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LEGIBILITY OF COMMUNICATIVE WRITING AND DRAWING IN APHASIA: DOES THE ORTHOGRAPHIC MEDIUM MATTER?

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LEGIBILITY OF COMMUNICATIVE WRITING AND DRAWING IN APHASIA: DOES THE ORTHOGRAPHIC MEDIUM MATTER?

THESIS

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Communication Sciences and Disorders in the College of Health Sciences at the University of Kentucky

By

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2020

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ABSTRACT OF THESIS

LEGIBILITY OF COMMUNICATIVE WRITING AND DRAWING IN APHASIA: DOES THE ORTHOGRAPHIC MEDIUM MATTER?

Expressive language difficulties are commonplace in aphasia and are often further complicated by co-occurring motor speech disoders. Therefore, many people with aphasia (PWA) are unable to meet all their communication needs by speaking, and they may compensate with the use of communicative writing and drawing. Communicative writing and drawing can be defined as preserved, but imperfect, orthographic skills that PWA use to compensate for expressive language deficits resulting from aphasic and/or motor speech difficulties. The purpose of this study was to determine if the orthographic medium used by a PWA to write and draw influenced the legibility of their writing and drawing. Four different orthographic mediums were used in sentence and figure copying tasks to determine if different orthographic mediums had an impact on legibility of the writing of a PWA.

KEYWORDS: Aphasia, Communicative Writing, Communicative Drawing, Total Communication

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CHAPTER 1. INTORDUCTION

Aphasia is an acquired, multimodal language disorder caused by damage to the brain's language-dominant hemisphere, usually from a stroke (Brookshire, 2003; Schuell et al., 1964). Expressive language difficulties are commonplace in aphasia and are often further complicated by co-occurring motor speech difficulties such as apraxia of speech (AOS) and unilateral upper motor neuron dysarthria (Duffy, 2005; Wambaugh & Shuster, 2008). The result is that many persons with aphasia (PWA) are unable to meet some of their communication needs by speaking and may resort to the use of writing (Parr, 1992), drawing (Lyon, 1995a;1995b), or both (Marshall, Freed et al., 1997). In this paper, this will be referred to as communicative writing and drawing.

Communicative writing and drawing can be defined as preserved, but imperfect, orthographic skills that PWA use to greater or lesser degrees to compensate for expressive language deficits resulting from aphasic and/or motor speech difficulties. Communicative writing should not be confused with normal handwriting and spelling or artistic drawings. Normal handwriting and spelling are complex skills based on cognitive neuropsychological models of language processing (Beeson & Rapcsak, 2004; Ellis, 1988), and artistic drawing is much more elaborate and detailed than communicative drawing (Gardner, 1984). In addition, PWA do not use communicative writing and drawing only if they cannot speak at all. For example, a PWA unable to retrieve the name of the largest city in California (Los Angeles) might write "LA" or draw an outline of the state of California with a star to designate the location of the city to resolve the word-finding difficulty. PWA who use communicative writing and drawing tend to write first, perhaps because it is more familiar to them or because family members seeking to be

helpful may ask the PWA to write what he or she is unable to verbalize. It may also reflect the fact that writing is taught in school and that stroke survivors continue to need to use writing for survival writing skills, such as making shopping lists, taking phone messages, writing personal notes, and completing forms (Brookshire, 2003; Parr, 1996; Van Drempt et al., 2011).

It should also be understood that communicative writing and drawing by PWA is usually less than perfect and may require training and instruction. To begin with, many PWA write and draw with their non-dominant hand because of a contralateral weakness. Further, because aphasia is a language problem, writing mechanics are often disrupted to greater or lesser degrees for most patients. Writing mechanics refers to the rules of written language such as capitalization, punctuation, and spelling and require an understanding of grammar (Lethbridge College, n.d.). Examples of errors in writing mechanics by PWA include misspelled words, hybrid abbreviations, word fragments, inappropriate capitalization, incomplete sentences and other errors. Similarly, communicative drawings of PWA may be asymmetrical, out of proportion, lack details, and differ in other respects from those produced by artistically inclined individuals (Gardner, 1984). Drawings from PWA usually consist of basic two-dimensional sketches used to depict what cannot be verbalized (Lyon, 1994; Lyon & Sims, 1989; Morgan & Helm-Estabrooks, 1987; Lyon & Helm-Estabrooks, 1987). For example, when asked to describe her home, Mable, a woman with conduction aphasia, drew a diagram of the floor plan of her house. Figure 1.1 shows how Betty, a woman with Broca's aphasia and severe AOS, used a combination of communicative writing and drawing to ask her therapist a question about his teaching schedule.

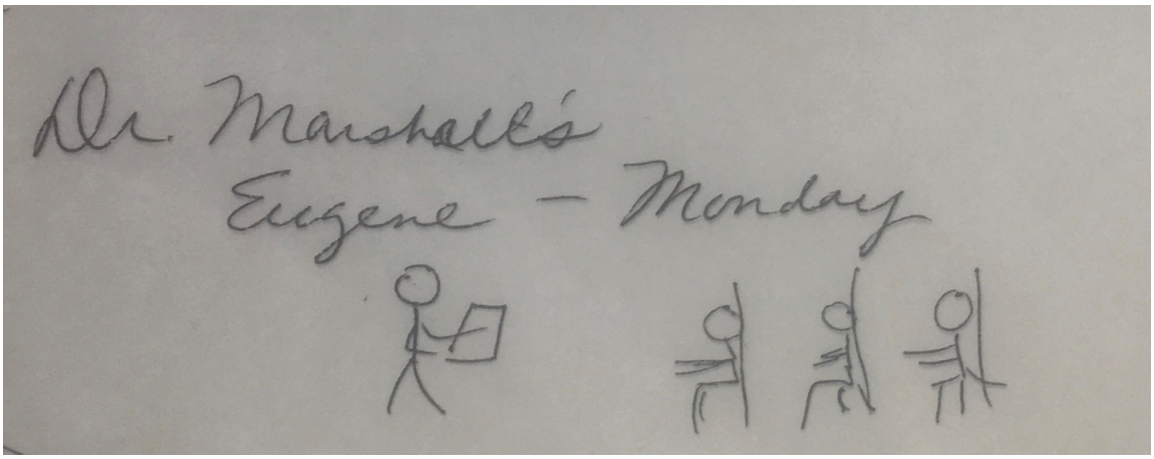

Figure 1.1 Communicative writing and drawing sample

Historically, Speech-Language Pathologists responsible for clinical management of PWA have encouraged the use of communicative writing and drawing by PWA who are unable to meet their communication needs orally. Clinician-researchers have developed procedures to assess the potential and willingness of PWA to use communicative writing and drawing (Alarcon, 2007; Garrett & Lasker, 2005; Lasker, 2008; Parr, 1992; 1996) and to measure outcomes of interventions that promote the use of these skills in day-to-day communication (Fawcus & Fawcus, 1990; Fratalli, 1992, 1998; Lebrun, 2013). Teaching, coaching, and encouraging the use of communicative writing and drawing is also an integral component of functional treatment programs emphasizing total or multimodal communication (Basso, 2010: Collins, 1986; Davis, 2005; Kagan, 1998; Simmons-Mackie, 2008) based on the premise that PWA "communicate better than they talk" (Holland, 1977; Simmons-Mackie, 2008).

For the most part, aphasia clinicians and communication partners of PWA overlook errors in writing mechanics and tolerate drawing flaws by PWA. This constitutes a "trade off" between writing and drawing imperfections and transactional success, or communicative effectiveness, of the communicative writing and drawing

(Fawcus & Fawcus, 1990; Sacchett, 2002). Effective communicative writing and drawing also benefits conversational partners of PWA by speeding up message exchange and reducing "communicative burden" on the partner (Linebaugh et al., 2006). An important component of the training of conversational partners for PWA involves teaching them to accept compensatory efforts, such as communicative writing and drawing, particularly if these facilitate communication (Simmons-Mackie, Raymer et al., 2010). Having more trained conversational partners to communicate with in turn benefits the person with aphasia by providing more opportunities for the PWA to reveal the underlying competence masked by the aphasia (Kagan, Black, et al., 2001).

The effectiveness of communicative writing and drawing of the PWA will suffer if the individual's writing and drawing efforts are not legible. With respect to written language, legibility refers to the features that contribute to its readability such as letter formation, size, spacing, and alignment (Graham et al, 1998). Legibility with respect to drawing is harder to define, but some researchers suggest it is synonymous with the clarity or recognizability of one's drawing (Lebrun, 2013; Sacchett, 2002). For example, Jacob, a young man with aphasia was asked by his therapist if he lived on a farm. He enthusiastically pointed to himself and said "me" and drew pictures of three animals. These drawings would be considered legible if they conveyed to the therapist that Jacob raised cows, pigs, and chickens on his farm.

Factors thought to affect legibility of handwriting of normal adults have been studied by researchers in Occupational Therapy (Van Drempt et al, 2011; Yancosek & Howell, 2010). Some of these factors include age, gender, speed, pen pressure, writing style, and upper limb movement (McCluskey et al., 2015). Little is known, however,

about the influence of the orthographic medium used to write and draw on the legibility of writing and drawing in normal adults or PWA. For the purpose of this study, an orthographic medium is operationally defined as "the combination of the writing implement (e.g. pen), writing surface (e.g. paper), and support for the writing surface (e.g. clipboard) used by a PWA to write or draw." While it would be unusual for a particular orthographic medium to impact the legibility of writing or drawing of a normal adult, stroke-survivors with aphasia present with deficits (e.g. hemiparesis, visual field cuts, and weakness) that could potentially interfere with legibility of writing and drawing. For these persons, the choice of a writing implement (e.g., pen, pencil, crayon, chalk, felt tip marker, and stylus), writing surface (e.g., paper, black board, dry erase board, and boogie board), and support for the writing surfaces (e.g., clipboard, easel, and table) may impact the legibility of the patient's writing and drawing.

The purpose of this study was to determine if the orthographic medium used by a PWA to write and draw influenced the legibility of their writing and drawing. The motivation to do the study came from observations of PWA in the UK Aphasia Lab who sometimes used communicative writing and drawing to meet a communication need. In general, it was observed that Aphasia Lab participants used different, self-selected orthographic mediums with varying degrees of success and frequency. For example, Robert used a boogie board and stylus to write or draw pictures of objects he could not name. He did this quickly and rather proudly. For Robert, communicative writing and drawing kept the conversation flowing and allowed him to direct the conversation. Mary, another participant in the Aphasia Lab, when unable to produce a word or sentence aloud, struggled to spell words she wanted to say on her iPad. This letter-by-letter procedure

was time-consuming and ineffective. Ben, another patient in the Aphasia Lab used a pen and blank sheet of 8 ½ x 11" paper for communicative writing and drawing with great efficiency. Ben, however, had a visual field cut and he often started his writing or drawing in the middle of the page. This reduced his communicative efficiency because of crowding. Rob, a patient with severe aphasia and right-sided weakness perfected his ability to write with his nondominant hand by copying books written by stroke-survivors such as Jill Bolte Taylor (2009). Interestingly, Rob carried no orthographic medium on his person. When he needed to use communicative writing or drawing, he simply reached for whatever tools were handy. For example, he pulled a pen from the therapist's pocket and drew a set of goal posts, a dollar sign ($), and the score of the Nebraska-Iowa football game on the corner of a postcard he found inserted in a magazine. He did this to inform the therapist he had won a small bet with his father on the game. It took the therapist a few minutes to interpret Rob's message because his writing and drawing were sloppy. This surprised the therapist because Rob had spent many hours copying books to perfect the speed and accuracy of his writing.

Observations of PWA like Robert, Mary, Ben, and Rob raised the question, if the orthographic medium for communicative writing and drawing by a PWA influences the legibility of the writing and drawing and the patient's willingness to use communicative writing and drawing? If this were true, PWA and their families may benefit from guidance from their clinicians in selecting an orthographic medium that works best for them rather than being left to their own devices. Doing this for every PWA who might use communicative writing and drawing would take some time and have a cost. It therefore seems necessary to conduct a study to determine if the orthographic medium

used to write and draw by PWA influences the legibility of their communicative writing and drawing.

CHAPTER 2. BACKGROUND INFORMATION

This chapter (1) overviews how communicative writing and drawing are used by PWA across the aphasia severity continuum, (2) highlights some of the factors a clinician might consider when selecting an orthographic medium for a PWA who is a candidate for communicative writing and drawing treatment, and (3) addresses methodological challenges of determining how different orthographic mediums might influence legibility of communicative writing and drawing.

2.1 Communicative Writing and Drawing Across the Severity Spectrum

Communicative writing and drawing are not exclusively used by persons with severe aphasia who lack verbal expressive language skills. Nearly all patients with aphasia use communicative writing and drawing beneficially at one time or another. Word finding difficulties are a cardinal deficit of aphasia (Schuell et al., 1964). Many PWA utilize communicative writing and drawing on their own to address these difficulties on occasion. For example, Robert, described earlier, uses verbal communication most of the time. However, when he cannot come up with a word he needs (e.g. Vince Lombardi), he writes it on his Boogie Board. This deblocks the irretrievable word and often leads to oral production (Weigl, 1968). Robert has relatively intact language skills, but occasionally, processing delays in finding a word frustrate him and disrupt the flow of a conversation. When this happens, Robert goes immediately to his Boogie Board and writes or draws. Robert's immediate action to write or draw rather than struggle to speak further suggests he takes into consideration the effects of time and

struggle on his conversational partner. While Robert developed his own self-cueing strategy, communicative writing can be taught as a self-cueing strategy by a clinician. A study by Lustig and Tompkins (1992) described how a woman with aphasia and AOS was trained to write the word she was blocking on paper and show it to her conversational partner after 3 seconds of struggle. This strategy was first trained in the therapy room, then the waiting room, and finally in a more public setting.

For some stroke survivors, communicative writing and drawing replaces speech. This is often the case when the patient's linguistic deficits are minimal but their motor speech deficits, usually AOS or unilateral upper motor neuron dysarthria, are severe and limit the production of intelligible speech. For example, Ed, a man with mild aphasia and moderate AOS had trouble pronouncing multisyllabic words such as "San Francisco." Ed kept a small notepad in his breast pocket, and when he had to come up with one of his "fear words," or words he commonly struggled to produce, in a conversation, he informed his listener of the difficulty and wrote the word on the pad. George, one of the patients in the Aphasia Lab at UK, has aphasia compounded by a severe mixed dysarthria (spastic and flaccid), and AOS. George's speech is limited to production of a single syllable or two, and he becomes fatigued when speaking. Out of necessity, he uses communicative writing and drawing exclusively when he must convey longer messages. A case report by Marshall, Gandour, and Windsor (1988) described Tom, a man with laryngeal apraxia. Tom used communicative writing and drawing until he was taught to use an electrolarynx to communicate orally. Patients like George and Tom require coaching to use communicative writing and drawing in a time-saving manner. This may

involve using abbreviations, telegraphic writing, and less detail in drawings to speed up information exchange.

Communicative writing and drawing are mainstays for persons with Global and other severe forms of aphasia. Global aphasia is the most severe form of aphasia and accounts for as many as 30% of all cases of the disorder (Kertesz, 1979; Peach, 2008). All language functions are affected in this aphasic syndrome with particularly severe deficits seen in comprehension and production (Hegde, 2010). Concomitant deficits of buccofacial and limb apraxia frequently accompany Global aphasia and further limit the patient's ability produce volitional speech (Alexander, 2000). Communicative writing and drawing must be taught to patients with Global and other severe forms of patients (Wallace, 2020). Communicative writing is taught to individuals with Global aphasia using structured approaches such as Anagram and Copy Treatment (ACT) and Copy and Recall Treatment (CART) (Beeson, 1999; Beeson, Hirsch, et al., 2002; Beeson, Rising, et al., 2003). The PWA, a family member, and the therapist collaborate to select a set of "key words" or phrases with high communicative value to the PWA. The PWA is trained to write and practices writing the words and phrases until he or she can do so volitionally to make specific requests and sometimes participate in a conversation. Patients with Global and other severe forms of aphasia have also been found to use communicative writing successfully in group situations (Clausen & Beeson, 2003; Robson et al., 2001).

People with Global aphasia can also be taught to use communicative drawing to transmit messages important to them and to make requests (Wallace, 2020). Methods for teaching communicative drawing to persons with Global aphasia tend to be individualized because some patients have a talent for drawing while others do not. Many

clinical reports provide details on the benefits of communicative drawing for persons with Global aphasia and give detailed instructions on how to improve communicative drawing (Lebrun, 2013; Lyon, 1995; Lyon & Helm-Estabrooks, 1987; Morgan & Helm-Estabrooks, 1987; Wallace, 2020; Ward-Lonerman & Nicholas, 1995). Some research has shown that communicative drawing by individuals with Global aphasia may be facilitated by allowing the patient to do the drawing in a manner that promotes the use of axial movements rather than proximal movements of the body (Morgan & Helm-Estabrooks, 1987). The act of drawing has also been shown to facilitate naming in people without brain damage, suggesting communicative drawing may have both compensatory and restorative benefits for people with Global aphasia (Farias et al., 2006).

Communicative writing and drawing are, as stated earlier, important components of functional aphasia treatments that stress communication over talking and function over form (Holland, 1977). In Supported Conversation for Aphasic Adults (Kagan, 1998) persons volunteering to serve as communication partners for PWA are trained and provided with resources to support the conversation of PWA. Treatment programs such as Promoting Aphasic Communicative Effectiveness (PACE) (Davis, 2005) and Natural Conversation (Basso, 2010) encourage open-channel communication (speaking, writing, drawing, gesture, and pointing) by those with severe aphasia and attempt to normalize conversations by the sharing new information, alternating roles as speaker and sender of messages, and providing the patient feedback based on communicative adequacy. Collins's (1986) description of "total communication" captures the essence of these treatment paradigms. Total Communication (Collins, 1986; Rautakoski, 2001) encourages PWA to do what normal communicators do when they are in a foreign

country and are unable to comprehend and speak the native tongue. This would involve using a combination of writing, drawing, speaking, gesturing, and pointing to get one's point across. In other words, the bottom line message to the PWA is communicate any way you can.

2.2 Factors to Consider in Choosing an Orthographic Medium

Selection of an orthographic medium for PWA, who are candidates for communicative writing and drawing treatment, should take into consideration and minimize the effects of any and all factors that could possibly influence the legibility of the patient's writing and drawing.

2.2.1 Hand Dominance

Many PWA aphasia have hemiparesis, or weakness on one side of the body. For most people with aphasia this is the right side of the body. Since roughly 95% of the world's population is right-handed (Brookshire, 2003), this means that most PWA will need to write and draw with the non-dominant left hand. For these patients, communicative writing and drawing may be harder to learn and once learned, more difficult to use. However, it is possible to adapt to writing with one's nondominant hand. Normal individuals do this all the time when they suffer injury to the dominant hand. Rob, described earlier, practiced writing with his left hand by copying books written by stroke survivors. He learned to copy printed script with his left hand accurately and quickly.

2.2.2 Visual Field Cuts

For patients with fluent aphasias, particularly Wernicke's aphasia, the causative lesion occurs in the temporal lobe, posterior to the optic chiasm (Brookshire, 2003). Sometimes these patients have a right homonymous heminanopsia (blindness in the right half of each eye). This may be an obstacle to using communicative writing and drawing because the right half of the writing surface does not get used. This factor must be taken into consideration in selecting an orthographic medium for communicative writing and drawing.

2.2.3 Weakness and Fatigue

Some patients have only a mild hemiparesis affecting their dominant hand and may choose to continue to use their dominant hand for communicative writing and drawing. In selecting an orthographic medium for such patients, the therapist may need to give special consideration to choosing a writing implement to compensate for weakness and combat fatigue brought about by sustained writing and drawing. Writing implements have been modified for use by patients with weakness to have larger grips and nibs that permit writing to be done with less pressure. Incorporating the use of these writing implements into communicative writing and drawing treatment with patients may involve collaboration between the Speech-Language Pathologist and the Occupational Therapist (Simpson et al., 2015).

2.2.4 Mobility

Some stroke survivors with aphasia do not regain the ability to walk. For these individuals communicative writing and drawing is carried out at a table with a willing conversational partner. This is advantageous in choosing an orthographic medium for writing and drawing. The fact that the patient stays in one place allows the clinician to create a stable writing surface that the patient can quickly adapt to. With practice, writing and drawing will improve over time.

2.2.5 Portability

If the PWA does move from place to place with ease, an orthographic medium is needed that is portable. Some people, such as Ed, can get by simply carrying a small tablet and pen in their breast pocket. Others need a stable writing surface and guidance in adapting to situations where they need to use communicative writing or drawing "on the fly."

2.2.6 Ease

In some respects, selecting an orthographic medium for communicative writing and drawing for a PWA who can benefit from this approach is like finding a pair of comfortable shoes. Most people have a favorite pair of shoes. Most have a favorite writing implement. One must try different things before deciding which one is the easiest or most suitable their lifestyle.

2.2.7 Writing Style

Although most individuals learn to use cursive writing in school, the handwriting of normal adults reflects a combination of print, cursive, and a mixture of the two on common everyday writing tasks, such as making a shopping list (Dettrick-James et al., 2015). However, PWA who use their non-dominant hand for writing prefer print. To understand why, all one needs to do is to try to write or copy a sentence in cursive using their non-preferred hand. It is quite a challenge.

2.3 Challenges to Assessing the Influence of Orthographic Medium on Communicative Writing and Drawing.

Writing is usually the most severely impaired language modality for PWA, and most patients have severely impaired writing skills (Brookshire, 2003). Clinical aphasiologists seldom treat writing, except in cases of very mild aphasia where the patient might need to return to work at a job which demands writing, such as teaching (Rau, 1986). When writing is the focus of therapy, it usually involves reestablishing survival writing skills important to the patient such as filling out forms or writing checks (Brookshire, 2003). However, communicative writing and drawing are different. As has been stated earlier, communicative writing and drawing by PWA who can benefit from it need not be perfect, but to be communicatively effective, the writing and drawing must be legible.

Several methodological issues come up when attempting to assess the influence of different orthographic mediums on the legibility of communicative writing and drawing

for PWA. These issues will be addressed here to clarify the study methodology presented in the following chapter.

2.4 Selecting Orthographic Medium

It is understood PWA have many orthographic mediums to choose from for employing communicative writing and drawing. A priori decision was made to assess the influence of orthographic mediums on writing by using orthographic mediums that were simple, low-cost, and readily available because that was what participants in the Aphasia Lab were observed to be using for their communicative writing and drawing.

2.4.1 Writing Style

Since writing is so difficult for PWA, it is possible the difficulty of the writing task could have a negative influence on writing legibility by increasing resource allocation demands on the PWA (McNeil et al., 1990). This might confound the assessment of the influence of orthographic medium on legibility of communicative writing. For this study, this problem was addressed by using a sentence copying task to keep the writing task demands as simple as possible and minimize the likelihood that legibility of writing would be impacted by the participants' aphasic deficits. Similarly, the drawing task utilized copying of a set of three geometric figures. This task was selected because of its simplicity and the variability in the ability to draw amongst PWA.

2.4.2 Motoric Demands

Many PWA write with their nondominate hand, and it is possible the motoric demand of the writing task would impact legibility. Ideally, the motoric demands of the writing task should be equalized as much as possible for the various orthographic mediums assessed. For this study, the sentence copying task was to copy four iterations of the holoalphabetic sentence, “The quick brown fox jumped over the lazy dog.” This kept the motoric demands of the sentence copying task relatively the same across the orthographic mediums assessed. The drawing task used for this study was to copy sets of three geometric forms. This made it unnecessary for the participant to possess any degree of artistic skill or animate object.

CHAPTER 3. METHODS

This study used a group design to assess the legibility of holoalphabetic sentences and sets of three geometric figures copied by persons with chronic aphasia in four orthographic mediums.

3.1 Participants

Persons volunteering for the study were 24 individuals with chronic aphasia recruited from the Aphasia Lab of the University of Kentucky College of Health Science. All participants were community-dwelling, native speakers of English, two or more-years post-onset from a stroke or traumatic brain injury causing aphasia. All participants gave informed consent on their own. Table 3.1 provides the pertinent demographic (gender, age, education, and marital status) medical (etiology of aphasia and time post-onset), and speech and language information (severity and type of aphasia; presence of a co-occurring motor speech disorder). This data shows that the study participants included 18 men and 6 women, 20-88 years of age (M=62.6 years), with 11-24 years of education (Mean=15.5). All participants had chronic aphasia with time post onset ranging from 2-21 years (Mean=7.2 years). Table 3.1 also shows Aphasia Quotients (AQ) on the Western Aphasia Battery (WAB; Kertesz, 1982) (Range 36-93; Mean=63.1), and all were below the normal cutoff score (93.8). Subjects represented a full range of aphasia classifications. There were six patients with anomic aphasia, five with Broca's aphasia, four with global aphasia, three with conduction aphasia, three with Wernicke's aphasia, two with transcortical aphasia, and one with mixed fluent/non-fluent aphasia based on WAB results. Lastly, Table 3.1 indicates that, in addition to their aphasia, 11 of 24

participants had a co-occurring motor speech disorder, either apraxia of speech or dysarthria.

Table 3.1 Demographic, medical, and speech and language information for participants

Participant #	*Gender*	*Age*	*Education*	*Marital Status*	*YPO*	*WAB-AQ*	*Type*	*MSD*
1	m	78	16	Married	3	36	Wernicke	None
2	m	59	12	Divorced	2	58	Broca	AOS
3	m	71	16	Married	11	55	Wernicke	None
4	f	53	12	Divorced	10	37	Global	AOS
5	m	24	12	Single	3	54	Broca	AOS
6	m	72	16	Married	12	57	Broca	AOS
7	f	73	16	Married	4	67	Broca	AOS
8	m	44	11	Divorced	10	69	Anomic	None
9	m	53	20	Single	13	47	Global	AOS
10	m	68	16	Married	4	44	Global	DYS
11	m	54	16	Divorced	2	92	Anomic	None
12	m	59	12	Divorced	2	71	Conduction	None
13	m	72	16	Married	8	93	Anomic	None
14	m	60	20	Single	13	83	Mixed	None
15	m	63	16	Married	3	80	Anomic	None
16	m	42	16	Married	2	51	Conduction	None
17	m	20	12	Single	2	72	Transcortical	None
18	m	74	20	Married	21	40	Global	AOS
19	f	78	18	Widow	14	90	Anomic	AOS
20	f	75	16	Married	6	88	Transcortical	None
21	f	82	12	Widow	2	74	Conduction	None
22	f	88	12	Married	15	57	Broca	AOS
23	m	74	28	Married	8	62	Anomic	DYS
24	m	66	12	Married	2	38	Wernicke	None
Range		20-88	11-28		2-21	36-93		
Mean		62.6	15.5		7.2	63.1		
SD		17.0	3.9		5.5	18.3		

Key: Age (in years); Education: in years; Marital status: married, single, divorced or widowed; YPO= years post onset; WAB-AQ = Aphasia Quotient on Western Aphasia Battery (Kertesz, 1982); Type= Aphasia classification; MSD=Presence of motor speech disorder; AOS = Apraxia of Speech; DYS = dysarthria; SD=Standard Deviation

3.2 Procedures

Participants asked to consider being in the study were seen by the student investigator in a private, quite room in the Speech and Hearing Clinic where the Aphasia Lab is held. The procedures and requirements of this study were explained to each

participant in simple terms, and the student investigator answered any questions the participant had about the study. Informed consent was then obtained by the student investigator. The participant was then interviewed by the student investigator to obtain pertinent demographic and other information shown in Table 3.1. Next, the Edinburgh Handedness Inventory (Oldfield, 1971), a 10-item questionnaire designed to determine hand dominance was administered to determine the participants' premorbid handedness. The Edinburgh Handedness Inventory is shown in Figure 3.1. This was followed by administration of the two experimental tasks associated with the study.

Edinburgh Handedness Inventory

Surname_____Given Name_____

Date of Birth_____Sex_____

Please indicate your preferences in the use of hands in the following activities by *putting + in the appropriate column*. Where the preference is so strong that you would never try to use the other hand unless absolutely forces to, *put* ++. If any case you are really indifferent put + in both columns.

Some of the activities require both hands. In these cases the part of the task, or object, for which hand preference is wanted is indicated in brackets.

Please try to answer all the questions, and only leave a blank if you have no experience at all of the object or task.

	Left	Right
1. Writing		
2. Drawing		
3. Throwing		
4. Scissors		
5. Toothbrush		
6. Knife (without fork)		
7. Spoon		
8. Broom (upper hand)		
9. Striking Match (match)		
10. Opening box (lid)		
i. Which foot do you prefer to kick with?		
ii. Which eye do you use when using only one?		

L.Q.	Leave the spaces blank	DECLE

Figure 3.1 Edinburgh Handedness Inventory

3.2.1 Experimental Task One

The first experimental task involved copying four iterations of the holoalphabetic sentence, "The quick brown fox jumped over the lazy dog." Holoalphabetic sentences contain all the letters of the alphabet, and the "quick brown fox" sentence was used because it is familiar to many adults, particularly those who have taken a typing class. Different plausible iterations of this sentence were created to keep the motoric demands of the copying task similar and to minimize learning effects across the four orthographic mediums. The various iterations of the sentences are shown in Table 3.2. For the sentence copying task, the participants were provided a model of the target sentence and given the instruction, "Copy this sentence as best you can." The model was always presented in print, but the participant could copy the sentence in print, cursive, or both.

Table 3.2 Iterations of the Quick Brown Fox Sentences for the figure copying task

Sentence Number	*Sentences*
1	The quick brown fox jumps over the lazy dog.
2	The lazy brown dog jumps over the quick fox.
3	The brown fox jumps over the lazy quick dog.
4	The quick dog jumps over the brown lazy fox.

3.2.2 Experimental Task Two

The second experimental task consisted of copying four sets of three geometric figures similar to those used on Graphic Subtest F of the Porch index of Communicative Ability (PICA; Porch, 2001). Replicas of these figures are shown in Figure 3.2. Like the sentence copying task, the participants were provided with the target set of figures as a

model. Instructions for the task were to, “Copy each of these figures as carefully as you can.”

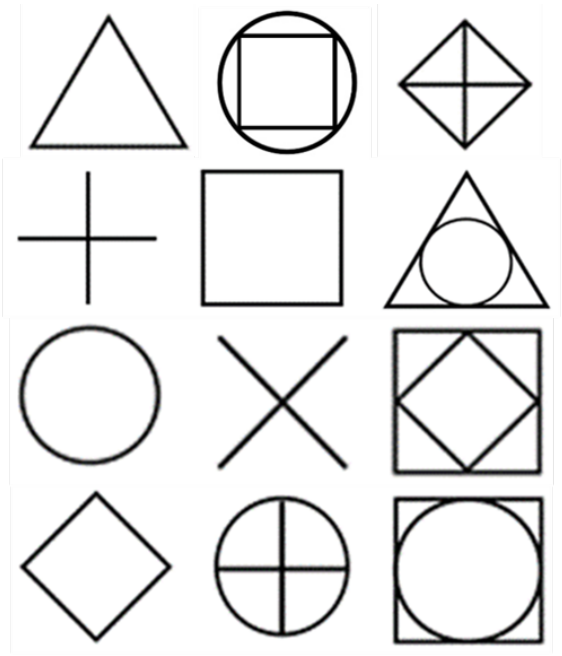

Figure 3.2 Geometric figures used in the figure copying task

3.3 Orthographic Mediums

Participants copied the sentences and figures in four orthographic mediums (1) using a pen and paper only (PP), (2) using a pen and paper with the paper affixed to a clipboard (CB), (3) using a black felt tip marker and dry erase board (DEB), and (4) using a stylus and Boogie Board (BB). The participants sat at a table across from the student investigator when doing the copying tasks and were allowed as much time as they needed to complete each task. The sentence copying task was always administered first, followed by the figure copying task. The order of the orthographic mediums in which the participant copied the sentences and figures, was counterbalanced across participants for

both tasks, and the sentences and figure sets were counterbalanced across the orthographic mediums to assess for possible order effects should the orthographic medium conditions be found to influence sentence or figure copying legibility.

3.4 Preference for Orthographic Medium

After completing the sentence and figure copying tasks, each participant was asked to select the orthographic medium he or she preferred by circling one of the four orthographic mediums depicted in Figure 3.3. After selecting the preferred medium, the participant was asked to rate how comfortable, or easy, it was to use his or her preferred writing method on a 1-10-point scale, as shown in Figure 3.4.

Figure 3.3 Tool use to obtain the participants' preference for orthographic medium

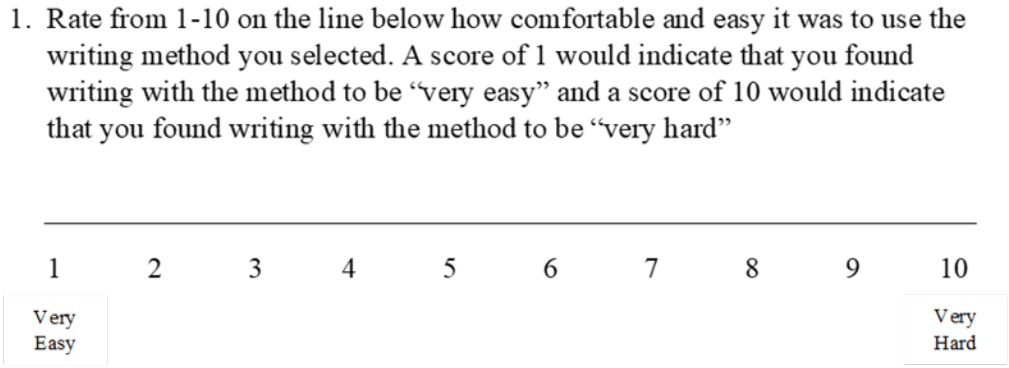

Figure 3.4 Rating scale used to determine the participants' comfort completing the writing and drawing tasks with their preferred writing medium

3.5 Data Preparation

The 24 study participants produced a total of 192 responses, 96 sentences and 96 sets of figures, to be scored for legibility. All sentences and sets of figures were individually photographed by the student investigator. Each photograph was coded for participant and orthographic medium identification by the student investigator, and the codes were stored in a locked filing cabinet. To carry out the scoring of the sentences and figures for legibility, the 96 sentence samples were randomized to create a PowerPoint slide presentation with the target sentence placed at the top of each slide and a participant's writing sample placed underneath, as shown in Figure 3.5. The 96 sets of figures were managed similarly with the model figure sets shown above the participant sample on each slide, as shown in Figure 3.6.

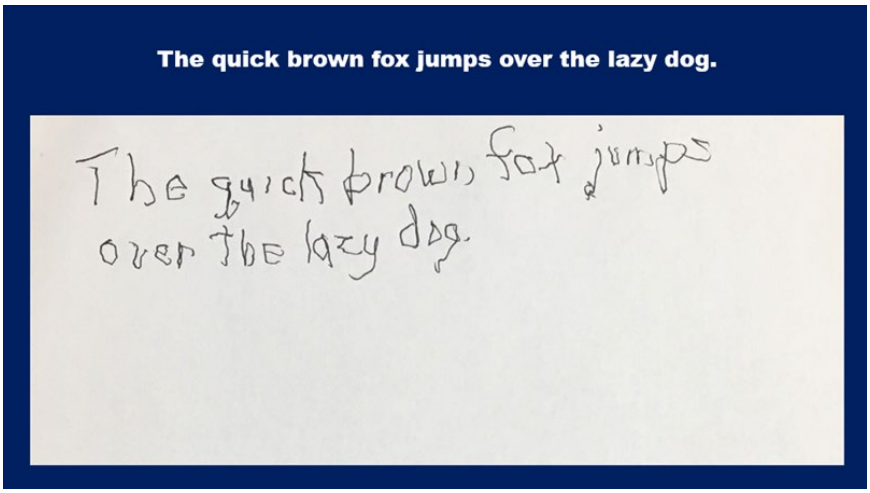

Figure 3.5 PowerPoint slide for sentence rating

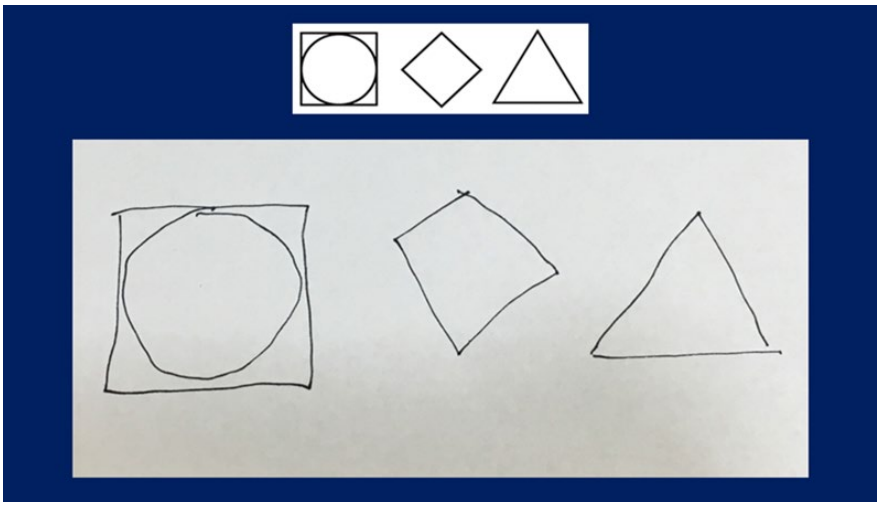

Figure 3.6 PowerPoint slide for figure rating

3.6 Scoring of Responses

Sentence and figure legibility were scored by an independent observer blinded to participant identity and the orthographic medium used to copy the sentences and figures. The sentences and figures were scored separately by the independent observer. Sentence legibility was quantified using a 5-point scale from the Writing Mechanics Subtest of the Boston Diagnostic Aphasia Exam (BDAE) (Goodglass & Kaplan, 1983), shown in Table 3.3. Figure legibility was quantified using the 1-15 point multi-dimensional scoring

system used for Graphic Subtest F on the Porch Index of Communicative Ability (PICA) (Porch, 2001). Each figure from a set was scored separately and the three scores from a set were averaged to provide a single score for each figure set. The independent observer doing the scoring was an experienced clinical aphasiologist, with more than 35 years' experience who was trained in the use of the PICA and BDAE scoring systems used to score the participants' samples.

Table 3.3 Scale for scoring of sentence legibility (Goodglass & Kaplan, 1983)

Score	*Criteria*
1	No legible letters
2	Occasional success on single letters (blocking print)
3	Blocking print with some malformed letters
4	Legible but impaired cursive writing and/or upper and lower case printing
5	Judged to be the same as premorbid writing with allowance made for use of nondominated hand.

Table 3.4 Scale for scoring figure legibility (Porch, 1971)

Score	*Criteria*
1	No awareness
2	Attends, no response
3	Undifferentiated, unintelligible
4	Differentiated, unintelligible
5	Intelligible, not associated with the test item
6	Inaccurate
7	Inaccurate, closely related
8	Accurate, stimulated by cue
9	Accurate, stimulated by repeat
10	Accurate after self-correction
11	Accurate, incomplete, delayed
12	Accurate but incomplete
13	Accurate, complete, delayed
14	Accurate but distorted
15	Accurate, complete, prompt

3.7 Scoring Reliability

Scoring reliability was determined by having a second experienced clinical aphasiologist, also trained in the use of the PICA and BDAE scoring systems, score 25% of the sentences and 25% of the figures on two occasions separated by a two-month interval. Inter-rater reliability was determined by comparing scores from the two experienced examiners. Intra-rater reliability was determined by comparing the second examiner's scores separated by the two-month interval.

CHAPTER 4. RESULTS

All participants completed the experimental tasks without difficulty. The time needed by participants to complete all activities associated with the study ranged from 30-60 minutes.

4.1 Orthographic Mediums

Table 4.1 and Table 4.2 show the participant legibility scores, group means, and standard deviations for the sentence and figuring copying tasks, respectively, for each of the orthographic mediums: PP, CB, DEB, and BB.

Table 4.1 Legibility scores for participants, group means, and standard deviations for sentences copied in four orthographic mediums: PP, CB, DEB, and BB

Participants	*Paper and Pen*	*Clipboard*	*Dry Erase Board*	*Boogie Board*
1	5	4	4	4
2	4	4	4	4
3	3	3	4	3
4	4	3	4	4
5	4	4	5	4
6	4	4	3	4
7	4	4	4	3
8	3	4	4	4
9	3	4	3	2
10	3	4	3	3
11	4	4	4	4
12	4	4	4	4
13	5	5	5	3
14	3	4	4	3
15	3	4	3	3
16	5	5	5	4
17	4	4	4	4
18	3	3	3	3
19	3	4	3	3
20	4	4	5	4
21	4	3	4	4
22	5	4	4	4
23	3	3	3	3
24	1	2	2	2
Range	1-5	2-5	2-5	2-5
Mean	3.46	3.79	3.79	3.67
SD	0.89	0.64	0.76	0.64

Table 4.2 Legibility scores for participants, group means, and standard deviations for figures copied in four orthographic mediums: PP, CB, DEB, and BB

Participant	*Pen and Paper Only*	*Clipboard*	*Dry Erase Board*	*Boogie Board*
1	14	13.3	14.3	14
2	12	14	13.3	13.3
3	14	14	13.3	14
4	11	14	14	13.3
5	12.3	13.3	12.7	12.7
6	14	14	14.3	14
7	12.7	12.7	13	12
8	14	13.3	14.7	14
9	14	12.7	13.3	13.3
10	13.3	13.3	12.7	12.7
11	14.3	13.3	12.7	11
12	13.3	13	13.7	14.3
13	13.3	14	13	14.3
14	12	13.3	12.7	13.3
15	8.7	12	11	11
16	14	13.7	14.7	14.7
17	12	14	14	14
18	11	11.3	14	12.7
19	12.7	12.7	14	12.7
20	14.3	14.3	14	14
21	14.3	12	13.3	23.7
22	14	12	12	12
23	12	12.7	14	12.7
24	12	6.7	11	9
Range	8.7-14	6.7-14	11-14	9-14
Mean	12.99	12.90	13.32	12.88
SD	1.35	1.50	0.99	1.28

Measures of scoring reliability were acceptable. Independent examiners doing the scoring of the responses agreed on legibility scores for sentences and figures 91 and 88 percent of the time respectively. The examiner scoring a portion of the sentences and figures two months apart obtained the same scores 90 and 91 percent of the time respectively.

Repeated measures Analyses of Variance (ANOVAs) were carried out to examine group differences in the legibility of sentences and figures copied by participants in the PP, CB, DEB, and BB orthographic mediums. Neither the ANOVA for sentences nor figures supported the existence of group differences in legibility between any of the orthographic mediums. Lack of differences in sentence or figure copying between the orthographic mediums made it unnecessary to examine for order effects.

4.2 Dominate and Non-Dominate Hand Copying

Table 4.3 and Table 4.4 provide the scores on the sentence copying tasks for participants who performed the tasks with their dominant hand (N=12) and those using their non-dominant hand (N=12) respectively. Table 4.5 and Table 4.6 provide the scores for the figure copying tasks in the same manner. Dominant hand specification, Table 4.7, was based on the Edinburgh Handedness Inventory (Oldfield, 1971) and questions answered by the participants about their pre-morbid handedness use.

Table 4.3 Sentence legibility scores, group means, and standard deviations for participants using their dominant hand for copying tasks in PP, CB, DEB, and BB orthographic mediums

Participant	*Pen and Paper Only*	*Clipboard*	*Dry Erase Board*	*Boogie Board*
1	5	4	4	4
3	3	3	4	3
6	4	4	5	4
10	5	4	3	3
12	4	4	4	4
13	5	5	5	3
15	3	4	3	3
16	5	5	5	4
19	3	4	3	3
20	4	4	5	4
21	4	3	4	4
22	5	4	4	4
Mean	4.17	4.00	4.09	3.58
SD	0.83	0.60	0.79	0.51

Table 4.4 Sentence legibility scores, group means, and standard deviations for participants using their non dominant hand for copying tasks in PP, CB, DEB, and BB orthographic mediums

Participant	*Pen and Paper Only*	*Clipboard*	*Dry Erase Board*	*Boogie Board*
2	4	4	4	4
4	4	3	4	4
5	4	4	4	4
7	4	4	3	3
8	3	4	4	4
9	3	4	3	2
11	4	4	4	4
14	3	4	4	3
17	4	4	4	4
18	3	3	3	3
23	3	3	3	3
24	1	2	2	2
Mean	3.33	3.58	3.50	3.33
SD	0.89	0.67	0.67	0.78

Table 4.5 Figure legibility scores, group means, and standard deviations for participants using their dominant hand for copying tasks in PP, CB, DEB, and BB orthographic mediums

Participant	*Pen and Paper Only*	*Clipboard*	*Dry Erase Board*	*Boogie Board*
1	14	13.3	14.3	14
3	14	14	13.3	14
6	14	14	14.3	14
10	13.3	13.3	12.7	12.7
12	13.3	13	13.7	14.3
13	13.3	14	13	14.3
15	8.7	12	11	11
16	14	13.7	14.7	14.7
19	12.7	12.7	14	12.7
20	14.3	14.3	14	14
21	14.3	12	13.3	12.7
22	14	12	12	12
Mean	13.33	13.19	13.36	13.36
SD	1.54	0.85	1.07	1.13

Table 4.6 Figure legibility scores, group means, and standard deviations for participants using their non dominant hand for copying tasks in PP, CB, DEB, and BB orthographic mediums

Participants	*Pen and Paper Only*	*Clipboard*	*Dry Erase Board*	*Boogie Board*
2	12	14	13.3	13.3
4	11	14	14	13.3
5	12.3	13.3	12.7	12.7
7	12.7	12.7	13	12
8	14	13.3	14.7	14
9	14	12.7	13.3	13.3
11	14.3	13.3	12.7	11
14	12	13.3	12.7	13.3
17	12	14	14	14
18	11	11.3	14	12.7
23	12	12.7	14	12.7
24	12	6.7	11	9
Mean	12.44	12.61	13.23	12.61
SD	1.11	2.01	0.97	1.41

Table 4.7 Hand dominance as determined by Edinburgh Handedness Inventory (Oldfield, 1971), hand used to perform copying tasks, preferred orthographic mediums, and the participants' judgment of perceived ease using preferred medium

Participant	*Hand Dominance*	*Hand Used*	*Preferred Medium*	*Rating of Ease*
1	R	R	DEB	2
2	R	L	DEB	4
3	R	R	CB	2
4	R	L	BB	3
5	R	L	BB	6
6	L	L	CB	8
7	R	L	PP	4
8	R	L	BB	7
9	R	L	CB	1
10	L	L	CB	3
11	R	L	CB	6
12	L	L	PP	1
13	R	R	CB	2
14	R	L	PP	1
15	R	R	CB	4
16	R	R	CB	2
17	R	L	DEB	1
18	R	L	CB	5
19	R	L	BB	4
20	R	R	PP	2
21	R	R	PP	1
22	R	R	PP	5
23	R	L	BB	5
24	R	R/L	CB	10

Key: Hand dominance and hand used: R=Right, L=Left; Participant's rating on 1-10 scale of "ease" of copying task for preferred medium: 1-2 = easy; 3-4 = fairly easy; 5-6 = fairly difficult; 7 and higher = difficult.

On the sentence copying task, multivariant analyses of variances (MANOVA) results comparing within-subject differences in legibility scores for the orthographic mediums revealed no within-subject differences for the group that used their dominant hand and no within-subject differences for the group that used their non-dominant hand. MANOVA results comparing between subject differences after adjusting for hand dominance, however, indicated that subjects who copied sentences with their dominant

hand had significantly higher legibility scores for sentence copying than the group that used their non-dominant hand.

For the figure copying task, MANOVA results comparing within-subject differences in legibility scores for the orthographic mediums revealed no within-subject differences for the group that used their dominant hand. MANOVA results comparing within-subject differences in figure copying legibility for subjects using their non-dominant hand, however, revealed significantly higher scores for the DEB orthographic medium. MANOVA results revealed no significant differences between the groups in figure copying related to hand dominance.

4.3 Preferred Orthographic Mediums

Table 4.3, shown above, presents information on participant preference for using one orthographic medium over another and the degree of "ease" using that medium. It was found that a total of 5 (20.8%) participants showed a preference for the PP orthographic medium, 10 (41.7%) preferred the CB, 3 (12.5%) preferred DEB, and 6 (25%) participants expressed a preference for the BB orthographic medium. When participants rated the ease of writing and drawing on their preferred orthographic mediums, it was found that 10 (41.7%) participants rated the tasks to be easy, 6 (25%) rated the tasks fairly easy, 5 (20.8%) rated the tasks fairly difficult, and 3 (12.5%)rated the tasks as difficult. Preferences for using one orthographic medium over another were also examined for participants doing the copying tasks with dominant and non-dominant hands. It was found that 10 of 12 participants (83%), who used their dominant hand,

preferred the PP or CB mediums and 6 of 12 participants (50%), who used their non-dominant hand, selected the DEB or BB as their preferred orthographic medium.

CHAPTER 5. GENERAL DISCUSSION, METHODOLOGIAL ISSUES, AND CLINICAL IMPLICATIONS

5.1 General Discussion

This study examined the legibility with which sentences and geometric figures were copied by participants with chronic aphasia in four conditions. Each condition involved copying the sentences and figures using a different orthographic medium including: pen and paper, pen and paper with the paper affixed to a clip board, felt tip marker and dry erase board, and stylus with a Boogie Board. Legibility of sentence copying was quantified with a 5-point scale from the Writing Mechanics Subtest of the BDAE (Goodglass & Kaplan, 1983). Legibility of copying of geometric figures (e.g., triangle, square, and circle) was assessed with the 1-15-point multidimensional scoring system from the PICA (Porch, 2001).

Findings indicated that the orthographic medium used by persons with chronic aphasia to copy sentences and figures did not impact legibility of the written product. Separate repeated measures analyses of variance (ANOVA) were carried out to compare differences in sentence and figure copying legibility in the orthographic mediums. These analyses failed to indicate any differences in the legibility of copying of sentences or figures between the orthographic mediums. Largely, the sentence and figure legibility scores within and between subjects reflected little variability. Qualitatively, the sentences and figures copied by the PWA differed considerably from the model sentence and sets of figures the participants were required to copy, but the end products were generally judged to be legible by scorers who were blinded to orthographic medium use.

Two positive findings emerged from this study when sentence and figure copying were examined for groups of participants who used their dominant (N = 12) versus their non-dominant hand (N = 12) for the copying tasks. After adjusting for hand dominance, participants that copied sentences with their dominant hand had significantly higher legibility scores on the sentence copying task than those using their non-dominant hand. This finding, however, should not be surprising to anyone who has tried to use their non-dominant hand to write for the first time. However, there were no between group differences in sentence copying legibility when comparing the different orthographic mediums amongst the dominant and non-dominant hand groups. Another positive finding was that the participants who copied figures with their non-dominant hand had significantly higher legibility scores in the DEB condition. This may reflect that using a felt tip marker as a writing implement in this condition required lighter pen pressure and facilitated copying of the geometric forms.

Findings of the study suggested individuals with aphasia prefer the simpler, more traditional, orthographic mediums for copying sentences and figures such as PP and CB. When participants rated an orthographic medium "easy" (1 or 2) or "fairly easy" (3 of 4) to use, they tended to be individuals that completed the copying tasks with their dominant hand. Ratings of "ease" did not always coincide with participants' hand preferences. Generally, more participants using their non-dominant hand rated copying of sentences and figures as difficult rather than easy.

5.2 Methodological Issues

The participants were limited to the copying of the "quick brown fox sentence" and sets of geometric forms so that the influence of the orthographic medium on legibility of copying could be assessed without being influenced by the participants' aphasic deficits. This may not have been the best procedure because it limited the findings of the study to only having applicability to the copying of sentences and figures, not communicative writing and drawing as used by PWA in day-to-day communication. Additionally, it may have affected the participants' motivation to give their best effort because they found the tasks to be boring. It may have been better to have used functionally relevant copying tasks. For example, participants could have been given a "standardized grocery list" and sketch stick figures or the floorplan of a house rather than the "brown fox sentence" and the geometric figures respectively.

During the data collection phase of the study, it was observed that participants needed different amounts of time to complete the sentence and figure copying tasks in the different mediums. It would have been informative to keep track of the time it took participants to perform the copying tasks in each orthographic medium. Relatedly, participants differed in the extent to which they self-corrected and revised their copying of sentences and figures. Some made a genuine effort to perfect their product. Others seemed to just want to finish the task. Additionally, some put great effort into the beginning of the task, but their motivation and effort faded as the task continued. This information could have been captured with some type of time measure.

The study participants consisted of 24 PWA capable of copying a sentence and a geometric figure set. Anecdotally, some of these participants were observed in the

Aphasia Lab to use communicative writing and drawing, but no effort was made to determine the extent to which individual participants "actually" used communicative writing and drawing. It may have been useful to obtain information in this regard from the participants' significant others, clinicians, or by interviewing the participant. This would have allowed for comparison of the performances of participants who did and did not regularly use communicative writing and drawing.

Participants were asked to select the orthographic medium they preferred. Rather than limit the participant to selecting one of the four orthographic mediums, it may have been useful to have participants rate each medium on a visual analog scale, and then determine if copying a sentence or a figure in that medium was easy, fairly easy, fairly difficult, or difficult for them. This would have provided information useful to clinicians seeking to assist PWA in selecting an orthographic medium for writing and drawing that was better for them.

Finally, it is possible that the procedures for measuring legibility of sentence and figure copying were not sensitive enough to detect differences in legibility. The scoring systems used for sentence and figure rating were descriptive scales. However, a more objective scale may have been better suited for measuring legibility. In addition, it may have been beneficial to measure aspects of legibility including spacing, slanting, and complete vs incomplete letters in order to obtain a total legibility score based on different legibility features. It is also a possibility that providing model sentences and sets of figures may have created a bias in the scorers' ratings of sentence legibility. Alternatively, it may be the case that "legibility" is not the appropriate metric. For example, a 100 mm. visual analog scale that quantified the "degree" to which the copied

sentences or sets of figures resemble the model may have been more sensitive and yielded different results.

5.3 Clinical Implications

While the absence of any substantive findings from this research endeavor was somewhat disappointing, much was learned about how clinicians might help PWA make use of communicative writing and drawing when they are not able to address a communication need or situation verbally.

Observations of the PWA that participated in this study, with few exceptions, suggested that most participants had not given much thought to the selection of an orthographic medium for writing and drawing. This suggests that PWA may be reluctant to use communicative writing and drawing because they are embarrassed about their verbal communication deficits, and writing or drawing will expose these deficits. The fact that some PWA come to the Aphasia Lab with no orthographic medium on their person suggests that clinicians need to take a more active role in helping patients find an orthographic medium that fits their needs. A clinician needs to consider several factors to find the right "fit" for their patients. Observations of the participants in this study revealed the following factors warrant considerations, and action should be taken to minimize the impact of these factors on the ability of the patient to use communicative writing and drawing.

5.3.1 Premorbid Handedness

Roughly, 95% of the world's population is right-handed and most people use their right hand to write and draw (Brookshire, 2003). Aphasia is usually the result of a left-hemisphere lesion, and in many cases, this lesion damages the primary motor cortex resulting in a weakness on the right side of the body. When the PWA must write and draw with the non-dominant left hand, there will be a learning curve. Writing and drawing may be harder to learn and once learned, it requires practice to sustain. However, with practice, this is possible. Normal individuals do this when they suffer injury to the dominant hand. Rob, described earlier, practiced writing with his left hand by copying books written by stroke survivors. He learned to copy printed script with his left hand accurately and quickly.

5.3.2 Visual Field Cuts

Some PWA have visual field cuts (blindness or partial blindness in the right half of each eye). This is usually a right homonymous heminanopsia (Brookshire, 2003), particularly if the causative lesion occurs posterior to the optic chiasm (Brookshire, 2003). Field cuts may interfere with the use of communicative writing and drawing because the patient needs to adjust his or her head position to see and utilize the right half of the writing surface. The extent of these adjustments will differ in accordance with the severity of the field cut.

5.3.3 Weakness and Fatigue

Weakness and fatigue become an issue for patients with mild contralateral weakness who opt to continue to use the paretic dominant hand for communicative

writing and drawing. Here, the therapist might consider the use of a writing implement that helps an individual compensate for weakness and combat fatigue brought about by sustained writing and drawing. Writing implements have been modified for use by patients with weakness to have larger grips and nibs that permit writing to be done with less pressure. This may involve collaboration between the Speech-Language Pathologist and the Occupational Therapist (Simpson et al., 2015).

5.3.4 Mobility

Some stroke survivors with aphasia do not regain the ability to walk. For these less-mobile individuals communicative writing and drawing are carried out at a table usually with a conversational partner. This is advantageous because the table provides a stable, fixed writing support for the writing surface. The simplest means of doing this is to use the CB medium, which was preferred by many participants in this study. However, clinicians should take caution when implementing the PP medium with PWA who have limited mobility. Many participants expressed difficulty with stabilizing the piece of paper on the table during the writing task due to hemiparesis. Typically, when writing one could use their non-dominate hand to stabilize the piece of paper. However, that is not an effective strategy for many PWA who present with co-occurring hemiparesis.

5.3.5 Portability

For patients who are ambulatory, the portability of the orthographic medium is important. Since these patients have a need to use communicative writing and drawing in different situations and environments, they require an orthographic medium that is flexible. Some people, such as Ed, can get by simply carrying a small tablet and pen in their breast pocket. Others need a stable writing surface and guidance in adapting to situations where they need to use communicative writing or drawing "on the fly." Writing mediums such as the CB, BB, and DEB could be advantageous for these patients because it allows them to have a stable writing surface that is also portable.

5.3.6 Acceptance of Effective Writing and Drawing

Communicative writing and drawing needs to be effective in conveying the intended message, not stylistic or fancy. Writing style does not matter. While most individuals learn to use cursive writing in school, the handwriting of normal adults reflects a combination of print, cursive, and a mixture of the two on common everyday writing tasks, such as making a shopping list (Dettrick-James et al., 2015). PWA who use their non-dominant hand for writing, however, prefer print. The writing style that a PWA uses should be accepted so long as it is legible to the reader.

5.4 Practical Clinical Implications

Some very important practical clinical implications emerged from our observations of participants in this study. Perhaps the most clinically relevant finding is that it is important to have different orthographic mediums readily available to PWA for communicative writing and drawing. This has been useful in promoting the use of communicative writing and drawing by patients in the UK Aphasia Lab. For example, care has been taken to ensure each treatment room is equipped with the CB orthographic medium, preferred by many study participants. In the group rooms, where several PWA participate in problem focused group treatment or supported conversation groups, each patent is provided with a pad and pen to use communicative writing and drawing if necessary. It has also been useful to make sure a DEB orthographic medium is available with different colored felt tip markers for writing and drawing by persons with severe aphasia. Finally, it has been useful to make sure paper placed on clipboards for writing and drawing is sectioned off in quadrants. This helps patients organize their writing and drawing efforts and helps the clinician make sense of these efforts at the end of the treatment session and summarize what the patient has communicated.

Further research is needed to determine the various ways PWA use communicative writing and drawing to supplement verbal communication limitations. It would be beneficial to look at how participants use each orthographic medium in their everyday communicative writing and drawing to gain a better understanding of how functional each medium is for daily use. Additionally, further research is necessary to determine if legibility is able to be measured more adequately by looking at different

aspects of writing legibility including, spacing, completeness of letters, and slanting of writing.

In sum, the research project has convinced the student clinician responsible for this research that PWA and their families should not simply be left to their own devices to select an orthograph medium for communicative writing and drawing. While each patient has preferences that should be considered, guidance, support, and encouragement are needed by their clinicians to find the most effective orthographic medium for communicative writing and drawing.

REFERENCES

Alarcon, N. (2007). Drawing Assessment Protocol. In Beukelman, D., Garrett, K., & Yorkston, K. (Eds.). Augmentative communication strategies for adults with acute and chronic medical conditions. Baltimore, MD: Brooks Publishing.

Alexander, M. P. (2000). Aphasia I: Clinical and anatomical issues. In M. J. Farah & T.E. Feinberg (Eds.) Patient-based approaches to cognitive neuroscience (pp. 165-181). Cambridge, MA: The MIT Press.

Basso, A. (2010) Natural conversation: a treatment for severe aphasia. *Aphasiology*, 24, 466-479

Beeson, P. M. (1999). Treating acquired writing impairments. *Aphasiology*, 13, 367-386.

Beeson, P., Hirsch, F., & Rewenga, M. (2002) Successful single word writing treatment: Experimental analyses of four cases. *Aphasiology,* 16, 473-492.

Beeson, P. M., & Rapesak, S. Z. (2004). Agraphia. In R. Kent (Ed.) The MIT Encyclopedia of communication disorders (pp. 233-236). Cambridge, MA: MIT Press.

Beeson, P. M., Rising, K., & Volk, J. (2003). Writing treatment for severe aphasia: Who benefits? *Journal of Speech, Language, and Hearing Disorders*, 46, 1038-1060.

Behrns I., Hartelius, I., & Wengelin, A. (2009). Aphasia and computerized writing aid supported treatment. *Aphasiology*, 23. 1276-1294.

Brookshire, R. H. (2003). Introduction to neurogenic communication disorders (6th ed.). St. Louis, MO: Mosby.

Brookshire, R. H. & McNeil, M. R. (2015). Introduction to neurogenic communication disorders. St. Louis, MO: Mosby.

Clausen, N. & Beeson, P. (2003). Conversational use of writing in severe aphasia: a group treatment approach. *Aphasiology*,17, 625-646.

Collins, M. (1986). Diagnosis and treatment of global aphasia. San Diego: College-Hill.

Davis, A. G. (2005). Pace revisited. *Aphasiology*, 19, 21-28.

Dettrick-James, M., McCluskey, A., Lannin, N., & Scanlan, J. (2015). Handwriting legibility in healthy older adults. *Physical & Occupational Therapy in Geriatrics*, 33, 189-203.

Duffy, J. M. (2005). Motor speech disorders: Substrates, differential diagnosis and management (2nd ed.), St. Louis: Mosby.

Ellis, A. W. (1988). Normal writing processes and peripheral acquired dysgraphias. *Language and cognitive processes*, 3, 99-127.

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

Fawcus, M., & Fawcus, R. (1990). Information transfer in four cases of articulatory apraxia. *Aphasiology*, 4, 207-211.

Fratalli, C. M. (1992). Functional assessment of communication: Merging public policy with clinical views. *Aphasiology*, 6, 61-82.

Fratalli, C. M. (1998). Measuring clinical outcomes in Speech-Language pathology. New York: Thieme.

Gardner, H. (1984). Artistry in aphasia. In M. Sarno (ed.). Aphasia Rehabilitation (pp. 234-234). New York: Harcourt Brace.
Garrett, K. & Huth, C. (2002). The impact of graphic contextual information and instructional information on the conversational behaviors of a person with severe aphasia. *Aphasiology*, 16, 523-536.
Garrett, K. & Lasker, J. (2005). The multimodal communication screening task for persons with aphasia. http://acc.unl.edu/screen/score.
Goodglass, H., & Kaplan, E. (1983). The assessment of aphasia and related disorders (2nd ed.). Philadelphia: Lea & Febiger.
Graham, S., Struck, M., Santoro, J., & Berninger, V. W. (2006). Dimensions of good and poor handwriting legibility in first and second graders: motor programs, visual-spatial arrangement, and letter formation parameter setting. *Developmental Neuropsychology*, 29, 43-60.
Graham, S. Weintraub, N., & Berninger, V. (1998). The relationship between handwriting style and sped and legibility. *Journal of educational research*, 92, 42-52.
Hegde, M. (2010). Introduction to communication disorders. Austin, TX: Pro-Ed.
Helm-Estabrooks, N., & Albert, M. A. (2004). Manual of aphasia therapy (2nd ed.). Austin, TX: Pro-Ed.
Holland, A. L. (1977). Some practical considerations in aphasia rehabilitation. In M. Sullivan and M. S. Kommers (Eds.) Rationale for adult aphasia therapy (pp.167-180). Omaha: University of Nebraska Medical Center.
Kagan, A. (1998). Supported conversation for adults with aphasia: Methods and resources for training conversational partners. *Aphasiology*, 9, 816-830.
Kagan, A., Black, S. E., Duchan, J., Simmons-Mackie, N., & Square, P. (2001). Training volunteers as conversational partners using "supported conversation for adults with aphasia" (SCA). *Journal of Speech, Language, and Hearing Research*, 44, 624-638.
Kertesz, A. (1979). Aphasia and associated disorders: taxonomy, localization, and recovery. New York: Grune & Stratton.
Kertesz, A. (1982). Western Aphasia Battery. New York: Grune & Stratton.
Lasker, J. P. (2008). AAC language assessment: Considerations for adults with aphasia. Perspectives on Augmentative and Alternative Communication, 17(3), 105-112.
Lebrun, N. (2013). Drawing assessment protocol for adults with aphasia: a rubric for scoring. Unpublished Masters Thesis, University of Texas, Austin.
Lethbridge College. (n.d.). lethbridgecollege.net
Linebaugh, C., Kryzer, K. M., Odin, S., & Meyers, P. (2006). Reapportionment of communicative burden in aphasia: a study of narrative interaction. *Aphasiology*, 20, 84-96.
Lubinski, R. M. (2001). Environmental systems approach to adult aphasia. In R. Chapey (Ed.). Language intervention strategies in aphasia and related neurologic communication disorders (3rd edition), pp.269-296, Baltimore, MD: Lippincott, Williams and Wilkins.

Lustig, A. P. & Tompkins, C. A. (2002) A written communication strategy for a speaker with aphasia and apraxia of speech. Treatment outcomes and social validity. *Aphasiology,* 16, 507-522.

Lyon, J.G. (1995a). Communicative drawing: An augmentative mode of interaction. *Aphasiology*, 9(1), 84-95.

Lyon, J. G. (1995b). Drawing: Its value as a communication aid for adults with aphasia. *Aphasiology*, 9, 33-50.

Lyon, J.G., & Helm-Estabrooks, N. (1987). Drawing: Its communicative significance for expressively restricted aphasic adults. *Topics in Language Disorders,* 8(1), 61-71.

Lyon, J. G., & Sims, M. (1989). Drawing: its use as a communicative aid with aphasic and normal speakers. *Clinical Aphasiology*, 18, 339-355.

Marshall, R. C., Freed, D. B., & Phillips, D. S. (1997). Communicative efficiency in severe aphasia. *Aphasiology*, 11, 373-384.

Marshall, R. C., Gandour, J., & Windsor, J. (1988). Selective impairment of phonation: a case study. *Brain and Language*, 35, 313-339.

McNeil, M., Odell, K., & Tseng, C. H. (1990). Toward the integration of resource allocation into a general model of aphasia. In T. Prescott (Ed.), Clinical *Aphasiology*, (pp. 21-39), Austin, TX: Pro-Ed.

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

Oldfield, R. C. (1971). The assessment and analysis of handedness. The Edinburgh Inventory. *Neuropsychologia*, 9, 97-113.

Parr. S. (1992). Everyday reading and writing practices of normal adults: Implications for aphasia assessment. *Aphasiology*, 6, 173-283.

Parr. S. (1996). Everyday literacy in aphasia: Radical approaches to functional assessment and therapy. *Aphasiology*, 10, 469-479.

Peach, R. (2008). Global aphasia: Identification and management. In R. Chapey (Ed.). Language intervention strategies in aphasia and related neurologic communication disorders (5th edition), pp.565-594, Baltimore, MD: Lippincott, Williams and Wilkins.

Porch, B. E. (2001). Porch Index of Communicative Ability (4th ed.). Albuquerque, NM: PICA Programs.

Rau, M. T. (1986). Beyond our usual treatment goals: Treatment of a high-level aphasic person. In R. Marshall (Ed.). Case studies in aphasia rehabilitation (pp.31-44). Austin, TX: Pro-Ed.

Rautakoski, P. (2011). Training total communication. *Aphasiology,* 25, 344-365.

Robson, J. Marshall, J., Chiat, S., & Pring, T. (2001). Enhancing communication in jargon aphasia: a small group study of writing therapy. *International Journal of Language & Communication Disorders*, 36, 471-478.

Roseblum, S., Weiss, P., & Parush,. S. (2004). Handwriting evaluation of developmental dysgraphia: process versus product. *Reading and Writing*, 17, 433-458.

Sacchett, C. (2002). Communicative drawing: towards the interactive. *International Journal of Human Computer Studies*, 57, 263-277.

Schuell, H., Jenkins, J., & Jiminez-Pabon, E. (1964). Aphasia in adults. New York: Harper and Row.

Simmons-Mackie, N. (2008). Social approaches to aphasia intervention. In R. Chapey (Ed.). Language intervention strategies in aphasia and related neurologic communication disorders (5th edition), pp. 290-317, Baltimore, MD: Lippincott, Williams and Wilkins.

Simmons-Mackie, N., Beukelman, D. R., & King, J. M. (2013). Supporting communication for adults with acute and chronic aphasia. Baltimore, MD: Paul H. Brooks.

Simmons-Mackie, N., Raymer, A., Armstrong, E., Holland, A., & Cherney, L. (2019). Communication partner training in aphasia: A systematic review. *Archives of Physical Medicine and Rehabilitation*, 91, 1814-1837.

Simpson, B., McCluskey, A., Lannin, N., & Cordier, R. (2015). Feasibility of a home-based program to improve handwriting after stroke: a pilot study. *Disability and Rehabilitation*, 38, 673-682.

Taylor, J. B. (2009). My stroke of insight. New York: Penguin Group.

Van Drempt, N., McClusky, A., & Lannin, N. (2011) A review of factors that influence adult handwriting performance. *Australian Occupational Therapy Journal*, 58, 321-328.

Wallace, S. E. (2020). The use of drawing as a therapeutic technique in aphasia therapy. Speech Pathology. https://www.speechpathology.com/ask-the-experts.

Wambaugh, J. & Shuster, L. (2008). The nature and management of neuromotor speech disorders accompanying aphasia. In R. Chapey (Ed.). Language intervention strategies in aphasia and related neurologic communication disorders (5th edition), pp. 1009-1042., Baltimore, MD: Lippincott, Williams and Wilkins.

Ward-Lonergan, J. M., & Nicholas, M. (1995). Drawing to communicate: a case report of an adult with global aphasia. *International Journal of Disorders of Communication*, 30, 475-491.

Weigl, E. (1968). On the problem of cortical syndromes: Experimental studies. In M.L. Semmell (Ed.), The reach of mind (pp. 143-159). New York: Springer.

Yancosek, K., & Howell, D. (2011). Systematic review of interventions to improve or augment handwriting ability in adult clients. *OTR: Occupation, participation and health,* 31, 55-63.

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