CHOOSING REMEDIATION TARGETS FOR NAMING DEFICITS IN PROBABLE ALZHEIMER DISEASE: DOES TYPICALITY MATTER?

By

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The purpose of this single session exploratory study was to determine if remediation targets could be selected to improve picture naming and promote generalization to untrained items in 12 adults with early probable Alzheimer disease (PAD). Because theories support competing predictions about the relative effects of training typical versus atypical semantic category members with respect to subsequent generalization, this study contrasted the effects of training typical and atypical semantic category exemplars. Specifically, it examined changes in picture naming and category generation following initial repetition of the items at pretest followed by a semantic training. Stimuli included 24 items from each of 3 semantic categories, half of the items were typical and half atypical based on Rosch's norms. Two categories received training, one using a subset of typical items, one using a subset of atypical items; the third category remained untrained to track effects of repetition. The untrained category showed nonsignificant improvements at post-test. Accuracy scores improved for all trained categories; however, only trained, typical items were named significantly faster at post-test. Generalization was found in the untrained typical items in the categories that were trained with typical items, which were named more accurately at posttest. Neither atypical items from the categories that were trained with typical items nor any of the items in categories that were trained with atypical items showed improved accuracy after training. These findings are consistent with those of other researchers investigating the semantic deterioration in adults with PAD. Several studies have found an advantage for typical items in this population. These findings are attributed to the redundant connections among features in typical items, which allow them to be more resilient in the face of progressive damage, allowing them to be more responsive to intensive semantic training. Atypical items lack the redundancy of connections and, thus, are more vulnerable to damage. These findings are extremely encouraging for the development of principled strategies for choosing items to encourage generalization in the remediation of anomia, as well as for the development of lexical-semantic treatment paradigms for individuals with early PAD.

CHAPTER 1
INTRODUCTION

Probable Alzheimer disease (PAD), a progressive neurodegenerative disease, is the most prevalent type of acquired cognitive dysfunction (Thal, 1999) and affects over four million Americans (Kawas & Katzman, 1999). The prevalence of PAD accounts for 50-80% of patients with dementia (Chui, 1989) and comprises the greatest percentage of the dementias in the geriatric population (Chui, 1989; Henderson & Finch, 1989; Sclan & Kanowski, 2001). Furthermore, PAD is already considered to be a major public health concern, and by 2025, the number of Americans affected by the disease is expected to be 12 million (Rosenberg, 2005) and 14 million by 2050 (Katzman & Fox, 1999). Although there is no known cure for PAD, and only symptomatic treatment is available at this time, current research endeavors are aiming to halt the progression of the disease as well as prevent its occurrence (Petersen et al., 2001; Rosenberg, 2005). Reducing the disability until this occurs is important (Rothi et al., 2005). Furthermore, when drug therapies are available that halt the progression of the disease, there will be a demand for linguistic and cognitive rehabilitation for this population. Therefore, it is incumbent upon speech-language pathologists to develop and test appropriate treatments for this population now, so that tested methods are available that address the language difficulties in PAD (ASHA, in press), which largely revolve around word finding

Word finding difficulties (i.e., anomia), as measured by poor performance on picture naming tasks have been widely reported in adults with PAD (Barbarotto, Capitani, Jori, Laiacona, & Molinari, 1998; Bayles, 1982; Bayles & Tomoeda, 1983;

Benson & Geschwind, 1985; Heilman, 2005; Hodges & Patterson, 1995; Hodges, Patterson, Graham, & Dawson, 1996; Huff, Corkin, & Growdon, 1986; Huff, Mack, Mahlmann, & Greenberg, 1988; Kirshner, Webb, & Kelly, 1984; Martin & Fedio, 1983; Smith, Faust, Beeman, Kennedy, & Perry, 1995; Smith, Murdoch, & Chenery, 1989; Williams, Mack, & Henderson, 1989; Williamson, Adair, Raymer, & Heilman, 1998). However, to date, there are only three PAD anomia treatment studies (Abrahams & Camp, 1993; Ousset et al., 2002; Rothi et al., 2005), and only one has reported generalization to untrained items (Abrahams & Camp, 1993). Consequently, developing treatments for this population that reduce the word finding difficulty is important (Rothi et al., 2005), especially those that promote generalization.

Generalization of learning, an essential objective for rehabilitation (Kearns, 1989; Thompson, 1989), has been described as an observation of an occurrence of a particular trained behavior in a context that has not been trained (McReynolds, 1989). Generalization is important for several reasons, including the clinical accountability of the speech-language pathologist to use methodologies to measure the effectiveness of treatment (Kearns, 1989). The mechanism underlying generalization has been a long-standing question (Martin, Laine, & Harley, 2002), and although cognitive models have been advanced over time, the construct of generalization remains a mystery (Francis, Clark, & Humphreys, 2002). Perhaps due to this, there is still a lack of generalization reported in the literature (Francis et al., 2002; Kearns, 1989; Kiran & Thompson, 2003b; McNeil et al., 1998; McReynolds, 1989; Nickels, 2002; Thompson, 1989; Thompson, Ballard, & Shapiro, 1998; Thompson et al., 1997; Thompson, Shapiro, Kiran, & Sobecks, 2003). Moreover, attempts to replicate methods that have promoted generalization in initial studies have not always been successful (McReynolds, 1989; Thompson, 1989).

There are two types of generalization that, according to Thompson (1989), play an important role in aphasia rehabilitation: response generalization (i.e., when an untrained response occurs after other responses have been trained (e.g., production of different, untrained items) and stimulus generalization (i.e., when there is carryover of a trained behavior to a different, untrained stimulus condition, e.g., outside of the clinic). Without the former, there would be an inordinate number of responses to train, and without the latter, trained behaviors would occur only in the clinic setting (Thompson, 1989). Although both of these are important, the current study focuses only on response generalization.

Several investigators (Hillis, 1998; Kiran & Thompson, 2003b; Plaut, 1996; Thompson, 1989) have suggested that treatment studies might be able to influence the recovery of language if they target factors that are modifiable. A principled selection of materials for training as well as for testing generalization is just one example of this (Hillis, 1998; Kiran & Thompson, 2003b; Plaut, 1996; Thompson, 1989; Thompson et al., 2003). One technique that has successfully induced generalization is to have a structural relationship among and across the stimuli (Stokes & Baer, 1977; Thompson, 1989; Thompson et al., 1998; Thompson et al., 1997; Thompson et al., 2003). One approach recommends choosing stimuli that are more versus less complex, a factor that has been shown to be important for increasing generalization to untrained items (Kiran & Thompson, 2003b; Plaut, 1996; Thompson et al., 1998; Thompson et al., 1997; Thompson et al., 2003). This phenomenon has been referred to as the “complexity effect” and the Complexity Account of Treatment Efficacy (Thompson et al., 1998; Thompson et al., 1997; Thompson et al., 2003), which has been successfully used in syntactic treatment studies in the aphasia population.

Kiran and Thompson (2003b) have equated the notion of semantic complexity with category typicality (i.e., by the degree to which a semantic category exemplar is similar to the category prototype, as described Rosch, (1975)) and applied this to a semantic training in adults with aphasia. In this study, Kiran and Thompson (2003b) found generalization to untrained items after atypical items from a category were trained. Findings from this study replicated similar results from a connectionist model that were simulated in a computer experiment of acquired dyslexia (Plaut, 1996). In a similar study, Stanczak, Waters, and Caplan (2006) reported generalization for one of two participants with aphasia, after training atypical category exemplars. However, two other aphasia naming treatment studies (Mayer, Murray, & Karcher, 2004; Stanczak, Waters, & Caplan, 2005) did not find generalization following trainings with either atypical and typical items, although treatment effects were observed. Thus, it is important to further explore the effectiveness of training typical or atypical category exemplars as a strategy to encourage generalization (Murray & Clark, 2005).

All of these studies (Kiran & Thompson, 2003b; Mayer et al., 2004; Stanczak et al., 2005, 2006) have tested the predictions of the Complexity Account of Treatment Efficacy (Thompson et al., 2003), and contrasted it with an older approach based on the family resemblance/prototype hypothesis by Rosch (1975). Arguments based on this view center around the benefits of training qualities or features that are shared among many members of a semantic category, so that many items in the category might benefit, and thus, it provides a rationale for training typical items, which contain a larger proportion of shared features. The structure of a semantic category is an essential element in the rationale for treatments based on typicality (Plaut, 1996); therefore, a population with preserved category structure such as individuals with PAD (Flicker, Ferris, Crook, & Bartus, 1987; Huff et al., 1986; Martin & Fedio, 1983; Nebes, Boller, & Holland, 1986; Salmon, Butters, & Chan, 1999; Schwartz, Marin, & Saffran, 1979; Schwartz, Kutas, Butters, Paulsen, & Salmon, 1996; Warrington, 1975) might be optimal for testing these hypotheses.

Some theories of how semantic representations are affected by PAD have specifically suggested that items that have many shared or intercorrelated features might be more preserved in PAD compared those with representations primarily consisting of distinguishing features, with relatively fewer shared features (Altmann, Kempler, & Andersen, 2001; Devlin, Gonnerman, Andersen, & Seidenberg, 1998; Gonnerman, Andersen, Devlin, Kempler, & Seidenberg, 1997). This literature combined with the evidence that the PAD population has worse performance on atypical items compared to typical items (Sailor, Antoine, Diaz, Kuslansky, & Kluger, 2004; Smith et al., 1995) provides further incentive to compare performance by adults with PAD on typical category exemplars, which have many shared features, and atypical category exemplars, which have relatively fewer shared features.

This exploratory study extends the small body of research comparing the effects of training typical and atypical category exemplars in adults with aphasia (Kiran & Thompson, 2003b; Mayer et al., 2004; Stanczak et al., 2005, 2006) to those with mild-moderate PAD using a modified version of the semantic feature generation task (Boyle, 2004; Boyle & Coelho, 1995; Coelho, McHugh, & Boyle, 2000). Since there were no reports of this type of training with the PAD population, it seemed appropriate to first apply it in a single session to determine its feasibility. Thus, the first aim of the study was to determine if there is a facilitation effect (Hickin, Best, Herbert, Howard, & Osborne, 2002; Howard, 1985; Howard, Patterson, Franklin, Orchard-Lisle, & Morton, 1985; Patterson, Purell, & Morton, 1983), for trained items from either item repetition alone (Kendall, personal communication, 2005, Fuller et al. 2001; Hickin et al., 2002; Mayer et al., 2004; Patterson et al., 1993; Rothi et al., 2005) or from the repetition plus a semantic training (Drew & Thompson, 1999; Le Dorze, Boulay, Gaudreau, & Brassard, 1994; Wiegel-Crump & Koenigsknecht, 1973). The second aim of the study was to determine whether there was generalization of training to untrained items in the semantically trained categories. The third aim of the study was to examine generalization to an untrained task, category generation, using the same semantic categories as the naming and feature analysis tasks.

The structure of this study is as follows. The next two chapters provide reviews of the literature. Chapter 2 discusses the naming deficits (i.e., anomia) in adults with PAD, and the anomia treatment studies for this population. The third chapter provides background information on semantic theory, the two competing views, the relevant findings from the connectionist model (Plaut, 1996) and the treatment studies in adults with aphasia using semantic category exemplar training with typical and atypical items (Kiran & Thompson, 2003b; Mayer et al., 2004; Stanczak et al., 2005, 2006). This is followed by a description of the current study, including rationale for applying these techniques to adults with PAD. Additional findings from the aphasia treatment literature are identified as they relate to the methodology for our study. Finally, our research questions and predictions based on the above literature are described. In Chapter 4, the study methods are explained in detail, followed by the results and discussion in Chapters 5 and 6, respectively. To foreshadow our results, this exploratory study provided good preliminary evidence that semantic training can have significant effects on the anomia found in PAD, and, with judicious choice of stimuli, this training may potentially generalize to other items in the same category.

CHAPTER 2
REVIEW OF THE LITERATURE 1: NAMING DEFICITS IN PAD

It is common for patients in the early stages of PAD to have picture naming deficits (Appell, Kertesz, & Fisman, 1982; Barker & Lawson, 1968; Bayles & Tomoeda, 1983; Chertkow, Bub, & Seidenberg, 1989; Flicker et al., 1987; Grossman et al., 2004; Kirshner et al., 1984; Lipinska & Backman, 1997; Schwartz et al., 1979; Warrington, 1975; Williams et al., 1989; Williamson et al., 1998). Furthermore, the exact nature of the naming deficit in PAD is controversial (Bell, Chenery, & Ingram, 2001; Nebes, 1992; Nebes, Brady, & Huff, 1989) regarding whether the deficit stemmed from impaired visual-perception, semantic memory, or lexical access (Nebes, 1989). An early theory suggested that visual misperception is the reason for the naming deficit, and this is based on the presence of visuo-perceptual errors, presumably due to difficulties perceiving the object (Barker & Lawson, 1968; Kirshner et al., 1984). These theories and studies providing evidence are discussed below, beginning with the semantic deficit, then the lexical access, and followed by the semantic and lexical access deficit. Next, a discussion of the few naming treatment studies that have targeted this population is provided (Abrahams & Camp, 1993; Fuller et al., 2001; Ousset et al., 2002; Rothi et al., 2005). These PAD naming therapy studies achieved a naming treatment effect (i.e., acquisition) but only one also reported generalization (Abrahams & Camp, 1993). This limited number of studies suggests a need for further research. Insights from all of these studies and additional research from the aphasia literature provided techniques that were applied in our exploratory study comparing the effects of training typical and atypical category exemplars.

Semantic Memory Deficit in Probable Alzheimer Disease (PAD)

Several studies have suggested that there is semantic memory loss or degradation and, consequently, a loss of information about semantic representations (Alathari, Trinh Ngo, & Dopkins, 2004; Hodges & Patterson, 1995; Hodges et al., 1996; Hodges, Salmon, & Butters, 1991, 1992; Huff et al., 1986; Huff et al., 1988; Margolin, Pate, Friedrich, & Elia, 1990; Martin, 1992; Salmon, Butters et al., 1999; Salmon, Heindel, & Lange, 1999; Salmon, Shimamura, Butters, & Smith, 1988; Schwartz et al., 1979). Evidence for this theory includes impaired naming with semantic errors related to the superordinate category or an associate item within the category (Bayles & Tomoeda, 1983; Martin & Fedio, 1983; Salmon, Butters et al., 1999); the presence of consistent naming responses at two different test periods (Henderson, Mack, Freed, Kempler, & Andersen, 1990) an association between the inability to name an item and the inability to recognize its name (Flicker et al., 1987; Huff et al., 1986; Huff et al., 1988); and a relationship between the naming failures and the lack of core information provided about the corresponding item (Hodges et al., 1996). In addition, deterioration of semantic memory in PAD has been described based on poor performance on explicit tasks such as picture naming tasks and category fluency (Bayles & Tomoeda, 1983; Chertkow & Bub, 1990; Flicker et al., 1987; Huff et al., 1986; Martin & Fedio, 1983); tasks requiring generation of semantic feature knowledge (Alathari et al., 2004), generation of verbal definitions (Garrard, Lambon Ralph, Patterson, Pratt, & Hodges, 2005; Hodges et al., 1996); as well as questions targeting feature knowledge (Chertkow et al., 1989; Giffard et al., 2002). Other tasks that have showed similar findings include making judgments about semantic relatedness

(Bayles, Tomoeda, & Cruz, 1999); and associating words, defining words, and ranking associations (Abeysinghe, Bayles, & Trosset, 1990).

There appears to be different interpretations or variants of this theory of semantic memory loss or degradation in PAD. For example, several investigators have found that, while attribute knowledge about a specific concept or exemplar in a category is impaired, superordinate category knowledge is preserved (Chertkow & Bub, 1990; Flicker et al., 1987; Giffard et al., 2002; Giffard et al., 2001; Hodges et al., 1991; Huff et al., 1986; Lukatela, Malloy, Jenkins, & Cohen, 1998; Martin & Fedio, 1983; Nebes et al., 1986; Salmon, Butters et al., 1999; Schwartz et al., 1979; Warrington, 1975). This led some researcher to assert that the attributes of concepts are degraded in PAD (Chertkow et al., 1989; Giffard et al., 2002; Giffard et al., 2001; Martin, 1992; Martin & Fedio, 1983).

Martin (1992) suggested that random damage from the pathological process of PAD resulted in changes to the semantic representations such that they would be degraded and thus more similar to one another. With progression of the disease, the ability to distinguish between items in the same category would be diminished. Thus, on a confrontation naming task, a semantic representation would be activated but it would lack the specificity needed to correctly name the item and, as a result, several lexical entries would be activated. Therefore, when the person with PAD sees a picture, the semantic representation that is activated may be underspecified in terms of the details. This is due to the absence of the essential attributes knowledge for that item such that the activated distinguishing features of that object are not strong enough to rule out other similar items (Altmann et al., 2001; Devlin et al., 1998; Gonnerman et al., 1997; Martin, 1992).

A property verification task has also been used in a group of adults with PAD (Smith et al., 1995). Participants were asked to verify brief statements containing information about an item's properties. The items were high or low typicality (and dominance, which relates to the relevance of the meaning of the item and is correlated with typicality) category exemplars. The statements were either distinguishing characteristics (i.e., distinctive) or shared features (i.e., common to the other items in that category). The results from the accuracy scores and reaction times indicated a degradation of property level information, particularly regarding both low dominance typicality items in the category. This was not interpreted as a loss of representations of the items' properties or a reorganization of relationships among properties of objects. Instead, Smith et al. (1995) offered this as evidence that the representations of category exemplars that are low-typical and low dominant have been degraded by the Alzheimer pathology. Furthermore, these investigators hypothesized that task demands might be a reason for differences in the literature. Smith et al. (1995) suggested that implicit knowledge allows adults with PAD to have faster verification response times. Thus, in a category verification task, the demands probably do not need the full semantic specification. Smith et al. (1995) also suggested that while explicit knowledge is needed to assess information could be impaired, for example, tasks requiring the participant to use relevant information in a ranking task. This example comes from Grober, Buschke, Kawas, and Fuld (1985) who reported that performance on an attribute ranking task showed that attributes about a concept are preserved, but that the *organization* of semantic information is altered by the disease process. Another example from Smith et al. (1995) is that the naming process involves computation such that an object's properties are activated to allow for distinction among other category members. If Alzheimer disease processes affect both distinguishing and shared features that are low dominant and low typicality, this could interfere with complete activation of the object representation (Smith et al., 1995). Consequently, it would reduce the accuracy on a naming task. Better performance is seen when contextual information is provided, yet when the task involves full semantic representation without the support, performance declines (Smith et al., 1995).

While the evidence above for a progressive deterioration of the semantic system comes largely from tasks requiring explicit access of semantic representations, evidence for an overall preservation of semantic category knowledge comes from tasks that require only implicit knowledge of word semantics.

For example, adults with PAD did not show a priming effect on a stem-completion task and had reduced number of productions for the second semantically related item on a free association task (Salmon et al., 1988). Hyper-priming has been reported on lexical decision tasks and found to be associated with degraded semantic representations (Chertkow et al., 1989; Giffard et al., 2002; Margolin, Pate, & Friedrich, 1996; Martin, 1992). To account for the hyper-priming in PAD, Martin (1992) suggested that changes in semantic activation are more robust for processing information that is degraded, such that a degraded semantic network benefits more from a semantic prime in than an intact semantic network. To account for the difference in performance on tasks requiring implicit versus explicit access to semantic representations, it has been suggested that participants with PAD have difficulty performing an intentional search through semantic memory, but perform relatively normally when relying on the automatic spread of activation in the semantic network (Chertkow & Bub, 1990; Nebes, 1992; Ober, Shenaut, & Reed, 1995).

All of these studies with explicit and implicit tasks suggest that at some level, the semantic system is impaired (due to loss or degradation), and different investigators have used different tasks and methodologies to address this. However, this theory does not go unchallenged; an alternative argument suggests that lexical access, specifically, access of the phonological word form from semantics, is the primary deficit in PAD.

Lexical Access Deficit in PAD

Several researchers have argued that the naming impairment in PAD results from impaired access to the phonological form of the word (i.e., a retrieval deficit) in the presence of an overall intact semantic knowledge structure (Albert & Milberg, 1989; Benson & Geschwind, 1985; Nebes, 1992; Nebes et al., 1986; Nebes et al., 1989; Nebes, Martin, & Horn, 1984; Neils, Brennan, Cole, Boller, & Gerdeman, 1988; Ober & Shenaut, 1999; Thompson-Schill, Gabrieli, & Fleischman, 1999). Along these lines, it has been suggested that the presence of semantic errors is actually an indication that knowledge about the item is intact, despite the lack of the ability to retrieve it, rather than in indication of a semantic impairment (Nebes, 1989).

Semantic priming paradigms (as discussed earlier) have been employed to evaluate the status of semantic memory via an implicit task, in order to reduce the participant’s use of attentional mechanisms (Ober, 1999). There are reports of normal priming in adults with PAD (Nebes et al., 1984), as well as reports of hyper-priming which have been interpreted as being caused by abnormal attentional processes in the presence of preserved semantic memory (Hartman, 1991; Ober & Shenaut, 1995; Ober et al., 1995). In a meta-analysis of semantic priming studies, Ober et al. (1995) reported that hyper-priming was due to attentional mechanisms which co-occurred with large increases in reaction times found in controlled priming paradigms. These researchers argued that the hyper-priming represented evidence that automatic spreading activation was occurring among semantic representations in the semantic priming task (Ober et al., 1995). Further evidence for this comes from another study by Ober and colleagues (1995) in which adults with PAD, as well as healthy young and older adults participated in a series of lexical decision tasks. Results showed that priming effects were equal across the groups. The PAD group demonstrated longer reaction times on low frequency words before making lexical decisions, and this was interpreted as an indication that additional time was needed for reaching activation level threshold for these items. Ober et al. (1995) argued that these data reflected an intact semantic memory structure in PAD.

Two event-related potential (ERP) studies offered more support for an access deficit in PAD (Ford et al., 2001; Schwartz et al., 1996). Event related potentials measure electrical manifestations of particular psychological processes that occur in preparation for or in response to discrete events (Fabiani, Gratton, & Coles, 2000; Kutas & Hillyard, 1980). The N400 is a negative going deflection occurring at ~400 ms and occurs in response to anomalous information, specifically, semantic violations; for example it is larger when the prime is unrelated to the target compared to when it is related (Fabiani et al., 2000; Kutas & Hillyard, 1980). Schwartz et al. (1996) compared healthy older adults and adults with PAD to determine whether or not the specificity of a category prime had a differential effect on the degree of semantic priming in these two populations. Using a variation of a category verification task, the investigators asked the participants first to listen to a prime that was delivered auditorily as a name of a category (different levels, e.g. superordinate and subordinate) and then, to read the written presentation of the target name (i.e., a member of a category). While the most robust priming effects were found in the young adults, the smallest priming effect and slowest reaction times were found in the PAD group. Responsiveness to the category manipulation was revealed in priming effects that were similar across the groups, not just in the reaction times but also in the ERP N400 congruity effects being larger on some levels, for example, the subordinate category level. Thus, category level manipulation affected the PAD group, and this was interpreted as evidence for an intact semantic network. In contrast, longer response times and smaller priming effects were attributed to the demands of the task and the necessity of searching through memory while engaged in online processing required for this and other similar tasks (Schwartz et al., 1996).

In a more recent ERP study, Ford et al. (2001) examined priming based on age and dementia, and asked whether the N400 amplitude could be used to show specific semantic memory deficits for objects that could not be named. The participants (adults with PAD, healthy young controls and healthy older adult controls) completed a pretest confrontation picture naming task consisting of items from 12 semantic categories. The following week, the participants completed a picture naming verification task while ERPs were measured. The participants were instructed to press a button to indicate whether or not the prime (a picture) matched the target (a word). The consistent finding across the groups was that for a word that did not match the picture, there was a more negative N400 amplitude. The ability of the PAD group to correctly name pictures was not associated with the N400 priming effect or any corresponding scalp distributions. Thus, despite an inability to access the name of an item, there was evidence from the N400 results that the PAD group had sufficiently intact knowledge for priming responses at the cortical level (Ford et al., 2001).

It has been suggested that while the structure of semantic memory is not damaged in PAD, there is a generalized cognitive processing deficit, which is required for intentionally retrieving and evaluating information, and decision making (Nebes, 1992). This results in word retrieval or access deficits. Two ERP studies (Ford et al., 2001; Schwartz et al., 1996) also provide evidence for a fairly preserved semantic structure in PAD. Additional support for an access deficit in PAD comes from the finding by Ousset et al., (2002) that initial syllable cues and the sound representing the item were among the most effective cues during a oral naming to definition task, while providing the semantic category was the least effective.

Semantic Impairment and Lexical Access Deficit in PAD

The most likely explanation of these disparate findings is that the naming deficit in PAD is due to a combination of a breakdown in both semantic memory *and* retrieval abilities (Bowles, Obler, & Albert, 1987; Huff et al., 1988; Watson, Welsh-Bohmer, Hoffman, Lowe, & Rubin, 1999; Williamson et al., 1998). This has been suggested based on results from confrontation naming and fluency tasks.

Williamson et al. (1998) made predictions about performance of healthy older adults compared to adults with PAD on two confrontation naming tasks: the Boston Naming Test (Kaplan, Goodglass, & Weintraub, 1983) and the Action Naming Test (Nicholas, Obler, Albert, & Goodglass, 1985), based on knowledge about the underlying anatomy and PAD pathology. More specifically, they predicted that, compared to action naming; object naming would be more impaired in PAD. This was because the disease process had resulted in more extensive damage to the left temporal area which is needed for naming objects, compared to the frontal areas required for naming actions. Compared to the control group, the participants with PAD were less accurate on both measures, but their overall performance was worse on the BNT, on object naming test, compared to the Action Naming Test. Williamson et al. (1998) suggested that object naming revealed significant impairments at the semantic specification and lexical levels. However, for action naming, the impairment was mostly at the semantic specification level, while the lexical level remained fairly intact. The authors also attributed the presence of more No Response errors on objects than on actions to the corresponding damage to the anatomy that underlies that function. Williamson et al (1998) concluded that compared to healthy older control participants, adults with PAD are not as accurate when they name objects and actions. Furthermore, the degree of deficit is more pronounced with objects, which was attributed to impairment not just at the semantic specification level, but also at the level of lexical access. Based on these findings, we designed our study to address both of these levels of deficits. The participants engaged in both lexical and semantic tasks to stimulate the system at both the lexical (e.g., repeating the correct name of the item to access the word form) and semantic levels (e.g., answering questions about semantic features of the item).

In summary, the naming impairment in PAD has been attributed to a loss of or degradation in semantic memory storage and/or organization, disruption of the retrieval of the information in the network, a combination of these, or other factors related to task demands. However, there is reason to believe that the semantic structure, at least in terms of semantic categories, is still fairly preserved in early PAD (Flicker et al., 1987; Huff et al., 1986; Martin & Fedio, 1983; Nebes et al., 1986; Salmon, Butters et al., 1999;

Schwartz et al., 1979; Warrington, 1975). For example, although Cronin-Golomb et al. (1992) reported longer reaction times on a category decision task as well as smaller number of items on a category generation task, the pattern was normal across categories and items were ranked by typicality in a normal manner. This was interpreted as being a reflection of intact semantic category organization (Cronin-Golomb et al., 1992).

Naming Treatment Studies in PAD

Although there is a plethora of research on the naming impairment in PAD, there are only a few naming treatment studies that involved participants with PAD (Abrahams & Camp, 1993; Fuller et al., 2001; Ousset et al., 2002; Rothi et al., 2005). Like the typicality training studies with the aphasia population (Kiran & Thompson, 2003b; Mayer et al., 2004; Stanczak et al., 2005, 2006), these three PAD studies also had picture naming outcomes based on comparisons of performance before and after the intervention (i.e., a treatment effect), and examined generalization to untrained items. Although these three PAD treatment studies are very different from each other, they each have important implications for the future of word finding treatment for this population.

Using a single subject design study with two adults with dementia, Abrahams and Camp (1993) used spaced-retrieval training (SRT). Spaced retrieval training is a technique that intersperses increasing time intervals between presentation of a target by the clinician and recall of it by the participant. Participant 1 was diagnosed with progressive dementia (16/30 on the Mini Mental Status Exam; MMSE) (Folstein, Folstein, & McHugh, 1975) and Participant 2 had PAD (13/30 on the MMSE). Each participant was tested on the Boston Naming Test (Kaplan et al., 1983). From these results, nine training items from each participant were identified for use as a subset of training and control items. While two of these items were treated, the other seven were controls (Abrahams & Camp, 1993). Abrahams and Camp (1993) reported that the results of two different treatment targets for each participant showed improved performance (e.g., naming an item after a maximum of 300 seconds). Only Participant 1 was tested two weeks later. This showed maintenance effects for one of the two items, despite a six point drop in her MMSE score (10/30). Abrahams and Camp (1993) described generalization to untrained exemplars of the trained items: a colored drawing of the target; a second target; and an actual exemplar. The investigators reported that SRT was effective in adults with dementia because they not only have word-finding deficits, but also have cognitive deficits that affect the ability to remember new information. It was suggested that SRT uses procedural memory, which appears to be intact in this population, and thus enabled the participants to benefit from the anomia treatment (Abrahams & Camp, 1993).

Although both participants did not have PAD, the findings from this early anomia treatment study by Abrahams and Camp (1993) have value because they were the first to demonstrate a treatment effect after using SRT, in the PAD population, even with participants with low MMSE scores. Spaced retrieval training does not provide any semantic information about the item, but uses repetition. It was not clear if the items that showed generalization actually generalized. Instead, it could be that it was easier for the participant to name the color drawing.

Ousset et al. (2002) compared the effects of an experimental lexical therapy targeting both episodic and lexical stimulation in adults with mild PAD who were on an acetyl cholinesterase inhibitor. The average MMSE score was 21.1. The participants were divided into two groups of eight: one group received lexical therapy (with narratives and definitions) and the other, a control group, received occupational therapy (i.e., pottery, drawing, and conversations). The treatment was provided in 16 sessions, once a week, with a two week break at the midpoint. The pre and posttest picture naming stimuli consisted of 120 black and white line drawings from three categories. While 80 of these items from the three categories were a part of the lexical therapy, the remaining 40 were not. During each lexical therapy session, the participant first read aloud a narrative from a computer screen and then listened while the examiner read it. Then, the participant completed a naming to definition task on the computer. There were 20 definitions, half of the words were in the narrative to provide both semantic and episodic reinforcement; and half of the words were not in the narrative, to provide episodic reinforcement. When the participant did not respond or was incorrect, the computer randomly provided one of five different types of cues (i.e., semantic category, first syllable, first grapheme, presentation of the item as a color drawing; or the item's associated sound). If this did not result in a correct response, the computer provided the answer. Compared to the control group, Ousset et al. (2002) reported a significant improvement from pretest to posttest for the treated items in the lexical therapy group (i.e., a treatment effect) but generalization to untreated items was not significant. The investigators also commented about the possible benefit of episodic long-term memory reinforcing the association between the object's form and the name of it. Although the narratives (i.e., part of the lexical therapy) were designed to assist in memorization of the lexical labels, the participants were better at retrieving the words that were not in the narratives. Ousset et al. (2002) interpreted this reduced naming as a possible indication that working memory was over-extended by the semantic context in the narratives.

The analyses from the cues revealed that the presentation of the color drawings and the initial syllable were the most effective cues, and Ousset et al. (2002) hypothesized that both of these improved the process of searching the lexicon. The semantic category cue was the least effective. To account for this, the authors suggested that the naming deficit in their patients primarily affected their ability to access the phonological form from semantics. Ousset et al. (2002) questioned if the participants actually had a semantic deficit and used the training as a semantic intervention. Alternatively, it was hypothesized that the participants were a subgroup of the PAD population, such that their anomia might have been due to a retrieval deficit, and the lexical therapy provided rehearsal targeting episodic lexical information and linking it to objects and their corresponding names (Ousset et al., 2002).

This group study by Ousset et al. (2002) clearly showed treatment effects from the training and provided an innovative approach to remediate anomia. Trained words were unrelated to each other. It is unclear why Ousset et al. (2002) did not report generalization to untrained items, when the training items were from three categories. Also, further examination of the results indicated that there was generalization to *another task*. The participants showed better naming performance at the posttest compared to the pretest, but the treatment involved narratives and oral naming to definition, *not* naming pictures. Generalization to another task suggests that the treatment strengthened connections between semantic and phonological representations (Hillis, 1998). As mentioned earlier, the findings from Ousset et al. (2002), which indicated that the category cue was the least helpful on the naming task, could provide further support for the notion that semantic category structure in PAD is still intact. The rationale for the use of the semantic categories as the semantic cue was not addressed. Given the evidence of preserved superordinate semantic category knowledge (Chertkow & Bub, 1990; Flicker et al., 1987; Hodges et al., 1991; Huff et al., 1986; Lukatela et al., 1998; Martin, 1992; Martin & Fedio, 1983; Nebes et al., 1986; Salmon, Butters et al., 1999; Schwartz et al., 1979; Warrington, 1975) but degraded attribute knowledge (Martin, 1992) it is not surprising that the category cue had minimal effects. Perhaps a more potent semantic cue would have been to provide more distinguishing information about the item or possibly a picture of it with some foils. This might have led to better performance on the oral naming to definition task.

A recent single subject design study (Fuller et al., 2001; Rothi et al., 2005) also used an acetyl cholinesterases inhibitor, but with an errorless learning paradigm to improve confrontation naming in six adults with PAD. The scores for the patients on the MMSE were $\geq$ 10. In this study, the stimuli consisted of 100 words, evenly divided for high and low frequency, matched with black and white line drawings from eight semantic categories representing both natural kinds (e.g., animals) and artifact categories (e.g., clothing) with 10 exemplars per category. Three subsets of stimuli based on baseline performance were developed for each participant using three categories, allowing for training on two of these, while the third subset was used both for generalization and experimental control. To establish baseline stability, each participant named the 100 pictures over eight daily probes (i.e., over eight sessions). Sixty minute therapy sessions were provided four times per week, until criterion was met (90%) or after 20 sessions (20-35 sessions were needed to complete the entire protocol) (Fuller et al., 2001; Rothi et al., 2005).

The therapy included two similar treatment phases to determine if the improvements seen in Phase 1 would show response generalization to performance from Phase 2, which at that point would be an untrained set of stimuli. There were two treatment conditions, immediate and delayed repetition. For Phase One, Treatment Condition One involved simultaneous repetition in which the clinician presented the picture, stated the correct name of it and had the participant repeat it. For Treatment Condition Two, delayed repetition was used in which the clinician presented the picture and if the participant knew the name, he/she stated it. If/when the participant did not know the name of the item, he/she informed the clinician. Then, the clinician stated it and had the participant repeat it (Fuller et al., 2001; Rothi et al., 2005). In other words, there was a delay from the time the participant saw the picture until he/she repeated. The results revealed that half of the participants (i.e., three of six) showed a treatment effect. There was no generalization to the untrained items. However, results from the three month maintenance probes showed that the treatment effect was still evident. The investigators also conducted a post hoc review of the participant's records and identified two other factors that appeared to play a role in the outcomes. The three participants who responded to the treatment both lived at home (versus in an institution) and were not on medications that could affect the learning process and brain plasticity (Fuller et al., 2001; Rothi et al., 2005).

This study (Fuller et al., 2001; Rothi et al., 2005) was the first to demonstrate successful application of errorless learning (i.e., treatment and maintenance effects) in a naming treatment in the PAD population. Furthermore, the influence of both the living status and the medications are important considerations for treatment planning. Perhaps another reason for the treatment effect was the use of semantic categories (both man-made and natural kinds) and their exemplars.

These three studies (Abrahams & Camp, 1993; Fuller et al., 2001; Ousset et al., 2002; Rothi et al., 2005) were theoretically motivated, well-designed, and offer different approaches for improving the naming performance in adults with PAD, including single subject and group design. More specifically, two of these treatment approaches combined cholinergic medication with training items from semantic categories, one in a lexical training with narratives and naming to definition (Ousset et al., 2002) and the other via an errorless learning paradigm (Fuller et al., 2001; Rothi et al., 2005). Generalization to untrained items essentially did not occur in any of these studies. However, the finding that treated behaviors were maintained for one participant two weeks after training (Abrahams & Camp, 1993) and for three participants three months after training (Rothi et al., 2005) is remarkable. This reflects the responsiveness to the training and that the effect was robust despite the MMSE scores. The lack of generalization to untrained items following anomia treatment in the PAD warrants further investigation.

According to Nadeau and Gonzalez Rothi (2004), the connectionist approach views anomia (that is caused by a semantic deficit) as a reflection of insufficiently engaged representations of features that are critical for making distinctions among concepts. When a network is damaged, a large amount of information still remains in the network, so the focus should be on refining the damaged network via semantic therapy. In particular, the network needs to be changed in terms of its connectivity so that there is more reliable engagement of the distinguishing features, while simultaneously there is relatively a disengagement of the shared features (Nadeau & Gonzalez Rothi, 2004). These findings