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AN OBJECTIVE REVIEW OF WORD-FINDING TREATMENTS IN APHASIA

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ABSTRACT

Word-finding deficits are prevalent in most cases of aphasia. Wisenburn and Mahoney (2009) performed a meta-analysis of numerous therapies for anomia, dividing treatments into semantic, phonological, or mixed approaches. An unbiased effect size for confrontational naming tasks was calculated for each therapy approach, including for follow-up measures. This paper expands on this previous research by describing the specific treatment procedures and providing the effect size for each therapy. This paper describes and analyzes 17 semantic, 13 phonologic, and 11 mixed therapy studies. Most of the therapies showed evidence of efficacy, although the appropriateness of any particular therapy depends upon the characteristics and needs of the client.

KEY WORDS

Anomia Treatment, Evidence-Based Practice

INTRODUCTION

Word-finding deficits are present in most cases of aphasia (Raymer, 2005). Clinicians treating cases of aphasia should be familiar with treatment procedures that have evidence of efficacy. Wisenburn and Mahoney (2009) provided an objective analysis of the research for anomia treatments. This paper expands on the previous research by describing the specific therapy procedures that have been studied and relating each individual therapy to its objective measure of efficacy. Therefore, from this review, clinicians can understand specific therapy procedures and provide evidence for their services related to word-finding deficits.

The American Speeech-Language Hearing Association has emphasized the need for clinicians to use evidence-based practice when providing clinical services. This obligates clinicians to be aware of the current research regarding treatment. However, the vast literature on various anomia treatments is difficult to synthesize and compare. Literature reviews of anomia therapy, such as Nickels and Best (1996) and Nickels (2002), provide an overview of treatment approaches, but lack an objective means to compare the efficacy of various treatments. A meta-analysis serves to objectively measure the efficacy for each therapy so that the literature can be synthesized and more easily understood. Meta-analyses of aphasia therapy in general have indicated their effectiveness (Robey, 1998; Whurr, Lorch & Nye, 1992). The only meta-analyses that have focused specifically on anomia therapy have indicated an overall efficacy of treatment (Wisenburn, 2008, 2009; Wisenburn & Mahoney, 2009).

Wisenburn and Mahoney (2009) searched the literature for anomia therapy studies and calculated an objective measurement of the efficacy of various treatments for confrontational naming tasks. For this study, Wisenburn and Mahoney found 44 research articles and calculated 107 effect sizes related to anomia treatment. Each therapy was categorized as having a semantic, phonological, or mixed approach. Approaches that focused on the meaning of words, such as categorizing words, defining words, describing words, naming words when given definition cues, or using gestures for words were all grouped together as semantic therapy. Phonological therapies included repeating words, reading or writing words in isolation, or naming pictures when given sound or letter cues. Therapies that combined these treatment techniques, including functional therapy approaches, were categorized as mixed. The gains in therapy were calculated by comparing the pre- and post-therapy scores on confrontational naming tasks using a standard formula for effect size. These effect sizes for naming tasks were separated depending on whether the measurement set was trained, untrained, or frequently exposed, and also upon whether the test set was semantically or phonologically related to the trained set of words. Effect sizes were also calculated for follow-up measures.

From this analysis, Wisenburn and Mahoney (2009) were able to make comparisons between the general approaches. The findings from this analysis were that all three approaches were effective at improving confrontational naming. For words that were trained in therapy, the phonological approach appeared to be the most efficacious. The semantic approach had the highest effect size for untrained-unrelated and untrained-related sets of words. However, this effect size was low. A more positive finding by Wisenburn and Mahoney was that substantial gains persisted for up to three months after the termination of therapy. Also, high effect sizes were also seen for individuals years after the onset of their injury. Caution must be used in interpreting these findings, as a large amount of variance was seen for most of the means of the effect sizes.

Wisenburn (2008) further analyzed the anomia treatment studies to examine a variety of other moderator variables. The general findings were that individuals with nonfluent aphasia showed slightly greater gains than those with fluent aphasia. Gains were also seen for trained words regardless of the severity of the aphasia. Wisenburn also found that larger amounts of weekly therapy sessions did not seem to correlate strongly with gains in therapy; large effect sizes for trained words were seen when treatment was provided two or three times weekly. An analysis of the amount of trained words in therapy showed that the largest gains were seen for 26-50 words, but substantial improvement was still seen in treatment focusing on 100 or more words.

A persistent question in anomia treatment research is how to match the most effective therapy with particular client characteristics. The main division of client characteristics is between those with semantically based deficits and those with phonologically based deficits (Li, 1996). Those with semantically based deficits show decreased auditory comprehension and often exhibit semantic paraphasias in confrontational naming tasks (Howard & Gatehouse, 2006). Those with phonologically based deficits show a full awareness of the meaning of the target word but struggle to find the correct sounds to produce the word (Howard & Gatehouse, 2006). Wisenburn (2009) further analyzed the data with regard to the type of therapy (semantic, phonological, or mixed) in relation to the client's characteristics (i.e., semantically or phonologically based deficits). The findings showed that those with semantically based deficits showed gains for both trained and (to a lesser extent) untrained words with either semantic or phonological therapy. Those with phonologically based deficits showed the most gains with phonological or mixed therapy for trained words and did not demonstrate generalization for untrained words.

The meta-analyses of Wisenburn and Mahoney (2009) and Wisenburn (2008, 2009) have provided objective data related to the efficacy of anomia therapy depending on numerous treatment and client variables. However, these studies have grouped together differing treatment procedures into general categories to reach broad conclusions. It would be clinically useful to describe in more detail the specific procedures applied in the various therapies and to relate specific therapy procedures to their efficacy for word-retrieval. This paper focuses on providing information to assist clinicians in implementing evidence-based practice for individuals with word-finding deficits due to aphasia.

METHOD

SELECTING THE STUDIES

This paper is based on the studies analyzed by Wisenburn and Mahoney (2009). A variety of search procedures were used to find anomia treatment studies. Each study included in the analysis was required to involve at least two participants with aphasia. Pre- and post-therapy measures were limited to confrontational naming tasks. Although some research has questioned the validity of confrontational naming tasks for measuring functional word-finding skills (Mayer & Murray, 2003), more recent studies (Herbert, Hickin, Howard, Osborne, & Best, 2008) have supported the use of these measures for anomia. Further details of the search procedure and criteria for inclusion are provided in the study (Wisenburn & Mahoney, 2009).

Wisenburn and Mahoney (2009) analyzed 47 studies. The statistical procedure Chauvenet's criterion (Taylor, 1997) was applied to these studies to eliminate outliers, leaving 44 studies for analysis (Wisenburn & Mahoney, 2009). For this paper, these 44 studies were reviewed. From these 44, 3 studies that did not adequately describe treatment procedures were eliminated from consideration, leaving 41 studies that were objectively reviewed.

ANALYZING THE STUDIES

The previous research (Wisenburn & Mahoney, 2009) focused on four variables: treatment approach, word set, follow-up measures, and median number of months post-onset of aphasia. For this study, the main variable of interest was the treatment procedure. Wisenburn and Mahoney grouped treatments within studies that were within the same general category (i.e., semantic, phonological, or mixed). For this analysis, different treatment procedures were not grouped into general categories but were analyzed separately. Therefore, individual procedures could be described in detail and related to their respective effect size. These individual effect sizes were separated by word set (trained, related-exposed, unrelated-exposed, unrelated-unexposed, and related-unexposed). Related word sets consisted of untrained words that were semantically or phonologically related to the trained set. A word set was considered exposed if it was presented for more than just baseline and final measures. Research has shown that repeated exposure to words may have an effect on the participant's ability to retrieve those words (Howard, 2000; Nickels, 2002a, 2002b). Most measurements for single-subject research consisted of frequent exposure to the same words. In addition, follow-up measures (one, two, or three months post-therapy) were also considered for this review.

CALCULATING EFFECT SIZE

To gain an objective measure of the efficacy of each therapy, an unbiased effect size was calculated. The standard effect size, often abbreviated as d, was calculated by subtracting the mean of the post-therapy confrontational naming scores from the mean of the pre-therapy scores, and dividing this result by the standard deviation of the pre-therapy scores: $d = (M\text{post tx} - M\text{pre tx}) / SD\text{pre tx}$. This result was then used to calculate an unbiased effect size. The formula for the unbiased effect size limits the magnitude of the result as the number of participants is reduced. The application of the unbiased effect size was useful for this research as many of the studies used few participants. The formula to calculate an unbiased effect size was: unbiased $d = (1 - (3 / ((4 \times n) - 9))) \times d$. This paper presents only the unbiased effect size for all comparisons, and so it will henceforth simply be referred to as the *effect size*. It should be noted that for many studies, an effect size could not be calculated for both trained and untrained confrontational naming tasks. For example, measures of trained words that only used items that were unsuccessfully named in baseline testing were rejected as the effect sizes for these measures were inflated since gains could be due to normal variation. Also, measures in which the pre-therapy standard deviation was zero were also rejected as this number is in the denominator in the formula for the effect size.

It is difficult to functionally interpret the value of the effect size. The larger the effect size, the larger the gains in therapy. An effect size of 0 indicates no change in status. In the comparison of effect sizes for anomia therapy, Wisenburn and Mahoney (2009) found that for trained words, a small, medium, and large effect size was approximately 1, 2, and 3. For untrained words, a small, medium, and large effect size was approximately 0.15, 0.3, and 0.6 (Wisenburn & Mahoney, 2009).

RESULTS

Each procedure is described and analyzed separately within the semantic, phonological, and mixed approach categories.

SEMANTIC-BASED THERAPIES

There are a wide variety of semantic-based therapies that have been experimentally studied. Some, such as semantic feature analysis (SFA), are formal approaches that have well-established procedures. For most treatment studies, however, the authors created their own procedures based on semantic tasks such as describing words, using words in sentences, using gestures for words, naming pictures when given a semantic cueing hierarchy, or matching spoken words with pictures. Therapies that focused on the syntactical properties of the target words were also included in this category. The effect

Table 1. Effect size for various semantic therapies.

Study	Therapy Description, Word Set, Follow-Up	Effect Size
Drew and Thompson (1999)	Match, categorize, or answer questions	
	trained	1.59
	2 month follow-up	1.02
	untrained, exposed, unrelated	0.87
	2 month follow-up	0.41
Edmonds and Kiran (2006)	Selection or description of features	
	trained	2.43
	1 month follow-up	1.92
	untrained, exposed, related	1.54
	1 month follow-up	1.54
	untrained, unexposed, unrelated	0.78
Edwards and Tucker (2006)	Sentence completion and definitions for verbs	
	trained	0.50
	3 month follow-up	0.44
	untrained, unexposed, unrelated	-0.42
	3 month follow-up	0.31
Fink et al. (1997)	Sentence assembly with gestures for verbs	
	trained	4.22
Fridriksson et al. (2007)	Semantic cueing hierarchy	
	untrained, unexposed, unrelated	0.53
Greenwald et al. (1995)	Semantic cueing hierarchy with repetition	
	trained	2.02
	1 month follow-up	1.21
	Definitions, match to related words, read	
	trained	1.41
Kiran and Thompson (2003)	Feature description or selection	
	untrained, unexposed, unrelated	2.72
Law et al. (2006)	SFA with semantic priming	
	trained	3.28
	1 month follow-up	4.39
	untrained, exposed, related	4.11
	1 month follow-up	2.52
	untrained, exposed, unrelated	1.98
	1 month follow-up	3.25
Lowell et al. (1995)	SFA with selected cues	
	trained	1.32
	untrained, exposed, related	0.27
	untrained, exposed, unrelated	2.23
Mackenzie (1991)	Match spoken/written words to picture, yes/no questions	
	untrained, unexposed, unrelated	0.24
Nadeau and Kendall (2006)	Feature description or selection	
	untrained, unexposed, unrelated	0.56
	3 month follow-up	0.23
Nettleton and Lesser (1991)	Picture match, yes/no questions, categorization	
	untrained, unexposed, unrelated	0.28
Nickels and Best (1996)	Written word to picture match	
	trained	1.87
	untrained, unexposed, unrelated	0.40
Pring et al. (1993)	Written word to picture match	
	trained	2.43
	1 month follow-up	1.99
	untrained, exposed, related	1.56
	1 month follow-up	1.49

	untrained, unexposed, related	0.54
	1 month follow-up	0.35
	untrained, unexposed, unrelated	0.65
	1 month follow-up	0.48
Raymer and Kohen (2006)	Produce target words in sentences	
	trained	0.28
	untrained, exposed, unrelated	0.13
	untrained, unexposed, unrelated	0.10
Raymer, Kohen, and Saffell (2006)	Word to picture match, repetition	
	trained	4.66
	1 month follow-up	4.52
	untrained, exposed, unrelated	3.03
	1 month follow-up	2.63
Schneider and Thompson (2003)	Describe verb type (motion/change of state)	
	trained	0.47
	1 month follow-up	0.45
	untrained, exposed, unrelated	0.14
	1 month follow-up	0.41
	Describe verb argument structure (1/2/3 places)	
	trained	1.34
	1 month follow-up	0.96
	untrained, exposed, unrelated	0.73
	1 month follow-up	0.83
Wambaugh et al. (2002)	Semantic cueing hierarchy	
	trained	1.41
Wambaugh et al. (2004)	Semantic cueing hierarchy	
	trained	4.22

size for each semantic therapy is provided in Table 1.

Semantic feature analysis (Boyle & Coelho, 1995) focuses on providing a variety of semantic cues related to each target word. For this therapy, a picture is placed in the middle of a chart, and the client is asked to name it and then say each of the semantic features in the chart for the clinician to write within one of six boxes. The six semantic features of SFA, along with their description for clients, is as follows: Group (is a ___), Use (is used for/to ___), Action (does what?), Properties (has/is ___), Location (is found ___), and Association (reminds me of a ___). If the client could not produce a feature description, the clinician would provide it. If the client could not name the target word after all of the semantic features were reviewed, the clinician would state the word for the client to repeat and then review the semantic features again (Boyle & Coelho, 1995).

Two experimental treatment studies used a variation of semantic feature analysis. Law, Wong, Sung, and Hon (2006) combined SFA with semantic priming. In this method, five semantically related pictures were placed in front of the participant. One picture was randomly selected and placed in the chart before the typical SFA procedures were followed. Lowell, Beeson and Holland (1995) substituted the feature "Parts" for "Action" and added an "Other" box to the SFA chart. The participants filled in the chart for all of the semantic features for the target words and then chose the four that were the most meaningful. For example, the participant chose the semantic cues *sit in*, *household furniture*, *living room*, and *cushions* for the word *sofa* (Lowell, Beeson, & Holland, 1995). These cues were then written on index cards. In the therapy task, the participant and the clinician read all four semantic cues, and then the participant was asked to name the word. If the participant could not name the word, he or she was asked to choose the target word from a choice of three written words.

Other semantic treatment procedures also focused on identifying features of the target words. Edmonds and Kiran (2006) utilized a procedure in which the participants first attempted to name the target. Then the clinician said the name and placed the picture and written name in front of the participant. As Edmonds and Kiran stated, "For each item (e.g., *apple*), five semantic features referring to the superordinate category (e.g., *fruit*), function (e.g., *provides nutrition*), general characteristics (e.g., *is sweet*), physical characteristic (e.g., *has skin/peel*), and location (e.g., *found in refrigerator/produce section*) were developed prior to treatment" (p. 735). The participant also generated a sixth semantic cue for each target. The participants were given 12 cards, 6 of which had the semantic features of the target, and 6 which were an unrelated distractor. The participants were instructed to choose the cards with correctly matching features. Each correct choice was reinforced by the clinician as belonging to one of the six semantic categories. For incorrect choices, the clinician provided additional information or modeling. After the selection of features, the clinician turned the picture over and asked 12 yes/no questions regarding the features (e.g., *Is it a fruit?*). The picture was then turned upright for the participant to name. A similar procedure was used by Kiran and Thompson (2003), in which the participants named and then sorted the target items before placing them under one of four written category cards. The clinician then displayed a variety of correct and incorrect written semantic feature cards for the participant to choose and then read six cards that matched the target. The participant then answered 15 yes/no questions about the target (e.g., *chicken*), 5 of which were correct (e.g., *Does it have wings?*), 5 that were incorrect but related to the same category (e.g., *Does it fly?*), and 5 that were incorrect and of a different category (e.g., *Is it made of metal?*). The participant then attempted to name the target once again.

Nadeau and Kendall (2006) provided pictures within the same category and asked each participant to state a semantic feature and then name the object. If the participant could not name the object after providing three features, then the clinician provided the name. Drew and Thompson (1999) used a wide variety of semantic tasks in therapy. First, participants sorted 45 pictured objects into three written categories. The 15 target pictures of the same semantic category were then sorted again based on attributes written down on cards (e.g., perceptual or functional characteristics). The clinician provided feedback as needed. The clinician then asked yes/no questions about the attributes for each item (e.g., *Is it used to tell time?*) or either/or questions (e.g., *Is it worn indoors or outdoors?*). After the clinician corrected any errors, the participant selected the target word from an array of five related items based on a spoken definition provided by the clinician. Additional semantic tasks were applied, such as asking semantic questions with the target name included (e.g., *Is a <u>watch</u> used to tell time?*), matching a written word to a picture in an array of five related pictures, and also a naming to definition task in which the clinician provided a verbal definition for a target word to be named.

Research on semantic anomia therapy has also focused on word-to-picture matching tasks commonly used in the stimulation approach for improving comprehension (Coelho, Sinotte, & Duffy, 2008). Pring, Hamilton, Harwood, and Macbride (1993) provided two matching tasks in therapy. In the first task, participants matched a picture to four written words. Of the three written distractors, one was semantically related, two were unrelated. In each session, each of the target words was presented twice as a picture and twice as a semantically related written distractor. In the second task, the clinician presented six semantically related pictures for the participant to match to three written words. In each session, each word was presented twice as a target and twice as a distractor. Nickels and Best (1996) similarly treated their participants by having them match a written word to four semantically related pictures or match a picture to four semantically related written words.

Raymer, Kohen, and Saffell (2006) used a computer program focused on semantic matching tasks. The computer program presented a picture of the target along with three semantically related distractors. When the participant pressed a button, the target word would be presented. Each target was presented in three ways each session: written, spoken aloud, and both. The participant then pointed to the target picture. If the answer was incorrect, the clinician pointed to the correct answer and modeled the name for the participant to repeat three times.

Nettleton and Lesser (1991) applied a procedure in which the participant pointed to a picture in an array of four when provided with the stated name, stated function, or written name of the target word. The distractors for this task were gradually made more semantically similar. In addition, the participants were asked yes/no questions about the category and attributes about each picture and to sort all of the pictures into categories.

Mackenzie (1991) also tested therapy involving picture-matching tasks. For therapy, participants matched a picture from an array of three semantically related objects to a target word that was spoken (e.g., *train, <u>plane</u>, boat*). This task was repeated with the same target words but with a written word as the stimulus. Mackenzie also utilized a series of yes/no questions related to the target (e.g., *Does a plane fly in the air?*) with some distractors (e.g., *Does a boat fly in the air?*).

The use of semantic cueing hierarchies in anomia therapy has also been studied experimentally. Greenwald, Raymer, Richardson, and Rothi (1995) combined the intensive use of definitions with repetitions. They first presented participants with pictured objects to name. When the participants were unsuccessful, they were first asked to name the semantic category of the object (e.g., *an animal*). Then the clinician pointed to a visually prominent feature of the target for the participant to describe (e.g., *It has a hump*). The clinician would summarize this information for the participant to repeat (e.g., *This animal has a hump*). These steps were repeated with a second visually distinctive feature. If still unsuccessful at naming, the participant was asked to describe the approximate size of the object. All information would be summarized by the clinician and repeated by the participant. If still unsuccessful, the clinician would provide the word for the participant to repeat three times while looking at the picture. Greenwald et al. also tested a therapy involving definition tasks and word reading. Participants named target words based on verbal definitions consisting of semantic category, function, and associated words (e.g., the word *canoe* for the target *teepee*). Participants also matched pictures of the target word to one of three semantically related pictures (e.g., matching the word *teepee* to *canoe*, *sailboat*, or *motor boat*). In addition, participants read words and performed frequent confrontational naming tasks.

Wambaugh, Doyle, Martinez, and Kalinyak-Fliszar (2002) and Wambaugh, Cameron, Kalinyak-Fliszar, Nessler, and Wright (2004) focused on retrieving verbs for naming action pictures. The participants were shown a picture to name the action and provided with progressive verbal cues after each unsuccessful attempt. Once the target was named, the clinician repeated the presentation of each of the previous cues in reverse order to elicit a repetition of the target. Therefore, if the client was initially unsuccessful at naming the target (e.g., *dig*), the clinician presented a description (e.g., *when you move dirt to make a hole*), a semantically nonspecific phrase to be completed (e.g., *dogs love to . . .*) and a semantically specific phrase (e.g., *you use a shovel to . . .*). If the participant still did not name the target action, then the clinician stated the word for the participant to repeat. Fridriksson et al. (2007) followed this same procedure but with nouns pictured instead of verbs.

In addition to the two studies by Wambaugh et al. (2002, 2004), other studies focused specifically on verb retrieval. Edwards and Tucker (2006) studied treatment for verb retrieval for participants with fluent aphasia. The clinician first presented a sentence-completion task that provided both semantic and syntactic cues for the verb. Second, the clinician provided dictionary definitions of the target words for the participants to name. Finally, the participants named the target verbs when shown action pictures. Bastiaanse, Hurkmans, and Links (2006) studied the specific therapy program *Verb Production at the Word and Sentence Level*. For this program, an action picture was shown with a written sentence omitting the infinitive verb. The participant read the sentence fragment and provided the missing word. Then this sentence-completion task was repeated but with an omitted inflected verb. In the final step, an action picture was shown for the participant to use the target verb in a grammatical sentence.

Fink, Schwartz, Sobel, and Myers (1997) also focused on verb retrieval for individuals with agrammatic aphasia. Their treatment procedure focused on only 10 verbs. At the start of each session, the clinician utilized a comprehension task in which the participant pointed to the appropriate action picture to match the spoken verb. Feedback was given as needed. After the participant named each picture without feedback, the clinician used a sentence assembly/verb probe procedure, such as the following (Fink et al., 1997):

> Examiner: Someone *carried* the sofa. It was the mover. Did I say the mover *dropped* the sofa?
>
> Subject: No, he (the mover) *carried* the sofa. (p. 42)

For three-quarters of these items, the verb in the clinician's question was a nontarget word that required the participant to say *no*. For all responses, the participant was required to say the target word. The clinician used gestures to cue the target verb, and the participant was encouraged to produce a gesture in response. If the participant could not retrieve the target word, the clinician provided the word and then gave two additional sentence-assembly trials for that word.

Schneider and Thompson (2003) studied the effect of two different anomia therapies for verb retrieval in cases of agrammatic aphasia. Two different types of verbs were trained in therapy: change-of-state verbs (e.g., *melt*) and motion verbs (e.g., *jump*). These verbs had three different argument structures: one-place (intransitive verbs needing only a subject, like *eat*), two-place (verbs requiring a subject and an object, such as *hit*), and three-place (verbs requiring a subject, object, and indirect object, such as *send*). One therapy procedure focused on the semantic aspects of the verbs. The clinician would begin by showing an action picture of a variety of verbs (e.g., motion verbs) and describing their category (Schneider & Thompson, 2003):

> The items you are going to see all describe a motion. This motion can be shown by movement in a particular direction, movement from one place to another, or a particular way of moving. For example, this picture shows *pass*. It shows movement in a particular direction. This picture shows *pick*. It shows movement from one place to another. And this picture shows *shuffle*. It shows a particular way of moving (p. 221).

A similar type of definition was given for change of state verbs. For each word, the verb was defined and the type of verb was reinforced, as shown by this example (Schneider & Thompson, 2003): "This picture shows *jump*. It shows a sudden movement off the ground using the legs. The movement shown is movement from one place to another" (p. 221). The final therapy procedure tested by Schneider and Thompson focused on the argument structure of each verb. In this procedure the clinician showed a variety of verbs with the same argument structure (e.g., two-place) and stated:

> The items you are going to see all show someone doing something to someone (or something). That is, someone is doing the action and someone (something) is receiving the action. For example, this picture shows *mold*. It shows "the artist is molding the clay." The artist is the person doing the molding; the clay is the thing being molded (p. 221).

For individual items, the argument structure was explained as follows (Schneider & Thompson, 2003): "This picture shows *jump*. It shows 'the girl is jumping the rope.' The girl is the person doing the jumping; the rope is the thing being jumped" (p. 221). For both therapies, the participant was asked to say what was happening in the action picture after the description was presented. For each incorrect response, the clinician stated the correct word for the participant to repeat. Gains were seen for the trained verbs, but little generalization occurred. However, the participants showed an overall grammatical improvement in their productions.

Raymer and Kohen (2006) studied the effect of sentence-context training for word-retrieval. This therapy focused on both nouns and verbs. The clinician first stated a sentence related to an action picture that contained the target word. After the participant read this sentence aloud, the clinician covered the target word for the participant to state while reading the rest of the sentence. The clinician then covered the entire sentence for the participant to produce. After this practice, each participant selected a picture and produced the sentence or target word for the clinician to guess the picture.

PHONOLOGICALLY-BASED THERAPIES

Phonologically based therapies have also been extensively studied in the literature. Phonological therapies focused on the sound of the word, such as phonemic, rhyming, or orthographic cues that encouraged sounding out the word or simply repeating words aloud numerous times. Table 2 shows the effect size for each treatment procedure.

Some studies have focused on therapies that provide phonemic cues in cases of word-retrieval difficulties. Best, Hickin, Herbert, Howard, and Osborne (2000) tested a therapy in which pictured items were presented for naming. If the participant could not name the item, then the first phoneme (plus schwa) of the target and of a distractor with the same order of consonants and vowels were presented. For each subsequent unsuccessful attempt at naming, an additional phoneme was provided until both the target and the distractor were completely stated by the clinician to be repeated by the participant. Gradually, the number of distractors was increased over the course of treatment. Hickin, Best, Herbert, Howard, and Osborne (2002) provided the same therapy, except that the cue level increased from the first phoneme to the first syllable for the target and the distractor after the second unsuccessful naming attempt.

The use of orthographic cues have also been tested. Best et al. (2000) presented orthographic cues in a similar manner to their test of phonemic cues. Written letter cues were presented and increased by one for both target and distractor after each unsuccessful naming attempt. If the entire word was spelled, the clinician would state the word for the participant to repeat. Likewise, Hickin et al. (2002) also repeated their phonemic treatment but with orthographic cues for the target and the distractor, increasing from the first letter to the first syllable to the entire word to be stated and repeated. Laganaro, Di Pietro, and Schnider (2003) tested the use of orthographic cues with computer-assisted therapy in which participants named pictures shown on the screen. If the picture could not be named, the participant would click on a button to see the first letter of the word. If still unsuccessful, the participant would click on a button to hear the word. In the same study, a different group of participants were shown pictures with empty boxes representing each letter of the word. The participant could click on a button to provide the first and then subsequent letters of the word. This therapy method of using blank boxes with letter cues was studied again by Laganaro, Di Pietro, and Schnider (2006).

Hickin et al. (2005) combined both phonemic and orthographic cues that were simultaneously presented upon unsuccessful confrontational naming attempts. For the first cue, the phoneme and first letter were presented, then the syllable, then the whole word to be repeated. The clinicians did not provide a distractor in one treatment and provided two unrelated distractors in the other treatment.

Numerous studies utilized phonemic cueing hierarchies for confrontational naming tasks. Hillis (1989) tested a treatment in which participants wrote the name of pictured objects. The following cues would be given after each successive instance of word-retrieval deficits for a single target item: a scrambled anagram (i.e., the letters of the target word in random order) along with two anagram distractors; a scrambled anagram of the target without distractors; an initial letter cue; and the verbal name of the target for the participant to write to dictation. Finally, the written name was briefly presented to be written by the participant. Raymer, Thompson, Jacobs, and Le Grand (1993) also tested a cueing hierarchy treatment. After each unsuccessful naming attempt, the clinician would first provide a word that rhymed with the target; then an initial phonemic cue; then the whole word. Once the target was retrieved, the participant would repeat the word five times. Measures were also taken for untrained but repeatedly exposed words that were semantically related or rhymed with the target. Wambaugh et al. (2002) also tested a similar phonological cueing treatment for verbs in addition to the semantic cueing treatment discussed earlier. For this treatment, the clinician first presented numerous action pictures along with two phonetically related and one unrelated distractors and asked the participant to point to the target picture. After this task, the clinician asked the participant to name the target items after providing the same cues as Raymer et al. (1993), except that the rhymed word was a nonsense word and the participant only repeated the named item once. Wambaugh et al. (2004) repeated the study of Wambaugh et al. (2002) with the same phonological cueing hierarchy for verbs. Fridriksson et al. (2007) also followed this treatment procedure, but with nouns and without the initial auditory stimulation task. Fillingham, Sage, and Lambon Ralph (2005) provided a therapy in which the participant named a picture when given the first phoneme and letter. This procedure was repeated three times in each session.

Beeson and Egnor (2006) applied the copy and recall treatment (CART) along with verbal repetition to assist with both written and spoken naming. After the target items were presented for the participant to name and write the word, the participant would press a button with the symbol of the target on an augmentative-alternative communication (AAC) device, which would speak the word. The participant would repeat and write the word. If a mistake was made, the clinician would correct the target word and the participant would rewrite it. This task was repeated three times for each target word, followed by a confrontational naming task for each target word.

Table 2. Effect size for various phonological therapies.

Study	Therapy Description, Word Set, Follow-Up	Effect Size
Beeson et al. (2006)	CART with verbal repetition	
	untrained, exposed, unrelated	0.81
Best et al. (2000)	Increased phonemic cues of target and distractor	
	trained	1.09
	Increased letter cues of target and distractor	
	trained	0.05
Fillingham et al. (2005)	Errorless therapy with three verbal repetitions	
	trained	17.69
	1 month follow-up	10.62
	Phonemic and letter cues presented with picture naming	
	trained	20.52
	1 month follow-up	13.09
Fridriksson et al. (2006)	Errorless therapy with repetition; phonemic cues for naming	
	untrained, unexposed, unrelated	0.02
Fridriksson et al. (2007)	Cueing hierarchy with rhymed words and initial phoneme	
	untrained, unexposed, unrelated	0.17
Hickin et al. (2002)	Increased phonemic cues of target and distractor	
	trained	1.15
	Increased letter cues of target and distractor	
	trained	0.95
Hickin et al. (2005)	Increased phonemic and letter cues	
	trained	1.17
	Increased phonemic and letter cues of target and distractor	
	trained	1.73
Hillis (1989)	Phonologic cueing hierarchy focused on written words	
	untrained, exposed, unrelated	8.01
Laganaro et al. (2003)	Computer assisted therapy (CAT), with first letter cue	
	trained	0.55
	CAT, with first and subsequent letter cues	
	trained	0.84
Laganaro et al. (2006)	CAT, with first and subsequent letter cues	
	trained	0.98
Miceli et al. (1996)	Errorless therapy with one verbal repetition	
	trained	1.68
	Errorless therapy in which the words were read once	
	trained	3.03
Raymer et al. (1993)	Cueing hierarchy with rhymed words and initial phoneme	
	trained	2.35
	2 month follow-up	1.90
	untrained, exposed, related	1.35
	2 month follow-up	1.17
Wambaugh et al. (2002)	Cueing hierarchy with rhymed words and initial phoneme	
	trained	4.04
Wambaugh et al. (2004)	Cueing hierarchy with rhymed words and initial phoneme	
	trained	3.03

Treatment efficacy has also been shown with errorless therapy methods. Fillingham et al. (2005) presented participants with a picture along with its spoken and written name. The participant repeated the name three times. This procedure was repeated for the target words three times each session. Miceli, Amitrano, Capasso, and Caramazza (1996) tested both a verbal and a written errorless therapy technique. For the verbal therapy, the clinician showed a picture and stated the word to be repeated once by the participant. This entire procedure was repeated 10 times per session. In the written word treatment, the participant simply read each target word presented by the clinician. This procedure was also repeated 10 times in each session.

Fridriksson, Morrow-Odom, Moser, Fridriksson, and Baylis (2006) combined errorless therapy with other phonological methods. The clinician presented the pictures and stated each word to be repeated three times by the participant. This procedure was repeated three times. After the picture was shown with an initial phonemic cue to be named and repeated three times, the clinician presented pictures without a cue to be named. If the participant could not name a word, then it was presented again at an easier cueing level (either errorless or with a phonemic cue).

MIXED THERAPIES

Mixed therapies usually combine aspects of both semantic and phonological therapy. Functional therapy, such as the use of conversation or other naturalistic communication contexts, is also included in this category. See Table 3 for the effect size for each therapy.

Linebaugh, Baron, and Corcoran (1998) applied a combination of auditory stimulation, a mixed cueing hierarchy, and a sentence-completion task for both nouns and verbs. Each session began with an auditory stimulation task in which the participant pointed to a picture in an array of four based on a description (e.g., for the noun *dishes*: *Point to the ones you clean after eating*; for the verb *wash*: *Which one shows how you clean dishes?*). For incorrect answers, the clinician first repeated the stimulus, then made gestural cues if needed, and finally pointed to the correct picture if the participant still did not respond correctly. Once the picture was identified, the participant named the noun or verb. If the attempt was unsuccessful, the following cues were given sequentially as needed: a sentence-completion task omitting the target; presentation of the first phoneme; finally, repetition of the word by the clinician. Then the clinician presented action pictures with a target noun and verb for the participant to use to complete a printed incomplete sentence (e.g., for the words *dishes* and *wash*, the sentence *He's ____ the ____*). Next, the same action pictures were presented without the printed sentence for the participant to produce a sentence containing the target noun and verb. Finally, the clinician presented a picture of an object and an action for the participant to combine the noun and verb to form a sentence.

Rodriguez, Raymer, and Rothi (2006) studied two different mixed therapies for producing verbs. One therapy focused pairing a gesture with the target word. The clinician first presented the picture and modeled the target word and gesture. The participant then produced the target word and gesture three times. Next, the clinician presented the gesture in isolation for the participant to imitate three times. The clinician provided hands-on help as needed. The clinician then stated the verb for the participant to repeat three times. After a five-second pause, the clinician showed the target picture again for the participant to name and produce the target gesture.

The other therapy tested by Rodriguez et al. focused on combined phonemic and semantic strategies. The clinician began by presenting the picture and modeling the action word to be repeated three times by the participant. Then the participant answered yes/no questions about the word. These yes/no questions involved semantic aspects, such as nouns and verbs associated with the target and phonologic aspects of the target verb, such as about the initial phoneme or rhyming word. When the participant correctly produced the verb, it was repeated three times. After a five-second pause, the participant was asked to name the verb in the action picture.

Robson, Marshall, Pring, Montagu, and Chiat (2004) utilized a variety of semantic tasks combined with phonological cues to focus on word-retrieval for proper nouns (especially famous people and places). The clinician presented written words for participants to match to pictures, in which the number and semantic relatedness of the distractors gradually increased. These tasks involved the participant either choosing an item from an array to match the stimulus or matching a few written words to the same number of pictures. In addition, participants answered yes/no questions and described the word. For unsuccessful attempts, clinicians provided a variety of phonological cues that included the first phoneme, the written form of the word, an alphabet chart for the participant to use to choose the first letter, or encouragement for the participant to write the first letter. The level of cueing was reduced over the course of therapy.

In a study by Cornelissen et al. (2003), the contextual priming technique was used in which words separated into semantic categories were repeated numerous times. In this therapy, the clinician showed pictures of five objects within the same semantic category and stated the name of each target word for the participant to repeat several times. The complete list of words was cycled through four times. The participant then named the items. If the participant could not name an item, the complete list was presented again.

The use of a mixed cueing hierarchy has been frequently applied to studies of computer assisted therapy. The computer program Multicue was tested by van Mourik and van de Sandt-Koenderman (1992). For this program, the participant named pictures of common objects. The participant could choose from nine cues as needed: word structure, first letter, associated words, sentence completion, cues to imagine the object (i.e., a general cue to consider use, movement, where it belongs, distinct details), semantic features, musical cues related to the object, cues to draw the object, and presentation of the word. Multicue was tested again by Doesborgh et al. (2004). A similar computer program was also used in a study by Deloche, et al. (1992). This program also presented pictures with a variety of cues that could be accessed if needed: first

Table 3. Effect size for various mixed semantic and phonological therapies, along with functional therapies.

Study	Therapy Description, Word Set, Follow-Up	Effect Size
Cornellisen et al. (2003)	Errorless repetition of words within semantic categories	
	untrained, unexposed, unrelated	0.45
Deloche et al. (1992)	Computer assisted therapy with choice of various cues	
	trained	6.64
	untrained, unexposed, unrelated	0.02
Doesborgh et al. (2004)	Multi-cue computer program with choice of various cues	
	untrained, unexposed, unrelated	0.33
Herbert et al. (2003)	Functional use of letter and phoneme cues	
	trained	1.88
	2 month follow-up	1.51
	untrained, unexposed, unrelated	0.23
	2 month follow-up	0.00
Hinckley and Carr (2005)	Functional therapy: role play with self-cues	
	untrained, unexposed, unrelated	0.40
Hinckley and Craig (1998)	Functional therapy: role play, outings, conversation therapy	
	untrained, unexposed, unrelated	1.09
Linebaugh et al. (1998)	Match description to picture, sentence completion—nouns	
	trained	0.53
	untrained, exposed, unrelated	0.18
	Match description to picture, sentence completion—verbs	
	trained	0.84
	untrained, exposed, unrelated	0.39
Pedersen et al. (2001)	Computer assisted therapy with a variety of tasks	
	trained	1.27
Robson et al. (2004)	Variety of semantic tasks with phonological cues	
	trained	2.50
	1 month follow-up	2.28
	untrained, unexposed, unrelated	0.31
	1 month follow-up	0.30
Rodriguez et al. (2006)	Gesture and verbal repetition for verbs	
	trained	5.22
	1 month follow-up	3.91
	Repetition, semantic/phonologic yes/no questions for verbs	
	trained	2.86
	1 month follow-up	1.68
van Mourik et al. (1992)	Multi-cue computer program with choice of various cues	
	trained	0.41

letter, first written syllable (or first two letters for one-syllable words), anagram, gender cues (as the therapy was conducted in French), and sentence-completion cues.

Pedersen, Vinter, and Olsen (2001) tested a computer program that provided a variety of semantic and phonological tasks related to the target words. These tasks included matching pictures to spoken and/or written words with related semantic or phonological distractors. In another computer task, the participants were shown a word with the initial letter missing. They were given a choice of two written letters with the corresponding sound. Later, only two written letters or sounds were provided as choices. In another task, a picture was shown with the written word. The participants retyped the word, formed the word in an anagram task, and then typed the word independently.

Research has also focused on treatments that use functional communication tasks. Hinckley and Craig (1998) studied a treatment that combined a variety of functional communication tasks. The use of compensatory strategies for contexts that were personally relevant to the participants was emphasized. Treatment included role playing, community outings, Promoting Aphasics' Communicative Effectiveness (PACE) treatment (Davis & Wilcox, 1981), and cueing hierarchies within discourse. Hinckley and Carr (2005) applied a similar functional therapy approach with a focus on role playing and context-specific cues. For example, participants acted in a role-play for talking on the telephone to order items from a catalog or to plan a vacation with a travel agent. The participants develop specific scripts to speak for this situation. They developed self-cueing strategies, such as using communication notebooks, producing circumlocutions to describe the word, or writing the first letter of the target word. Herbert, Best, Hickin, Howard, and Osborne (2003) combined both phonological and functional approaches in treatment. The pictured items for naming were sorted into conversational categories, such as shopping, family, and household items. The participants helped choose functional words for this therapy. Cards with line drawings with written cues were made for each target word. The written cues consisted of the target word and two semantically unrelated words that closely matched the targets in syllable structure and orthographic form (e.g., the target *milk* had the distractors *gold* and *desk*). The first line under each picture contained the first letter of the target and the distractors. The next line contained the first two letters (for monosyllabic words) or the first syllable (for multisyllabic words) for each word. The third line contained all three words. The participants could keep the cards to practice and self-cue as needed. In confrontational naming tasks, the clinician also offered phonemic and orthographic cues for the target words as needed. Therapy gradually moved to more natural contexts, using the target words in PACE therapy (Davis & Wilcox, 1981), and role playing functional communication. The clinician and participant reviewed the target word list when planning for functional activities, and chose and practiced (by naming) appropriate words for the functional communication situation. The participant then carried the cards during the activity to self-cue when necessary. This therapy then eliminated the use of word lists before engaging in spontaneous conversation about topics of interest to the participant.

DISCUSSION

A number of caveats should be considered when interpreting this objective review of therapies. Foremost, care should be taken in considering and comparing the effect size. A large variance was seen between similar therapies, and few therapies were directly replicated. Many variables, such as severity, time post onset, type of aphasia, and the number of trained items could affect the level of gains regardless of the effectiveness of the therapy. Also, many studies were based on only a small number of participants. Finally, it is extremely important to consider the measurement set of the study. For all therapies, gains in untrained-unrelated words (such as the Boston Naming Test and other standardized confrontational naming tests) were extremely small, and should not be used to compare the effect sizes for trained or exposed words.

This review presented in considerable detail the procedures for a wide variety of therapies for word-finding deficits due to aphasia. These specific procedures may be combined with some general principles of anomia therapy gained from previous meta-analyses:

1. Clinicians should follow a researched-based therapy method when providing services for anomia. As shown by this review, this common characteristic of aphasia has been heavily researched and efficacy has been shown for a wide variety of treatment methods.

2. Clinicians should evaluate whether the anomia relates more to semantically or phonologically based retrieval deficits. This can be an important factor when selecting a treatment method. Although there are numerous ways to assess the underlying cause, the most straightforward method is to assess auditory comprehension. If it is mostly intact, then the deficit is probably due to phonological retrieval deficits. Otherwise, there is probably a semantic component (Howard & Gatehouse, 2006).

3. Those with semantically based deficits appear to make the most gains with either semantic or phonological therapy (Wisenburn, 2009). However, semantic therapy appears to show more generalization (Wisenburn, 2009) and may be more beneficial for improving auditory comprehension and other aspects of communication.

4. Those with phonological deficits appear to make the most gains with phonological or mixed therapy (Wisenburn, 2009). Since mixed therapy is more time-intensive per word, clients may make gains on more words if phonological therapy is implemented.

5. Gains for untrained/unrelated words are small for those with semantic deficits, and close to zero for those with phonologically based deficits (Wisenburn, 2009). Regardless of the therapy used, clinicians should not expect substantial generalizations to untrained/unrelated words.

6. Some gain has been seen for semantically related words not trained in therapy (Wisenburn & Mahoney, 2009). Kiran and Thompson (2003) found that this generalization was largest when individuals that were trained with atypical words showed gains for typical words that were semantically related.

7. Gains for trained words are often substantial (Wisenburn & Mahoney, 2009). Clinicians should focus on training words that are functional for the client. Large effect sizes were seen for large sets of trained words (Wisenburn, 2008). Therefore, it may be more efficient for clinicians to focus on more words for less time per word.

8. Gains were seen for individuals with various levels of

severity and for substantial time post-onset (Wisenburn, 2008). These factors should not be a major consideration regarding the implementation of anomia therapy.

CONCLUSION

This paper reviews specific procedures for a wide variety of experimentally tested treatments for word-finding deficits due to aphasia. Although more data is needed to directly compare individual therapy, some general principles can be gathered from the research. From the procedures and the objective efficacy results of the reviewed studies, clinicians can gain an understanding of how anomia therapy may be implemented. In addition, this study shows the copious amount of research related to word-finding therapy so that evidence-based practice can be implemented.

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EFFECTS OF BINAURAL MASKING ON SELF-REPAIRS AND DISFLUENCIES IN APHASIA AND APRAXIA OF SPEECH

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ABSTRACT

The fluency of speech of individuals with apraxia of speech and nonfluent types of aphasia is often compromised by disfluencies and perseverative attempts to self-repair speech errors. Postma and Kolk (1992) found that by using auditory masking they could reduce the number of self-repairs and normal disfluencies in the speech of their nonimpaired participants. This pilot study sought to discover if auditory masking is a viable way to increase the fluency of individuals with apraxia of speech and nonfluent aphasia by reducing self-repairs and disfluencies. Participants read words and short phrases under three levels of auditory masking. Counts for errors, self-repairs, and disfluencies were taken and compared between conditions. Four participants displayed increases in their number of speech errors during the masker conditions. One participant reduced the number of self-repairs, disfluencies, and errors in her speech under the masking conditions.

KEY WORDS

Aphasia, Apraxia, Binaural Masking

INTRODUCTION

The verbal communication of individuals with apraxia of speech (AOS) and the nonfluent aphasias are greatly inhibited by the presence of semantic and phonetic errors. In addition to speech errors, the communicative efficiency of individuals suffering from these disorders is also negatively impacted by decreased fluency of speech (Brown & Cullinan, 1981). A decrease in fluency among these populations may exacerbate the task of message decoding by the listener (Liss, 1998) as well as increase speaker frustration (Whitney & Goldstein, 1989). This decrease in fluency can be a direct result of word finding deficits but may also be the result of perseverative self-repairs (Goodglass & Kaplan, 1972; Liss, 1998; Marshall & Tomkins, 1982; Whitney & Goldstein, 1989) as well as stutter like disfluencies (Brown & Cullinan, 1981).

A self-repair occurs when a speaker restates or revises a word or phrase in an attempt to produce it in an error free fashion or refine it to better reflect the intended meaning (Levelt, 1983). Although unimpaired speakers produce speech errors and repair them by restating words or revising phrases, most unimpaired speakers are highly successful at correcting speech errors on their first attempt (Farmer, 1977; Levelt, 1983). Individuals with nonfluent aphasia and individuals with AOS make more errors and therefore produce proportionately more self-repairs to correct for these errors (Liss, 1998; Farmer, 1977). However, speakers with aphasia are less successful at self-repairing errors in their speech than normal speakers. Farmer (1977) found that less than half of the self-repair attempts of her participants with nonfluent aphasia were successful. Marshall and Tomkins (1982) stated that their participants with aphasia would usually generate more than one nonproductive self-repair in attempting to correct a speech error. These perseverative and unsuccessful attempts to self-repair semantic and phonetic errors may further compromise the communicative efficiency of speakers with AOS and aphasia by decreasing their fluency of speech. Goodglass and Kaplan (1972) suggested that individuals with conduction aphasia, an aphasia associated with fluent speech, may sometimes be perceived as a Broca's type aphasia due to disfluent speech. They suggested that the origin of this disfluency is the high number of attempts to self-repair literal paraphasias in a "zeroing in" type of behavior in which the patient "struggles with repeated approximations" (Goodglass & Kaplan, p. 68, 1972). Marshall and Tomkins (1982) and Whitney and Goldstein (1989) have also observed that multiple attempts to self-repair an error within an utterance can slow the rate of speech as well as increase speaker frustration. Marshall and Tomkins (1982) suggested that future research was needed to determine if individuals with aphasia could be prompted to refrain from self-correction behaviors in order to maximize their communicative competency.

It has also been observed that the fluency of individuals with nonfluent aphasia can also be inhibited by "stutter like" disfluencies (Brown & Cullinan, p. 358, 1981; Whitney & Goldstein, 1989). These behaviors consist of sound, word, part-word or phrase repetitions, prolongations, and interjections (Brown & Cullinan, 1981). Whitney and Goldstein (1989) trained four individuals with mild nonfluent aphasias to monitor and identify these disfluencies in their speech as well as their superfluous revisions and self-repairs. Following treatment these behaviors decreased in the speech of the participants. For all participants this decrease in disfluencies, revisions, and self-repairs led to an increased mean length of uninterrupted grammatical strings. Also, most of the participants reported being more comfortable in social speaking situations.

Postma and Kolk (1992) have been studying disfluencies and self-repairs in the speech of people who stutter to develop support for their Covert Repair Hypothesis of stuttering. The Covert Repair Hypothesis assumes that disfluencies in speech are a form of self-repair to errors in the outgoing speech plan (Postma, Kolk, & Povel, 1990). Within this model Postma, Kolk, and Povel define speech errors as "deviations from a speech plan", while disfluencies are "interruptions in the execution of the speech plan" and self-repairs are "corrections of speech errors" (p. 19). Much of this research centers on illustrating that under conditions of decreased speech monitoring, disfluencies behave similarly to self-repairs. Postma and Kolk (1992) examined the effects of binaural masking noise on the speech patterns of an unimpaired sample of participants. They elicited production of sentences of neutral difficulty as well as more difficult tongue twisters in various conditions including a white noise masker presented at 90 decibels. Postma and Kolk found that when blocking the auditory monitoring of their participants the error rates of their participants were not significantly affected. However, it was found that while under noise masking conditions the number of both self-repairs and disfluencies decreased in the speech of the participants. Although this study, in context, is used to support a hypothesis on the etiology of stuttering, it nonetheless has implications for nonfluent aphasia and AOS populations whose communicative efficiency is negatively impacted by the presence of both disfluencies and self-repairs. A communicative benefit may exist for the aphasic and apraxic speaker if they are able to reduce their disfluencies, revisions, and self-repairs using an auditory masker.

STATEMENT OF THE PROBLEM

If self-repairs and disfluencies in nonfluent aphasia and AOS can be reduced under auditory masking then fluency of speech may be better maintained. If fluency is increased then the communicative effectiveness among some speakers with aphasia may increase as well. However, this improvement could occur only if the speech errors of the participant that are going uncorrected are not seriously deleterious to a listener's understanding of the speaker. Results of Glosser, Wiener, and Kaplan (1988) showed that contextual information, redundancy, predictability, and extralinguistic cues all contribute to carry meaning for a speaker with aphasia despite their difficulties with speech. This would suggest that a person

Table 1. Participants and their major characteristics.

Ss	Age	Gender	Etiology	Hand	Aphasia	AOS	Months Post-Onset CVA
1	69	F	Left CVA	R	Severe Global	None	2
2	54	M	Left CVA	R	Severe Transcortical Motor	None	1
3	54	F	Left CVA	R	Moderate Anomia	None	24
4	63	F	Left CVA	R	Moderate Mixed Nonfluent	Moderate	19
5	62	M	Left CVA	R	Mild Mixed Nonfluent	Mild	15

with aphasia might be able to retain substantial communicability despite uncorrected verbal errors. Studies by Birch and Lee (1955) and Birch (1956) indicated that masking noise increased the word finding abilities and reduced latency of verbal responses in individuals with nonfluent aphasia. However, subsequent studies by Weinsten (1959) and Wertz and Porch (1970) showed that their participants' were either unaffected by the presence of masking noise or that they performed slightly poorer. Nonetheless, even if auditory masking increases the number of errors in the speech of an individual with nonfluent aphasia or AOS then perhaps a more functional balance between an increase in errors and decrease in disfluencies and self-repairs could be established. This improved balance could create improvements in communicative efficiency. If a reduction of self-repairs increases communicative effectiveness for people with nonfluent aphasia and AOS, then once a patient has maximized their recovery potential via traditional speech therapy they could begin focusing on learning an increased reliance on communicative context, nonverbal communication, and avoidance of perseveration on self-repairs to further heighten the person's ability to communicate. If masking of the speech signal does decrease the rate of self-repairs and if the intensity of the masking signal could be presented below the speaker's acceptable noise level (ANL) (Nabelek, Tucker, & Letowski, 1991) and still achieve positive effects then perhaps patients could be fitted with instruments whose purpose would be to feed a masking noise into the ears at a functionally appropriate volume.

The purpose of the present study was to examine the effects of auditory masking on self-repairs and disfluencies in the speech of participants with global aphasia, trancortical motor aphasia, anomia, mixed nonfluent aphasia with concomitant AOS, and AOS with minimal aphasic involvement.

RESEARCH QUESTION

Does masking the auditory speech signal at the following three non-harmful intensity levels of twelve talker babble masking: 10 dB SL, 40 dB SL, and 60 dB SL (re: twelve talker babble threshold) with twelve talker babble have an effect on the type and number of speech errors, disfluencies, and self-repairs of persons with nonfluent aphasia and/or AOS?

METHOD

PARTICIPANTS

There were five participants in this study. Recruitment sites for this study included outpatient rehabilitation clinics and long-term care units surrounding Mobile, Alabama. Major participant characteristics are listed in Table 1. Participants in this study consist of an individual with apraxia of speech with minimal aphasic involvement as well as four individuals, each with a different type of nonfluent aphasia.

DESIGN

This study consisted of five single subject A-B-B-B-A designs. In the design of this study each participant underwent a baseline (A1) phase followed by three phases of treatment (B1, B2, B3) and finished with a second and final baseline (A2) phase.

PROCEDURES

During pretesting participants were administered the Boston Diagnostic Aphasia Examinations, 3rd edition, (BDAE) (Goodglass, Kaplan, & Barresi, 2001) short form to confirm their aphasia diagnoses. If applicable, the Apraxia Battery for Adults, 2nd edition, (ABA) (Dabul, 2000) was administered to determine level of AOS involvement. Oral reading abilities were required to be intact at least at the single word level for participation. Participants underwent a vision and an air conduction hearing screening. Any participant with a greater than mild hearing loss (>40 dB) was excluded from this study (Harrell, 2002).

Once a participant was found to be acceptable for the study, a hearing threshold measurement for the masking noise was taken. Twelve talker babble was used as the masker in this study. The twelve talker babble threshold functioned as the participant's zero point above which sensation level (SL)(re: twelve talker babble threshold) for the auditory masking condition was calculated. Masking intensity levels were presented at 10 dB SL, 40 dB SL, and 60 dB SL (re: twelve talker babble threshold) above twelve talker babble threshold to achieve standardized SL level across participants. The 10 dB SL intensity level was presented to test for any effects among participants at a minimal level of auditory masking that could perhaps be used habitually during conversation to increase fluency. The 60 dB SL (re: twelve talker babble threshold) intensity level in this study was representative of the highest intensity level of the masker that the author was willing to expose the participants to in order to elicit possible changes in speech patterns. Intensity levels of masker were not allowed to exceed 70 dB HL since damage to hearing can occur at levels of 80 dB HL and higher.

Stimulus items took the form of written words, phrases, and short sentences. Five hierarchical sets of stimuli were used with each participant. One set of the stimuli is the Repetition section of the Western Aphasia Battery (WAB)(Kertesz, 1982). The next three sets of stimuli were modeled directly from this section of the WAB and the last set of stimuli was composed of various items taken from the first four sets. Items across stimulus sets were based on the WAB and controlled in descending priority for; word type and function, syllable number, initial consonant, and frequency of use.

A digital audiometer was used to screen the participants' hearing and to deliver the masking noise. E-A-Rtone 3A insert earplugs were worn by the participants during the three test conditions as well as the two baseline conditions.

Stimulus items were presented to the participants individually on a computer screen. Participants began the study with elicitation of a set of stimulus items in the first control condition (A1). The three test conditions (B1, B2, B3) followed in order of increased masker intensity levels. The last condition presented was a second baseline phase (A2). A different 10-item set of stimuli was presented in each condition. The pairing of the 10-item stimuli sets with control and test conditions did not vary across participants.

The elicited speech of the participants was analyzed for the number of speech errors, disfluencies, and self-repairs in each test condition. Exact specifications on what constitutes speech errors, disfluencies, and self-repairs were adapted from Dell's parameters used by Postma, Kolk, and Povel (p. 19, 1990).

RELIABILITY

Reliability measures employed were intra-speaker, inter-rater, and intra-rater reliability. Intra-speaker reliability was higher in participants with milder expressive language deficits. Participant one who was the most severely impaired had 30% intra-speaker reliability. Participant two had 50% intra-speaker reliability while participant three had 70%. Participant four who was the next to least impaired participant had an intra-speaker reliability value of 80%. Participant five who was the least impaired had the highest intra-speaker reliability of 90%. The inter-rater reliability score was calculated using a point-by-point agreement ratio and yielded a score of 90.5% agreement between the two raters. Intra-rater reliability scores were 100%.

DATA ANALYSIS

This study consists of five single-subject protocols. The independent variable in this study was the presence vs. absence of masking noise and the intensity level of the masking noise delivered. Dependent variables were the number of speech errors, self-repairs, and disfluencies produced by each participant during the five conditions. Final data is in the form of counts for self-repairs, disfluencies, and speech errors, for each participant in each condition. Analysis of data involved visual inspection involving graphs of each participant's response patterns for each variable being measured.

RESULTS

PARTICIPANT #1

Participant #1's twelve talker babble threshold was 10 dB. Actual HL intensity levels of the masker presented were 20 dB, 50 dB, and 70 dB. A bar graph of results for Participant #1 is presented in Figure 1. Participant #1 displayed an increase in self-repairs, disfluencies and speech errors with 10 dB SL (B1) of auditory masker. However, she decreased speech errors, disfluencies, and self-repairs in the next two test conditions of 40 dB SL and 60 dB SL (B2, B3) of auditory masker. With 60 dB SL (B3) of auditory masking present Participant #1's totals of self-repairs, disfluencies, and speech errors dropped below both baseline measures (A1, A2).

At the 40 dB SL (B2) and 60 dB SL (B3) intensity levels of auditory masking Participant #1 displayed decreases in disfluencies and self-repairs as was expected based on Postma and Kolk's (1992) results. An unexpected result is the decrease in speech errors from a mean of 12.5 in the conditions with no auditory masking (A1, A2) to five in the 60 dB SL condition (B3).

PARTICIPANTS #2 AND #3

Participants #2 and #3 displayed large increases in phonetic and semantic errors, self-repairs, and disfluencies relative to their baseline measures in all test conditions with auditory masker present (B1, B2, B3). The informal trend displayed by

Figure 1. Participant #1 (Global Aphasia).

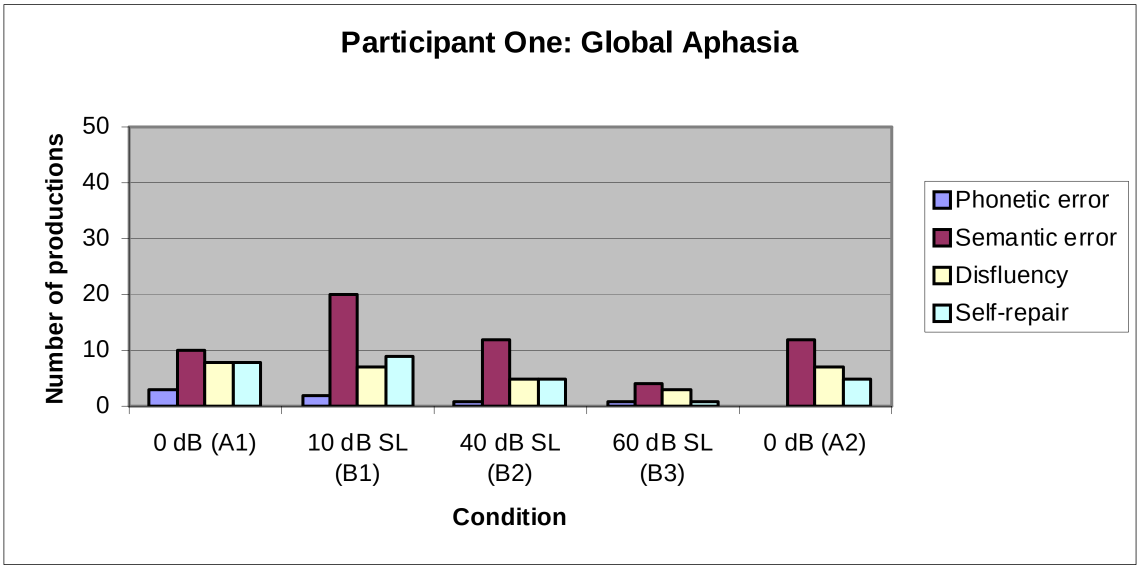


Figure 2. Participant #2 (Transcortical Motor Aphasia).

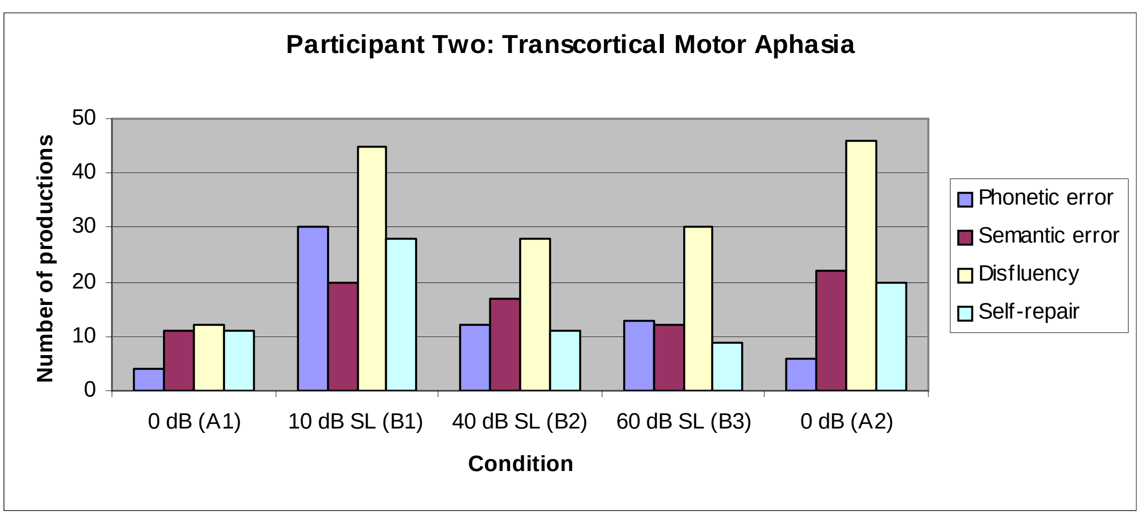
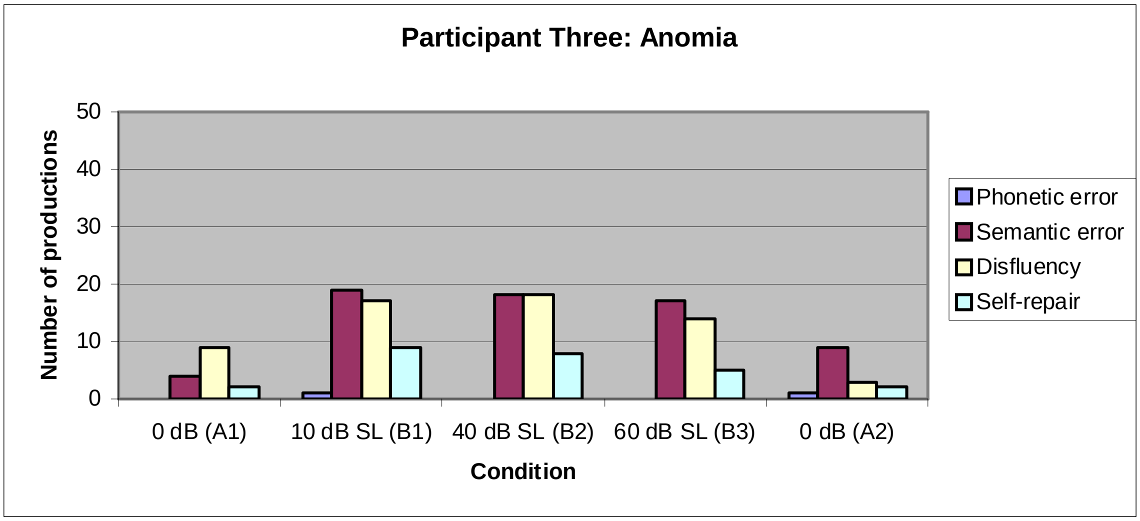


Figure 3. Participant #3 (Anomia).



these participants is that the higher the intensity level of the auditory masker, the more errors, self-repairs, and disfluencies produced by these participants.

PARTICIPANTS #4 AND #5

Participants #4 and #5 were the least impaired of the five participants. They produced such small numbers of disfluencies, speech errors, and self-repairs (less than five of each in each condition) that it is difficult to draw even informal conclusions from their data. Their results are presented in Figures 4 and 5. Notice that the y-axis scale on Figures 4 and 5 have been changed from those in the results of the previous participants.

DISCUSSION

Comparing baseline conditions A1 and A2 to the 60 dB SL (B3) (re: twelve talker babble threshold), four of the participants were negatively affected by the presence of the noise. The speech of Participant #3 who had an anomia of moderate severity was the most negatively impacted by the noise. Her error rates as well as disfluencies and self-repairs increased dramatically from A1 and A2 compared to all the conditions with auditory masker. Participant #2 who had transcortical motor aphasia increased totals of errors, disfluencies, and self-repairs under all masker conditions compared to his A1 baseline totals. Participant #2 seemingly displayed a carryover effect from the masker conditions to his second baseline totals of A2. These A2 totals were far above his A1 totals and even higher than his totals at B3. Participants #1, #2, and #3 produced more errors at B1 than at B3. Any changes in rate of errors, disfluencies, and self-repairs seen for these participants indicate that there was no increase in fluency and possible increase in communicative efficiency associated with any intensity level of the masker. However, a strong positive reaction to the masker was observed in Participant #1. This participant reacted to the masker at the 40 dB SL (B2) and 60 dB SL (B3) by producing fewer disfluencies and fewer self-repairs than during A1 and A2. Surprisingly though, Participant #1 also displayed fewer speech errors at B3 with a combined total of 5 semantic and phonetic errors compared to the A1 total of 13 errors and A2 total of 12.

No participant completely responded as predicted in the hypotheses. Some predicted trends in behavior were noted for certain participants. The prediction that the participants' disfluencies would behave similarly to self-repairs proved accurate for Participants #1, #2, and #3. The observation of disfluencies behaving similarly to self-repairs in the speech of Participants #1, #2, and #3 supports Postma and Kolk's (1992) assumption that disfluencies are a form of covert repair to prearticulatory plans for speech. In Participants #1, #2, and #3, these disfluencies seem primarily associated with word finding difficulties. Participants #4 and #5, who had the least word retrieval deficits, produced the fewest number of disfluencies. Participants #1, #2, and #3 who all had moderate to severe word finding difficulties displayed high numbers of disfluencies compared with the totals of Participants #4 and #5. This observation is congruent with Brown and Cullinan's (1982) study, which indicated that the more difficulty an individual with anomia has with word finding, the more disfluencies they will produce. The higher number of errors and disfluencies of these participants in masker conditions suggests that the masker exacerbated the word finding difficulties of participants #2, #3, #4, and #5.

In participants #2, #3, #4, and #5 no functional benefit or possible benefits to fluency or communication were observed under masker conditions. The large increase in errors displayed by these participants between baseline and masker conditions would produce a negative impact on their ability to communicate. The consequent increase in attempts to self-repair this increased number of errors will also negatively

Figure 4. Participant #4 (Moderate Mixed Nonfluent Aphasia with Moderate NOS).

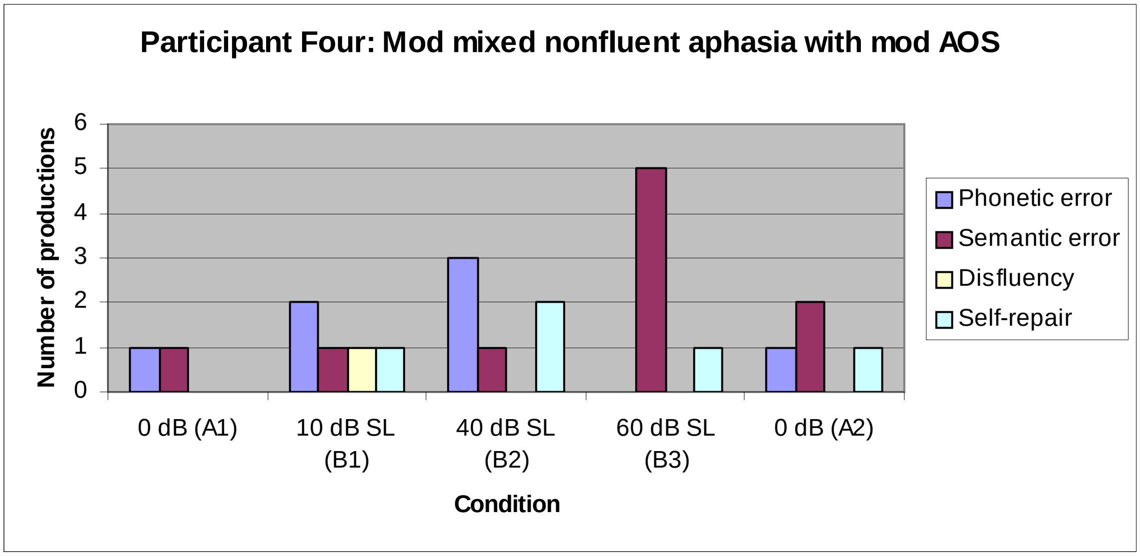


Figure 5. Participant #4 (Minimal Aphasia with Moderate AOS).

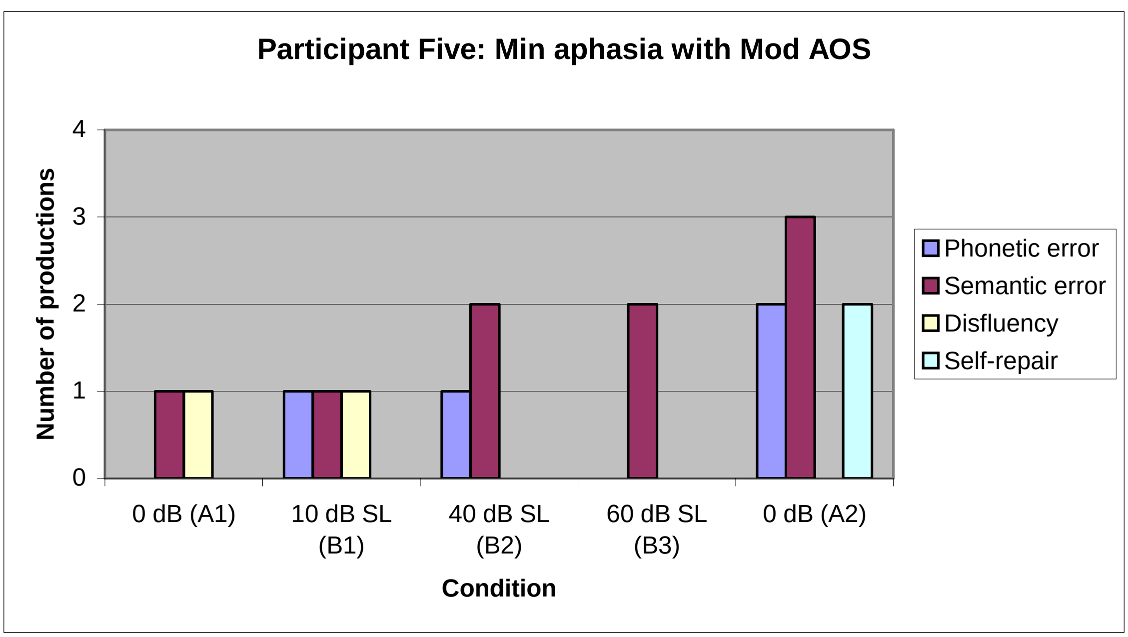
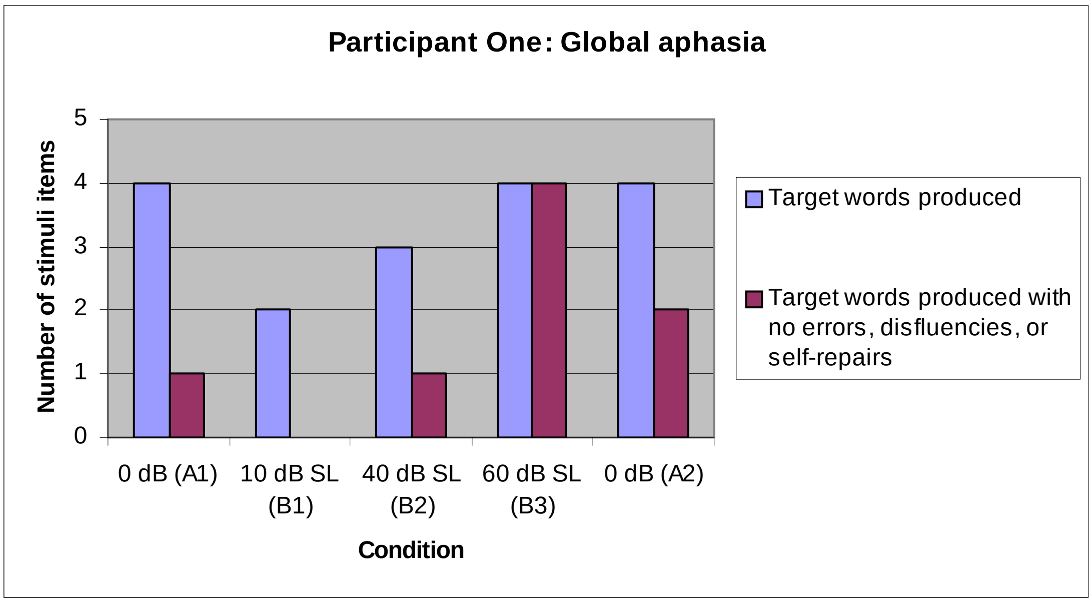


Table 2. Participant #1, Mean value of seconds spent on target word retrieval in each condition.

Condition	Mean seconds spent on target word retrieval
A1	8.5
B1	7.5
B2	17
B3	2.25
A2	4.25

Figure 6. Participant #1 (Global Aphasia), word finding success and associated decrease in production of errors, disfluencies, and self-repairs.



impact the fluency theses participants. In addition to the increase in errors and self-repairs the large increase of disfluencies seen in Participants #2 and #3 would also significantly decrease their ability to communicate.

PARTICIPANT #1

A decrease in self-repairs and disfluencies based on the removal of auditory feedback regarding speech errors was predicted for the participants in this study. The mechanism by which this was predicted to have taken place was the reduction of the participants' awareness of their speech errors. This was to occur by reduction of feedback concerning speech through inhibition of the participants' auditory feedback with an auditory masker. The participant's number of errors would have remained constant but their number of self-repairs would have decreased. With the decrease in self-repairs a parallel decrease in disfluencies was also predicted based on the results of Postma and Kolk (1992). In this scenario, the amount of time the participants required to produce a target word or utterance would have remained the same between baseline and masker conditions. The masker would have decreased the ability of the participants to detect their errors, which would have lowered their number of self-repairs and disfluencies but their word finding difficulties would have remained unchanged. This scenario would have replaced Participant #1's disfluencies and self-repairs with silence as she struggled silently to find the target word for utterance. Participant #1's disfluencies and self-repairs did drop well below baseline totals during B3, but this predicted mechanism was not responsible for the reduction of self-repairs and disfluencies observed in Participant #1.

POST-HOC ANALYSIS FOR PARTICIPANT #1

Participant #1's reductions of self-repairs, disfluencies, and errors from A1 and A2 to B3 seem to result from an increase in the speed of target word retrieval during B3. Participant #1 displayed a 72% decrease in the amount of time she used to achieve production of target words and phrases from A1 to B3. At A1 Participant #1 spent 32 seconds producing the target words or phrases for the four stimuli items she correctly produced during the condition. This same value for B3 decreased to only nine seconds for the four items successfully produced during that condition. Furthermore, this increase in speed of target word retrieval seemed to generalize to A2 where she spent only 17 seconds retrieving the four target words and phrases she produced. Seventeen seconds is a 47% decrease in time spent on successful word retrieval from A1 to A2. The mean values for seconds between presentation of stimuli and the execution of Participant #1's target words and phrases are presented in Table 2.

Although Participant #1 increased her speed of word retrieval from A1, to B3, and A2, her success at word retrieval remained constant between these three conditions.

During A1, B3, and A2 Participant #1 correctly identified four out of the ten stimuli items. This indicates that participant one was not able to produce more targeted words and phrases under masking. She maintained the same level of word finding success on the task. Nonetheless, her efficiency at achieving the same overall rate of success increased dramatically.

In addition to occurring 72% faster at B3, Participant #1's target words and phrases were occurring with none of the self-repairs, errors, or disfluencies that were associated with her successful word retrieval in all other conditions. Figure 6 presents Participant #1's number of target words that were produced successfully in addition to the number of those same utterances that were produced without disfluencies, errors, or self-repairs. The number of target words produced by Participant #1 with no associated disfluencies, errors, or self-repairs was one at A1 and two at A2. At B3 all four of the target words produced had no associated disfluencies, errors, or self-repairs.

The reduction of self-repairs and disfluencies illustrated in figure one seems to be a result of Participant #1's producing the target words faster and with greater precision. By producing four out of ten stimuli items in B3 successfully and with a mean response latency time of 2.25 seconds as compared to 8.5 seconds during A1, Participant #1 had far fewer opportunities to produce errors while attempting to find her words. This reduction in errors created 62% fewer opportunities for Participant #1 to produce self-repairs.

Brown and Cullinan (1981) found that in anomia disfluencies are associated directly with the severity of word finding difficulties. Generalizing these results to Participant #1, we can infer that the decrease in her disfluencies from A1 to B2, B3, and A2 could have resulted from a decrease in her struggle to find the correct words for production. This would be congruent with Participant #1's increase in the speed of her target word retrieval and reduction in production of errors, which both suggest she was having less difficulty finding target words.

Functional benefits Participant #1 displayed under the 60 dB SL (re: twelve talker babble threshold) (B3) condition are multiple. First is that because Participant #1 was severely and globally aphasic any improvement in any aspect of her speech is of substantial importance. Reducing the response latency and number of errors, disfluencies, and self-repairs in the speech of an individual with an aphasia of minor severity may be of little value to the individual who is already functioning at high level. However, relative to Participant #1's level of disability a decrease in response latency of target words by 72% plus the increase in fluency associated with removal of all errors, disfluencies, and self-repairs associated with target words may easily translate into large improvements in functional communication. Also, Fillingham, Hodgon, Sage, and Lambdon Ralph (2003) suggest that the repetitive speech errors and unsuccessful attempts of people with nonfluent aphasia to self-correct speech errors may function to habituate and reinforce the production of speech errors. If this true then 62% reduction in errors from A1 to B3 as well as a 62% reduction in disfluencies and an 82% reduction in self-repairs is possibly of very high consequence in the avoidance of habituation and establishing long term negative speech habits.

Studies on the increase in the efficiency of word finding abilities due to the presence of auditory masking have resulted in conflicting results. Birch and Lee (1955) and Birch (1956) found an increase word finding accuracy as well as reduced response latency of verbal responses in ten out of 14 participants that we can infer from description as having severe nonfluent aphasia. A follow-up study by Weinstein (1959) revealed no results to support these findings. Wertz and Porch (1970) performed an additional follow up study and found no improvement in word finding accuracy under masker conditions. They did, however, confirm Birch and Lee (1955) and Birch's (1956) report of faster responses under masker conditions. Wertz and Porch (1970) reported that their participants changed "a distorted response during quiet to a fluent response during noise" (p. 407). The results of Wertz and Porch (1970) are congruent with the performance of participant one. She increased her speed of response under noise substantially and also by decreasing her number of errors, disfluencies, and self-repairs associated with those responses her fluency was also increased. Wertz and Porch (1970) suggested that the increase in speed of response in their participants might have been a result of participants wanting to avoid the "noxious stimulation" (p. 406). The performance of Participant #1 here contradicts that suggestion. If such were the case, then her target word response latency should have increased back to A1 baseline levels instead of remaining below that level during the second baseline (A2). This explanation also fails to explain why Participant #1 had disfluencies, errors, and self-repairs associated with her target word retrieval during A1 but not during B3. Following this explanation Participant #1's production of disfluencies, self-repairs, and errors at A1 was a volitional behavior capable of being removed at will during B3. The willful production of speech errors, disfluencies, and self-repairs would imply a psychological disorder rather than aphasia. This is an unacceptable premise for the production of disfluencies, self-repairs, and errors in the speech of Participant #1 at A1 and the subsequent deletion of those behaviors at B3.

Birch and Lee (1955) and Birch's (1956) original hypothesis on why their participants with aphasia improved under a masker concerns the presence of a cortical inhibitor. In the model proposed by Birch the individual with aphasia retains greater word finding abilities than are revealed in speech. According to Birch and Lee, as well as Birch, this was due to the presence of another cognitive system inhibiting the correct functioning of his participants' word finding abilities. Birch hypothesized that the auditory projection system was the system acting as inhibitor. He believed that by introducing a strong and irrelevant stimulation the auditory projection system could itself be inhibited. This inhibition of the auditory system was hypothesized to free up any latent word retrieval abilities in his participants. Although his results confirmed his hypothesis, failure of subsequent studies led to the abandonment of the cortical inhibition theory. However, a possible explanation of why Participant #1 in this study was able to speed up and streamline her speech to such a degree as seen during B3 does have semblance to Birch's original idea cortical inhibition.

CONCLUSION

This pilot project certainly has great limitations. Not the least of these are a small number of participants and a lack of data to which appropriate statistics can be applied. The possibility of improving the fluency of individuals with aphasia specifically by decreasing self-repairs and disfluencies in speech using an auditory masker is not supported by this study. Nonetheless, the observed changes in the speech patterns of Participant #1 raises important questions for future investigations. Primarily, can the decrease in response latency, removal of disfluencies, and consequent increase in fluency seen here and reported anecdotally by Wertz and Porch (1970) be replicated reliably in other individuals with global aphasia? Also, since Participant #1 was the only participant in this study with a receptive language deficit, future research needs to examine if the presence of a receptive deficit alone, as seen in the fluent aphasias, plays a role in creating this effect. If this effect can be reliably established in individuals with aphasia, future work needs to address if and how it can be used to benefit individuals with aphasia.

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THE ROLE OF COMMON AND DISTINCTIVE FEATURES IN SEMANTIC KNOWLEDGE OF PERSONS WITH APHASIA: A PILOT STUDY

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ABSTRACT

This study investigated semantic feature knowledge in persons with aphasia, the relationship between feature knowledge and ability to choose among semantically related foils, and the relationship between semantic feature knowledge and comprehension ability. Participants completed tasks for choosing among unrelated and related foils and a sorting task involving common and distinctive features controlled for importance. The primary hypothesis was that participants having difficulty choosing among related foils would demonstrate more difficulty with identification of distinctive features than common features and would have more difficulty with identification of distinctive features than participants having less difficulty choosing among related foils. The current findings would not support either the acceptance or rejection of these hypotheses. However, some interesting trends were noted. Participants having difficulty choosing among related foils demonstrated decreased knowledge for low importance distinctive features while the other feature conditions remained more intact. Comprehension was also significantly correlated with semantic feature knowledge.

KEY WORDS

Aphasia, Semantic Knowledge, Features

Understanding how semantic knowledge is affected in persons with aphasia is vital to improving both assessment and treatment techniques. Semantic knowledge refers knowledge a person acquires about the world. Semantic concept knowledge can be further defined as the information stored in our brains that defines a concept as a distinct entity (e.g., specific type of food, item of furniture, specific animal, etc.) (Martin, 2001). The representation of the concept is made up of semantic features including category, use, action, properties, location, and associations.

Persons with aphasia have comprehension and word-finding problems that may relate to deficits in semantic feature knowledge. Therefore, the idea of using features to define concepts has been incorporated into treatment for the word-finding problems traditionally associated with aphasia. Many studies have investigated the efficacy of semantic feature treatments for persons with aphasia. Coelho, McHugh, and Boyle (2000) investigated Semantic Feature Analysis as a treatment for naming difficulties in a person with aphasia. The authors reported that gains were made in both confrontation naming of trained and untrained stimulus items. Semantic Feature Analysis was also associated with modest improvements in measures of connected speech. Treatment and generalization effects were maintained for two months after treatment was discontinued.

Conley and Coelho (2003) used the combination of Semantic Feature Analysis and Response Elaboration Training with a fifty-seven-year-old female who was eight years post-onset of a left cerebrovascular accident and demonstrated a moderate to severe Broca's aphasia. The individual participated in three hours of therapy per week for six weeks. Findings showed that the combined treatment approach resulted in improved naming of the treatment pictures as well as untreated control pictures. During a follow-up phase, it was found that the treatment effect was maintained at a higher level for the treatment pictures than for the control pictures. These findings indicated that the combined treatment approach was effective in improving the individual's word retrieval of object nouns.

Freed, Celery, and Marshall (2004) investigated the effectiveness of personalised and phonological cueing on long-term naming performance by aphasic individuals. Personalised cueing is a semantically based word-finding treatment procedure that asks individuals with aphasia to create their own treatment cues for stimulus words. The cues act as mnemonic devices that are paired with the stimulus words over multiple treatment sessions. The authors reported that the three participants had significantly higher levels of naming accuracy in the personalized cue condition up to three months post training compared to the phonological cue condition and untrained control condition.

Boyle (2004) investigated Semantic Feature Analysis for anomia in two fluent aphasia syndromes. Results indicated that confrontation naming of treated nouns both improved and generalized to untreated nouns for both participants. In addition, both participants improved in some aspects of discourse production associated with the Semantic Analysis Feature treatment approach.

All of these research findings suggest that a semantic-feature approach is efficacious for the treatment of aphasia. Psycholinguists have studied how normal adults classify semantic features; however, only a small number of studies have been published regarding how features should be classified for treatment of aphasia and other disordered populations.

Feature classification systems using importance ratings have been researched using both adults with no known neurological impairment and adults with aphasia. Hampton (1979, 1987) looked at the importance of semantic features in the normal population. Hampton defined high importance attributes as those that are more commonly identified with a concept and found that features could be systematically ranked for importance in defining a concept by neurologically intact adults. Germani and Pierce (1995) built upon the findings of Hampton (1979, 1987) to investigate semantic feature knowledge in thirteen adults with right hemisphere damage, thirteen adults with left hemisphere damage and aphasia, and thirteen adults with no history of brain damage. Twenty normal adults completed surveys to determine importance rankings used in the study. An example of an importance ranking from the study was "chapters" and "title" as high importance features and "table of contents" and "pictures" as low importance features in identifying the concept of book.

Findings showed that participants with left hemisphere-damage and aphasia exhibited reductions in identification of low importance features, but not high importance features, across word frequency levels. In addition, comprehension and naming performance showed a systematic relationship with feature knowledge in participants with left-hemisphere damage. This study illustrated that the semantic knowledge in persons with aphasia is influenced by importance of semantic features.

DISTINCTIVE VS. SHARED FEATURES

Garrard, Lambon Ralph, Patterson, Pratt, and Hodges (2005) investigated distinctive versus shared feature knowledge using ten persons in the early stages of dementia of the Alzheimer type who had semantic knowledge deficits. Participants were tested in five areas: category fluency for six categories, naming of sixty-four drawings without cueing, word-picture matching in response to a spoken word for all sixty-four items, sorting pictures and words at three levels, and a probed test of semantic feature knowledge. For the probe test, participants were asked to produce as much information as possible about the stimulus items. Findings suggested that damage to the semantic knowledge in persons with dementia of the Alzheimer's type affected distinctive rather than shared features to a disproportionate degree. Even the most mildly affected participants scored well below the lower limit of the control range when a probed test of semantic knowledge was used. Findings from this study clearly showed that distinctive features of concepts were more vulnerable than shared features in this disordered population.

SEMANTICALLY RELATED VS. UNRELATED FOILS

With these findings, the speech-language pathologist must ask if distinctive features of concepts are more vulnerable than shared features in persons with aphasia. More insight into the differential effects of distinctive versus shared features in the aphasic population can be gained by examining studies involving the use of semantically related versus semantically unrelated foils in persons with aphasia. Past research findings have shown that aphasic persons make more errors in comprehension tasks when semantically related foils are used versus semantically unrelated foils. Commonly used tasks include: picture pointing tasks to auditory command and single-word reading comprehension tasks.

Butterworth, Howard, and McLoughlin (1984) asked thirty persons with aphasia to point to pictures on auditory command both when the foils came from the same semantic category as the target and when the foils were unrelated to the target picture. Array size for this study was five pictures. Findings showed that participants could, in general, point to pictures correctly when presented with semantically unrelated foils. This showed that the concept had been correctly recognized auditorily, otherwise no relevant semantic information would have been available and the person with aphasia would have performed at chance only. The occurrence of errors when the foils were semantically related showed that the semantic information made available was insufficient to differentiate between concepts in the same semantic category. Thus, the information retrieved was incomplete or underspecified.

Grogan and Pierce (1994) found that semantic relatedness was a factor that significantly affected reading comprehension in adults with aphasia. Two groups of twenty adults with aphasia participated in two reading comprehension tasks. Findings showed participants pointed to mid frequency printed nouns with five unrelated foils with significantly increased accuracy than mid frequency printed nouns with five related foils. There was no difference in performance on comprehension of mid frequency nouns with three unrelated foils and five unrelated foils. This finding again adds strength to the notion that accurately selecting among unrelated foils, which requires comparison of more general semantic features, is easier than accurately selecting among related foils, which requires the knowledge and appreciation of distinctive semantic features.

In addition, Grogan and Pierce (1994) found that approximately half of the participants demonstrated the effect of relatedness. The two groups of participants in the study could not be differentiated based on age, education, and other identifying criteria. Six of thirteen participants did not perform differently on tasks with unrelated foils in comparison to tasks with related foils. The remaining seven subjects performed better when using unrelated foils versus related foils.

Howland and Pierce (2004) examined the influence of semantic relatedness and array size on single-word reading comprehension in aphasia. Ten adults with aphasia were asked to match a spoken word to a printed word. The foils were systematically varied based on array size and semantic relatedness. The performance of the persons with aphasia with semantically related printed words was significantly worse than with unrelated printed words at all array sizes (arrays of two, four, six, and eight words). This finding may suggest that persons with aphasia are more impaired in their knowledge of distinctive features that are essential for choosing among related items.

Results from Howland and Pierce (2004) also demonstrated that only about half of the participants with aphasia were affected by semantic relatedness. Six of the ten participants in the study performed more than 10% worse with related words than with unrelated words. This is consistent with Grogan and Pierce (1994) who found that approximately half of the aphasic participants (54%) demonstrated the effect of relatedness.

Cole-Virtue and Nickels (2004) investigated several factors affecting performance on spoken word to picture matching. Fifty-four individuals with aphasia participated in this study. Ratings of semantic similarity were collected from twenty college students without aphasia. The college students were asked to judge how semantically related/similar a close semantic distractor, a distant semantic distractor, and an unrelated distractor were to a target item. A rating scale of 1-7 was used to reflect whether words were highly unrelated, moderately related, or highly related. Ratings from the college students were used to evaluate the performance of aphasic participants.

Cole-Virtue and Nickels (2004) found that the rated semantic similarity between a target and a close semantic foil affected the performance of the participant group. The participants showed improved performance as the rated semantic similarity between the target and the close semantically related foil decreased. In other words, the aphasic participants were less accurate on items where the close semantic foil was rated as highly semantically similar to the target word.

Findings that suggest that distinctive versus shared features may be differentially impaired in the aphasic population rely on studies that only looked at comprehension using unrelated foils. Vecchi (1994) found that aphasic individuals were more impaired in their knowledge of distinctive features than shared features. However, Vecchi did not determine whether the aphasic participants were able to choose among semantically related foils or not.

On the other hand, Germani and Pierce (1995) found when looking at importance of features in persons with aphasia that many of the high importance features also appeared to be distinctive. In fact, 79 percent of the high importance pairs were distinctive in nature and sixty-five percent of the low importance features were classified as distinctive when a survey was completed by ten normal persons following the original study. Since high importance knowledge was intact in participants with aphasia, post hoc analysis argued against the presence of a selective impairment in distinctive versus shared feature knowledge in these persons. However, it was not determined if persons with aphasia who participated in this study had difficulty selecting among related foils.

THE PRESENT STUDY

Based on these findings, the assumption might be made that increased difficulty with semantically related foils arises because of a deficit in distinctive features. This might also lead the speech-language pathologist to believe that distinctive versus common features are differentially impaired in at least a portion of the aphasic population based on the ability to choose among semantically related foils. Although two studies using persons with aphasia have shown very different results, neither determined whether the participants had difficulty choosing among related foils. No study to date has investigated distinctive versus common feature knowledge in persons with aphasia who have difficulty choosing among semantically related foils. A need clearly exists for investigation into this aspect of semantic feature knowledge in persons with aphasia.

The purpose of the present study is to determine if the identification of distinctive versus common features of a concept are differentially impaired in persons with aphasia when concepts are controlled for frequency of occurrence and importance of features. The primary hypothesis is that participants will have greater difficulty with the identification of distinctive features than common features. In addition, the participants who have difficulty choosing among related foils will have significantly more difficulty with the identification of distinctive features than participants who do not have as much difficulty choosing among related foils.

METHOD

PARTICIPANTS

Six adults with aphasia participated in this study. The adults had aphasia as the result of no more than two unilateral left hemisphere cardiovascular accidents. All participants were right-handed native speakers and readers of English. In addition, all participants had no medical history of mental deterioration, such as dementia or right hemisphere syndrome based on information from the referring speech-language pathologist and confirmation from each participant. All participants demonstrated adequate visual and auditory skills as determined by their ability to pass the language screening tests. The presence of aphasia was diagnosed by the referring licensed certified speech-language pathologist and confirmed by the author.

Participants were administered the short version of the Boston Diagnostic Aphasia Examination (BDAE) (Goodglass, Kaplan, & Barresi, 2001) and Boston Naming Test (BNT) (Kaplan, Goodglass, & Weintraub, 2001) to determine type and severity of aphasia. To ensure an adequate ability to read single words and short phrases, participants were administered a 16-item noun and phrase reading test. In this screening test, participants were shown an array of four semantically unrelated printed nouns or phrases and asked to point to the one presented verbally. The nouns and phrases consisted of both high and low importance common and distinctive nouns and phrases. Participants who achieved 70% accuracy or better on the 16-item screening test were included in the study. All participants who were screened passed the screening process and participated in the present study.

Table 1 contains the relevant identifying information and scores on the independent measures for each participant. Three participants were male and three participants were female. Age ranged from 59 to 77 years (M=70.3 years, SD=7.1 years). Education level ranged from high school diploma to master degree. Time post onset ranged from 4 months to 109 months (M= 50.2 months, SD=48.6 months). Participants were classified as having fluent or non-fluent aphasia based on analysis from the BDAE by the author. This resulted in four fluent and two non-fluent aphasic participants.

DEVELOPMENT OF STIMULI

The final stimulus items consisted of 42 low (<8/million) and mid (10-25/million) frequency nouns selected from an original list of 63 nouns taken from the Francis and Kucera (1982) word-frequency list. All 63 nouns used had importance ratings collected by Germani and Pierce (1995). A pilot study was completed to obtain normal ratings for common and distinctive features for the 63 nouns that had importance ratings. A group of 33 adults, 14 males and 19 females, completed the questionnaire for the pilot study. The mean age of this group was 52.9 (SD=6.4) and level of education ranged from less than high school to doctoral degree with the majority of participants having a high school diploma (N=10) or master degree (N=10).

Participants were asked to rate each feature as typical or not typical for examples within a category. Individual ratings were averaged across the 33 participants to provide a mean rating of 1-5. A rating of 4-5 was classified as common. A rating of 1-2 was classified as distinctive. Nouns that had at least one high importance common (HIC) feature, high importance distinctive (HID) feature, low importance common (LIC) feature, and low importance distinctive (LID) feature were used in the experimental task. Forty-two of the 63 nouns met this criterion.

MATERIALS

Table 1. Participant Characteristics.

Participant	*Gender*[a]	*F/NF*[b]	*Age*[c]	*TPO*[d]	*Education*[e]	*BNT*[f]	*BDAE*[g]
1	M	F	59	15	MD	12	77.5
2	M	F	78	109	HSD	4	53
3	F	F	70	5	AD	15	87.5
4	F	NF	72	102	HSD	0	5
5	M	NF	66	66	HSD	0	27.5
6	F	F	77	4	HSD	1	53
Mean			70.3	50.2		5.3	50.58
SD			7.1	48.6		6.6	30.69

[a] M=male, F=female

[b] F=fluent aphasia, NF=nonfluent aphasia

[c] Age in years

[d] Time post-onset in months

[e] HDS=high school diploma, BD=bachelor degree, MD=master degree

[f] Boston Naming Test—shortened version (max=15)

[g] BDAE Language Competency Index (max=100)

Table 2. Examples of Stimulus Items.

	Carrot	*Squirrel*	*Hammer*
HIC features	Vegetable	Animal	Handle
HID features	Orange	Eats nuts	Pound with
LIC features	Cut it	Brown	In wood shop
LID features	Put in cake	Small	Claw

The 42 nouns were presented in a fixed random order with no more than 2 nouns within a category being adjacent. For each of the 42 nouns there was at least one HIC, HID, LIC, LID, and one unrelated feature. All nouns and features were printed in black ink on white cards for the experimental task. See Table 2 for stimuli examples.

PROCEDURES

The experimental task was divided into three stages. Stage 1 was completed on the first day of testing following completion of the preliminary tests. Stage 2 and Stage 3 were completed on the second day of testing. In stage 1, subjects were shown a horizontal array of four printed nouns and instructed to point to the word presented auditorily. One of the nouns corresponded to the target, and the other three were unrelated to the target semantically or perceptually. The location of the target noun within the array was randomized within the task with no more than two consecutive arrays with the target noun having the same location within the array (i.e., first, second, etc.). The first 21 nouns that were correctly identified in stage 1 were used for the experimental tasks in stage 2 and stage 3.

In stage 2, participants were shown a horizontal array of four printed nouns and instructed to point to the word presented auditorily. One of the nouns corresponded to the target, and the other three were semantically related to the target. The location of the target noun within the array was randomized within the task with no more than two consecutive arrays with the target noun having the same location within the array (i.e., first, second, etc.). The same 21 target nouns used in stage 2 were then used in a feature sorting task in stage 3. Completion of stage 2 revealed that participants fell into 2 groups of 3 participants each, those who had difficulty choosing among related foils and those who were able to choose among related foils. See Table 3 for groups.

Stage 3 involved a sorting task. The first 21 nouns correctly identified in stage 1 were used in the sorting task. Three target nouns were placed horizontally in front of each participant along with a fourth card containing the word 'UNRELATED'. Participants were given a deck of 15 feature cards containing one HIC, one HID, one LIC, one LID, and one unrelated feature for each noun (5 attributes x 3 target nouns= 15 cards). Participants were instructed to sort the deck of 15 cards into one of the four designated piles. The 3 targets and 'UNRELATED' cards were read aloud by the examiner at the beginning of the task. The nouns and phrases on the feature cards were read aloud by the examiner as they were to be sorted. Once a card was sorted by the participant, it was removed from the table. This sorting task was repeated seven times for each participant for a total of 21 target nouns. The three target nouns in each sorting array were randomly selected with the limitation that the nouns were not members of the same category or semantically related. Responses in this second stage were scored as correct (+) or incorrect (-). Participants were trained for this sorting task using common nouns sorted into broad categories (colors, shapes, drinks, unrelated). Category names and examples were read aloud similar to the experimental sorting task. Participants sorted from groups of 8 examples. A criterion of 7/8 correctly sorted needed to be reached before the participant could do the experimental sorting task. If the participant did not reach criterion with the first eight examples, directions were repeated and 8 new examples were repeated. The task was repeated three times or until criterion was reached. All participants reached criterion in 1-2 trials.

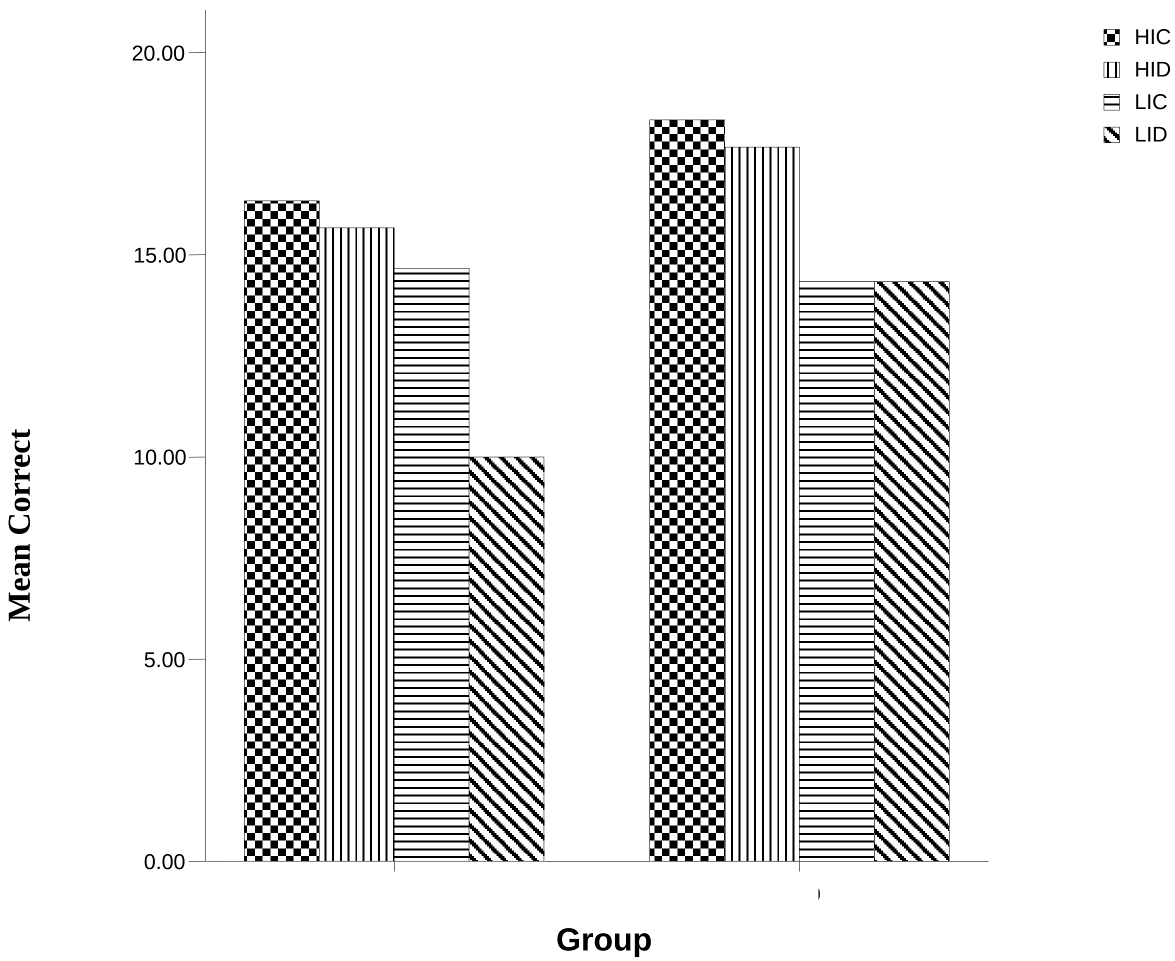
RESULTS

Table 4 contains the mean scores for the experimental conditions. A three-way ANOVA with one between-subjects factor (group) and two within-subjects factors (importance and commonality versus distinctiveness) did not indicate with statistical significance the differential impairment of low importance distinctive features and greater impairment of these features for participants who had greater difficulty choosing among related foils, $F(1,4)=5.30$, $p<0.08$. The three-way ANOVA revealed only one significant main effect, that of importance, $F(1,4)=20.39$, $p<0.01$. That result replicates the findings of Germani and Pierce (1995) in that high importance features were sorted more accurately than were low importance features. There were no significant two-way or three-way interactions. See Table 5 for results of the three-way ANOVA.

The findings would not support either the acceptance or the rejection of the hypotheses presented. Further research is needed to clarify the findings of the present study. Future studies can be strengthened by including more participants to increase the power of the research design. Despite lack of statistical significance in the present study, interesting trends were noted that merit further discussion.

In general, the high importance features were more accurately identified than were low importance features by both participant groups for both common and distinctive features. The group that did not have difficulty choosing among related foils was equally impaired on identification of both LIC and LID features. Both groups did worse at identifying low importance distinctive features than high importance features; however, the group that had difficulty choosing among related foils performed worse, though not to a statistically significant level in the present study, at identifying LID features than the group that was able to choose among related foils. Findings suggest that although identification of both high importance and low importance common features and high importance distinctive features remained relatively accurate for participants having trouble with choosing among related foils, some reduction in the identification of low importance distinctive features was found. This reduction was found only for the group who had difficulty choosing among related foils. The group who did not have difficulty choosing among related foils did equally well identifying both LIC and LID features.

Figure 1. Mean Number of Correct Features by Feature Condition and Group.



[a]DC= Difficulty choosing among related foils.

[b]AC= Able to choose among related foils.

To investigate the relationship between feature knowledge and comprehension and naming skills, correlations were computed among scores on the BDAE, BNT, and the LID condition. Table 6 shows the correlation matrix. A positive significant correlation was observed between scores on the BDAE and BNT (r=0.83). These significant correlations indicate that the participants' performances on these measures of comprehension and naming are inter-related and presumably related to participant's overall severity of aphasia. Participant's scores on the low importance distinctive attributes condition correlated significantly ($p<0.01$) with scores on the BNT (r=0.79) and the BDAE (r=0.87). These two correlations suggest a relationship between participants' naming and auditory comprehension and their ability to identify LID features of words.

DISCUSSION

There was not a significant differential impairment for identification of LID features in persons with aphasia based on the present findings. However, the group who had difficulty choosing among related foils did appear to have a greater impairment for LID feature knowledge than HIC, HID, and LIC feature knowledge. The identification of LID features was less accurate than the other conditions for the group who had difficulty choosing among related foils, though not significantly less accurate with the small sample size in the present study.

These results, though not significant with the small sample size

Table 3. Difficulty Choosing among Related Foils vs. Ability to Choose Among Related Foils.

Participant	*Group*[a]	*Number Correct*[b]
1	AC	20
2	AC	20
3	AC	21
4	DC	13
5	DC	14
6	DC	16

[a] AC=Ability to choose among related foils, DC=Difficulty choosing among related foils.

[b] Related foil task, highest possible number correct=21.

Table 4. Means, Standard Deviations, and Ranges for Experimental Conditions (N=6), Based on 21 Test Items.

		High Importance		*Low Importance*	
Group		*Common*	*Distinctive*	*Common*	*Distinctive*
AC	Mean	18.3	17.7	14.3	14.3
	SD	3.8	4.1	3.5	3.8
	Range	14-21	13-20	11-18	10-17
DC	Mean	16.3	15.7	14.7	10.0
	SD	1.2	2.1	2.5	4.4
	Range	15-17	14-18	12-17	7-15

Table 5. Results of Three-Way Mixed (Between-Within) ANOVA (N=16).

Source	*df*	*Partial Eta Square*	*Mean Square*	*F*	*Significance*
Group	1,4	0.14	24.00	0.66	0.46
Importance	1,4	0.84	80.67	20.38	0.01
Group X Importance	1,4	0.00	0.00	0.00	1.00
Group X C/D[a]	1,4	0.45	8.17	3.32	0.14
Importance X C/D	1,4	0.40	4.17	2.70	.18
Group X Importance X C/D	1,4	0.57	8.17	5.30	0.08

[a] C/D= Common versus Distinctive Features.

Table 6. Correlations among Participants' Scores (N=6).

	LID[a]	BDAE[b]
BDAE	0.87**	-
BNT[c]	0.79**	0.83**

** p<0.01 (one-tailed test)

[a] Ability to identify low importance distinctive features.

[b] Boston Diagnostic Aphasia Examination Language Competency Index.

[c] Boston Naming Test—shortened version.

in the present study, support the idea that even when persons with aphasia demonstrate comprehension of a word by selecting it among unrelated foils, they do not necessarily have full semantic knowledge of the word. They know some aspects of the word but not others. This distinction between what is known and what is not known is reflected in the differential impairment of common versus low importance distinctive features for the group who had difficulty choosing among related foils shown in the current study.

As Germani and Pierce (1995) discussed about their findings regarding importance of features, participants with aphasia often choose a semantically related foil when making errors in forced-choice comprehension tasks (Gainotti, Caltegirone, Micheli, & Masullo, 1981), and choosing among semantically related foils versus unrelated foils is a more difficulty tasks for some persons with aphasia (Butterworth et at., 1984, Howland & Pierce, 2004). Butterworth et al. (1984) reasoned that some persons with aphasia do not have rich enough semantic representations to make distinctions among items in the same semantic category. Their more superficial semantic analysis for common feature knowledge is only adequate for selecting among unrelated foils. The limited but promising results of the present study support this interpretation presented by Butterworth et al. (1984) and Germani and Pierce (1995).

Another area investigated in the present study involved the relationship of comprehension level to feature knowledge. Because HIC, HID, and LIC feature knowledge was more intact for the group who had difficulty choosing among related foils, the relationship between LID feature knowledge and comprehension was of particular interest. Scores on measures of comprehension correlated significantly with scores on LID feature knowledge. Goodglass and Baker (1976) found that persons with aphasia with lower comprehension abilities identified significantly fewer features than those with higher comprehension abilities (Germani & Pierce, 1995). The findings of the present study support this notion in that participants with lower comprehension scores identified fewer LID features. Participants with higher comprehension scores have more intact semantic knowledge for words.

The present findings need to be strengthened in future studies. Ideally, a larger sample size should be used to increase the power of the research design. In addition, a greater corpus of HIC, HID, LIC, and LID features need to be determined from the normal population. These research findings hold great promise for the future of treatment in aphasia. Perhaps by targeting the differential impairment of low importance distinctive features in treatment sessions for persons with aphasia who have difficulty choosing among related foils, gains could be made faster and generalize to common features, as well.

In summary, the results of the present study suggest a possible differential impairment of common versus distinctive feature knowledge in persons with aphasia who have difficulty choosing among related foils, when importance is controlled. In general, low importance distinctive features are most impaired in this group of participants. Participants who have difficulty choosing among related foils are more impaired in LID feature knowledge than those who can select among related foils, though not significantly with the small sample size in the present study. In addition, comprehension abilities significantly correlated with one's semantic feature knowledge. These findings support the notion that distinctive feature knowledge is likely intact to select among related foils. Persons with aphasia who are more impaired in LID feature knowledge also have more difficulty choosing among related foils.

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STUDENT PERCEPTIONS OF LEARNING SPEECH SCIENCE CONCEPTS IN A HYBRID ENVIRONMENT

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ABSTRACT

The purpose of this program-specific, descriptive, mixed methods case study was to explore undergraduate speech-language pathology students' perceptions of a hybrid delivery format and their own learning of course content in a speech science course. An anonymous, online survey was administered to elicit students' perceptions of the course format and their learning due to this format. Survey data were made up of both quantitative data and qualitative data. Quantitative data were analysed through descriptive statistics and qualitative data were subjected to thematic analysis. Results indicated that laboratory activities enhanced comprehension of speech science concepts as well as how speech-language pathologists use speech science concepts clinically. Use of asynchronous online discussions enhanced students' comprehension of course concepts. Overall, the course structure allowed more time for students to access course information and increased students' independent learning skills. Findings are discussed and directions for future research are recommended.

KEY WORDS

Speech Science, Hybrid Learning, Active Learning

There is a sense in many university programs which educate future speech-language pathologists (SLPs) that students feel as if they are frequently taught theory and rarely how to apply it in clinical situations (Horton, Byng, Bunning & Pring, 2004). This sentiment is particularly true for students studying speech science (Finan, 2008). The term 'speech science' is used somewhat differently throughout the world. For instance, Van Dort (2005) described a Malaysian Bachelor of Speech Science Honours degree which included clinical and academic elements of speech pathology, including language science. 'Speech science' as it is used here refers to 'the study of the acoustics, aerodynamics, and physiology of the production, transmission, and effects of speech. When used in the general sense, speech science includes voice science.' (Behrman, 2007, p. 423).

Speech science not only plays an enormous role in SLPs' theoretical understanding of the physical, neurological and acoustic bases of speech production, hearing, and speech perception, its clinical practice brings accountability to the SLP (Sapienza & Stathopoulos, 1998) by way of objective measurement of speech phenomena. The subject matter of speech science, however, has traditionally been problematic for SLP students due to its focus on acoustic, and thus mathematical, principles. How speech science instructors may best teach SLP students the theories which make up speech science in a manner which directly relates to students' clinical practise remains unclear.

In fact, there is little understood about how to best educate SLP students (Mok, Whitehill & Dodd, 2008). A review of the literature regarding specific approaches to teaching speech science resulted in no studies which collected data regarding the effectiveness of the approaches employed. All of the reported approaches located were from conference proceedings from the Acoustical Society of America (such as Arai, 2006; Sanders, 2009) and Forum Acusticum (Arai, 2002) in Europe. While many of the approaches are helpful in initially designing a course in speech science for SLP students, it is also necessary to ensure the approach's effectiveness in aiding students' learning.

Literature outlining general approaches to academic education in speech-language pathology is beginning to emerge. Mok, Dodd, and Whitehill (2009) investigated SLP students' approaches to learning in a problem-based learning curriculum in Hong Kong. The researchers found that students' use of both deep approaches and surface approaches to learning increased during the completion of the curriculum. Interestingly, the researchers pointed out that students might continue to use surface approaches to learning as a function of the types of assessments they are given. In other words, if an assessment requires that a student only list facts, students use a surface approach to learning consisting of memorization of facts (versus integration of knowledge for use). These findings suggest that the type of activities an instructor chooses to include in a curriculum affects the type of learning approaches students take. While some memorization of facts is to be expected, learning to become a knowledgeable SLP is not a series of steps in which facts are internalized and then repeated on examinations. Instead, the processes of perspective-taking, critical thinking, reflective action, and informed integration of facts leads to competent professionals.

Further complicating the study of the effectiveness of approaches to teaching speech science principles is the expanding use of internet technology to supplement (blended learning) or replace (online learning) face-to-face course delivery. Hybrid or blended learning environments in higher education make use of both face-to-face learning and distance or online learning (Delialioglu & Yildirim, 2007). The use of online learning in institutions of higher education is on the rise and with this growth comes the demand for assurance of quality of instruction (Yukselturk & Bulut, 2007). One approach to measuring quality of hybrid instructional formats is the use of student perceptions regarding course formats as a benchmarking initiative (Alexander & Golja, 2007). Use of student perceptions of learning in online or blended environments allows the tailoring of course delivery decisions to better fit the modern students' learning needs. Further, students' needs should be a major consideration in the design, development, and delivery of distance learning courses due to distance learning's student-centred approach (Sahin & Shelley, 2008). In this vein, the purpose of this descriptive case study was to explore undergraduate speech-language pathology students' perceptions of a hybrid delivery format and their own learning of course content in a speech science course.

METHOD

This program-specific, descriptive case study required three distinct methods to achieve its goals. First, the course was developed using a humanistic orientation to education. Second, a survey was developed and implemented to assess student perceptions of the course format for learning speech science concepts. Last, the survey results were analysed to draw conclusions regarding the students' perceptions of the course format. Each of these methods is described next.

DESCRIPTION OF THE COURSE AND ITS DESIGN

CSD 1750: Speech Science is an undergraduate course at St. John's University in New York City and is currently offered as an elective course for students majoring in Speech-Language Pathology and Audiology. Prerequisite courses for CSD 1750 are a course in phonetics and a course in anatomy and physiology of the speech system. The course's general description included the acoustic characteristics of speech and their relation to articulatory and perceptual events. The course, as it was taught in the semester this study took place, addressed theories of both speech perception and production, acoustic correlates of phonation including vocal quality, nasality in speech production, and respiratory physiology in addition to basic principles of acoustic phonetics. The course's goals included: (1) providing the student with an understanding of the complexity of the acoustic speech signal; (2) introducing the student to basic theories of speech production and speech perception; (3) introducing methods and instrumentation for measures of speech perception and production; and (4) providing introductory-level material on possible causes of disorders of speech communication.

The course instructor designed the course activities and assessment approaches using a humanist orientation to education. 'From a learning theory perspective, humanism emphasizes that perceptions are centred in experience, and it also emphasizes the freedom and responsibility to become what one is capable of becoming' (Merriam, Caffarella & Baumgarten, 2007, p. 282). The course was designed with a heavy emphasis on self-directed learning and cognitive development of students. Reliance on students' self-directed learning behaviours with a focus on their cognitive development toward autonomy is a purposeful approach to instruction from the humanistic orientation.

The course was delivered in a hybrid format with one day of coursework being replaced by online activities. Therefore, one day a week, the course met face-to-face and all other activities were accomplished asynchronously online using the learning management system *Blackboard Learning System Campus Edition 6* (Blackboard CE6). Instructional strategies consisted of traditional lecture; face-to-face class discussion; in-class, instructor-led completion of laboratory exercises as a whole class; asynchronous discussions online in groups; and online, self-paced, instructor-created tutorials (E-lectures) covering all course content areas except theories of speech production/perception and the physiology of speech perception. All information presentation for course topics was accomplished through these E-lectures. The course information from the latter two areas was delivered via live, face-to-face lecture. The interested reader may view an example of an E-lecture by visiting http://www.patrickwalden.com/ijslp/player.html. Assessment for the course consisted of individual creation of a web-based portfolio in which students posted laboratory exercise results and interpretation of the results; two student presentations (one at the beginning of the semester and one at the end of the semester) on the individual student's preferred theories of both speech production and speech perception; active participation in online, asynchronous discussions; and a paper-based final examination at the end of the course. Each of these assessment methods is explained next.

WEB-BASED PORTFOLIO

Each student was required to create and post a complete course portfolio to the World Wide Web (E-portfolio). The instructor provided web space for each student to post her work, but students were allowed the freedom of posting to any of the free web hosting services available. Knowledge of hypertext mark-up language (HTML) for creating web pages was circumvented by instructing students to use a 'what you see is what you get' (WYSIWYG) web authoring program. The Seamonkey Internet Application Suite (http://www.seamonkey-project.org/) was recommended to students due to its open-source format which allows for use of the software at no cost. The course instructor created a web-based, self-paced tutorial to help students get started with both web page creation and upload of the web page to the instructor's web space.

The laboratory exercises consisted of a pre-course statement of a preferred theory of speech perception and production, seven laboratory exercises which made use of instrumental and non-instrumental assessment procedures (including pure and complex tones, sound pressure level, vocal frequency/intensity, respiration, vocal quality, nasalance, and spectrograms of vowels and consonants), and a post-course statement of preferred theory of speech perception and production. The web-based portfolio directions with which the students were supplied can be found in the Appendix. Instrumental assessment procedures were accomplished using the *Computerized Speech Lab 4500* (CSL4500) by KayPENTAX. Each laboratory exercise was required to be posted onto the student's web page the week after the lab was completed in class. Students who adhered to this deadline were rewarded by receiving direct feedback from the course instructor regarding ways to improve the lab interpretation. Students who did not post their labs on time did not receive feedback from the instructor. The final grade for the web-based portfolio was determined for each student based upon the appropriateness and completeness of their interpretations. Whether or not the student had received direct instructor feedback for their web pages was not a factor in grading the portfolios. That is, students who did not adhere to the deadline for posting labs did not receive instructor feedback but were graded as if they had.

STUDENT PRESENTATIONS

Two student presentations were used in order to assess students' thinking regarding theories of speech perception and production and to monitor change in their thinking as a function of students' exposure to course concepts. The first presentation consisted of individual student's preference for one theory of speech perception and one theory of speech production. The student was instructed to describe these two theories as well as why she prefers the specific theory.

Likewise, the students' second presentation consisted of the individual student's preference for one theory of speech perception and one theory of speech production. The students also had to state why they prefer the specific theories and if their opinions had changed over the course. In addition, students were required to cite at least three sources outside of course materials which helped them reach their conclusions. Detailed student instructions for this assignment are part of the Appendix.

PARTICIPATION IN ASYNCHRONOUS DISCUSSIONS

Students were required to actively participate in weekly online, asynchronous instructions using Blackboard CE6. The instructor posted three to four questions each week, and students were required to (1) directly answer the questions posed; (2) reply to each post submitted by their group members; and (3) reply to at least one person's reply to the individual student. Students were given fixed deadlines with which their posts were to be made in order to receive credit. In addition, posts that the instructor believed were not the product of active and full participation were addressed by asking the individual student to amend her post. If the student did not amend the post, a partial reduction in participation grade for the discussion was implemented.

Discussion questions were formulated in order to draw student attention to important, clinically relevant concepts in speech science. Most questions required students to access, remember, and evaluate information (Bloom, 1994) from the course text and the course lectures. Some questions allowed active and lively debate by eliciting student opinions/perspectives on course concepts. Most questions were, however, designed to focus student attentions toward concepts which directly relate to the contemporary practice of speech-language pathology.

FINAL EXAMINATION

One final examination consisting of 95 questions was completed. The final examination was formulated to directly mirror the content areas covered in the course. The examination included general acoustic knowledge, acoustic knowledge as it pertains to frequency and intensity variables, acoustic knowledge as it pertains to the decibel scale, respiratory physiology, vocal quality, nasality, articulation, physiology of the perception of speech, and both speech production and speech perception theories. Examination items were made up of recall-driven multiple choice questions, true and false statements, and analysis-driven multiple choice questions.

ANONYMOUS ONLINE SURVEY

A web-based survey (using *Survey Gizmo Online Survey and Questionnaire Software*; http://www.surveygizmo.com/), which sought to elicit student perceptions regarding the success of the course format and the students' learning as a function of this format as well as students' preference for learning activities during the course, was constructed and posted onto the internet. Student *preferences* for course learning activities are conceptually distinct from their *perceptions* of the course format. For example, students may perceive that asynchronous, online discussions are effective for learning course content; however, students may prefer not to complete them due to the time required to craft posts each week (which seemed to be the case in this course based on students' face-to-face feedback in class). Therefore, only survey items which corresponded to students' perceptions of course format and student learning are reported in this paper. Table 1 lists the survey statements used to elicit this information. Fourteen of the 17 questions eliciting information regarding student perceptions of the course format were statements regarding the activities in the course. The student participants were asked to rate their level of agreement regarding the statement. Possible ratings for all close-ended questions included '*Strongly Agree*', '*Agree*', '*Neutral*', '*Disagree*', and '*Strongly Disagree*'. Three open-ended questions were asked in which students were free to respond without response limitations. The open-ended questions concerned the students' perceptions of their development as independent learners, which courses should follow a similar format, and why courses should be structured this way. Completion of the online survey was anonymous and voluntary. Survey topics included questions regarding their perceptions of E-lectures, course labs, online discussions, E-portfolio, overall perceptions, and miscellaneous questions.

Two weeks prior to the end of the semester, a research assistant came to the classroom at the end of a face-to-face class meeting, described the study to the students, and disseminated and answered questions regarding informed consent. The instructor was not present for the presentation of the study to the students. Students were given the hyperlink to the online survey in the informed consent document and as a web link within Blackboard CE6. Two reminder e-mails were sent to all students regarding the survey using the Blackboard CE6 mail function. These e-mails also contained a direct link to the online survey. The instructor was blind to the identity of the students who participated in the study. The blinding of the researcher/instructor to the identity of the study participants was implemented to foster student participation by providing a level of assurance that their participation was indeed anonymous. Power relations in higher education traditionally take the form of the instructor as authority with position power. By blinding the researcher/instructor, the purpose was to attempt to elicit truthful responses to the online survey without student fear of damaging the instructor-student relationship in the course as well as for future course offerings.

DATA ANALYSIS

Results from the online survey were exported into a .csv (comma delimited) file from the Survey Gizmo website and opened using spreadsheet software. These results contained both quantitative and qualitative data (in the form of textual data). Qualitative data were removed from the spreadsheet and imported into a word processing document for thematic analysis. Quantitative data derived from the fourteen close-ended statements were coded using integers one through five ('*Strongly Agree*' was assigned the value of 5, '*Agree*' was assigned the value of 4, '*Neutral*' was assigned the value of 3, '*Disagree*' was assigned the value of 2, and '*Strongly Disagree*' was assigned the value of 1).

Quantitative data regarding students' perceptions of course format and student learning were analysed using descriptive statistic techniques (mean, standard deviation, and median

Table 1. Mean, Standard Deviation, and Median Scores for Student Survey Responses.

Survey Statement	Mean	SD	Median
I feel the course e-lectures enhanced my understanding of course content.	4.23	0.59	4
The e-lectures allowed me to access course information at a time best suited to me.	4.46	0.66	5
E-lectures expounded upon information presented in the course text.	4.38	0.96	5
E-lectures were easily accessed.	4.69	0.48	5
I possessed enough technological knowledge to complete the e-lectures.	4.69	0.48	5
The e-lectures interfered with my understanding of course content.	1.92	1.03	2
The labs enhanced my understanding of course content.	4.76	0.43	5
The labs helped me understand course concepts as they are used in work settings.	4.76	0.59	5
The online discussions enhanced my understanding of course content.	4.69	0.48	5
I feel completion of an e-portfolio was an effective way to show my learning in this course.	4.46	0.66	5
Completion of the e-portfolio enhanced my understanding of course content.	4.53	0.51	5
Overall, I feel the course structure enhanced my understanding of course content.	4.61	0.65	5
Overall, I feel the course structure allowed me more time to access course information on my own time.	4.23	0.83	4
Overall, I feel I am a more independent learner due to completion of this course.	4.3	0.75	4

Note: Mean and Median values represent levels of agreement on a scale of five possible levels. A value of 5 represents 'Strongly Agree' whereas a value of 1 represents 'Strongly Disagree'.

using the assigned values described above). Qualitative data were analysed on a per question basis. For qualitative data analysis, each question was read separately and coded for meaning by hand. Codes were then collapsed into themes across study participants in order to discover the major ideas in the qualitative database. These major ideas were then compared to the raw data in an attempt to locate disputing evidence or negative cases (Bogdan & Biklen, 2007).

RESULTS

Thirteen of the 20-student population in CSD 1750: Speech Science completed the anonymous, online questionnaire, yielding a 65% return rate. Of these 13 student participants, six (46%) students were in their third year and seven students (54%) were in their fourth year of university study. Nulty (2008) cited various researchers regarding acceptable return rates and described research which accepted return rates to surveys from 50% to 70%. The 65% response rate is toward the higher end of this range, although only calculated from a total possible participant sample of 20 students. Therefore, caution is necessary in attempting to generalize the findings presented in this paper. The purpose of the research was not, however, to generalize to all speech-language pathology students; instead, the purpose consisted of understanding the perceptions of the participants in this specific course.

Table 1 depicts the survey questions and the student responses represented in mean, standard deviation, and median. Overall, the student participants indicated that they felt that the E-lectures enhanced their learning of course content (mean rating of 4.23, indicating 'Agree'). The participants also agreed that the E-lectures allowed them to access course information at a time which was best suited to them individually (mean rating of 4.46). The E-lectures were perceived as expounding upon information presented in the course text (mean rating of 4.38) and they were easily accessed (mean rating of 4.69). Participants also perceived that they had enough technological ability to complete the E-lectures (mean rating of 4.69). The participants further indicated disagreement with the statement regarding the E-lectures' interfering with their learning of course content (mean rating of 1.92).

The study participants indicated that the laboratory activities in the course enhanced their learning of course content (mean rating of 4.76) and that these activities helped the students understand speech science course content as it is used in work settings (mean rating of 4.76). Further, the student participants indicated that the online, asynchronous discussions also enhanced their learning of course concepts (mean rating of 4.69).

The completion of the E-portfolio was perceived to be an effective way for students to show their learning in the course (mean rating of 4.46) and enhanced their understanding of course content (mean rating of 4.53). Overall, student participants indicated that the course structure enhanced their understanding of course content (mean rating of 4.61), allowed them more time to access course information (mean rating of 4.23), as well as helped them become more independent learners (mean rating of 4.30).

The three open-ended questions students completed were 'Please explain why you feel you are (or are not) a more independent learner due to completion of this course', 'Which courses do you think are best suited for structuring in a similar format?', and 'Why do you think other courses should be structured this way (or why not)?'. Themes which emerged from each question are described next.

INDEPENDENT LEARNING

Analysis of the qualitative data elicited by asking the student participants why they feel developed into more independent learners (or why not) revealed three themes: *being responsible for their own learning pace*, *relying on their own self-directedness for learning course concepts*, and that the *structure of course activities requiring higher level thinking* (analysis versus memorization). Student participants indicated that being responsible for their own learning pace was both a positive and a negative. One student described her positive orientation to learning at one's own pace, 'I like to learn at my own pace and when I study all the information independently, I learn more.' Although most students indicated that learning at one's own pace helped them become more independent learners, many felt that there is also a negative side. For example, one student wrote:

> *This course definitely required a lot of independence because we only met once a week and all our work was done online so you need to constantly keep checking the syllabus and make sure you are up to date. Besides the labs, all of the learning material we needed to look at [was] on blackboard or … [in] the book. Had I not read the e-lectures or the book or SCORM (E-lectures were provided in SCORM format) I don't think I would have done well in this class. It was not difficult but if you are not used to it then you can fall behind.*

Student participants also reported that they had to rely on their own self-directed behaviors and this allowed them to develop independent learning skills. One student wrote:

> *I feel I a more independent learner due to this course because most of this course was independent learning. All of the resources available just guided me through the course but I really had to understand the information on my own, however the professor was always there to help.*

Lastly, students indicated that their independent learning skills were enhanced due to course activities' reliance on higher-level cognitive skills (Bloom, 1994). This was exemplified by a student participant's responding:

> *I feel that I am an independent learner based on the expectations of completing the websites and discussion posts. This made me read the chapter and summarize in my own words. I feel that because we had to reply to each other[s'] posts, this enabled us to critically think. Also, the lab has made me an independent learner because rather than copying word for word in the text books, we had to explain why such things occur. This course has also allowed me to think how and why things occur because we were supposed to explain the labs in detail rather than state the facts.*

FUTURE COURSES USING THIS DELIVERY FORMAT

The student participants provided various responses regarding which courses in speech-language pathology and audiology majors' curriculum should be offered using a similar format. Responses ranged from 'almost all' to 'not sure.' No themes were derived from this question. More illuminating, however, was why the student participants thought other courses should be structured like CSD 1750. Students indicated that the course structure was more interesting than traditional lecture formats. For instance, a student responded that the format 'gives people an interesting way to learn and also you actually learn instead of just memorize information'. Another student responded that the format 'makes the class more interesting when there are labs rather than lectures. Labs keep the students interested and focused.'

Students also indicated that courses which require practice are generally not appropriate for delivery in a format similar to this course. One student commented:

> *Some classes, such as Speech Pathology 1 and 2 [Speech-Language Pathology I is an introductory course in language disorders across the lifespan and Speech-Language Pathology II is an introductory course in disorders of speech across diverse populations], as well as Phonetics should not be structured this way. That is because I feel these classes require lectures and in class practice, as opposed to online discussions.*

DISCUSSION

First and foremost, the number of participants in this study was extremely small and it is acknowledged that generalization to the SLP student population at large is not possible. Overall however, student participants' perceptions of the format of CSD 1750 and their own learning due to this course format were decidedly positive, and it can be concluded that students enrolled in the course believed they had enough technical knowledge to participate in the course. While complete generalization of the current research results to other speech-language pathology students is not possible, some conclusions regarding the course format and learning activities as they were implemented for this course may be made specific to the students who were enrolled in the course. Overall, students liked the freedom the hybrid course format allowed for accessing course information at a time which was more convenient to them. Further, all the learning activities and resources the students were given in the course were perceived to enhance their learning of the course content. This is not to say, however, that other teaching and learning activities would not also enhance the students' learning of speech science concepts. It also cannot be concluded to what magnitude each course activity and resource enhanced the students' learning.

Judging from the mean response to survey statements, the laboratory activities held a slight advantage in student perceptions of enhanced learning of course concepts. Contrastively, the E-lectures, while still perceived as enhancing student learning, were perceived to do so to a lesser degree. These results, however, would not lead to statistical significance for students' perceived enhancement of learning, but the results can guide future offerings of the course to include more laboratory activities in an attempt to teach from a more student-centred perspective. Likewise, reliance on E-lectures to present information to students can be present but perhaps to a lesser degree in the future.

A significant finding in the current research was the course format's positive influence on students' development of independent learning skills. Overall, the students felt the course format helped them become more independent learners. Finan (2008) wrote that 'It is unrealistic and unreasonable to assume that our students should learn everything' (p. 29). Instead, he pointed to Golper's report that the American Speech-Language-Hearing Association-sponsored Speech-Language Pathology Education Summit 'identified qualities such as proficiency in technical skills, scientific attitude and critical thinking skills, [and] ability to access, judge, and use… research in clinical practice, as desirable future traits for future clinicians' (p. 29). These qualities and traits which were identified may be improved through developed independent learning skills. Given the broad and varied nature of the practise of speech-language pathology, academic preparation cannot address every fact and practise currently known and used in the field. Instead, academic preparation may be used to develop self-directed learners who are capable of independent adaptation to new and changing clinical environments. While discipline-specific knowledge acquisition is a necessity in academic training, formal coursework may also serve as a context in which more active learners are developed.

A surprise finding regarding the development of students' independent learning skills in the current study arose from the qualitative data. The student participants reported becoming more independent learners through the exercise of higher-level cognitive skills. Students perceived that critically thinking about course content through discussion in the online learning environment as well as the requirement to analyse laboratory results helped them become more independent learners. The surprise for the researcher was not that the activities fostered more independence (in fact, the course was designed assuming this) but that the students came to realize this (and felt positively about it), as well. While specific to the study population, this finding may help inform speech science instructors who are unsure whether undergraduate students are either capable of higher-level thinking or want to engage at this level in speech science. Each instructor may then gauge his or her students' response to activities requiring higher levels of thought in speech science education and make adjustments appropriately to fit the students' abilities and desires in the subject matter.

Finally, the nature of the descriptive case studies does not allow direct extrapolation of results to a population, in this case to the broad population of students studying speech-language pathology. To lend further evidence to the effectiveness and efficacy of active teaching approaches to speech science similar to the approaches requiring much student self-direction presented in this paper, experimental designs are required. More specifically, experimental group designs need to be implemented to discern the contribution of more active teaching approaches versus traditional lecture-based formats to student learning of speech science content. While the student participants in this study perceived enhancement of learning from the course format, one cannot attribute this learning strictly to the format. It is entirely possible that the students would have perceived learning enhancement from a variety of approaches. Qualitative findings in the current research, however, suggest that the students were aware of the course format and could readily compare it to past experiences in higher education. To more directly attribute enhanced learning to more active approaches, a control group is required. Creating a control group within a course is, however, difficult. Instead, collaborations between teaching faculty in universities are recommended. Collaborations between university faculty will also allow greater participant numbers from which more broad interpretations may be made from the data gathered.

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APPENDIX

DIRECTIONS FOR E-PORTFOLIOS AND LABS

General Directions:
You will be creating an e-portfolio which showcases your activities, thinking, and research throughout this semester. The e-portfolio is made up of three distinct sections: (1) Pre-course statement of your preferred theories of speech production and perception including your reasoning; (2) All 7 of your labs, including interpretation; and (3) Post-course statement of your preferred theories of speech production and perception including your reasoning and the sources (you need 3 additional sources) you used to help you construct your reasoning. Your e-portfolio will be created in a web page format and will be uploaded to the internet throughout the semester, culminating in a complete e-portfolio at the end of the semester. What is important to remember is that you have creative freedom regarding how you choose to format your web page. As long as all the necessary information is present and correct, you will have met the requirements.

I. Pre-course Statement of Theory:
The first section of your web page will be a statement of which theory of speech production and speech perception makes the most sense to you. You should name and describe each theory you prefer (one for speech production and one for speech perception). Use your text and supplementary readings as sources. Be sure to use APA citation format to cite your sources. Lastly, you will describe your reasoning as to why you prefer a specific theory. You will also present this information in class.

II. Labs:

Lab 1: Pure Tone vs. Complex Tone Lab:
In class, we will create three different sound waves. One will be a sound wave from a tuning fork, one will be a male voice and the other a female voice. We will capture these signals together in class and create the sound wave for each together. You will be provided with both the audio file and the resulting sound wave. Your job, to be done individually, is to compare and contrast the three different waveforms and post the sound wave graphics as well as your interpretation online. You should work together in the creation of the web page as well as posting your page.

Lab 2: SPL Lab:
In class, we will measure the sound pressure level of various sounds around campus. You will keep a log of what sounds we measure and how loud these sounds are. Your job for your web page is to report this information (what was measured and how loud it was) and to discuss what it means to be loud. You should concentrate on an explanation of what sound pressure is and why one sound is louder than another. This, like all other labs, will be part of your web page.

Lab 3: Vocal Frequency/Intensity:
In class, each person will capture his or her voice using the CSL (hardware and software which performs acoustic analysis). Each person will then discuss their voice in terms of frequency and intensity parameters. You will be provided with both the audio file and the graphic file of the sound wave. This is to be uploaded to your web page.

Lab 4: Respiration Lab:
In class, we are going to build a spirometer. We will then measure each person's lung volumes. For your web page, you will describe the process we used to build the spirometer and how we measure each lung volume. You will then describe what each lung volume measured is and how this lung volume is/is not involved in speech production. You will also complete, in class, Form 11-3 from the Shipley & McAffee text. All of this is to be uploaded to your web page including interpretation.

Lab 5: Vocal Quality Lab:
In class, each person will capture his or her voice and we will perform both Jitter and Shimmer analyses on each person's voice. You will be provided with the graphic file resulting from your analyses. Your job is to describe what each analysis is, what it is for and what your results mean. Also, you will complete an s/z ratio (found in your Shipley & McAffee text on page 395) as well as forms 11-1 & 11-2 from that text. Be sure to read the supplemental reading available in the resources section of Blackboard regarding the use of the s/z ratio for a perspective regarding the use of this measure. All of this is to be uploaded to your web page including interpretation.

Lab 6: Nasality Lab:
In class, we will measure each person's nasality using the Nasometer. Each person will have the opportunity to read a passage and to view his/her resulting nasalance readings. You will be provided with the graphic file from your analysis. Your job is to describe what you see on the graph as well as to define nasality. You will also complete the six resonance assessment procedures found on pages 396-

400 of your Shipley & McAffee text (Assessing Resonance Counting task, Hypernasality task, Assimilation Nasality task, Hyponasality task and Assessing Velopharyngeal Function task). All of this is to be uploaded to your web page including interpretation.

Lab 7: Vowels/Consonants Spectrogram Lab
In class, each person will produce two vowel sounds and two consonant sounds of their choice. These will be captured and analyzed using the CSL. A spectrogram will be created and each file will be provided to you. Your job is to describe both what a spectrogram is and what you see on your four spectrograms. Also, you will complete Forms 6-1 & 6-2 from your Shipley & McAffee text. All of this will be uploaded to your web page, including interpretations.

<u>III. Post-course Statement of Theory</u>:
The last section of your web page will include a statement of which theory of speech production and speech perception makes the most sense to you after being exposed to the course content and activities throughout the semester. You should <u>name</u> and <u>describe</u> each theory you prefer (one for speech production and one for speech perception). Use your text, supplementary readings, and <u>at least 3 outside sources you found and read on your own</u>. Be sure to use APA citation format to cite your sources. Lastly, you will describe your reasoning as to why you prefer a specific theory and how your choice of preferred theory has changed or was strengthened through your participation in the course and your outside readings (basically, compare and contrast with your pre-course statement of theory). You will also present this information in class as well as upload this to your web page.

FACTORS THAT CORRELATE WITH SUCCESSFUL COMPLETION OF COURSEWORK IN LANGUAGE DEVELOPMENT AND DISORDERS

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ABSTRACT

A fundamental knowledge of language development and disorders between teachers and speech-language pathologists improves collaboration between professionals when providing services to the same students. A correlation analysis of factors among a population of 475 undergraduate students of education and non-education majors who had taken a Language Development and Disorders course over a period of 14 years identified whether any factors correlated with academic success in that course. A multiple regression analysis further investigated the relationship of multiple variables on predicting academic success in this course. Correlation analysis revealed patterns among some variables, and the multiple regression analysis further identified that variables representing personal characteristics had the greatest effect on academic performance in this course. These variables included gender, major, credit status, and whether the course was a required or an elective choice. A regression model is presented that explains 11% of the variability in predicting this grade.

KEY WORDS

Active Learning, Collaboration, Language Development

INTRODUCTION

INTEREST IN TYPICAL LANGUAGE DEVELOPMENT

PROFESSIONAL ASSOCIATION STANDARDS

Professional organizations provide performance based standards for the preparation and licensure of school professionals, which are reviewed and approved by the National Council for the Accreditation of Teacher Education (NCATE). The professions of education, special education and speech-language pathology have identified standards that reflect on acquisition of knowledge in language and collaboration.

The Council for Exceptional Children (CEC) is the organization that provides professional support to special education teachers and advocates for policies and services that impact the education of children with disabilities. This organization has the responsibility for developing performance based standards for the preparation and licensure of special educators and establishing a code of ethics for the profession. These performance-based standards are reviewed and approved by the National Council for the Accreditation of Teacher Education (NCATE) (Turnbull, Turnbull, Shank, & Smith, 2004).

CEC has developed ten standards, identified as categories, that include knowledge and skills necessary to meet certification requirements as a special education teacher. Standard 6 has the heading *Language* and describes the essence of the coursework necessary to meet that standard. This standard is explained in the following narrative: "Special educators understand typical and atypical language development and ways in which exceptional conditions can interact with an individual's experience with and use of language. Special educators use individualized strategies to enhance language development and teach communication skills to individuals with exceptional learning needs (ELN). Special educators are familiar with augmentative, alternative, and assertive technologies to support and enhance communication of individuals with exceptional needs. Special educators match their communication methods to an individual's language proficiency and cultural and linguistic differences. Special educators provide effective language models, and they use communication strategies and resources to facilitate understanding of subject matter for individuals with ELN whose primary language is not English" (Turnbull et al., 2004, p. 489). Coursework that is listed under this narrative to meet the standard described above must include knowledge in the areas of impact of language development and listening comprehension on academic and non-academic learning of individuals with disabilities, communication and social interaction alternatives for individuals who are non-speaking, and typical language development and how that may differ for individuals with learning disabilities (CEC, 2001).

STATE DEPARTMENT OF EDUCATION STANDARDS

The Educational Testing Services also administers PRAXIS tests that acknowledge important information for beginning teachers. *The Special Education: Knowledge-Based Core Principles* is divided into three components. One of these components is related to understanding exceptionalities and includes testing of knowledge in the following areas: (1) Theories and principles of human development and learning, including research and theories related to human development, theories of learning, social and emotional development, language development, and physical development, including motor and sensory areas, (2) Characteristics of students with disabilities, including medical/physical, educational, social, and psychological, (3) Basic concepts in special education, including definition of all major categories and specific disabilities, causation and prevention of disability, the nature of behaviors (including frequency, duration, intensity, and degrees of severity), and classification of students with disabilities, including classifications as represented in the IDEA and labeling of students (Turnbull et al., 2004).

THE COMPETENCE OF THE CLASSROOM TEACHER RELATED TO LANGUAGE DEVELOPMENT/DISORDERS

A seminal study conducted by Phillips (1976) investigated variables that affected the awareness of speech disorders by classroom teachers. Analysis of 858 questionnaires obtained from classroom teachers identified four variables that were consistently significant to all three areas that measured teachers' attitudes concerning children with speech disorders and their understanding of speech disorders and therapeutic procedures. The most highly significant variable was whether the respondent had taken a course in speech remediation. The higher scores of teachers with this variable indicated that teachers had acquired factual information and knowledge of speech disorders and remedial procedures, as well as indicating a more positive attitude concerning students with speech disorders. Other characteristics that were highly correlated with awareness of speech disorders were age, number of years teaching, and access to the speech-language pathologist. These results demonstrated that younger teachers with fewer years of teaching had a better understanding of speech problems and remediation. Phillips speculated that correlation may reflect the changing focus of teacher preparation programs to require a speech disorders course for elementary education majors.

A study by Bennett and Runyan (1982) examined teachers' perceptions of the effects of communication disorders on educational performance. Of the 282 questionnaires included in this analysis, 201 were from classroom teachers, 64 were special educators, and 17 included other school personnel. The results reflected that 66% of the educators indicated that communication disorders adversely affected some aspect of educational performance. A further breakdown of this percentage revealed that 40% reported that both academic and social skills were impaired, 17.4% believed only academics were affected, and 9.6% perceived that social development alone was affected. Also, educators were asked for their impressions regarding the effect of speech therapy on the abilities of children with speech disorders. From those who responded, 81% indicated that therapy resulted in improved academic performance, while 77% believed that social interactions with both peers and adults improved as a result. These responses support the view that classroom teachers are aware of some connection between communication skills and academic performance and consider speech therapy as having positive effects on students.

Classroom teachers generally determine if a child is experiencing academic and/or social problems due to communication difficulties and often are the primary sources of referrals for special education services. Based on the federal clarification provided by request from ASHA, "educational performance" was further defined as including both academic and oral communication, or psychosocial skills (Bennett & Runyan, 1982). This interpretation clearly places the classroom teacher in a position to observe whether communication difficulties are affecting a student's academic skills. Therefore, teachers' knowledge about communication disorders, as well as their awareness of the impact of communication disorders on educational performance has important implications for appropriate referrals for special education services. Also, teachers' awareness of the impact of communication disorders to academic success is also important for a supportive collaborative relationship between the teacher and SLP.

PEDAGOGICAL CONSIDERATIONS RELATED TO COURSEWORK IN LANGUAGE DEVELOPMENT/DISORDERS

There have been challenges related to providing this information on language development and disorders to education majors. Papers presented at ASHA Conventions (Gunter, Koenig, & Curtin, 2003; Koenig & Gunter, 2004) addressed their experiences as instructors for an undergraduate course in language development and disorders for students enrolled in a special education curriculum. The authors presented the pedagogical challenges inherent in the instruction of such a course. Their conclusions stemmed from their observations of class discussions, criteria-based evaluations of examinations and papers, notations of trends in students' semester grades, attention to student feedback across the semester, and review of end-of-semester course evaluations.

The authors identified various pedagogical challenges inherent in this educational experience. One such challenge was the perceived irrelevance, by the students, of language-related courses to their academic curriculum and professional aims. Non-SLP students questioned the reasons for the inclusion of language-related courses in their curriculum and are resistant to explanations of the value of the information. Another challenge was the perceived difficulty, by the instructors, of the difficulty in both student comprehension and student application of language-related information. Non-SLP students presented a substantial number of complaints about how difficult the information was to understand, even after its presentation in diverse formats. The reputation of the language-related courses as difficult enhanced this perception. Another challenge was the students' confusion with respect to language-related terminology. Non-SLP students as a whole found it difficult to distinguish among basic concepts, such as speech-language-communication, and found it difficult to separate the technical from the casual meanings of these concepts and to recognize how different disciplines use different definitions. Yet another challenge was the students' deficits in both language-related and overall vocabulary. Non-SLP students as a whole found it difficult to understand basic language arts concepts related to parts of speech, sentence structures, and others. Non-SLP students as a whole also found it difficult to use accurate, technical terms to describe examples of communication behavior. In addition, the authors noted the instructional challenge of negative perceptions of and inconsistent reactions to instructional approaches. Reaction to a diverse assortment of instructional approaches was quite variable across students, as well as across sections of the course and semesters of instruction. The course instructors were unable to predict levels of instructional success for any particular approach over time.

As a result of their conclusions, the authors recommended the pursuit of a course of research to determine which, if any, factors are correlated with or, in fact, serve to predict student success in coursework in language development and disorders.

PURPOSE OF THE PRESENT RESEARCH

This research study examined whether there are variables that correlate with academic success in a language development course among both SLP and non-SLP students. The results of this study may contribute to the formulation of a future direction to pursue regarding the provision of language related information to non-SLP students and professionals. The process of providing a successful way to educate all professionals who work with children with special needs will fulfill provisions within the ASHA Code of Ethics, enhance service delivery models for children with language disorders, and build a stronger base for a collaborative partnership among the general education teacher, the special education teacher, and the SLP.

METHOD

RESEARCH QUESTION

This study addressed the question: What student-related and instructor-related variables correlate with and/or serve to predict successful completion of academic coursework in language development among undergraduate students?

RESEARCH DATA: NATURE OF DATA

This research used student information from archival records to comprise the accumulated data for this study. Archival data are defined as "any observations, texts, or analyses that pre-date a planned research project" (University of Calgary, 2005). The use of existing data to answer research questions is also referred to as secondary analysis.

RESEARCH DATA: NATURE OF DATA SET

The population for this data set consisted of archival data for 475 undergraduate students who attended an institution located in the American Midwest and completed an undergraduate class in language development. The archival data were used with the permission of the professor who taught this class over a period of 14 years from 1985 to 1999 and were structured in a way to ensure appropriate levels of confidentiality. The use of the archival data was approved by the appropriate Human Subjects Committee.

RESEARCH DATA: NATURE OF VARIABLES

Student Variables

Student Gender: Differences in academic performance among male and female students may delineate gender-related differences on patterns of thinking in college students that impact learning style differences (McKeachie, 2002). With the current representation of both male and female students in undergraduate programs, gender is a distinguishing personal characteristic to include as a variable in relationship to academic performance and will be considered in this study.

Student Major and Credit Hour Status: Demarie and Aloise-Young (2003) studied the level of interest that education students had in their college major and whether personal interest varied as a function of their year in school. Findings from their study reported that first-year education majors indicated a lower level of interest in their majors than upper-level students. In addition, their findings also suggested that first-year students who were taking courses in their majors have greater personal interest in those courses than in required core courses taken outside of their major. The distinction is made in this study that a required course may reflect different interest levels if it is offered by a different Department than that of the declared major.

Due to the impact that interest and academic performance may have in the choice of a particular major, variables correlated in this study will include the students' choice of majors, their credit status towards a declared major, as well as the semester in which the course was taken. Students in this course represent a total of 26 different majors, primarily split between the College of Education and the College of Arts and Sciences. For this study, a student's major identifies whether the discipline is housed in the College of Education or another College. The credit status of a student will indicate whether the student is a freshman, sophomore, junior, or senior. The course includes Fall and Summer enrollments, so the relationship of academic performance by semester will reflect any differences depending on the time of enrollment.

Required or Elective Participation: In a review of research, Boyar (1976) described research studies in which one criterion used in studies of undergraduate student ratings of college teaching included correlations between the ratings of instructors and whether the course was a requirement or an elective. The majority of the studies support the hypothesis that students enrolled in required courses tend to rate their instructors and courses lower than those enrolled in elective courses.

Traditional or Non-Traditional Student Status: A combination of certain personal characteristics also separates the student population into traditional and nontraditional students. The National Center for Education Statistics (NCES) identifies a nontraditional student based on the presence of one or more of the following characteristics: delayed enrollment (does not enter postsecondary education immediately following high school); part-time attendance; financially independent of parents; working full-time while enrolled; has dependents; is a single parent; and a recipient of a GED or high school completion certificate. For the purposes of this study, information provided by the archival data regarding the students' age and attendance status will identify their role as a traditional or nontraditional student.

Instructor Variables

Instructional Methods: Along with personal characteristics, instructional methods can affect learning ability in a classroom. Bligh (2000) summarized experimental studies in which lectures were compared with other teaching methods where acquisition of information was the criterion of effectiveness. These studies revealed that lectures were as effective as other methods to teach facts. However, according to McKeachie (2002), discussion methods are superior to lecture in student retention of information, transfer of knowledge to new situations, development of problem solving, thinking, attitude change, and motivation for further learning. For this reason, the methods of instruction in this language development and disorders course will be examined with other variables to determine if any relationship exists with the achievement of academic objectives identified for that course.

Instructor Experience: One possible influence on student learning could reflect changes in teaching methods as an instructor gains experience. The data collected for this research reflect the teaching experiences of one particular instructor. This situation provides an opportunity to investigate whether teaching experience impacts on student learning. One variable will examine whether increases in years of teaching is a factor in determining the academic success, at least as measured in traditional academic formats, of these students.

Evaluation Methods: Another factor associated with teaching influences is the method implemented to assess student learning. The primary method of providing this assessment is through grading procedures. Information from the student records indicate that during some semesters, grades were obtained from class exams only, while other semesters provided grades from tests as well as from out-of-class assignments. These different approaches to assessment will be another variable to consider in this study.

Valuable but Unavailable Data

Although the use of archival data for this study provided useful details, additional data could have been useful to this study if these had been available in the student records. One variable that would have been used, if available, would have been the students' Grade Point Average (GPA). This information could have been correlated with their academic performance in the language course and would have provided a way of comparing their present performance in a class with their cumulative academic performance. Another item that could have been reviewed as a possible variable would be the course completion and grade of a higher education level English and/or Linguistics course. Since past classes and grades for these classes were not listed in the student records reviewed, it was not possible to correlate academic performance between an English or Linguistics course with a language development and disorders course. The results of these correlations could have provided information as to whether there existed a relationship between these variables.

STATISTICAL ANALYSES

In this study, decisions were made to categorize information about students in a systematic way. In order to address the research question, the decision was made to convert data into dichotomous categories, whenever possible, to allow for statistical analysis. Several independent variables (also known as predictor variables) were coded in this study. The variable of *Student Gender* , already a dichotomous variable, used 0 = female student and 1 = male student. The variable of *Student Major,* already a dichotomous variable, used 0 = College of Education and 1 = Other College or School (which included the College of Arts and Sciences and each other major). The variable of *Course Selection,* already a dichotomous variable, used 0 = required course and 1 = elective course. The variable of *Student Age* was converted to a dichotomous variable, with 0 = traditional student and 1 = non-traditional. The variable of *Semester,* which reflected the time frame in which the course was offered and which was already a dichotomous variable, used 0 = Fall Semester and 1 = Summer Semester. The variable of *Instructional Method*, already a dichotomous variable, used 0 = lecture and 1 = lecture/discussion. The variable of *Evaluation Method,* already a dichotomous variable, used 0 = use of examinations only and 1 = use of examinations combined with other methods (such as papers or projects). In addition to these variables, in this study, some data, because of their nature, remained continuous. The variable of *Credit Hour Status* identified the number of credits that a student earned, with 1 = Freshman, 2 = Sophomore, 3 = Junior, and 4 = Senior. The variable of *Instructor Experience* addressed the length of time the instructor taught this particular course, with numbers between 1 and 14 to represent the number of years of actual experience. In addition to these independent variables, the *Final Course Grade* was used as the dependent variable to represent a measure of academic success in the course. Since the grading scale was based on continuous data, this variable was entered into the analysis as the numerical equivalent of the letter grade (i.e., A = 4.0, A- = 3.67, B+ = 3.33, B = 3.0, B- = 2.67, C+ = 2.33, C = 2.0, C- = 1.67, D+ = 1.33, D = 1.0, D- = .67, F = 0). The variables included for this study as continuous or dichotomous are listed in Table 1.

RESULTS

The data set for this study was compiled in a spreadsheet format using Microsoft Office Excel 2003 and was analyzed using both Microsoft Office Excel and SAS (Statistical Analysis System) 9.1 software, which is designed to perform analyses on large sets of data.

CORRELATION ANALYSIS OF DATA

An important consideration on the choice of whether continuous data are changed to a forced dichotomous variable is related to the statistical methods available to correlate the variables involved in a study. Statistical methods dictate the format of the data required for analysis. If one set of data is a true dichotomy and the other set is continuous, then the statistical method necessary to use for calculation of the correlation coefficient is the Point Biserial. This correlation coefficient was calculated via the use of the descriptive statistics of Microsoft Excel. The results of this analysis are presented in Table 2. Of the 55 correlation coefficients calculated, 26 coefficients were between 0.000 and 0.099. An additional 17 coefficients were between 0.100 and 0.199, while five were between 0.200 and 0.299, and four were between 0.300 and 0.399. The ranges of 0.500 to 0.599, 0.600 to 0.699, and 0.800 and 0.899 had one correlation each within them.

REGRESSION ANALYSIS OF DATA

The outcome of academic performance in this Language Development and Disorders course was measured by the Final Course Grade on a 0.0 to 4.0 grading system, with higher scores associated with academic success. The final grade in the course was identified as the dependent or outcome variable. Consideration was given to the following variables as predictor variables: personal characteristics of the student (age, gender, credit status, and major); the effect of the course when taken as an elective; and teaching methods of the instructor (instructional delivery format, grading format, and instructor experience).

Table 1. Continuous and dichotomous variables in the data set for this study.

Continuous Variables, N=3	Dichotomous Variables, N=7
Student Credit Hour Status	Student Gender (Male/Female)
Student Final Course Grade	Student Age (Traditional/Non-Traditional)
Instructor Experience	Student Major (Education/Non-education)
	Course Selection (Required/Elective)
	Semester Enrolled (Fall/Summer)
	Instruction (Lecture/Lecture-Discussion)
	Evaluation Format (Exams/Exams-Projects)

Table 2. Correlations of the variables in this study. 01 = Student Age. 02 = Student Gender. 03 = Student Credit Status. 04 = Semester. 05 = Student Major. 06 = Instructional Method. 07 = Course Mid-Term Grade. 08 = Course Final Grade. 09 = Evaluation Format. 10 = Required/Elective Course. 11 = Instructor Experience.

	01.	02.	03.	04.	05.	06.	07.	08.	09.	10.	11.
01.	1.000	0.104	0.184	0.096	0.157	0.070	0.098	0.053	0.031	0.385	0.072
02.		1.000	0.061	0.004	0.138	0.052	0.106	-0.147	0.050	0.208	0.062
03.			1.000	0.224	0.282	0.135	0.107	0.101	0.043	0.264	0.145
04.				1.000	0.028	0.682	0.125	0.033	0.511	0.137	0.302
05.					1.000	0.020	0.180	0.181	0.039	0.313	0.096
06.						1.000	0.118	0.003	0.230	0.141	0.013
07.							1.000	0.872	0.018	0.041	0.084
08.								1.000	0.020	0.023	-0.024
09.									1.000	0.056	0.330
10.										1.000	0.142
11.											1.000

Table 3. Two-tailed t-test p values for each variable analyzed.

Predictor Variable	P Value
Student Gender	<0.0001
Student Credit Status	<0.0001
Student Major	<0.0001
Required/Elective Course	0.231
Instructor Experience	0.343
Semester	0.449
Student Age	0.591
Instructional Method	0.920
Evaluation Method	0.928

Table 4. Regression analysis for variables with predictive value for success in a course in language development.

Variable	Parameter Estimate	Standard Error
Intercept	1.298	0.231
Student Gender	-0.853	0.200
Student Major	0.653	0.105
Credit Status	0.295	0.061
Required/Elective	0.539	0.449
CS/R Interaction	-0.220	0.111

Table 3 includes the p values for each of the variables. Based on the results of the *p* values, six variables were excluded as non-significant: age, semester, instructional method, grading format, and instructor experience. The remaining variables included gender, credit status, major, and course selection. If the *p* value > .05, the variable was considered non-significant in terms of demonstrating a relationship between the predictor and the outcome.

Table 4 includes the results for the regression analysis for each of the remaining variables, which attempted to determine the predictive value of each variable for eventual course success. The analysis revealed three main effects and one interaction effect among the predictor variables and the criterion variable. Described below are the intercept parameters that were calculated for each predictor variable. With respect to the variable of Student Gender, females scored 0.853 higher than males. With respect to the variable of Student Credit Status, for each increase of year in school, students had a corresponding increase in grade of 0.295. With respect to the variable of Student Major, students in non-education majors scored 0.653 higher than students in education majors. With respect to the variable of Course Selection, students enrolled in the course as an elective scored 0.539 higher than those for whom the course was a requirement.

Statistical regression analysis further investigated the interaction terms for all paired combinations of the significant variables. Of these combinations, only the interaction between credit status and course requirement proved to be significant and identified as the only interaction in the model. The interaction parameter for these variables, -.220, indicates that the relationship between the course requirement variable and the grade varies depending on the grade of the student. For example, if the class is taken as an elective, particular results are predicted. For Freshmen for whom this is an elective, 0.22 is subtracted from the grade, (.539 - .22), and these students will score .319 higher than freshman required to take the class. For Sophomores for whom this is an elective, 0.44 is subtracted from the grade (.539 - .44), and these students will score .099 higher than sophomores required to take the class. For Juniors for whom this is an elective, 0.66 is subtracted from the grade (.539 - .66), and these students will score .121 lower than juniors required to take the course. For Seniors for whom this is an elective, 0.88 is subtracted from the grade (.539 - .88), and these students will score .341 lower than seniors required to take the class.

The final regression model is now presented. The R-squared (R^2) for the model is .11, meaning that the model explains 11% of the variability in predicting the grade. The model is: 1.298(Intercept) + .853*Gender + .295*Credit Status + .653*Major + .539*Requirement + .220 Credit Status//Requirement Interaction = Final Course Grade.

DISCUSSION

This study addressed the question of whether any factors correlated with and/or predicted the academic success of undergraduate students in a language development course. The primary objective of exploring the issue of success in this course is the mandate of meeting the needs of certification and/or licensure requirements for professionals in various disciplines. One of these requirements refers to obtaining knowledge specific to language development and disorders. Student success in this course indicates compliance with this requirement. This section discusses the results of the statistical analyses of data to address the aforementioned question.

CORRELATION DATA

Items with Highest Correlation (0.800 to 0.899)

The highest correlation was between the midterm grade and the final grade. This relationship is expected since the final grade consists of the same grades that make up the midterm. However, this correlation indicates that the midterm grade is positively correlated with the final grade and that, as one variable increases, the other increases, as well.

Items with Higher Correlation (0.500 to .699)

The variables of semester and instruction method achieved the second highest correlation among the variables. This could indicate that the instruction method demonstrated a relationship with the semester in which the course was taken. Due to the difference in the class schedule between a fall and summer semester, the choice of an instruction method that included discussion may have been related to the use of time allotted for a daily lesson. This correlation indicates that the variables of semester and instruction used during the particular semester had a positive relationship.

The variables of semester and grading format also revealed a correlation within this range. Again, the different structures of a summer and fall semester may have influenced the choices given for out-of-class assignments. The fall semester permits a longer period of time between classes, and is better suited for projects. The relationship indicated from this correlation may reflect patterns that are determined due to the semester in which the course was offered.

Items with Lower Correlations (0.300 to 0.399)

There were four variables that revealed correlations in this range. Two correlations involved course selection as one of the variables. Course selection correlated with both age and major in this range. It is likely that the influence of both of these personal characteristics impacted with the choice of whether this course was taken as an elective or required class. However, although a correlation in this range is low, this study did review data from a large sample size.

The second set of correlations in this category both involved the variable of instructor experience. The two variables that correlated with instructor experience was semester and grading format. The increase in time teaching a particular course could allow philosophies to emerge regarding particular grading procedures, which could be reflected by this relationship. The last sets of variables correlated in this range indicate some relationship between experience and semester of course. This could simply reflect a preference or availability of an instructor to teach during a fall or summer session.

Items with Lowest Correlations (0.200 to 0.299)

There were two sets of variables that correlated in this range with course selection, credit status and gender. It may be that whether a course was taken as an elective or required course was determined by the credit status of the student. Credit status was also correlated with major and semester. Depending on the requirements of the particular degree or the availability of the course, these situations could have influenced the relationship between these two sets of variables. The two variables of instruction method and grading format were also correlated in this range. The instruction method used during a particular course could affect the structure of the grading format offered to assess learning.

REGRESSION DATA

In addition to the calculation of correlation coefficients, which indicated strength of relationships between individual variables, a multiple regression procedure revealed patterns in these data. This procedure revealed, overall, that those variables related to student characteristics were more predictive of success than variables that reflect teaching influences. According to the data from this study, students who experienced the most success in the course from which these archival data were used were female, junior or senior level undergraduate, and enrolled in academic departments other than those related to Education. The relative predictive value for these variables was expressed in the formula at the conclusion of the Results section.

Predictor Variable 1: Gender

The majority of students enrolled in this particular language development and disorders course were female. Male students represented 5% of the total number of students included in this study. However, academic achievement is of interest to compare between female and male students enrolled in this course. Female students averaged a 2.57. In comparison, grades of the male students averaged 1.91. The lower grade scores of males can be interpreted to indicate that male students included in this study experienced more difficulty achieving success in this class.

Among the male students, there were also patterns that existed by the student's major. Among that percentage of the male students, 19% were education majors. The average grade for male education majors in this study was 1.47. The average grade in this course for those male students with majors other than education increased to 2.03. The performance of male students with education majors fell below the average for the overall performance of the male student population in this course. This may indicate that learning differences exist for students in this course based on their gender as well as their major.

Predictor Variable 2: Credit Hour Status

Regarding the variable of credit status, results indicate that freshman and sophomore students earn lower grades in this course than juniors and seniors. A possible explanation of this occurrence supports the Model of Domain Learning, created by Alexander (as cited in DeMarie & Aloise-Young, 2003). This Model states that as students enter the later stages of their education (the expert stage), personal interest in their major increases. This increase in personal interest and a stronger commitment to a major could explain the increase of academic success among these students. It could also reflect on the improvement of study skills and persistence in learning that accompanies students' progression in an academic environment. The prediction formula also revealed a specific interaction between credit hour status and the status of the course as required or elective. The influence of whether a course is taken as a requirement or elective revealed a pattern in which academic performance decreased when the course was taken as an elective as the credit hour status increased. In this case, if a junior or senior level student takes this class as an elective, then the outcome for success is less than for a freshman or sophomore level student. This relationship possibly occurs as a result of an increase in focus on required courses as a student nears completion of a program of study. It also could reflect on the possibility that a freshman or sophomore level student may still be exploring his or her interest in other coursework which he or she is completing as an elective.

Predictor Variable 3: Academic Major

Students enrolled in the Language Development and Disorders course for this study represented a total of 26 different majors divided primarily between the College of Education and the College of Arts and Sciences. The results from this study support that students enrolled with majors offered through the College of Arts and Sciences achieved higher academic success than those students with majors in the College of Education. The distinction between these two colleges may indicate whether preparatory coursework taken before this course assisted those students to achieve higher levels of success in this particular course. Also, credit status was supported by this study as an indicator of higher academic success in this course. As reported by Willingham (1985), students with lower grades obtained as freshmen and sophomores are more likely to change majors. Further research is needed to evaluate whether poor performance in this class by education majors also reflects their achievement in other coursework for their major, as well as consideration of their credit status when enrolled in the course. It remains an important issue to further investigate factors that enhance the performance of education majors in this coursework.

IMPLICATIONS OF THE STUDY

Results from this study provide support for evidence of a relationship between certain variables and academic success in a language development course. Results also establish a foundation for examining characteristics of a specific student population and for identifying relationships among certain of these characteristics that had a predictive effect on higher achievement in the class.

Clarification must be made that this does not infer causation but instead can be useful as a way of explaining the variability that occurs in this particular set of students.

An unexpected result was the interaction effect between credit status and an elective course. However, this finding supports the value of conducting statistical analyses, which can offer insight into relationships that may not be superficially apparent.

It is also important to reflect on pedagogical challenges that this study presents. The interaction effect reveals questions regarding the motivation to learn at different times in a student's course of study. It also invites speculation regarding why certain populations of students, e.g., females and non-education majors, are more successful in this course than males and lower division students. This speculation could pertain to the learning styles, study habits, or even personal interests of students in these groups. The search for answers may lend support to teaching methods to increase student interest and achievement in this course.

DIRECTIONS FOR FUTURE RESEARCH

Results from this study indicate that the personal characteristics included in these archival data account for a relatively small amount of the variance that occurs in the academic performance of students in this particular language development course. It is important to remember that the variables in the regression model only explain 11% of the variability of academic success for this class. This indicates the need to explore additional factors in order to further explain how students can successfully learn basic information about language development. These factors could include information about students' GPAs, which could reflect on their overall interest and aptitude in academic achievement, as well as information about their relevant entrance scores, such as ACT and SAT verbal measures. Additional personal information could include their academic performance specific to other language based classes, such as English, Linguistics, or Language Arts. Another future study could explore prior knowledge of basic concepts of language development before taking the class, then could compare this preparation with the final grade in the course. This type of study could help to determine the knowledge base that students bring into the class at the beginning and provide direction for teaching these students in a more effective manner. These possible future studies could provide additional information to better understand the student population who enrolls in this course. It remains important to continue to identify different factors that affect academic performance in this class in order to improve the knowledge base of students across various disciplines regarding language development.

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JOURNAL

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