic aphasia after stroke. *Stroke, 32*(7), 1621–1626.

Purdy, M., & Van Dyke, J. A. (2011). Multimodal communication training in aphasia: A pilot study. *Journal of Medical Speech-Language Pathology, 19*(3), 45-53.

Richards, M. P., & Ross, H. E. (1967). Developmental changes in children's drawings. *British Journal of Educational Psychology, 37*(1), 73-80.

Rider, J. D., Wright, H. H., Marshall, R. C., & Page, J. L. (2008). Using semantic feature analysis to improve contextual discourse in adults with aphasia. *American Journal of Speech-Language Pathology, 17*, 161-172.

Sacchett, C., Byng, S., Marshall, J., & Pound, C. (1999). Drawing together: evaluation of a therapy program for severe aphasia. *International Journal of Language and Communication Disorders, 34*(3), 265-289.

Sparks, R. W., & Holland, A. L. (1976). Melodic intonation therapy for aphasia. *Journal of Speech and Hearing Disorders, 41*, 287-297.

Weissling, K., & Prentice, C. (2010). The timing of remediation and compensation rehabilitation programs for individuals with acquired brain injuries: Opening the conversation. *SIG 12 Perspectives on Augmentative and Alternative Communication, 19*, 87-96.

Appendix 1: Recruitment Flyer

Aphasia Research Study

Drawing conclusions on aphasia: An examination of the relationship between word retrieval, drawing, and semantics

This project will examine how drawing is related to language abilities in people with aphasia.

To Participate You Must:

- have the diagnosis of aphasia
- be at least 6 months post-onset stroke to the left side of your brain
- have a history of right hand dominance
- have at least a high school education
- speak American English
- range in age from 18 to 85 years
- demonstrate hearing and vision adequate to complete the experimental task

To Participate You Must NOT:

- have dementia or other progressive neurologic disease impacting cognition
- have known hearing or vision loss which is uncorrected with appropriate aids
- have a history of major untreated psychiatric disorders (e.g., depression)

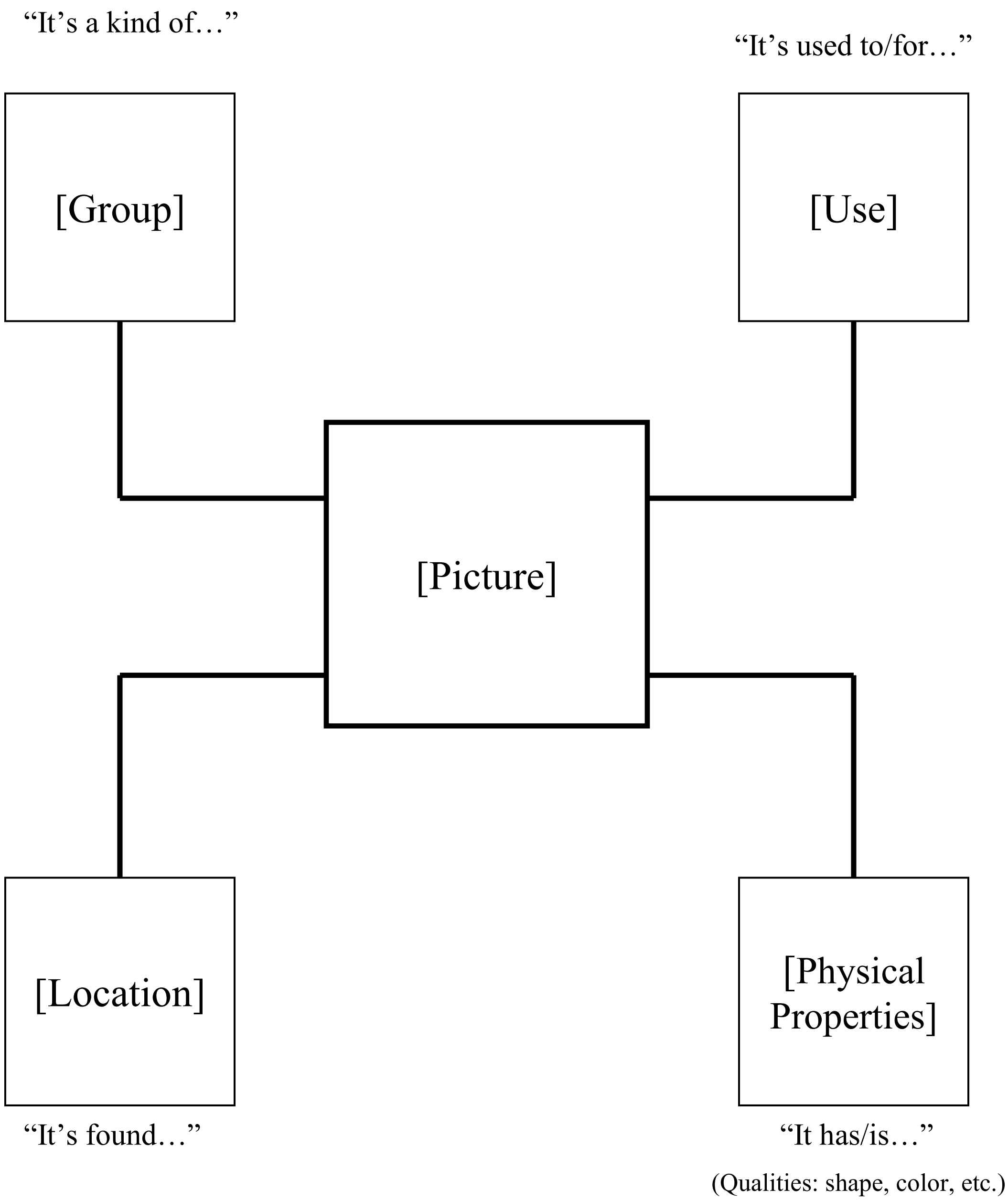
Time Required:
A total of up to 4 hours over 2 days

Participants will receive $30 for completing the entire study.
Location:

- Sessions can take place at Duquesne University, your home, or
- another facility.
- You will receive free parking at the Duquesne University clinic for
- study sessions.

If you are interested please contact:
Sarah Wallace, PhD., CCC-SLP
Duquesne University Department of Speech-Language Pathology
410 Fisher Hall
Pittsburgh, PA 15282
wallaces@duq.edu
412-396-4219

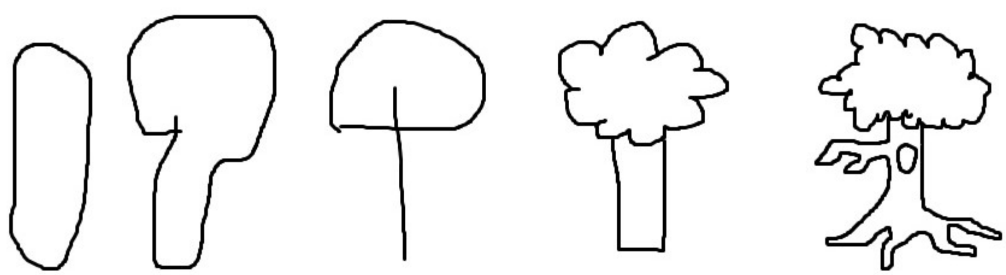
Appendix 2: Semantic Feature Cueing chart modified from Davis & Stanton (2005)



Appendix 3: Scale modified from Farias, Davis, & Harrington (2006)

Rating	Details	Recognizable as an object?
1	does not include any of the object’s details, even general shape	
2	includes the object’s general shape	
3	represents the object’s general shape, although unclear what the object	X
4	incorporates details which can identify the object, although it may be confused for another object	X
5	very clear which object the drawing is representing	X

Example:



1 2 3 4 5