University of Alberta

The Effects of Constraining Errors on Learning by Individuals with Probable Alzheimer Disease

by

Shawn Drefs ©

A thesis submitted to the Faculty of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of

Master of Science

Faculty of Rehabilitation Medicine

Edmonton, Alberta
Fall, 2007

Your file Votre référence
ISBN: 978-0-494-33235-1
Our file Notre référence
ISBN: 978-0-494-33235-1

Abstract

Individuals with Alzheimer disease (AD) have significant cognitive impairments; however, they may be able to learn using strategies meant that capitalize on relatively spared cognitive functions. Spaced-retrieval training (SRT) is one such strategy. In this study, two forms of SRT were used to teach four individuals with dementia new face-name associations: one in which errors were constrained (SRT-Errorless/SRT-EL) and one in which errors were not constrained (SRT-Traditional/SRT-T). It was hypothesized that learning would be faster and associations would be retained longer under the SRT-EL condition. Errors were also analyzed. Key findings:

- The participants did not learn associations faster under SRT-EL; one of the participants learned faster under SRT-T.
- Three participants retained associations learned under SRT-T longer than those trained under SRT-EL.
- Two participants made errors under both conditions; errors did not appear to be related to learning or retention.

Acknowledgements

I would like to thank my supervisor, Dr. Tammy Hopper whose support, advice and direction throughout the duration of my Masters program will always be greatly appreciated. You have been an excellent teacher and mentor. Additionally, I would like to thank my supervisory committee members, Dr. Sheree Kwong See and Dr. Lili Liu for their contributions and time afforded to this thesis project. Lastly, I would like to thank Dr. Paul Hagler for his guidance and encouragement throughout my program.

Table of Contents

List of Tables

List of Figures

Literature Review

Dementia and Alzheimer Disease

Dementia is a syndrome or set of symptoms caused by many diseases. In the *Diagnostic and Statistical Manual for Mental Disorders* (DSM-IV, American Psychiatric Association, 1994) the diagnostic features of dementia include short and long-term memory impairment and at least one of the following: aphasia, apraxia, agnosia or disturbances in executive functioning. These deficits must not be due to delirium and must be sufficient to interfere with social or occupational functioning.

The Canadian Study of Health and Aging Working Group (CSHA, 1994) reports that an estimated 250,000 older adults are living with dementia in Canada. Dementia affects approximately 1% of the Canadian population aged 65 to 74, 6.9% of individuals 75-84 and 26% of individuals 85 years and older (CSHA,1994). Based on CSHA data, by 2011, the incidence of dementia is expected to reach 111,560 cases per year.

Alzheimer disease (AD) is the most common form of dementia. In AD, one must meet the criteria for a diagnosis of dementia and exhibit a gradual onset and progressive deterioration of functioning and cognition, with deficits not due to other CNS etiologies, systemic conditions, substance-induced conditions, or other disorders (DSM-IV, American Psychiatric Association, 1994). In AD, memory is a prominent impairment; however, certain types of memory are more affected than others, based on the neuropathology of the disease. What follows is a brief description of memory systems and how these systems are affected in AD.

Memory

Memory can be of many types. Evidence for this assertion comes from research with patients who display specific learning and memory deficits, from animal models of memory and from neuro-imaging studies. Although debate continues as to exactly how each system interacts, a general consensus exists surrounding the multi-faceted nature of memory.

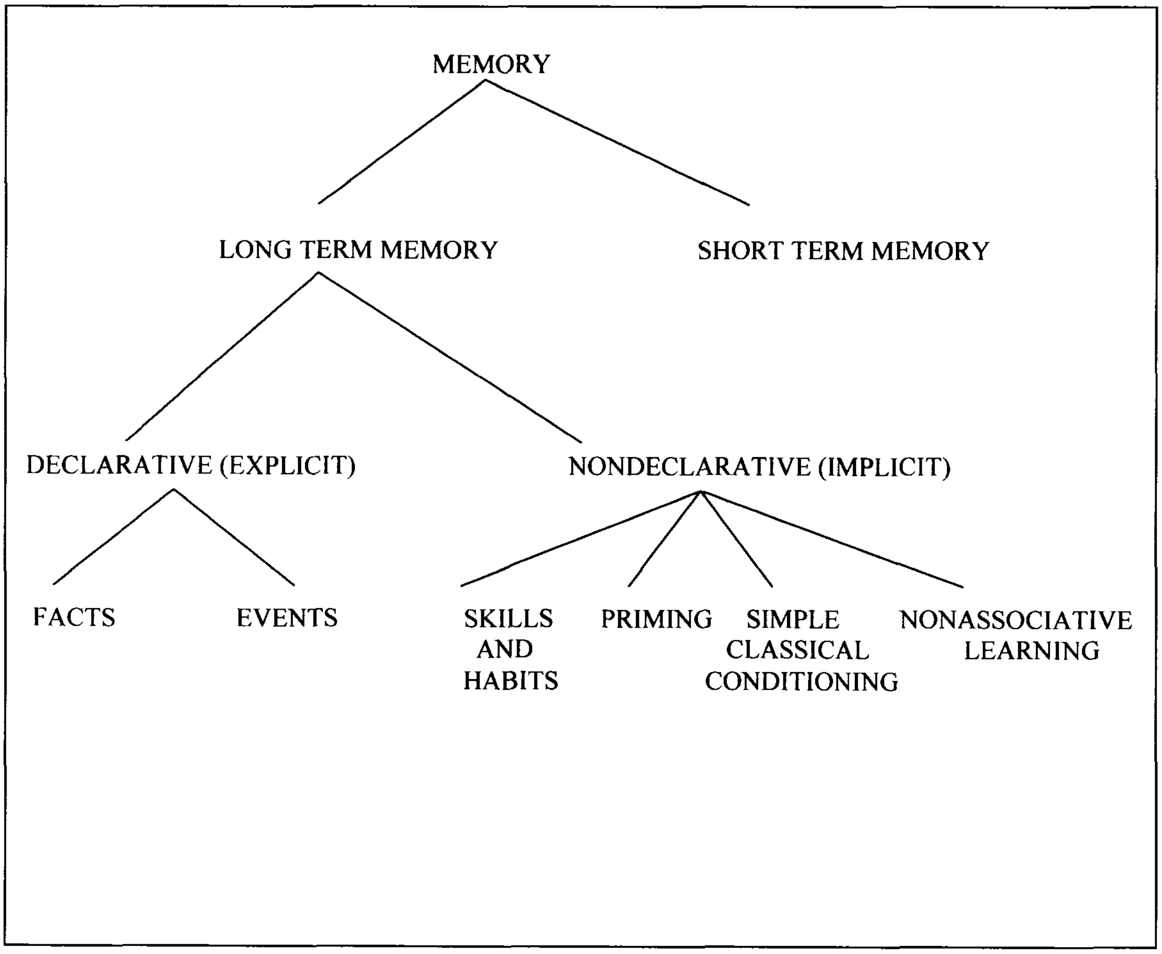
Many models of memory are described in the literature. For the purposes of this study, the model based on Squire and Zola-Morgan (1991) will be used (see Figure 1). The first distinction made in this model is between short-term or working memory (WM) and long-term memory (LTM) systems. Working memory (WM) is conceptualized as a tripartite model consisting of short-term storage components for verbal and visual information (phonological loop and visuo-spatial scratchpad) and a central executive component (Baddeley & Hitch, 1974). The central executive performs storage, manipulative and attentional functions and acts as the main control center of WM. Information comes into working memory from various sensory systems and from long-term memory as information is retrieved and called into consciousness. Recently, Baddeley (2000) proposed a revision to the earlier model of WM. The new model includes an additional component termed the episodic buffer (EB) which performs integrative functions under the control of the central executive. Features of the EB are that it is a limited capacity system responsible for the temporary storage of information. Furthermore, the information is stored as a multi-dimensional code and acts as a temporary interface between slave systems (phonological loop and visuo-spatial scratchpad). This component is hypothesized to be capable of receiving information from LTM and various subsystems and bringing the information together into a single episodic representation.

Within the domain of long-term memory, Squire and Zola-Morgan (1991) distinguish between declarative (explicit) and non-declarative (implicit) memory. Declarative memory is information recalled as facts or events and consists of episodic and semantic memory. Episodic memory comprises representations in which the individual is an active participant or observer, whereas semantic memory includes representations of situations, objects and relations to the world at large (Tulving, 1972; 1993). Tulving cites geographical knowledge, knowledge of social customs, knowledge of people and of experiences of the world, the color of things and their smells and textures as some examples of the enormous store of information that constitute the core of our semantic memory system. Tulving (1993) postulates that episodic and semantic memory systems operate in a hierarchical fashion. That is, semantic memory can store and retrieve information independently of episodic memory, but episodic memory cannot store or retrieve information independent of semantic memory.

Episodic memory relies heavily on medial temporal lobe structures including the hippocampus (Burgess & Gruzelier, 1997; Elderidge, Knowlton, Furmanski, Bookheimer & Engel, 2000; Fell, Klaver, Elger & Fernandez, 2001; Squire & Zola-Morgan, 1991) as well as prefrontal cortex (Kramer, et al., 2005; Wheeler, Stuss & Tulving, 1995). Semantic memory is thought to rely on widely distributed neo-cortical association areas (Damasio, Damasio, Tranel & Brandt, 1990; Hodges & Patterson, 1995; Squire, 1992).

In contrast to declarative memory, non-declarative memory (also known generally as procedural memory) is memory for skills and habits and underlies priming, classical conditioning and non-associative learning (Squire & Zola-Morgan, 1991). Information in non-declarative memory is not stored as facts one recalls; rather knowledge is expressed through behaviour and can be acquired implicitly without conscious awareness (Squire & Zola-Morgan, 1991). Mishkin, Malamut and Bachevalier (1984) state that a key feature of habit memory, a type of non-declarative memory, is that information or skill is learned slowly, often involving a stored association between a stimulus and response, and remains relatively stable over time. Structures of the basal ganglia underlie procedural memory (Knowlton, 2002; Yin, Knowlten & Belleine; 2004).

Figure 1. *Memory Model* (Squire & Zola-Morgan, 1991)



Memory in AD

Researchers have demonstrated that individuals with AD have greater deficits in declarative memory systems than non-declarative memory systems (Eslinger & Damasio, 1986; Postle, Corkin & Growdon, 1996; Verfaellie, Keane & Johnson, 2000). This pattern is explained by the neuropathology of the disease, which begins initially in the hippocampus and adjacent structures and spreads to other cortical areas as the disease progresses (Braak & Braak, 1991; 1997). Thus, early impairment in episodic memory is the hallmark characteristic of the disease (Brandt & Rich, 1995; Butters, Granholm, Salmon, Grant & Wolf, 1987; Grady, Haxby, Horowitz, Sundaram, Berg, Shapiro & Freidland, 1988). Semantic memory, though impaired as the disease progresses, may remain accessible, with appropriate cues, until the later stages (Hodges, Salmon & Butters, 1990; Squire & Knowlton, 1995). The neuroanatomical structures that support non-declarative memory appear to remain relatively unaffected by AD until later in the disease course (Braak & Braak, 1991) and therefore, individuals with AD may exhibit some preservation of this type of memory.

Researchers have reported that some individuals with dementia can learn new information, skills, and procedures (Burgess, Wearden, Cox, & Ray, 1992; Little, Volans, Hemsley & Levy, 1986; Salmon, Heindel & Butters, 1992). The mechanisms of learning are unknown; however, researchers hypothesize that individuals with AD are relying on residual episodic memory, some preservation of semantic memory and the ability to benefit from practice and learn implicitly, without conscious awareness (Glisky, 1997; Rau, 1993). Therefore, capitalizing on more intact cognitive abilities may be a primary consideration when designing behavioural interventions for individuals with AD. In addition to spared memory systems, some communication abilities remain intact and can form the basis for interventions in which researchers manipulate linguistic aspects of treatment (e.g., reading).

Communication Abilities in AD

Language and communication problems are present in most individuals with AD (Kempler, 1991). Although cognitive deficits have an adverse effect on communication, individuals with AD retain communicative strengths throughout the disease course. In the early stages of the disease, cognitive-communicative strengths include intact phonology, syntax and pragmatics. In addition, investigators have observed relative preservation of reading and writing skills. During this stage the individual can still express needs, comprehend language, converse, and respond appropriately to open-ended questions (Bayles & Tomoeda, 1993).

Deficits do occur in the early stages, however, and include problems with auditory comprehension for complex directions, word finding, and initiation, cohesion and maintenance of discourse (Bourgeois, 2002; Orange, Ryan, Meredith & MacLean, 1995; Murray, Schneider, Banerjee & Mann, 1999; Powell, Hale & Bayer, 1995).

In the moderate stages, areas of relative strength include intact grammar and syntax, the ability to read aloud, and write or print single words (Bayles & Tomoeda, 1993). In addition, individuals often can still follow two stage directions, express needs with assistance and can usually understand gestures (Bayles & Tomoeda, 1993). Deficits include poor topic maintenance, difficulty in reading comprehension and social withdrawal. Individuals at this stage may miss the point of a conversation and have difficulty generating a series of meaningful ideas (Bayles & Tomoeda, 1993).

In late stage AD, strengths are few. However, Bayles and Tomoeda (1993) report that individuals may have appropriate affective responses to sensory stimuli, respond to some cues and express desire for social interaction. Individuals have a limited ability to express needs, but may be able to answer simple yes/no questions. Form of language (syntax) is generally still intact. In addition, individuals often can add to a conversation and may retain some social aspects of conversation (Bayles & Tomoeda, 1993).

In summary, specific areas of cognitive and communication strengths remain in many individuals with AD. Therefore, behavioural interventions should be designed to capitalize on these abilities and to reduce the demands on abilities that are more impaired.

Interventions for individuals with AD

There is currently no cure for AD. However, the use of medications to slow the progression and alleviate or improve symptoms associated with AD is now considered standard practice (Cummings, 2003). Behavioural interventions to help maximize function of individuals with AD are not considered standard practice; in fact, in the past, researchers expressed pessimism regarding behavioural interventions aimed at improving function of individuals with AD (Martin, Bowers, Cox & Fedio, 1995). Increasingly, however, researchers are publishing results on the positive effects of behavioural approaches such as the use of pet and doll therapy (Bailey, Gilbert & Herweyer, 1992; Francis & Baly, 1986), environmental modifications (Burgess, Wearden, Cox & Rae, 1992), cognitive stimulation (Spector, Orrell, Davies & Woods, 1998), music therapy (Casby & Holm, 1994; Denney, 1997), Montessori-based activities (Orsulic-Jeras, Judge & Camp, 2000) and memory books (Bourgeois, 1990; Hoerster, Hickey & Bourgeois, 2001). Of particular interest in the current proposed study is the technique of spaced-retrieval training (SRT; Camp, 1989).

Spaced-retrieval Training

Landauer and Bjork (1978) first described SRT as a potential memory intervention for recall of face-name associations in individuals with impaired explicit memory. Camp (1989) adapted the SRT protocol for use in individuals with dementia. In SRT individuals learn and retain target information by using active recall attempts over increasingly longer periods of time (i.e., individual is given some target information and repeatedly tested for recall of the target information immediately, at 30 seconds, 60 seconds, 2 minutes and so on). If unsuccessful recall attempts are made at any interval, the target information is re-stated by the researcher and the next recall interval is reduced until the individual responds correctly (Camp, Foss, O'Hanlon & Stevens, 1996).

SRT is hypothesized to strengthen conceptual associations through the repeated activation of stimulus-response pairings (Camp et al., 1993). This type of stimulus-response training may engage the implicit memory system defined by Schacter (1992) as '...an unconscious form of retention ... assessed with tasks that do not require conscious recollection of specific episodes' (p.559). Hopper and Bayles (2001) propose that success of SRT is due to: 1) the reduction of demands on impaired episodic and working memory systems because explicit recall of the learning episode is not required; 2) the increased reliance on non-declarative memory, such as conditioning, which requires minimal cognitive effort; and 3) repeated activation and strengthening of the stimulus item's lexical and conceptual attributes.

Since Camp (1989) reported on the use of SRT with individuals who have dementia, several researchers have published additional results of the effects of SRT on memory and behaviour of individuals with AD. Hopper et al. (2005) performed a systematic review and classification of the research evidence related to SRT as used with individuals who have AD or a related dementia. Associations trained using the SR paradigm were classified as one of two general types: cue-behaviour associations and face/object-name associations. Cue-behaviour associations included verbal cues to use external memory aids (Camp et al., 1996; Stevens, O'Hanlon & Camp, 1993), to perform experimental tasks such as handing the researcher a coloured coupon (Camp et al., 1996; McKitrick, Camp & Black, 1992), associating a verbal and then auditory cue (alarm) with the procedure of opening and reading task instructions in a book or box and performing the task written there (Bird & Kinsella, 1996), and putting glasses in a case or a lid on a jar (Bird & Kinsella, 1996). Other researchers also focused on teaching positive alternatives to problem-behaviours associated with dementia such as verbal aggression (Bird, 2001; Bird, Alexopoulos, & Adamowicz, 1995).

Face name associations were taught in studies by Vanhalle, Van der Linden, Belleville & Gilbert, (1998) and Camp (1989). Object-name associations were taught in studies by Cherry and Simmons-D'Gerolamo (1999), Cherry, Simmons and Camp (1999), Abrahams and Camp (1993), and McKitrick and Camp (1993). Brush and Camp (1998) incorporated face-name associations, a piece of important information, and a compensatory strategy for each participant in their study.

Although outcomes of all studies were generally positive, Hopper et al. (2005) recommend further research on variables that may affect learning via SRT. Few studies, for example, included systematic evaluation of maintenance of learned information after treatment. Nor did investigators attempt modifications of the SRT protocol to improve learning efficiency.

After the period of the review, several studies were published and are reviewed here as the findings provide support for the use of SRT with individuals with AD. Cherry and Simmons-D'Gerolamo (2004) trained four older adults with probable AD to recall everyday objects using the SRT technique. Two of the participants were part of an earlier study (Cherry et al., 1999) and researchers were interested in the long-term maintenance of the information acquired in this earlier study. They hypothesized a "savings in re-learning" for these two participants; specifically, that they would learn the associations faster based on their previous exposure to the items and training two years earlier. Training consisted of six, hour-long sessions given on alternate days over a two-week period. Each trial consisted of having the participants select a designated object from an array of other items over increasingly longer retention intervals. They found positive effects for all participants in fewer errors per trial and longer retention duration across sessions. The original and newly enrolled participants performed comparably, however, which did not support the "savings in re-learning" hypothesis.

Cherry and Simmons-D'Gerolamo (2005) followed this study with another aimed at determining the long-term effects of SRT. They trained 10 participants (five from their 1999 study) with probable AD to recall everyday objects using SRT. At the time of this study it had been approximately 12 months since these five participants had been exposed to SRT, shorter than the 18 to 24 months in the 2004 study. For comparison purposes, the study included five newly enrolled or "control" participants, matched on cognitive status and who had not received any prior SRT training.

The primary task consisted of having participants select a target object from an array of items over increasingly longer intervals. Long-term effects of SRT, or the benefits of prior learning, as measured by a reduction in the number of failed recall attempts and longer retention intervals, were observed initially for the original participants. However, by the fourth training session both groups were performing comparably.

Hawley and Cherry (2004) extended the research of Cherry and Simmons D'Gerolamo (1999) and taught face-name associations rather than objects. In this study, the researchers were interested in two outcomes: learning of the face-name association and generalization from learning in SRT to recall of the face-name association when the person in the picture was encountered in a real-life situation. Also measured were the number of recall failures, total number of trials to learn and longest time-interval duration across trials and training sessions.

Six older adults with probable AD participated in the study. Each trial consisted of having participants select a target photograph and state the target name from a choice of eight foil photos at increasingly longer retention intervals. Learning was defined as correct recall of the target 1 day after the last training session. A total of nine, thirty-minute training sessions over a four-week period were completed on consecutive or alternate days. All of the participants were successful in the selection and recall of the target name over longer periods of time within and across training sessions. Training schedule had little influence on performance and half of the participants correctly recalled the name of the individual in the target picture when they encountered the actual person.

Modifications of the SRT procedure were made in a study by Hochhalter, Bakke, Holub and Overmier (2004). The researchers taught five participants with AD to recall one pill name using adjusted spaced retrieval training (correct recall followed by longer delays than incorrect recall) vs. uniform retrieval training (short delays between practice trials). Outcome measures included the percent of errors made during training and whether participants learned the name of the pill. Researchers defined learning as correctly recalling the name of the pill at least one day after the previous training session. They found that the five participants with a diagnosis of AD (five others had an alcohol related memory impairment) benefited by learning the pill name only in the adjusted spaced retrieval condition. Interestingly, they found that participants made more errors in the adjusted SRT condition.

All of the studies reviewed provide evidence of the positive effects of SRT on learning by individuals with AD. Yet many questions remain unanswered. Specifically, the effects of a modified SRT protocol on learning and retention of information should be further studied. The effect of constraining errors during SRT deserves special emphasis as errors are hypothesized to interfere with learning by individuals with episodic memory impairments as occur in AD (Baddeley & Wilson, 1994). Some researchers have proposed that SRT is a form of errorless learning (Brush & Camp, 1998) because the format of SRT elicits a high number of correct responses during training. However, learning during SRT may be enhanced by incorporating other errorless learning principles into the SRT method.

Errorless Learning

Errorless learning (EL) refers to reducing opportunities to make errors during training sessions (Clare, et al., 2000). Errors can be particularly problematic for individuals with episodic memory impairments because they cannot remember the nature of the error, nor the correction, and thus cannot inhibit the error from being made repeatedly during learning (Baddeley & Wilson, 1994). Several researchers have reported negative effects on learning by individuals with episodic memory impairments (primarily those with amnesia) when errors are made during training tasks (Hunkin, Squires, Parkin, Tidy, 1998; Tailby & Haslam, 2003; Wilson, Baddeley, Evans & Sheil, 1994). Although individuals in these studies did not have AD, other researchers have reported positive effects of constraining errors on learning by individuals with AD.

Clare, Wilson, Breen and Hodges (1999) attempted to establish whether it would be possible to teach face-name associations to an individual with early stage AD in accordance with EL principles. The researchers used a single-subject, multiple baseline across items design in which the items were 11 face name associations from the participant's social club. This study had five phases; initial baseline, intervention, generalization, post intervention baseline, and follow up. During twice-weekly training sessions, the participant used verbal elaboration when recalling a specific name (e.g.., Gladys with the gleaming smile) and vanishing cues (i.e., asked to complete the name with a step by step reduction in the number of letters provided as the mnemonic was rehearsed at the same time). To reduce the potential for errors throughout the intervention the participant was instructed not to guess but instead to say he did not know. The participant continued to practice recall of face-name associations during the days in between training sessions. Analysis involved a statistical comparison of the proportion of correct responses achieved for each item in each phase and the number of correct responses achieved in the initial and post-intervention baseline trials. The participant improved in his ability to recall the face name associations trained during the intervention phase and was able to correctly recall the 11 face name associations up to 9 months after the end of the study. Once the 9 month follow up had been completed the participant was required to return the pictures used during intervention to the researchers.

Two years later, in 2001, Clare, Wilson, Carter, Hodges and Adams re-visited this participant to assess the long-term maintenance of previous treatment gains. The researchers returned for follow up sessions weekly for one year and monthly for the second year to assess recall (44 recall scores from year one and 12 recall scores from year two). In year one there was minimal decline with a mean score of 80% correct during probe sessions. Performance declined in year two with a mean of 71% correct, almost three years after initial training.

Metzler-Baddely and Snowden (2005) also reported positive effects of EL techniques on learning in AD patients. In the EL training condition of this study, patients were discouraged from guessing and in the Errorful (EF) condition they were encouraged to guess. They investigated whether EL relative to EF could result in better memory for old material and novel face-name associations. Using a within subject design each patient learned one set of the old/new material, with the EL method and the other set with the EF method. This design allowed the direct comparison of learning results in the EL with the EF condition for new and old material. The order of learning condition and material learned in each condition was counterbalanced across patients. Each set in both conditions was repeated three times per day in random order for a total of eight days. The experimenter carried out the baseline and post training assessment as well as the training sessions on the first two days of each session. Researchers explained the training procedure to the spouses who continued training for the following six days. Spouses used written instructions and data collection forms to record memory performance for each item on each repetition for all training days. The dependant measure was the number of correctly recalled names under EL baseline, EF baseline, EL post-training and EF post-training condition for novel and familiar material. Combined data analysis demonstrated a significant group advantage of EL over EF for both old and novel learning. However, patients also learned in the EF condition. The authors suggest that EL may be most beneficial for patients with profound amnesia and in situations that make effortful processing difficult; however, they note that residual explicit memory capacities may override EL benefits.

Taken together, the results of EL research with individuals with AD suggest that reducing errors during learning trials may be beneficial. However, several of the studies included many types of training components for each individual participant, making comparison across participants problematic. Also, the nature and number of errors were not always examined, making it difficult to interpret results. Finally, errors made during learning were not always detrimental (Hochalter et al., 2004). Thus, more research is needed to explicate the role of errors during learning for individuals with AD.

Purpose of the Study

The purpose of this study was to compare the effects of two forms of SRT on the learning of individuals with AD: one format in which errors were constrained and one in which they were not. The research question was as follows: What is the effect of two forms of SRT (the traditional format and a modified format in which errors are constrained) on (a) efficiency of learning as measured in the number of sessions to learn; (b) retention of learned information, as measured in length of time following treatment that individuals can recall target information, and (c) type and number of errors made during learning sessions and after learning during retention probes.

Method

Participants

Participant contact information was received through the Alzheimer Society of Alberta and the Northwest Territories. A total of ten individuals consented to have a university researcher phone them to further explain the study and potentially participate. Three of these individuals declined participation, two individuals were assessed but did not meet the inclusion criteria for participation (i.e., AD had progressed to moderate-severe level), and one individual was unreachable. Therefore, four individuals with mild to moderate probable AD, as diagnosed by their primary care physician, participated in the study. These individuals met the following inclusion criteria: were fluent speakers of English; passed a speech discrimination test with 80% or better accuracy with an adaptive hearing device (if necessary); had visual acuity sufficient to read large print (18 point font), and had scores indicative of dementia on the Mini Mental State Examination (MMSE; Folstein, Folstein & McHugh, 1975) using age and education adjusted norms (see Appendix A).

Researchers have found that individuals of comparable dementia severity may perform differently on the same learning task (Hopper, Bayles, Tomoeda & Drefs, 2005) or that those with lowest cognitive functioning scores performed better on some learning tasks than others with higher scores (McKitrick, Camp & Black, 1992). Therefore, further assessment of language comprehension and verbal memory abilities was conducted to help fully describe cognitive and language factors that may mediate responsiveness to SRT.

The authors gathered personal demographic information through interviews with family members and participants (see Appendix B for participant demographics sheet). Participants were three males and one female ranging in age from 63 to 83 years old (see Table 1). All had a primary diagnosis of AD with average time since diagnosis of 3.6 years (range; eight months to five years). One participant was categorized as having moderate AD and three participants were categorized as having mild AD. All participants were taking cognitive enhancing medications at the time of the study. None of the participants reported having a prior history of depression. Education levels varied, with one participant having finished grade 11, two having a high school diploma and some college training and one having two university Bachelors degrees. All of the participants resided in their own homes and lived with their spouses. Participant one's (P1) previous occupation included running a nursing home, working as a secretary at a car dealership and selling shoes. Participant two (P2) worked for Edmonton telephones in the wire center departments' central office for 38 years. Participant three (P3) worked for a religious organization as an organizational events director for 20 years and ran a paint supply franchise for 20 years. Participant four (P4) was a high school teacher his entire career. All participants were fluent speakers of English.

Table 1. *Participant Demographics*

	Primary Diagnosis	Time since Diagnosis	Cognitive Enhancers	Age	Gender	Dementia Severity*
P1	AD	4 years	Exelon	83	Female	Moderate
P2	AD	5 years	Reminyl	74	Male	Mild
P3	AD	5 years	Reminyl	63	Male	Mild
P4	AD	8 months	Reminyl	78	Male	Mild

* Based on F.A.S.T.

Procedures

Pre-Study Evaluation

Assessments. (see Table 2 for assessment results of participants)

The MMSE is a brief screening tool used to detect cognitive impairment. The assessment can be administered in about 15 minutes, covers numerous constructs (such as orientation to time and place, episodic memory, visuospatial construction, and verbal abilities) and yields a total score of 30. A score of 30 indicates normal cognitive functioning and decreasing scores are indicative of progressive cognitive impairment. Individuals who score below 24 on the MMSE are generally classified as having cognitive impairment (Tombaugh & McIntyre, 1992). Additionally, the MMSE has well established validity and reliability. Tombaugh and McIntyre (1992) observed that MMSE sensitivity (correctly classifying individuals with cognitive impairment) and specificity (correctly classifying non-impaired individuals as being non-impaired) were affected by education level. Additionally, age may affect scores. However, normative data accounting for age and educational differences have been established (Crum, Anthony, Bassett, & Folstein, 1993). Lower education level has been associated with lower MMSE scores and an inverse relationship exists between MMSE score and increasing age (lower scores associated with higher age).

MMSE scores were thus interpreted using the age and education adjusted norms (Crum et al., 1993). For example, an 83 year old individual with a fourth grade education may score below the generally accepted cutoff of 24 however, the individual may not be cognitively impaired compared to other individuals of the same age or education level. The purpose of using these norms is primarily to avoid making false positive and false negative classification errors.

P1 scored 11 out of 30 indicating a moderate level of impairment. P1's associated normative score matched for age and education is 25 confirming that P1's observed score falls well below those of her reference group. P2 scored 22 indicating mild impairment. P2's associated normative score of 27 confirms impairment compared to his age and education matched reference group. P3 scored 24, which falls below his reference group score of 28, and was classified as mildly impaired. P4 scored 25 which hovers around the accepted cutoff score between normal and impaired cognitive functioning. However, when accounting for similar age and education level, the normative comparison score for P4 was 28. In other words, individuals with normal cognitive functioning of similar age and education tended to score higher than P4.

To help describe dementia severity, the *Functional Assessment Stages* (FAST) (Reisberg, Ferris & Franssen, 1985) was used. Scoring gauges progressive deterioration in abilities such as performing complex tasks such as handling personal finances, choosing proper clothing, bathing, and the loss of functional abilities such as incontinence. The modified version of this assessment tool contains scores ranging from 4, indicative of mild dementia, to 7 which is indicative of severe dementia. Participants' functional status was scored on the modified FAST, which was completed based on initial assessments, through information gathering at subsequent meetings and in conjunction with input provided by the participants' spouses. P1 was classified at 5.5 (moderate dementia); the remaining three participants scored 4 and were classified as having mild dementia.

Participants also completed the cognitive subscale of the *Alzheimer's Disease Assessment Scale* (ADAS-Cog; Rosen, Mohs, & Davis, 1984). This instrument is standardized with well-established reliability (test-retest and inter-rater) and validity (concurrent) and is widely used. The ADAS-Cog contains nine tasks which have an upper scoring limit of 48 and two memory tasks that have an upper scoring limit of 22. Higher scores (to a maximum of 70) indicate an increased level of impairment on most tasks. Constructs assessed include episodic memory, orientation to time and place, ideational and constructional praxis, and language.

P1 scored 37 out of 70. P1's scores on the language-based tasks were indicative of moderate AD level of language impairment. P2 scored 16 out of 59, consistent with mild AD. P3 scored 15 and P4 scored 18, both within the range of mild AD.

The *Arizona Battery for Communication Disorders of Dementia* (ABCD; Bayles & Tomoeda, 1993) was used to provide information on participants' reading, auditory comprehension, expressive language and verbal memory abilities. Data from the test have been reported to have strong validity and reliability and the ABCD is one of the few available cognitive-communication batteries designed specifically for individuals with mild to moderate AD. The assessment contains 17 tasks covering the constructs of mental status, episodic memory, linguistic expression, linguistic comprehension and visuospatial construction. The ABCD yields standard scores on each of the five constructs (out of 5 points, with 5 indicating highest levels of functioning) and a total possible score of 25.

P2's total overall construct score on the ABCD was 19 out of 25. P3 scored 20.3 and P4 scored 19.8. All three scores were indicative of mild dementia. These three participants scored lowest on tasks which assessed mental status and episodic memory such as story retelling (all scored zero on delayed retell) or word recall.

P1, who was more moderately impaired, could not complete the ABCD. Instead, the *Functional Linguistic Communication Inventory* (FLCI; Bayles & Tomoeda, 1994) was used to characterize this participant's cognitive and communicative ability. The FLCI has been standardized on individuals with mild to very severe cognitive impairment and allows for plotting of the individuals profile on a graph against the plots of the various standardized subgroups. The assessment covers 10 tasks such as answering questions, greeting and naming, reminiscing, following commands, naming objects and level of conversation. Lower scores on the FLCI indicate higher levels of impairment and higher scores indicate lower levels of impairment. Total possible score on the FLCI is 87 and P1 scored 48. Additionally, sub scores can be calculated and converted to a range that corresponds to the modified FAST scoring scheme. Specifically, P1's score on the FLCI was consistent with her FAST stage of 5.5 - moderate dementia.

Table 2. *Participant Assessment Score Description*

	MMSE	ABCD	Story Retell Delayed	ADAS-Cog	FLCI	Modified FAST
P1	11	n/a	n/a	37	48	5.5
P2	22	19	0	16	n/a	4
P3	24	20.3	0	15	n/a	4
P4	25	19.8	0	18	n/a	4

Experimental Design

Participants were asked to learn two new face-name associations (one male and one female) under two conditions: a standard SRT format in which individuals generate a response to the stimulus question at designated recall intervals (traditional SRT or SRT-T) and an "errorless" format in which individuals identified the correct response in a forced-choice recognition task (SRT-errorless learning or SRT-EL). Each intervention was conducted in sequence across participants and order of presentation of treatment conditions and stimulus items was counterbalanced (see Table 3).

Table 3. *Order of treatments*

	Treatment Condition 1	Treatment Condition 2
P1	SRT-EL-F	SRT-T-M
P2	SRT-T-F	SRT-EL-M
P3	SRT-T-M	SRT-EL-F
P4	SRT-EL-M	SRT-T-F

T=Traditional SRT condition, EL=Errorless learning SRT condition, M=Male, F=Female

A single-subject multiple baseline across behaviours design, with replications across participants was used to answer the research questions. Single-subject design (SSD) involves studying a single individual or system by taking repeated measures of one or more dependent variables and systematically applying and sometimes withdrawing or varying the independent variable (Bloom & Fischer, 1982; Ottenbacher, 1986). Single subject designs are often considered 'designs of choice' when measuring changes in behaviour or when performing behavioural modification (Heffner, 2004). Rather than comparing groups of subjects, this design relies on the comparison of treatment effects on a single subject or group of single subjects. Use of a multiple baseline across behaviours with replication across participants design was appropriate for this study because it allowed the researcher to teach more than one association in sequence and across more than one participant. Thus, effects could be compared both within and between participants.

Intervention

Stimuli.

Two pictures were used as stimuli in this study. The individuals in the pictures were one female and one male, approximately 25-35 years old, who were unknown to the participants. The pictures were printed in black and white on 4" x 6" photo paper. The name Thelma was selected for the female and the name Nathan was selected for the male. Both names were matched for frequency of use in the English language and for length. These two target names appeared as highly popular names over multiple decades in the United States (SSA; Social Security Administration, 2007). Additionally, for the EL condition foil names were printed in black 20-point font and pasted to 4" x 6" index cards. All foil names were matched to target names based on frequency of occurrence in the English language and number of syllables (SSA, 2007).

Baseline phase.

The baseline phase was conducted in the following manner: Two pictures (each assigned to either the SRT-T or SRT-EL condition for learning) were presented individually and in alternating sequence over three days. The participant was asked, "What is his/her name?" when presented with the picture. The participant had 10 seconds to respond. If no response was made within the 10 second time-frame, it was counted as an error. The researcher did not provide feedback during the baseline phase. Only new associations were used in this study so the participant responding with a name when asked 'What is his/her name?' during baseline was not expected. After at least three baseline sessions on consecutive days and a stable level of responding, treatment was implemented. During baseline sessions, errors were of interest, specifically, the nature of error responses and whether these errors were made again in subsequent treatment sessions. The designated female association was 'Thelma' and the male association was 'Nathan'.

The researcher asked the spouses if the participants had any acquaintances or personal relationships with individuals who had the names matched to the pictures being used in this study. P1 knew someone named 'Nathan' in the family so another name, matched for frequency of occurrence and syllables, was selected (i.e., Daniel). P4 also knew someone in the family with the target male association name so the name 'Richard' was selected for treatment.

Intervention phase.

Treatments were presented in a counterbalanced order for each participant to control for order and sequencing effects. In both conditions, fixed recall intervals were used as per Camp et al. (1996) and Hopper, Bayles, Tomoeda and Drefs (2005) as follows: immediate,10 seconds (s), 20s, 30s, 60s, 90s, 2 minutes (m), 3m, 4m, 6m and 8 minutes.

The training took place on consecutive days. The treatment program was considered criterion-based in that the duration of the treatment was dependent upon the number of sessions each participant required to learn the associations. However, no more than seven sessions were to be conducted in either condition. This number was based on previous research in which most participants who learned associations learned them in fewer than 10 sessions, particularly in the mild to moderate stages of dementia severity (Hopper, Bayles, Tomoeda & Drefs, 2005).

SRT-T.

The first session began with the researcher showing the target picture and saying the name of the person (This is [name]). The participant was asked to immediately freely recall the target name. If correct, the target name was confirmed (That's right it's [name]) and the researcher proceeded to the next interval (i.e. 10 seconds). If incorrect the participant was encouraged to guess the name or to give the first name that came to mind. If correct at this level, the response was confirmed verbally and the interval at which the participant last gave a successful freely recalled response was implemented. If incorrect at this level the target name was provided verbally (Actually, his/her name is [name]) and the interval at which the participant last gave a correct response was used. All incorrect responses were followed by shorter intervals than correct responses. For example, if the participant correctly recalled the target name at the 4-minute interval but couldn't correctly recall at the 6m interval, the picture was presented at the previous 4-minute interval in which recall was correct. Sessions were terminated once the participant had correct recalled the face-name association at the 8-minute interval or approximately 30 minutes had elapsed (see Appendix C for SRT-T protocol).

SRT-EL.

In the SRT-EL condition, errors were constrained by giving the participants a forced-choice recognition task instead of asking them to freely recall the information at designated, fixed intervals. The first session began with the researcher showing the target picture and the target name printed on a note card while saying the name of the person. Immediately and at each interval thereafter, the participant was shown the target picture as well as two printed names (one target and one foil, equal in length and frequency of occurrence in English) and asked the question 'What is his/her name?' If the participant identified the correct name, the researcher confirmed the correct response verbally, removed the note cards and initiated the next designated interval. If the participant gave an incorrect response or no response within 10 seconds, the note cards with the printed names were left on the table and the researcher pointed to the note card with the target name and said 'Actually, his/her name is [name]' and had the participant repeat the correct response. The researcher then proceeded to the next interval at which the participant last correctly responded (see Appendix D for the SRT-EL protocol). As in the SRT-EL condition, successful responses were followed by longer delays than unsuccessful responses. Additionally, to prevent participants from learning the foil name due to repeated exposure during treatment sessions, different foil names (measured for frequency of occurrence and number of letters) were provided at all treatment session intervals. That is, no participant saw the same foil name twice within one training session; however, foil names were used across treatment sessions.

During both conditions, several activities were conducted during recall intervals. Participants either conversed with the researcher about issues or events of interest or read short passages and answered questions about the content of the passages.

Probe Sessions.

Probe sessions were conducted at the beginning of every treatment session to assess learning, and after treatment was terminated, to assess long-term maintenance of learning. At the beginning of each treatment session in both conditions, the researcher presented the target picture and asked the participant to name the person in the picture (What is his/her name?). This probe was similar to probes conducted during baseline sessions. If the individual responded correctly during the probe, then treatment was discontinued for that target name-face association and retention probes were conducted on the following schedule after the last treatment session: 2 days, 4 days, 2 weeks, 3 weeks and 6 weeks. If the participant gave an incorrect or no response 1 day after the last treatment session then intervention continued for that association. P1 was unable to meet with the researcher to complete the 4 day retention probe and was administered the probe at 120 hours (5 days) post treatment. To be consistent across treatment conditions, a 5 day retention probe was administered for this participant in SRT-T as well.

Baseline, treatment and probe sessions were conducted individually with each participant. All sessions took place in the participants' homes and were audio and video recorded. Additionally, all sessions were conducted by the same researcher.

Dependent Measures and Analysis

The primary outcome measure was the time it took participants to learn the associations under each treatment condition. For the purposes of this study, and consistent with the definition other researchers have used in SRT studies (Cherry et al., 1999; Hawley & Cherry, 2004), learning was defined as the correct recall of an association 1 day after the most recent training session. The number of sessions necessary to learn the association was compared between treatment conditions.

Within-session variables were also of interest. First, the maximum recall interval was measured in each session (see Appendix E for data collection sheet for within session data). Second, the number and nature of any errors made were also compared across treatment conditions (see Appendix F). Specifically, the investigators counted and classified the incorrect responses by type including no response, phonologically similar response, unrelated response, or foil response (in SRT-EL condition only).

Reliability

A second person (the student's supervisor) independently scored participants' responses made during a randomly selected subset of at least 20% of the total probe sessions (including baseline, 1 day retention probes and long-term retention probes). Inter-rater reliability was calculated using the following formula: total number of correctly scored responses/total number of correct + incorrectly scored responses x 100 (McReynolds & Kearns, 1983). Of the 56, probe sessions across the four participants, 11 were randomly selected for review by the second researcher. Agreement was observed on all recall and probe sessions and was calculated at 100%. Additionally, two treatment sessions were randomly selected for reliability analysis. Agreement on total correctly scored responses for the two sessions and for both researchers was 27, with one disagreement; therefore, inter-rater reliability was 96% for the treatment sessions.

Procedural reliability also was analyzed by having the second judge assess the fidelity of procedures used in the study. Using a procedural checklist (Appendix G), the second judge noted any deviations from the protocol during a random selection of 20% of all sessions for each participant. Procedural reliability on recall and retention probe sessions was 100%. Two treatment sessions were also selected to further establish procedural reliability and was 93% (two instances of deviation from the protocol were noted, both related to timing of recall intervals).

Results

Participant One (P1)

Learning.

During the baseline phase, P1 did not provide the correct face-name response for either of the pictured stimuli. All responses given were unrelated to the target name. This individual required one session to learn the association in the SRT-T format and three sessions to learn the association under the SRT-EL format (see Figure 2). The longest within-session recall interval in the one SRT-T treatment session was 3 minutes (see Figure 3); the longest within-session recall intervals in the three SRT-EL sessions increased progressively from 4 minutes in session one, to 6 minutes in session two, and 8 minutes in session three (see Figure 4).

Retention.

P1 provided the correct target response only at the 2 week retention probe (incorrect responses at 2 day, 5 day, 3 week and 6 week recall) in the SRT-T condition.

The pattern of retention was different in the SRT-EL condition, with P1 correctly responding to retention probes at 2 days and 5 days after treatment (incorrect responses at 2, 3 and 6 weeks – see Figure 2).

Figure 2. *P1 Learning and retention profile in SRT-EL and SRT-T*

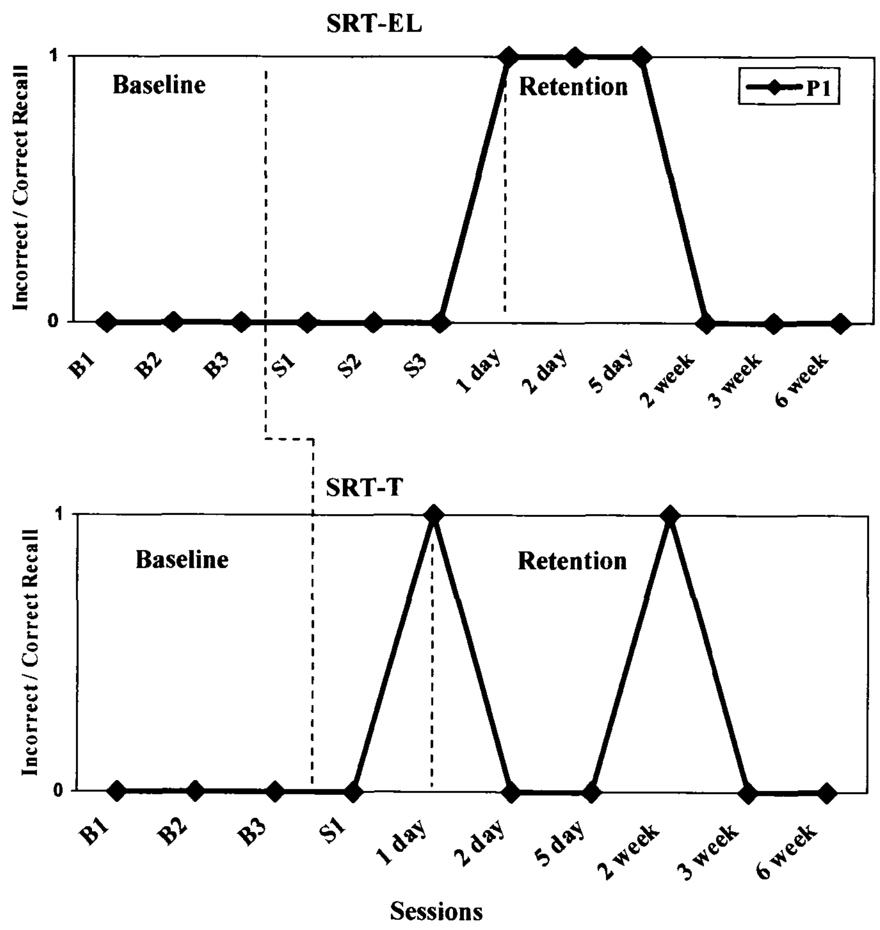


Figure 3. *P1 Within session recall intervals SRT-T*

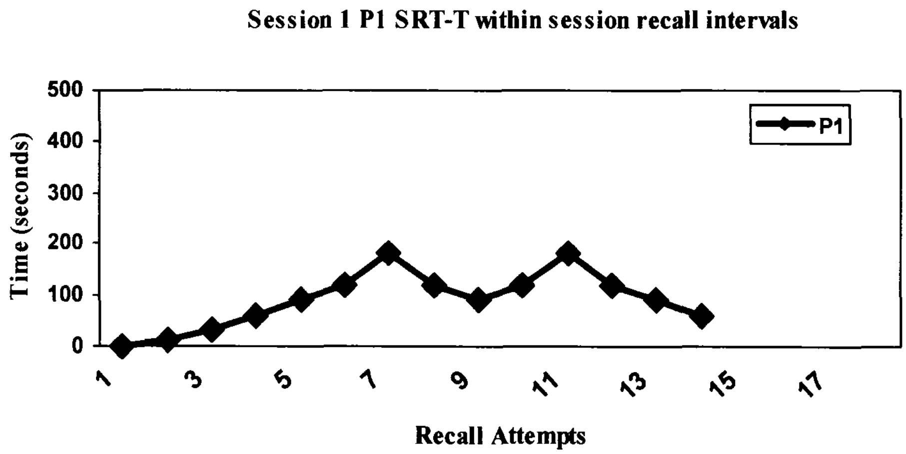
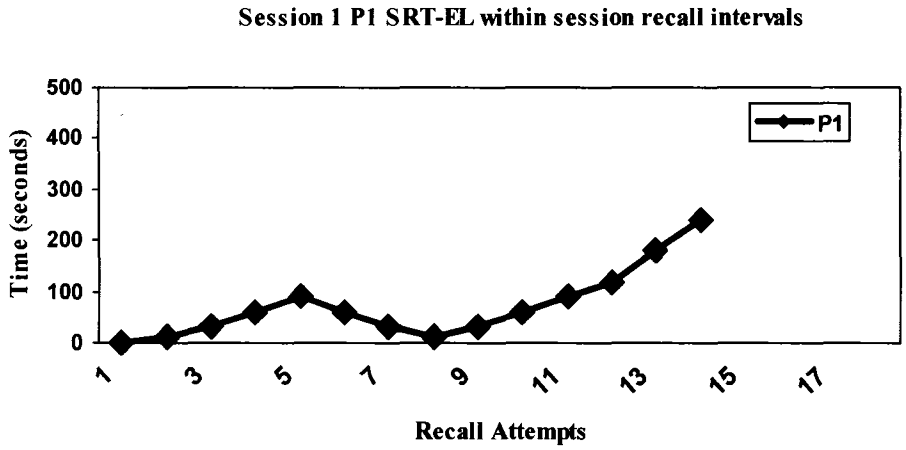
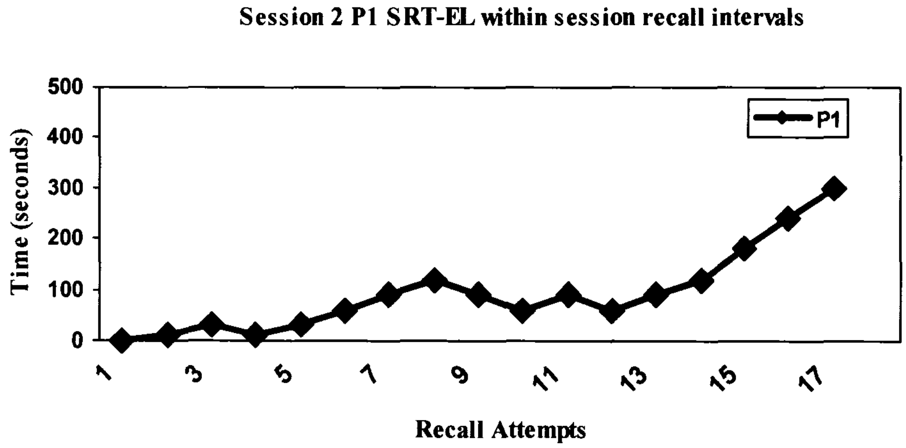
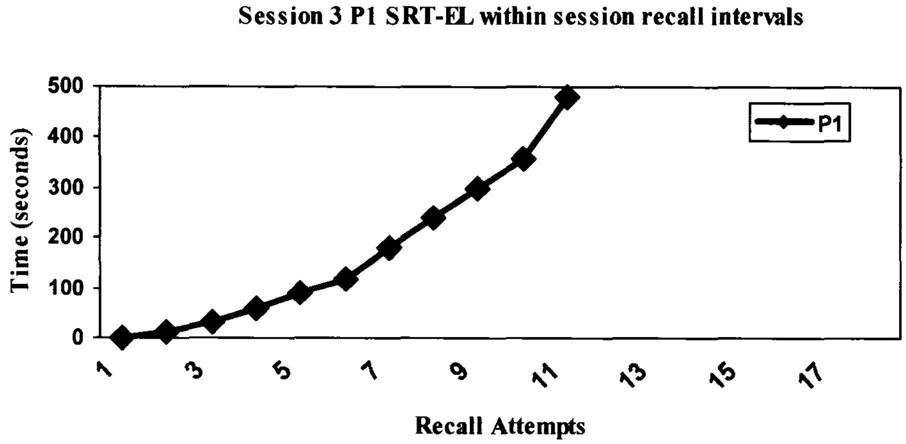


Figure 4. *P1 Within session recall intervals SRT-EL*







Errors.

During treatment sessions in both conditions, P1 gave several incorrect responses. Of 18 responses during SRT-T, 11 (61.1%) were correct and 7 (38.8%) were errors. The 7 errors made by P1 during the one SRT-T treatment session were unrelated to the target name. In the SRT-EL condition (3 sessions), 44 total responses were made of which 36 were correct (81.8%) and 8 were incorrect (18.2%). The 8 errors during SRT-EL comprised unrelated error responses and foil errors (see Appendix H for a list of errors).

During probe sessions for the association trained using SRT-T, P1 made similar types of unrelated errors during retention probes at 2 days, 5 days, 3 weeks and 6 weeks. The unrelated error 'Hansen' was provided at the 5 day recall and again at 3 weeks. An unrelated response (Walter) was provided at the 6 week retention probe.

During probe sessions for the association trained using SRT-EL, P1 made unrelated responses during baseline (i.e., the names Janie and Amy), which were not made again at during treatment or probe sessions. In response to 1 day recall probes conducted at the beginning of each SRT-EL session, P1 provided one unrelated response, one foil response and one phonologically similar response. The error responses made at the 2 and 3 week retention probes were foil responses. At the 6 week retention probe P1 produced an unrelated response (see Appendix H).

Participant Two (P2)

Learning.

P2 did not correctly name either face during the baseline condition. He required two sessions to learn the target face-name association under both treatment conditions (see Figure 5). Additionally, the longest within session retention interval for P2 under

SRT-T and SRT-EL formats was the maximum possible eight minutes (see Figure 6 & 7).

Retention.

This participant correctly recalled the association at 2 days, 4 days and 2 weeks after the last treatment session in SRT-T. P2 retained the face-name association taught under SRT-EL for 2 days after the last treatment session (see Figure 5).

Figure 5. *P2 Learning and retention profile in SRT-T and SRT-EL*

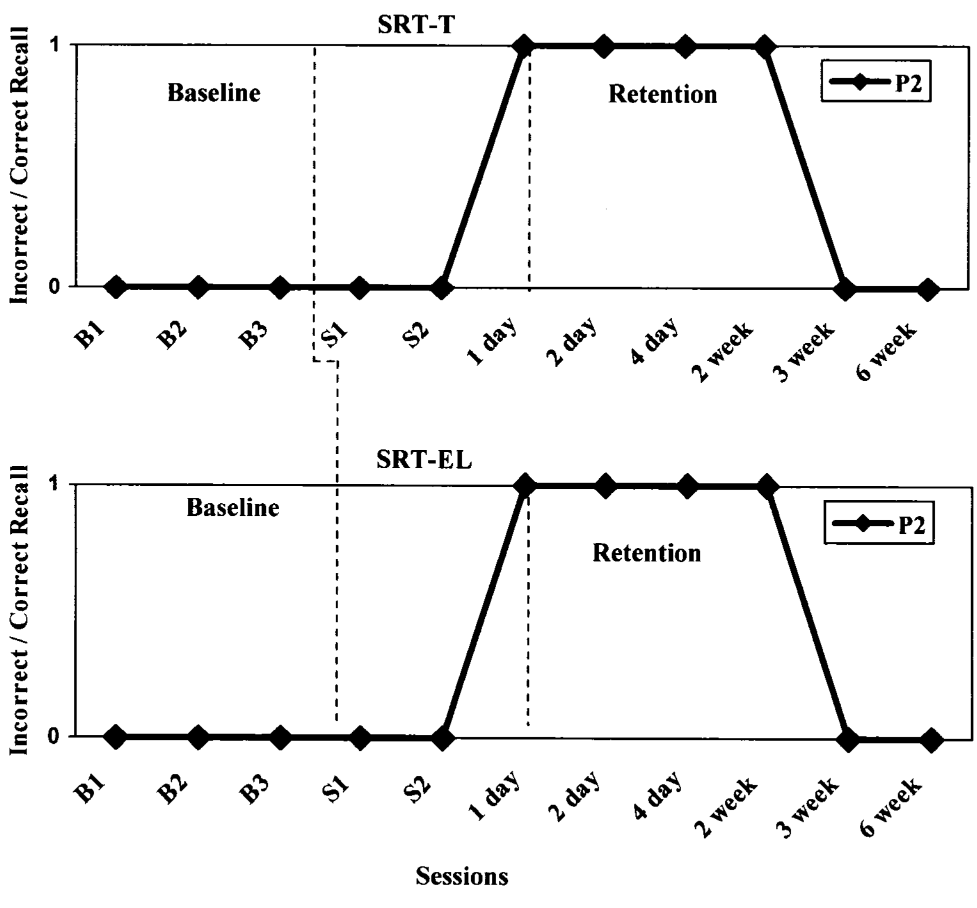
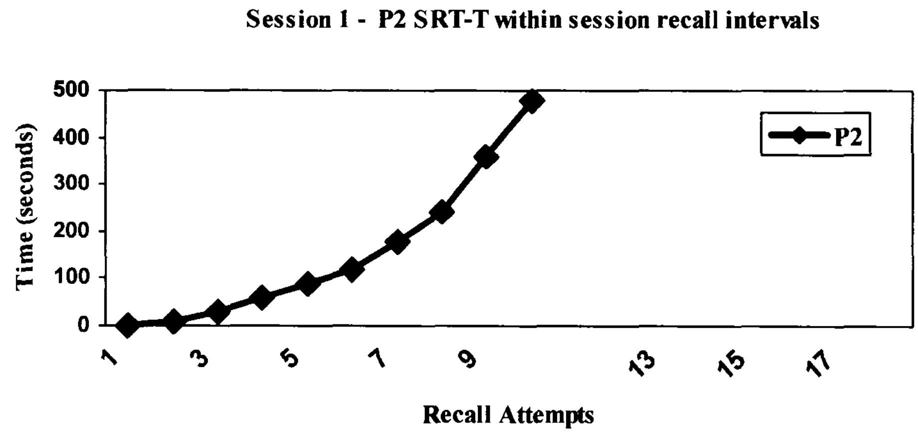


Figure 6. *P2 Within session recall intervals SRT-T*



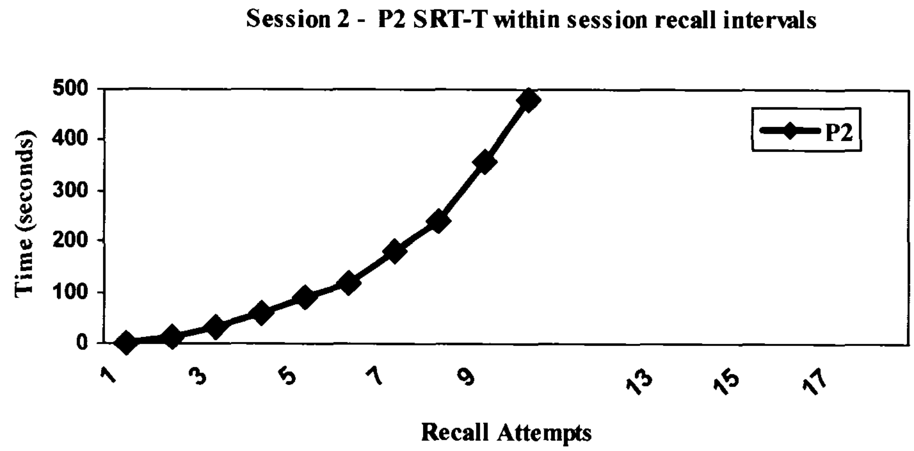
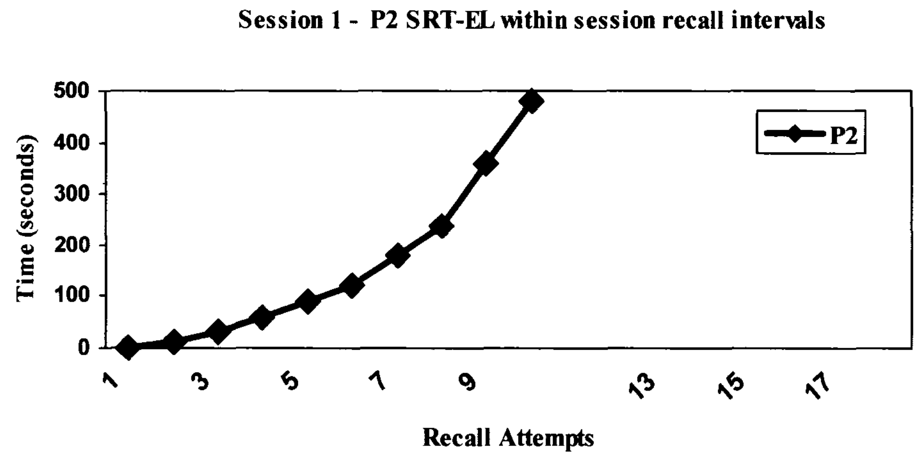
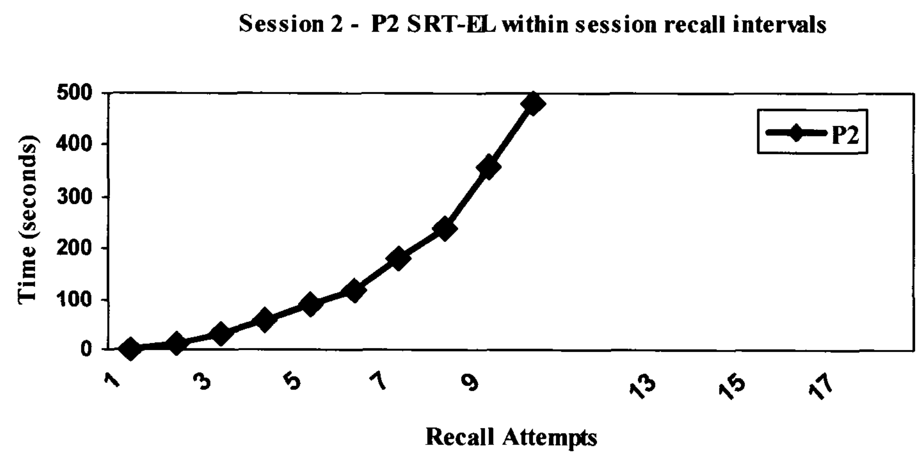


Figure 7. *P2 Within session recall intervals SRT-EL*





Errors.

During treatment sessions in both conditions, P2 gave a total of 20 responses under SRT-T and 20 responses under SRT-EL (see Figure 6 & 7). He made no within session errors in either treatment condition. Therefore, a total correct response rate of 100% was calculated for P2 under both learning formats and total incorrect response rate was 0%. However, P2 made several errors during long-term retention probes under both learning formats.

For the association trained during SRT-T, P2 made errors at 1 day recall between sessions and at 3 week and 6 week retention probes. Specifically, he gave one phonologically similar error response at the 1 day recall and two unrelated errors during 3 and 6 week retention probes (see Appendix I for a list of errors).

For probes on the association trained during SRT-EL, P2 made several types of errors. During the 1 day recall he made an unrelated error, at the 4 day probe he gave the response 'Tom' (one of the foil response options was Thomas), at 2 weeks he gave the name 'Theodore' which is phonologically similar to the target female name learned under the SRT-T condition. Additionally, P2 gave the name 'Phillip' at 3 and 6 week recalls (similar to name provided at 6 week recall under SRT-T which was 'Phyllis' – see Appendix I).

Participant Three (P3)

Learning.

P3 did not correctly name the pictures during the baseline phase, providing unrelated responses. He required one session to learn the associations in both SRT-T and SRT-EL conditions (see Figure 8). Additionally, P3 was able to retain the associations up to the 8 minute interval in both SRT-T and SRT-EL conditions (see Figure 9 & 10).

Retention.

P3 provided correct responses at 2 days, 4 days, 2 weeks, 3 weeks and 6 weeks as measured by long term retention probes in SRT-T. A matching retention profile was observed for the association learned under SRT-EL as P3 provided the correct responses at all retention probe intervals (see Figure 8).

Figure 8. *P3 Learning and retention profile in SRT-T and SRT-EL*

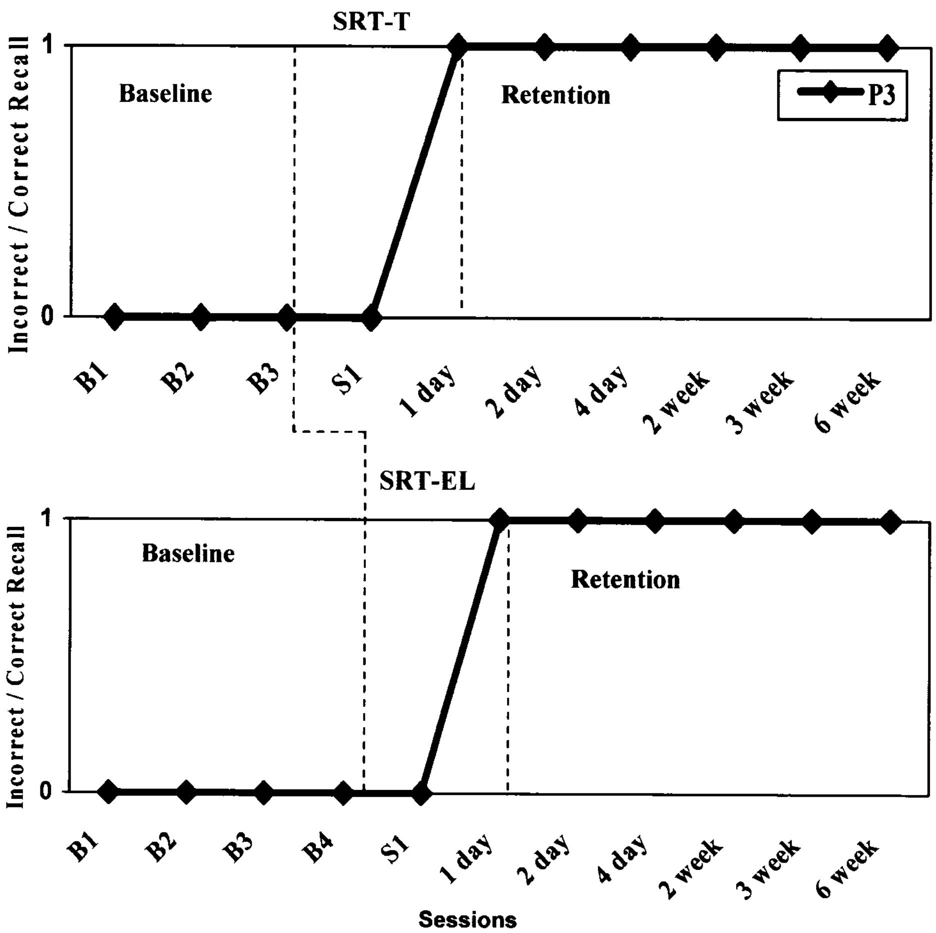


Figure 9. *P3 within session recall intervals SRT-T*

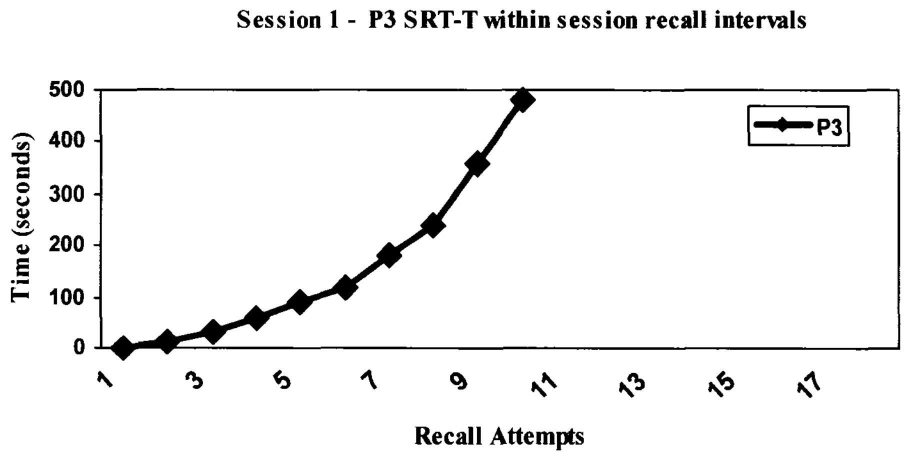
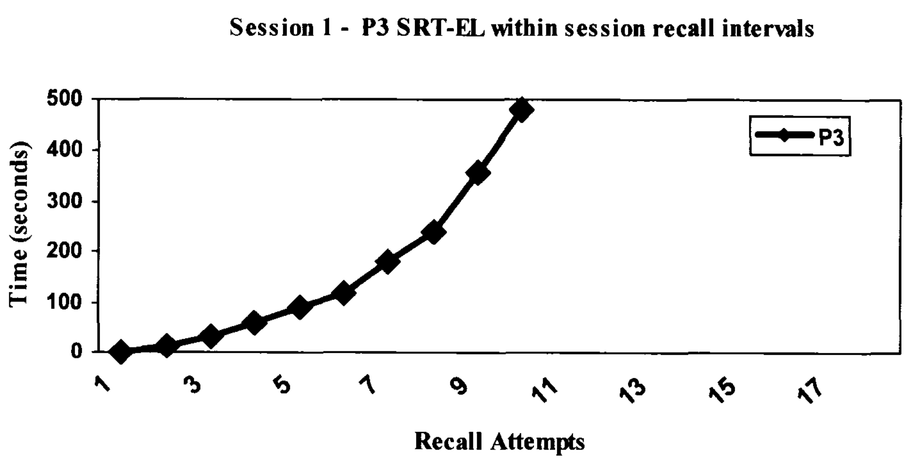


Figure 10. *P3 within session recall intervals SRT-EL*



Errors.

P3 gave a total of 10 responses in SRT-T none of which was an error response. Additionally, a total of 10 responses were given during SRT-EL (see Appendix J).

Therefore, a total correct response rate of 100% was calculated for P3 under both learning formats and total incorrect response rate was 0%.

P3 did not correctly name the pictures during baseline and his errors were unrelated to the target responses in both conditions (e.g., 'Belinda Stronach' and 'Brad Pitt). This participant made no further errors and once the target names were provided, was able to recall learned associations up to 6 weeks.

Participant Four (P4)

Learning.

P4 did not correctly name pictures during the baseline condition and made unrelated errors. This participant required three sessions to learn the association under both SRT-T and SRT-EL formats (see Figure 11). However, a difference in longest within session retention interval was observed between formats (see Figure 12 & 13). Specifically, under SRT-T retention progressively decreased across sessions from 6 minutes in session one, to 4 minutes in session two and 2 minutes by session three (see Figure 12). In SRT-EL P4 reached the 8 minute recall interval in all three sessions (see Figure 13).

Retention.

P4 was able to retain the face-name association learned under SRT-T at 1 day, 4 days, 2, 3 and 6 weeks post treatment. For the association trained under SRT-EL, P4 retained face-name information at only the 4 day probe, followed by errors at 2, 3 and 6 week retention probes (see Figure 11).

Figure 11. *P3 Learning and retention profile in SRT-EL and SRT-T*

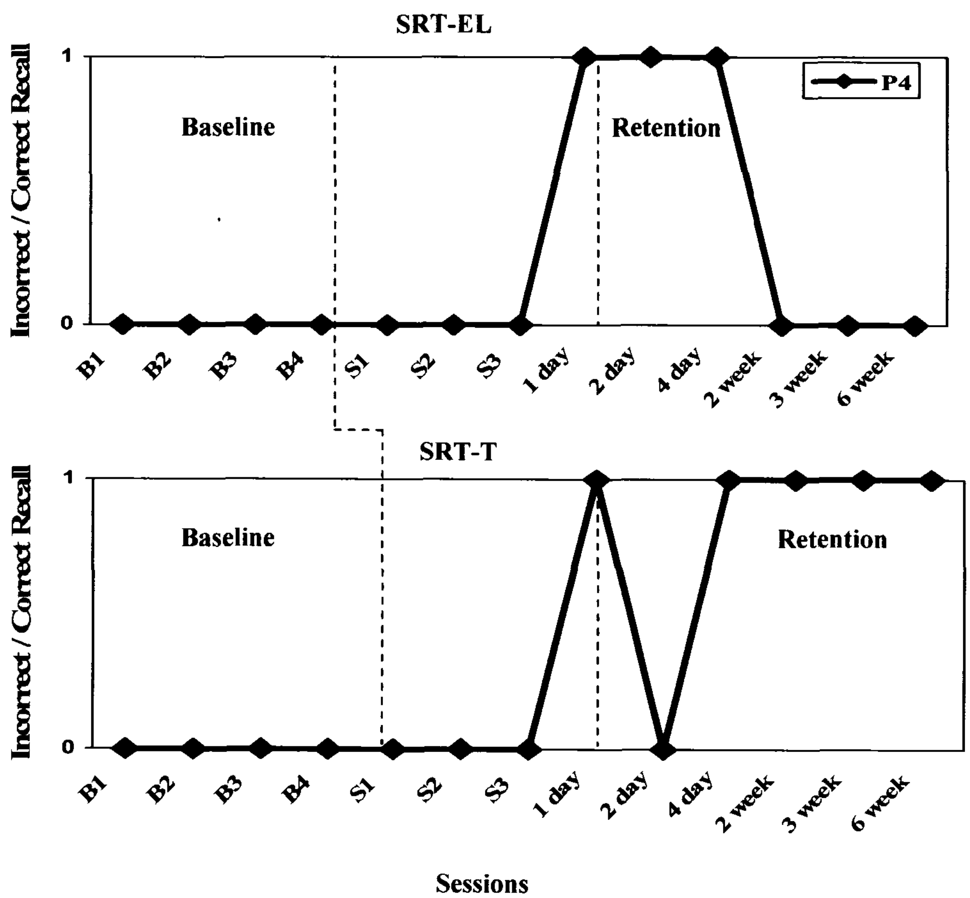
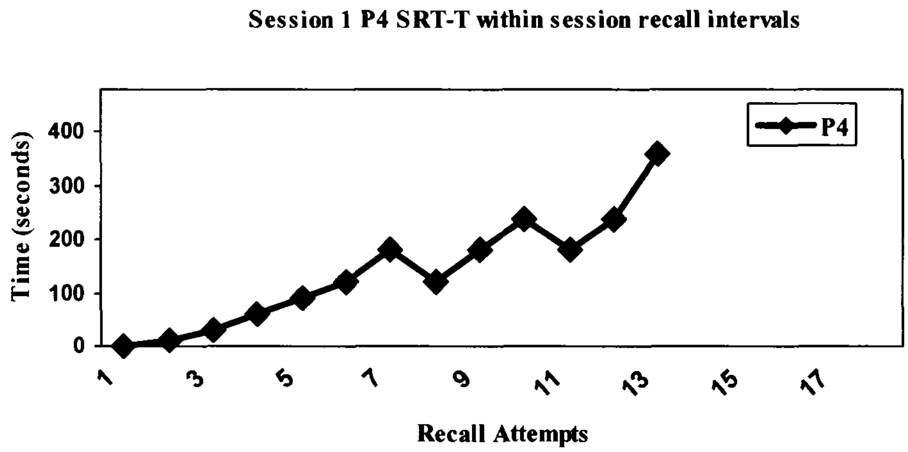
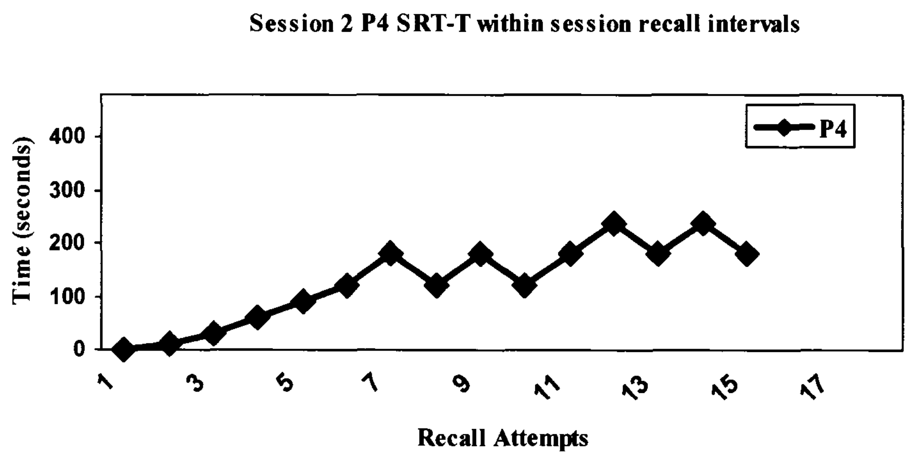


Figure 12. *P4 Within session recall intervals in SRT-T*





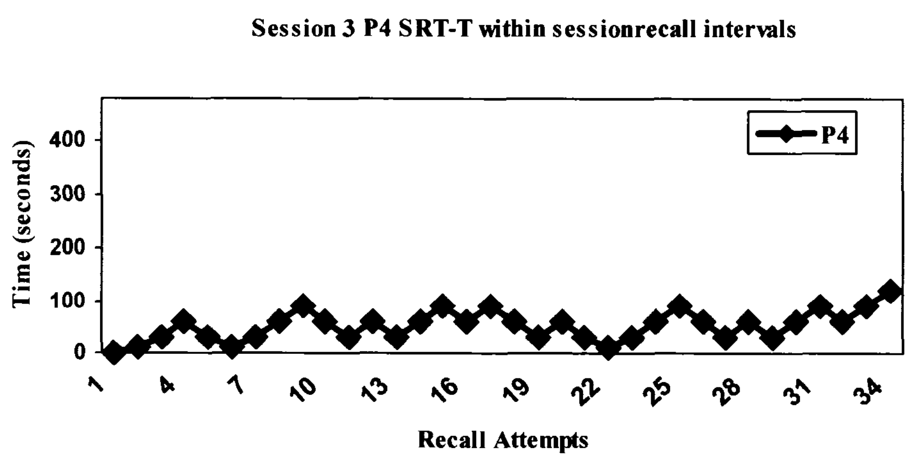
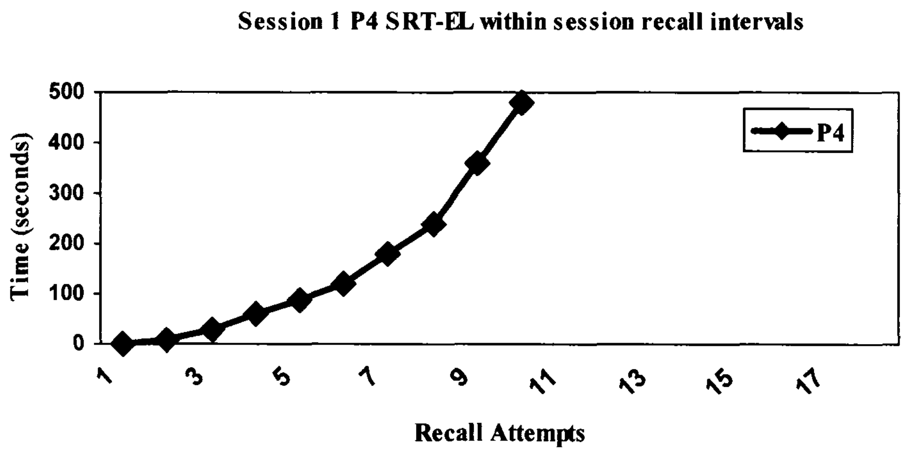
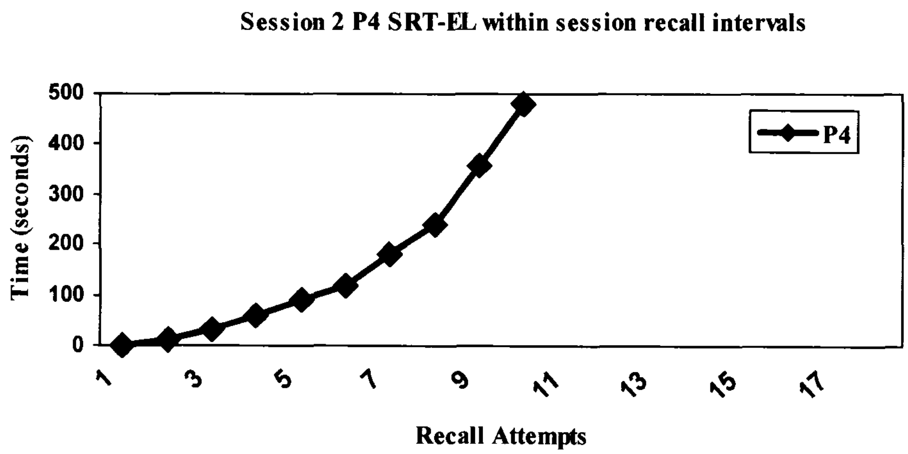
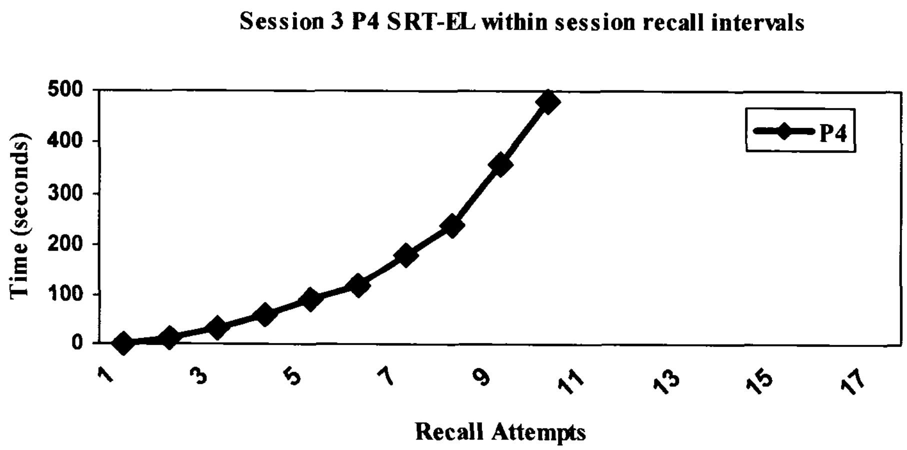


Figure 13. *P4 Within session recall intervals SRT-T*







Errors.

P4 provided 62 responses during SRT-T sessions. A total correct response rate of 62.9% and total incorrect response rate of 37% was observed in this condition. P4 made several within session error responses in this condition, all of which were unrelated to the target association (i.e., Gloria; see Appendix K). In SRT-EL, 30 correct responses were provided, with a total correct response rate of 100% and total incorrect response rate of 0%.

During probes related to the association trained during SRT-T, P4 made the same unrelated error responses at the 1 day recall between sessions in SRT-T and again at the 2 day recall probe. However, he provided correct response at 96 hr, 2, 3, and 6 week recall probes. Upon completion of all the recall probes the researcher asked both the participant and his wife whether or not they knew anyone by the name of 'Gloria' and both responded that they did not know anyone by that name.

During probe sessions for the association learned under SRT-EL, P4 gave one unrelated response and one foil response at the 1 day recalls (see Appendix K). P4 was able to retain the association up to 4 days and gave foil and unrelated error responses at 2 and 3 and 6 week probes. At the 2 week recall probe, he gave the foil error response 'Robert'. This response was followed by a phonologically similar error at 3 week recall 'Albert' and then an unrelated response at 6 weeks 'Mark' (the target name was Richard).

Discussion

The purpose of this study was to assess the effects of two treatment protocols (SRT-T and SRT-EL) on learning and retention of face-name associations by four individuals with mild to moderate AD. Also of interest in this study were the nature of errors made during learning trials and the relation of these errors, if any, to treatment outcomes.

Learning

All four participants were able to learn the face-name associations in both treatment conditions in three or fewer sessions. For one participant (P1), more sessions were required to learn the association in the SRT-EL format than in SRT-T (three sessions vs. one session). However, no differences were observed in time to learn by treatment conditions for any other participant.

The ability of individuals with mild to moderate AD to learn new information is consistent with previous research findings. For example, Camp (1989) observed that three participants in his study learned the names of continuing care staff members after three training sessions. Others (Cherry, et al., 1999; Cherry & Simmons-D'Gerolamo, 2004; Cherry & Simmons-D'Gerolamo, 2005; Hawley & Cherry, 2004; Hochhalter, et al., 2004) have reported similar findings on the ability of individuals with AD to learn new and previously known information and behaviors using SRT.

Although there is ample evidence for learning by individuals with AD under SRT protocols, the focus of this study was on the effects of modification of the standard SRT protocol using EL principles. In the current study, individuals did not learn faster when the SRT-EL protocol was used; in fact, P1 needed more time to learn an association when the EL protocol was used. This finding is consistent with those of Metzler-Baddeley & Snowden (2005) who found that participants with AD in their study learned both familiar and novel face-name associations in errorless and errorful conditions (although there was a reported modest advantage of the EL condition over the EF condition). They reasoned that a participant's ability to use effortful processing strategies, such as mnemonics, lends itself to learning in the EF condition. However, when the participant's ability to use additional memory aids deteriorates, the benefits of EL procedures may be maximized, as in the case of a person with more advanced dementia. Yet in the current study, the individual with the most advanced cognitive decline took longer to learn in the SRT-EL condition. The lack of a facilitative effect of EL for any of the participants in the current study may be a result of several factors, including the way SRT-T was modified to make it "errorless," and the nature of learning by individuals with AD.

The standard SRT protocol is thought to encourage an automatic type of learning and is, arguably, already based on errorless learning principles (Camp, 1989; Camp, et al., 2000; Wilson, et al., 1994). In the current study, the way that errors were constrained may have added no benefit to a procedure that is already sufficiently "errorless." In fact, these modifications may have actually increased the likelihood of errors being made by some participants. P1 provided unrelated error responses in session one of SRT-EL but in session two she made errors that were foils or phonologically similar to foil names that she had seen during learning trials (Shirley, Cheryl. Shelly, Shannon – see Appendix H). Also, P4 provided a foil response at 1 day recall in SRT-EL (Walter) on two separate occasions (Appendix K). This particular name was never provided during subsequent long term retention probes. However, a different foil error response was made during the 2 week retention probe (Robert).

Response cue cards with foils were changed upon each presentation during EL training but were re-used in subsequent treatment sessions. Clearly, at least two participants seemed to have acquired the foil names and associated them with the target picture. Perhaps using separate sets of foil names so that participants would never see the same foil name twice across treatment sessions is required to avoid the potential acquisition of erroneous responses related to the target name.

The nature of learning by individuals with AD may also be a factor in explaining the lack of a benefit of SRT-EL over SRT-T. Individuals with AD, as is true of other adult learners without AD, may need to actively generate responses to learning questions and situations to facilitate recall of information (Metzler-Baddely & Snowdon, 2005). Komatsu, Mimura, Kato, Wakamastsu & Kashma (2000) have suggested that the nature of learning, specifically, the degree of effort required during a learning task, may be a potential contributor to time to learn and retain information. They posit that because EL procedures require little effort on the part of the learner, recall is diminished because it requires effort that was not used during EL tasks. However, they note that effortful recall during learning has the potential to increase the number of errors and negatively affect acquisition of associations. Thus, a balance between errors and effort is required to achieve efficient learning.

It is important to note that although SRT-EL did not improve efficiency of learning in the current study, participants made fewer errors during SRT-EL treatment sessions than in SRT-T sessions. This finding might be important for individuals with AD who have difficulty inhibiting incorrect responses during recall intervals and for whom making errors is frustrating. Constraining errors and providing support may not make learning faster for these individuals, but it may make learning sessions more positive for them. For example, P4 expressed mild frustration several times throughout SRT-T training at not being able to provide the correct response and instead repeatedly providing the same incorrect response. He mentioned that he just 'didn't know why' he could not inhibit the erroneous response. This was not the case in SRT-EL where no error responses were provided throughout treatment sessions.

In the current study, three of the participants scored similarly on all assessments taken yet exhibited different learning and retention profiles. One participant learned the associations in one session, another required two sessions, and two others required up to three sessions. Severity of cognitive decline may be one contributor to observed differences in learning. However, P1, the most cognitively impaired individual in this study, learned the association in SRT-T in less time than two other participants who were less cognitively impaired (P2 and P4). Therefore, it is likely that other factors which may affect learning and retention contributed to this finding. This is consistent with the findings of McKitrick, et al., (1992) who observed that individuals in their study with the lowest cognitive functioning scores performed better on some learning tasks than others with higher scores.

Other variables clearly play a role in learning and may be characterized as personal factors using the terminology from the ICF (ICF; WHO, 2001). These factors include characteristics of the individual including their past experiences, education levels, motivation, personality and so on. These factors are difficult to assess yet are recognized for their impact on a person's level of functioning – in this case, the ability to learn. In this study, for example, P3 was the youngest of all the participants and exhibited a learning and retention profile quite different from the other three participants in that he was able to learn both associations in one session and retained the associations up to six weeks post-treatment. He seemed to be the most aware of his memory problems of all the participants as he often talked about his memory loss and his desire to use as many coping strategies as possible to maintain his memory and communication abilities. He was very involved in the local Alzheimer association helping to facilitate groups and encourage others facing the same situation and might be considered highly "motivated" to excel in a treatment program such as the one in this study. Indeed, P3 used several explicit memory strategies to learn the target associations. P3 linked the target male association to an individual he mentored with the name 'Jonathan' which he was able to actively recall upon presentation of the picture stimulus (target was 'Nathan').

Additionally, P4 reported remembering the target female association by linking it with the wife of a friend of his when he lived out of province. In contrast, P2 stated that the reason he could not remember the target name was that it was not 'all that important' to him. This individual may have been attempting to mask his deficits but the possibility exists that the lack of meaningfulness of the task affected his ability to learn. This is an important consideration for rehabilitation of individuals with dementia. Information to be learned must be meaningful and relate to functional, everyday activities if it is to be useful – and motivating for the patient.

Within session recall intervals were also of interest in this study because little known about the relation of within session recall intervals and retention. The results were mixed; for example, two participants who exhibited shorter within session recall intervals in SRT-T than SRT-EL went on to retain the associations for longer periods of time in the SRT-T condition. Additionally, two other participants who had the same within session recall profiles (8 minutes no errors) exhibited different long term retention profiles. Therefore, within session recall intervals did not appear to be related to retention, which is discussed in the next section.

Retention

Retention profiles varied within and between the four participants. All individuals were able to retain the face-name associations, as measured by the long-term maintenance probes, but the pattern of retention was inconsistent over time for three of four participants. Whereas one participant recalled consistently at each retention probe interval, the others would have recall failures at earlier times and then recall the information at a later probe.

The long-term retention findings are consistent with previous research, although few studies have been published that include formal, systematic probes of retention following learning by individuals with AD. Clare, et al. (1999) observed long term maintenance (up to 9 months after the end of the study) of previously known face-name associations in a single case study using a multi-component errorless learning approach, although the participant practiced during the interval. However, in a follow-up study, Clare, Roth, Wilson, Carter and Hodges (2002) reported retention up to 6 months after training, without intervening practice sessions. Others have reported shorter retention intervals of one week (Camp, 1989) to 5 weeks (McKitrick & Camp, 1989) following associations trained using SRT specifically. Yet the pattern of recall at specific intervals (e.g., 1 day, 2 days, 2 weeks) has not been reported. By observing the maximum length of time discrete pieces of information can be retained and the number of training required to learn, researchers and clinicians can determine the intensity and frequency of individualized treatments. For example infrequent 'practice' sessions at various time intervals (i.e., perhaps once or twice a year) or "booster" sessions, may be required.

The present findings are in support of a retrieval deficit hypothesis, that is, the information has been encoded, yet individuals are unable to access it consistently over time. For instance, P1 failed to provide the correct response at 4 days but then went on to give the correct response at 2 weeks post treatment. Similarly, P4 could not recall the association in SRT-T at 2 days but went on to correctly recall the association for the remainder of the retention probe sessions. The possibility exists that situational variables may help to explain the preceding finding. Variables such as motivation, fatigue or the general heterogeneity of the study sample may account for this observation. Hultsch, MacDonald and Dixon (2002) note that variability in cognitive test performance (i.e., reaction time) is significantly greater among older adults as compared to younger adults. Furthermore, performance variability may be more pronounced in individuals with cognitive impairment, as in AD.

For three participants, SRT-T associations were retained longer than the SRT-EL associations. Although no definitive statements can be made about the benefits of one type of training over another with regard to retention, it is clear that time to learn is not the primary factor in retention. Also, within session recall intervals were unrelated to retention. Error type and number also appeared unrelated to retention. In clinical contexts, it is probable that meaningful, oft-used information will be recalled more consistently and across longer intervals of time than information is not used in daily life. The "use it or lose it" adage (Hultsch, Hertzog, Small, & Dixon, 1999) may apply equally to individuals with dementia as it does to typical learners.

Errors

Much has been written about the potential adverse effects on errors during learning (Baddeley & Wilson, 1994; Hunkin, et al., 1998; Wilson, et al., 1994). However, few details are available about the number and type of errors made during learning trials and how these affected treatment outcomes in previous studies. Metzler-Baddeley & Snowden (2005) compared errorful vs. errorless learning in their study but did not specify the type of errors made. In most other studies on this topic, researchers stated that errors were made but described these errors only as failed recall attempts.

In the current study, fewer overall error responses were observed under SRT-EL (8 errors) than under SRT-T (31 errors) across participants. However, the majority of the errors was made by one participant (P4, 24 errors) in SRT-T. P4 had trouble inhibiting the erroneous response 'Gloria' throughout treatment sessions under SRT-T. Although, P4 made numerous errors these did not have an impact on the long term maintenance of the association trained under SRT-T. Although we did not test inhibition abilities in the participants, it is possible that susceptibility to interference from errors is different among individuals with AD. Those individuals who are more susceptible to interference are those who would more likely benefit from EL protocols.

The nature of the error may also help explain learning by individuals with AD in the SRT paradigm. For example, the presence of foil errors clearly indicates some learning of the incorrect responses across trials. Phonologically similar errors may represent that some information about the target was encoded but degraded such that only part of the sound pattern of the word is retrieved. More research on the nature of errors made by participants with AD while recalling information is necessary to help explain the nature of learning under the SRT paradigm.

Limitations

The lack of larger study sample limits external validity of the study. Thus, future research should be conducted on this topic with larger groups of individuals with AD. Also, a test of inhibition should be administered to help explain factors that predict response to treatment, including long-term retention of learned information. One such test that may be used is the Stroop task where a word is printed or displayed in a color different from the color it actually names; for example, if the word "blue" is written in green ink (Stroop, 1935). This could help determine whether susceptibility to interference is another factor that may affect learning. As well, foil names should not be used more than once during all treatment sessions, to reduce the likelihood that participants will learn error associations.

Conclusion

The results of this study are consistent with previous research in which individuals with mild to moderate AD have learned face-name associations using SRT. The current study expands on knowledge about SRT and EL for individuals with dementia. Specifically, the combination of EL principles and SRT did not have significant effects on time to learn or retain information. Maximum length of within session recall intervals also did not affect the learning outcomes. Although error type and number did not have a significant effect on time to learn or retain information, the errors made during earlier probe and treatment sessions did occur in subsequent sessions for some participants. And, for P4, errors during learning trials may have been frustrating.

Future research focused on these issues in larger group studies may help to further explicate factors involved in the learning and retention of discrete pieces of information and the role of errors during learning by individuals with AD.

References

Abrahams, J.P. & Camp, C.J. (1993). Maintenance and generalization of object naming training for anomia associated with degenerative dementia. *Clinical Gerontologist, 12,* 57-72.

American Psychiatric Association (1994). *Diagnosis and Statistical Manual of Mental Disorders, Fourth Edition.* Washington, DC: American Psychiatric Association.

Baddeley, A. D., & Hitch, G. (1974). Working memory. In G. A. Bower (Ed.), *The psychology of learning and motivation, Vol. 8.* New York: Academic Press.

Baddeley, A., & Wilson, BA. (1994). When implicit learning fails: Amnesia and the problem of error elimination. *Neuropsychologia, 32(1),* 53-68.

Baddeley, A. (2000). The episodic buffer: a new component of working memory? *Trends in Cognitive Science, 4(11),* 417-23.

Bailey, J., Gilbert, E., & Herweyer, S. (1992). To find a soul... doll therapy to reach out to Alzheimer's patients. *Nursing, 22(7),* 63-4.

Bayles, K., & Tomoeda, C. (1993). The Arizona Battery for Communication Disorders of Dementia. Canyon lands Publishing: Tucson, AZ.

Bayles, K., & Tomoeda, C. (1996). Functional Linguistic Communication Inventory. Tuscon, AZ: Canyonlands Publishing, Inc.

Bird, M. (2001). Behavioural difficulties and cued recall of adaptive behaviour in dementia: Experimental and clinical evidence. *Neuropsychological Rehabilitation, Special Issue: Cognitive Rehabilitation in Dementia, 11*, 357-375.

Bird, M., Alexopoulos, P. & Adamowicz, J. (1995). Success and failure in five case studies: Use of cued recall to ameliorate behaviour problems in senile dementia. *International Journal of Geriatric Psychiatry, 10,* 305-311.

Bird, M., & Kinsella, G. (1996). Long term cued recall of tasks in senile dementia. *Psychology of Aging, 11(1),* 45-56.

Bloom, M., & Fischer, J. (1982) Evaluating Practice: Guidelines for the Accountable Professional. Englewood Cliffs, NJ: Prentice-Hall

Bourgeois, M.S. (1990). Enhancing conversation skills in patients with Alzheimer's disease using a prosthetic memory aid. *Journal of Applied Behavior Analysis, 23(1),* 29-42.

Bourgeois, M. (2002). Where is my wife and when am I going home? The challenge of communicating with persons with dementia. *Alzheimer Care Quarterly, 3*, 132-144

Braak, H. & Braak, E. (1991). Neuropathological staging of Alzheimer-related changes. *Acta Neuropathologica, 82*; 239–259.

Braak, H. & Braak, E. (1997). Staging of Alzheimer-related cortical destruction. International Psychogeriatrics, 9 (Suppl 1), 257–261.

Brandt, J. & Rich, J.B. (1995). Memory disorders in the dementias. In A.D. Baddeley, B.A. Wilson & F.N. Watts (Eds.), Handbook of memory disorders (pp. 243-270). Chichester, UK: Wiley.

Brush, J.A., & Camp, C.J. (1998). Using Spaced Retrieval as an intervention during speech-language therapy. *Clinical Gerontologist, 19(1),* 51-64.

Burgess, A.P. & Gruzelier, J.H. (1997). Short duration synchronization of human theta rhythm during recognition memory. *Neuroreport, 8 (4),* 1039-42.

Burgess, I.S., Wearden, J.H., Cox, T., & Rae, M. (1992). Operant conditioning with subjects suffering from dementia. *Behavioral Psychotherapy.*

Butters, N., Granholm, E., Salmon, D.P., Grant I., & Wolfe, J. (1987). Episodic and semantic memory: a comparison of amnesic and demented patients. *Journal of Clinical & Experimental Neuropsychology: Official Journal of the International Neuropsychological Society, 9(5)*, 479-97.

Canadian Study of Health and Aging Working Group. (1994). Canadian study of health and aging: Study methods and prevalence of dementia. *Canadian Medical Association Journal, 150(6),* 899-913.

Camp, C. J. (1989). Facilitation of new learning in Alzheimer's disease. In G. Gilmore, P. Whitehouse, & M. Wykle (Eds.), *Memory and Aging: Theory, Research and Practice* (pp. 212-225). New York: Springer.

Camp, C.J., Foss, J.W., O'Hanlon, A.M., & Stevens, A.B. (1996). Improving prospective memory task performance in persons with Alzheimer's disease. In (Eds.). Maria Brandimonte, Gilles O. Einstein and Mark A. McDaniel. *Prospective memory: Theory and applications*. (pp. 351-367). New Jersey: Lawrence Erlbaum Associates.

Camp, C. J., Foss, J. W., Stevens, A. B., Reichard, C. C., McKitrick, L. A., & O'Hanlon, A. M. (1993). Memory training in normal and demented elderly populations: the E-I-E-I-O model. *Experimental Aging Research, 19*, 277-290.

Casby, J.A, & Holm, M.B. (1994). The effect of music on repetitive disruptive vocalizations of persons with dementia. *American Journal of Occupational Therapy, 48, (10),* 883-9.

Cherry, K.E.& Simmons-D'Gerolamo, S.S. (1999). Effects of a target object orientation task on recall in older adults with probable Alzheimer's disease. *Clinical Gerontologist, 20(4)*, 39-63

Cherry, K., & Simmons-D'Gerolamo, S. (2004). Spaced-retrieval with probable Alzheimer's. *Clinical Gerontologist. 27(1/2):* 139-57.

Cherry, K., & Simmons-D'Gerolamo S. (2005). Long-Term Effectiveness of Spaced-Retrieval Memory Training for Older Adults with Probable Alzheimer's disease. *Experimental Aging Research, 31(3),* 261-289.

Cherry, K.E., Simmons, S.S. & Camp, C.J. (1999). Spaced-retrieval enhances memory in older adults with probable AD. *Journal of Clinical Geropsychology, 5(3),* 159-175.

Clare, L., Wilson, B., Breen, K., & Hodges, J. (1999). Errorless learning of face-name associations in early Alzheimer's disease. *Neurocase.* 5, 37-46.

Clare, L., Wilson, B., Carter, G., Hodges, J., & Adams, M. (2001). Long-term maintenance of treatment gains following a cognitive rehabilitation intervention in early dementia of Alzheimer type: A single case study. *Neuropsychological rehabilitation.* 11(3/4), 477-494.

Clare, L., Wilson, B.A., Carter, G., Breen, K., Gosses, A., & Hodges, J.R. (2000). Intervening with everyday memory problems in dementia of the Alzheimer's type: An errorless learning approach. *Journal of Clinical and Experimental Neuropsychology, 22 (1),* 132-146.

Clare, L., Roth I., Wilson, B., Carter, G., & Hodges, J. (2002). Relearning face-name associations in early Alzheimer's disease. *Neuropsychology.* 16(4), 538-547.

Crum, R.M., Anthony, J.C., Basset, S.S., & Folstein, M.F. (1993). Population-based norms for the Mini-Mental State Examination by age and education level, *Journal of the American Medical Association, 269,* 2386–2391.

Cummings, J.L. (2003). Use of cholinesterase inhibitors in clinical practice: Evidence-based recommendations. *American Journal of Geriatric Psychiatry, 11(2),* 131-145.

Damasio, A.R., Damasio, H., Tranel, D. & Brandt, J.P. (1990). Neural regionalization of knowledge access: preliminary evidence. *Cold Spring Harbor Symposia on Quantitative Biology, 55,* 1039-47.

Denney, A. (1997). Quiet music. An intervention for mealtime agitation? *Journal of gerontological nursing, 23(7),* 16-23.

Eldridge, L.L., Knowlton, B.J., Furmanski, C.S., Bookheimer, S.Y., & Engel, S.A. (2000). Remembering episodes: a selective role for the hippocampus during retrieval. *Natural Neuroscience, 3,* 1149–1152

Eslinger, P.J. & Damasio, A.R. (1986). Preserved motor learning in Alzheimer's disease: implications for anatomy and behavior. *Journal of Neuroscience. 6(10),* 3006-9.

Fell, J., Klaver, P., Elger, C.E., & Fernandez, G. (2002). The interaction of rhinal cortex and hippocampus in human declarative memory formation. *Reviews in the Neurosciences, 13(4),* 299-312.

Francis, G., & Baly, A. (1986). Plush animals -- do they make a difference to nursing home residents. *Geriatric Nursing, 7(3)*, 140-2.

Folstein, M., Folstein, S., Mchugh, P. (1975). The Mini-Mental State Examination. *Journal of Psychiatric Research.* 12, 189-198.

Glisky, E. L. (1997). Rehabilitation of memory function. In T. E. Feinberg & M. J. Farah (Eds.), *Behavioral neurology and neuropsychology.* New York: McGraw-Hill

Grady, C.L., Haxby, J.V., Horwitz, B., Sundaram, M., Berg, G., Schapiro, M., Friedland, R.P. & Rapoport, S.I. (1988). Longitudinal study of the early neuropsychological and cerebral metabolic changes in dementia of the Alzheimer type. *Journal of Clinical & Experimental Neuropsychology, 10(5),* 576-596.

Hawley, K., & Cherry, K. (2004). Spaced-retrieval effects on name-face recognition in older adults with probable Alzheimer's Disease. *Behavior Modification, 28, (2),* 276-296.

Heffner, C. L. (2004). Chapter 5: Experimental design. *Research Methods.* Online. http://allpsych.com/researchmethods/index.html.

Hoerster, L., Hickey, E.M.& Bourgeois, M.S. (2001). Effects of memory aids on conversations between nursing home residents with dementia and nursing assistants. *Neuropsychological Rehabilitation, 11(3/4),* 399-427.

Hochhalter, A., Bakke, B., Holub, R., & Overmier, J. (2004). Adjusted spaced retrieval training: a demonstration and initial test of why it's effective. *Clinical Gerontologist, 27,(1/2),* 159-168.

Hodges, J.R. & Patterson, K. (1995). Is semantic memory consistently impaired early in the course of Alzheimer's disease? Neuroanatomical and diagnostic implications. *Neuropsychologia, 33,* 441–59

Hodges, J.R., Salmon, D.P. & Butters, N. (1990). Differential impairment of semantic and episodic memory in Alzheimer's and Huntington's diseases: a controlled prospective study. *Journal of Neurology Neurosurgery and Psychiatry, 53(12),* 1089-1095.

Hopper, T., & Bayles. (2001). Management of neurogenic communication disorders associated with dementia. In R. Chapey (Ed.). *Language Intervention Strategies in Aphasia and Related Neurogenic Communication Disorders, 4th edition.* New York, NY: Lippincott Williams & Wilkins.

Hopper, T., Bayles, K., Tomoeda, C.K. & Drefs. S. (2005, April). *The effects of Spaced Retrieval Training for individuals with dementia.* Poster presented at Reprogramming the Human Brain: Translating brain plasticity into clinical practice, Dallas, TX.

Hopper, T., Mahendra, N., Kim, E., Azuma, T., Bayles, K.A., Cleary, S.J., Tomoeda, C.K. (2005). Evidence-based recommendations for with individuals with dementia: Spaced-retrieval training. *Journal of Medical Speech Language Pathology, 13 (4), xxvii-xxviv.*

Hultsch, D., Hertzog, C., Small, B., & Dixon, R. (1999). Use It or Lose It: Engaged Lifestyle as a Buffer of Cognitive Decline in Aging? *Psychology & Aging, 14, (2)*, 245-63.

Hultsch, D. MacDonald, S.W.S., & Dixon, R. (2002). Variability in reaction time performance of younger and older adults. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences,* 57: P101-P115.

Hunkin, N., Squires, E., Parkin, A. & Tidy, J. (1998). Are the benefits of errorless learning dependent on implicit memory? *Neuropsychologia.* 36(1), 25-36.

Kempler, D. (1991). Language changes in dementia of the Alzheimer Type. In R. Lubinski (Eds.). *Dementia and Communication: Research and clinical implications*. New York: Decker.

Knowlton, B. (2002). The role of the basal ganglia in learning and memory. In, *Squire, Larry R (Ed); Schacter, Daniel L (Ed). Neuropsychology of memory (3rd ed.).* (pp. 143-153). xviii, 519 pp. New York, NY, US: Guilford Press.

Komatsu, S., Mimura, M., Kato, M., Wakamatsu, N., & Kashima, H. (2000). Errorless and effortful processes involved in the learning of face-name associations by patients with alcoholic Korsakoff's Syndrome. *Neuropsychological Rehabilitation, 10,* 113-32.

Kramer, J.H., Rosen, H.J,. Du, AT., Schuff, N., Hollnagel, C., Weiner, M.W., Miller, B.L., & Delis, D.C. (2005). Dissociations in hippocampal and frontal contributions to episodic memory performance. *Neuropsychology. 19(6),* 799-805.

Landauer, T.K., & Bjork, R.A. (1978). Optimum rehearsal patterns and name learning, in practical aspects of memory, P.E.M. M.M. Gruneberg, & R.N. Sykes, Editor. Academic Press: London, 625—63.

Little, A.G., Volans, P.J., Hemsley, D.R., & Levy, R. (1986). The retention of new information in senile dementia. *British Journal of Clinical Psychology. 25 (Pt 1),* 71-2.

Martin, A., Brouwers, P., Cox, C., & Fedio, P. (1985). On the Nature of the Verbal Memory Deficit in Alzheimer's Disease. *Brain and Language, 25,* 323-341.

McKitrick, L., Camp, C., & Black, F. (1992). Prospective memory intervention in Alzheimers's disease. *Journal of Gerontology: Psychological Sciences. 47(5),* 337-343.

McKitrick, L. & Camp, C. (1993). Relearning the names of things: The spaced-retrieval intervention implemented by a caregiver. *Clinical Gerontologist. 14(2),* 60-62.

McReynolds, L., & Kearns, K. (1983).*Single-subjects experimental designs in communicative disorders*. Baltimore: University Park Press.

Meztler-Baddely C. & Snowden, J. (2005). Brief report: Errorless versus errorful learning as a memory rehabilitation approach in Alzheimer's Disease. *Journal of Clinical and Experimental Neuropsychology*. 27, 1070-1079.

Mishkin, M., Malamut, B. & Bachevalier, J. (1984). Memories and habits: Two neural systems. In Lynch, G., McGaugh, J. L., and Weinberger, N. W., editors, *Neurobiology of Learning and Memory*, pages 65--77. Guilford, New York.

Murray, J., Schneider, J., Banerjee, S., & Mann, A. (1999). EUROCARE: a cross-national study of co-resident spouse carers for people with Alzheimer's disease: II--A qualitative analysis of the experience of caregiving. *International Journal of Geriatric Psychiatry, 14(8),* 662-7.

Orange, J.B., Ryan, E.B., Meredith, S.D., & MacLean, M.J. (1995). Application of the Communication Enhancement Model for longterm care residents with Alzheimer's disease. *Topics in Language Disorders*, 15(2), 20-35

Orsulic-Jeras, S., Judge, K., & Camp, C. (2000). Montessori-based activities for long-term care residents with dementia: Effects on engagement and affect. *The Gerontologist, 40(1),* 107-111.

Ottenbacher, K.J. (1986). Reliability and accuracy of visually analyzing graphed data from single-subject designs. *American Journal of Occupational Therapy, 40(7),* 464-9.

Postle, B.R., Corkin, S., & Growdon, J.H. (1996). Intact implicit memory for novel patterns in Alzheimer's disease. *Learning & Memory, 3(4),* 305-312.

Powell, J.A., Hale, M.A., & Bayer, A.J. (1995). Symptoms of communication breakdown in dementia: carers' perceptions. *European Journal of Disorders of Communication, 30(1),* 65-75.

Rau, M.T. (1993). Coping with communication problems in Alzheimer Disease. San Diego, CA.: Singular

Reisberg, B., Ferris, S. & Franssen, E. (1985). An ordinal assessment tool for Alzheimer's type dementia. *Hospital and Community Psychiatry*, *36*, 939-944.

Rosen, W., Mohs, R.& Davis, K. (1984). A new rating scale for Alzheimer's disease. *American Journal of Psychiatry.* 141, 1356-1364.

Salmon, D.P, Heindel, W.C., & Butters, N. (1992). Semantic memory, priming, and skill learning in Alzheimer's disease. Backman, Lars (Ed). (1992). Memory functioning in dementia. (pp. 99-118). xii, 299 pp. Oxford, England: North-Holland.

Schacter, D.L. (1992). Priming and multiple memory systems: Perceptual mechanisms of implicit memory. *Journal of Cognitive Neuroscience, 4(3),* 244-256.

Social Security Administration. (2007). Retrieved on June 23, 2007, from http://www.ssa.gov/OACT/babynames/.

Spector, Orrell, Davies & Woods, 1998. Reality orientation for dementia: a review of the evidence for its effectiveness. In: The Cochrane Library. Issue 4 ed: Oxford: Update Software.

Stevens, A.B., O'Hanlon, A.M., & Camp, C.J. (1993). Strategy training in Alzheimer's disease: A case study. *Clinical Gerontologist, 13,* 106–109

Stroop, J. R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology, 12,* 643-662.

Squire, L.R., & Zola-Morgan, S. (1991). The medial temporal lobe memory system. *Science, 253(5026),* 1380-1386.

Squire, L.R. (1992). 1,2,3 Memory and the Hippocampus: A Synthesis From Findings With Rats, Monkeys, and Humans. *Psychological Review, 99(2*), 195-231.

Squire, L.R. (1992). Declarative and nondeclarative memory: Multiple brain systems supporting learning and memory. *Journal of Cognitive Neuroscience, 4(3),* 232-243.

Squire, L.R., & Knowlton, B.J. (1995). Memory, hippocampus, and brain systems. Gazzaniga, Michael S (Ed). *The cognitive neurosciences.* (pp. 825-837). xiv, 1447 pp. Cambridge, MA, US: The MIT Press.

Tombaugh, T., & McIntyre, N. (1992) The Mini-Mental State Examination: A comprehensive review, *Journal of the American Geriatric Society, 40*, 935–92.

Tailby, R. & Haslam, C. (2003). An investigation of errorless learning in memory-impaired patients: Improving the technique and clarifying theory. *Neuropsychologia, 41(9),* 1230-1240.

Tulving, E. (1993). What is episodic memory? Current Directions in Psychological *Science, 2(3),* 67-70.

Tulving, E. (1972). Episodic and semantic memory. In E. Tulving & W. Donaldson (Eds.), *Organization of memory.* New York: Academic Press.

Vanhalle, C., Vanderlinden, M., Belleville, S., & Gilbert, B. (1998). Putting names on faces: Use of a spaced-retrieval strategy in a patient with dementia of the Alzheimer type. *Neurophysiology and Neurogenic Speech and Language Disorders, 8(4),* 17-21.

Verfaellie, M., Keane, M. & Johnson, G. (2000). Preserved priming in auditory perceptual identification in Alzheimer's disease. Neuropsychologia, 38(12), 1581-1592.

Wilson, B.A., Baddeley, A., Evans, J., & Shiel, A. (1994). Errorless learning in the rehabilitation of memory impaired people. *Neuropsychological Rehabilitation, 4(3),* 307-26.

Wheeler, M.A., Stuss, D.T., & Tulving, E. Frontal lobe damage produces episodic memory impairment. *Journal of the International Neuropsychological Society, 1(6),* 525-36.

WHO (2001). ICF: International Classification of Functioning, Disability and Health. Geneva: WHO

Yin, H.H., Knowlton, B.J., & Balleine, B.W. (2004). Lesions of dorsolateral striatum preserve outcome expectancy but disrupt habit formation in instrumental learning. *European Journal of Neuroscience, 19(1)*, 181-189.

Appendix A. MMSE scores adjusted for age and education level

	Age													
Education	**18-24**	**25-29**	**30-34**	**35-39**	**40-44**	**45-49**	**50-54**	**55-59**	**60-64**	**65-69**	**70-74**	**75-79**	**80-84**	**>84**
4th grade	22	25	25	23	23	23	23	22	23	22	22	21	20	19
8th grade	27	27	26	26	27	26	27	26	26	26	25	25	25	23
High School	29	29	29	28	28	28	28	28	28	28	27	27	25	26
College	29	29	29	29	29	29	29	29	29	29	28	28	27	27

Appendix B. Participant Demographics

1. Diagnosis:

(a) Primary:

____

____

(b) Secondary:

____

____

(c) Criteria used for dementia diagnosis: ________________
(e.g., DSM-IV or V, NINCDS-ADRDA criteria)

2. Other medical conditions
(e.g., hypertension, diabetes, emphysema)

1. ________________	4. ________________
2. ________________	5. ________________
3. ________________	6. ________________

3. Cognitive Enhancers: ________[1]Yes ______ [2] No

4. Age: _______

5. Sex: _____[1] Male _______[2] Female

6. Date of Birth: ____________

7. Education level ____________________
Day/Month/Year

8. Marital Status: _____[1] Married _____[2] Single
_____[3] Common-Law _____[4] Widowed
_____[5] Divorced _____[6] Separated

9. Previous Occupation: ________________________________

10. Admission Date: ____________
Day/Month/Year

11. Date Dementia Diagnosed: ______________
Day/Month/Year

12. Family/ Contact Information: Name ________________________

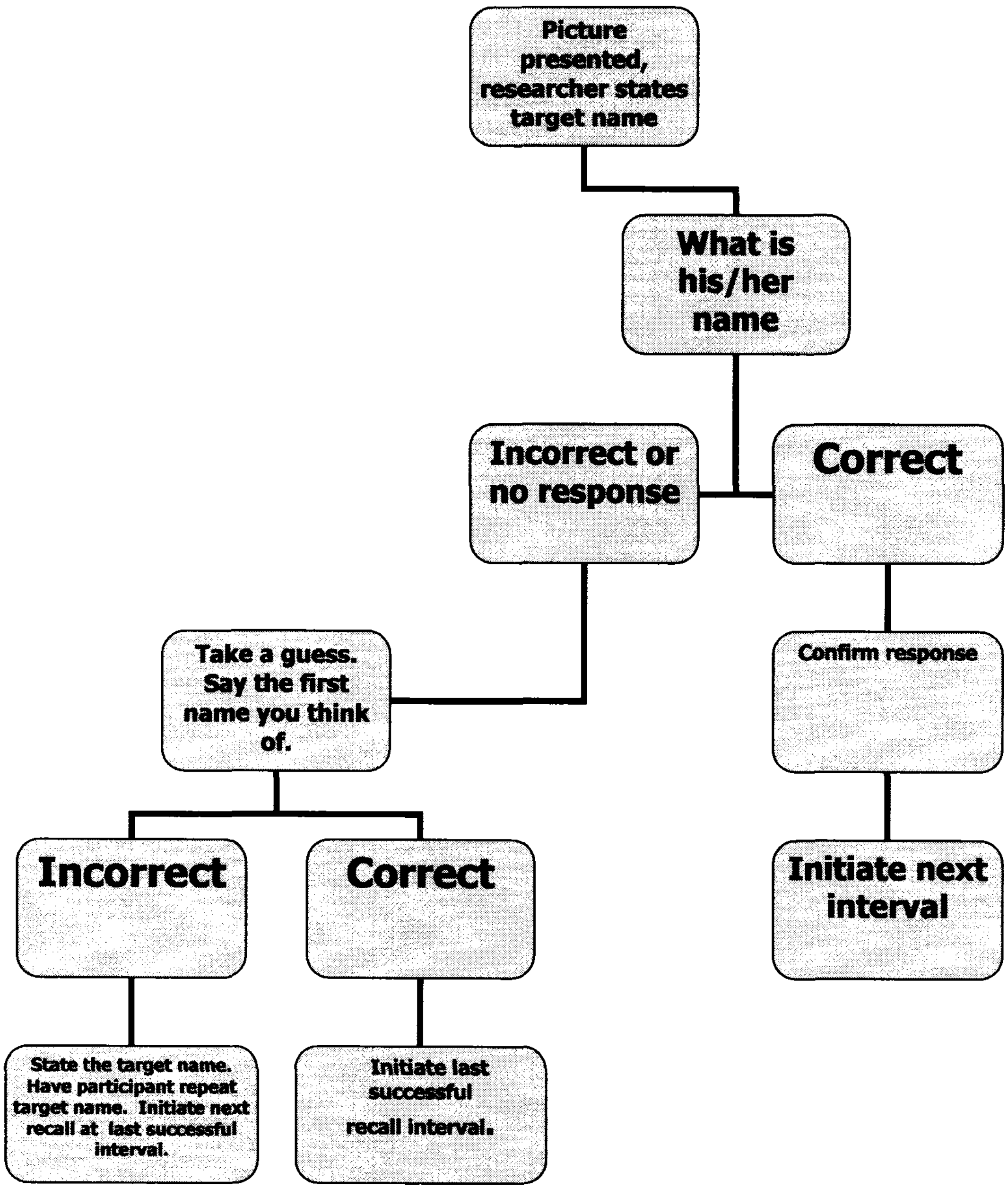
Address ________________________

Phone Number________________________

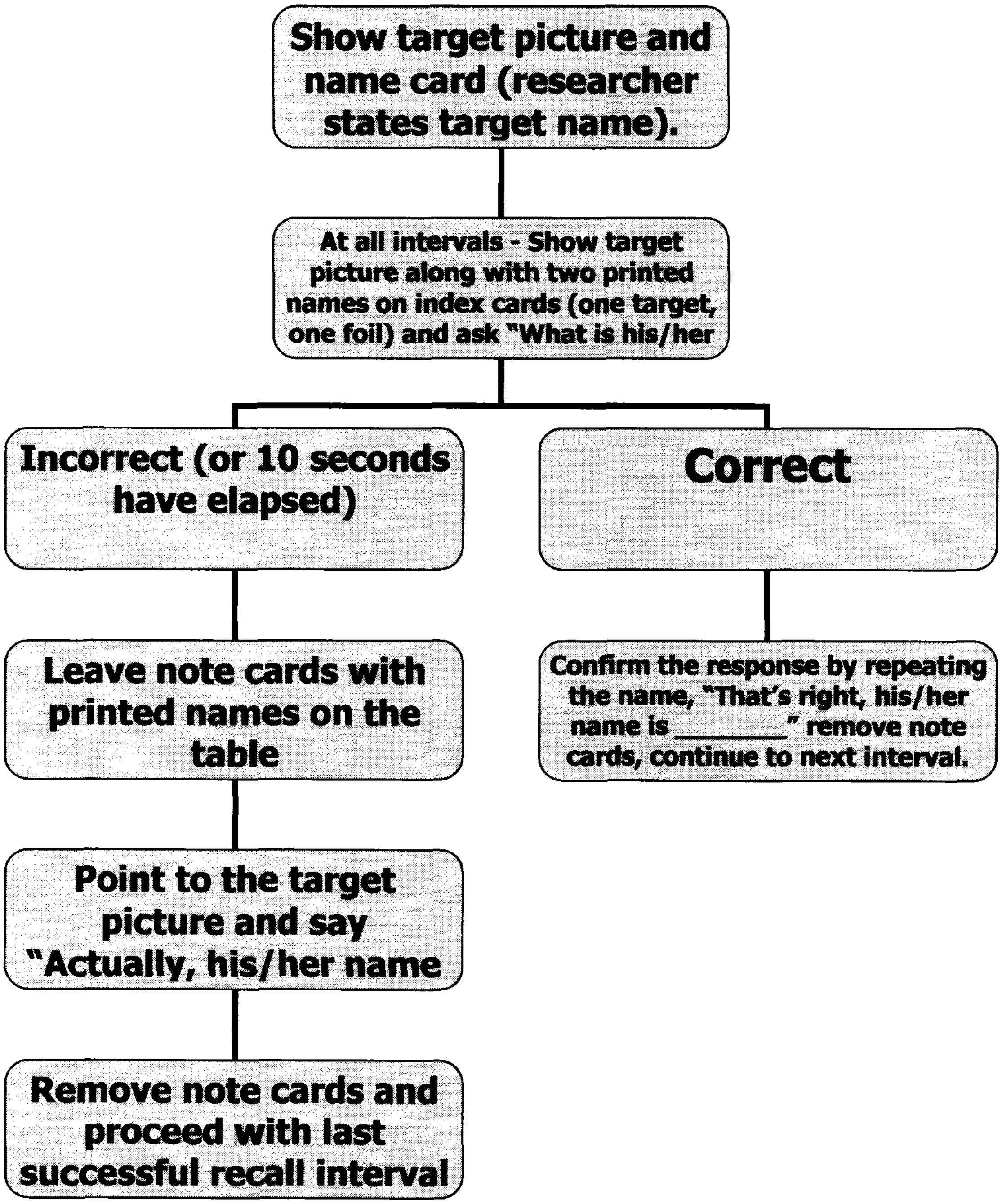
13. First Language: _____[1] English _____[2] Other

14. Social Activities, hobbies, interests:

Appendix C. SRT-T Protocol



Appendix D. SRT-EL Protocol



Appendix E. SRT Data Collection Form

1. Participant I.D. : ______________ 2. Researcher Name: ___________

3. Treatment Session: 1 2 3 4 5 6 7 8

4. Date: _______________

The numbers below represent the minutes between recall of information. Circle the time interval completed and indicate if the recall was correct or incorrect by placing a plus (+) or minus (-) sign in the box.

	Immediate Recall	10 sec	30 sec	60 sec	90 sec	2 min.	3 min.	4 min	6 min	8min.
TI 1										
TI 2										
TI 3										
TI 4										
TI 5										
TI 6										
TI 7										

Notes: ____

____

____

____

Appendix F. Error Analysis Sheet

Error Analysis

Participant	SRT-T					SRT-EL				
Error Type*										

* PS – Phonologically similar
UR – Unrelated Response
NR – No Response
F – Foil response
CR – Correct Response

** F- Foil name from 24-hour probe

Appendix G. Procedural checklists for SRT-T and SRT-EL

Procedural checklist for treatment protocols

Procedure checklist for SRT-T

- Show target picture and say "This is (target name)".
- Elicit immediate response from participant by asking "What is his/her name?"
- Wait five seconds for response.
- If correct, confirm response verbally, remove the target picture, and continue to next interval
- If no response, cue the participant to "Take a guess. Say the first name you think of."
- Give no more than 10 seconds for a response.
- If correct: Confirm response verbally and have the participant repeat the target name, remove the target picture, and ask prompt question again at next interval.
- If incorrect or NR: Researcher provides the target name verbally (Actually, his/her name is _ _ _ _ _), have the participant repeat the target name, remove the target picture, and the previous interval at which the participant was last successful is implemented.

Procedure checklist for SRT-EL

- Show target picture and say "This is (target name)".
- Immediately provide two choices – One correct name, one foil (equal in characteristics) on note cards in 18 point font and place the cards on the table. The picture should be below the two name cards and be at an equal distance from each (the picture should never fall just below only one of the name cards).
- Elicit immediate response from participant by asking "What is his/her name?"
- If correct: Confirm verbally, take away the note cards and target picture and ask prompt question again at the next interval.

- If incorrect or NR (no response): Researcher to give target name "Actually, this is (target name)" while pointing to the target name card.
- Have the participant repeat the target name.
- Remove the note cards and target picture.
- Implement previous interval at which the participant was last successful.

Second and Subsequent Sessions: Always begin with a probe of the association

- Show picture and ask "What is this person's name?"
- Give participant the opportunity to **FREELY RECALL** the name – Allow the person to guess.
- If the participant makes the **correct response** to the FREE RECALL probe at the **1 day INTERVAL**, then teaching of the particular association is completed.
- If the participant makes the **incorrect response**, treatment on that association (in the assigned condition) is started for another session.

Appendix H. P1 Error Analysis

P1 – Within treatment session errors.

	Phonologically Similar.	Unrelated	Foil	NR
SRT-T		Walter Barely Donald Douglas		
SRT-EL		Cathy Sandy Shelly	Shirley Cheryl	

P1 – Retention probe errors.

	Phonologically Similar.	Unrelated	Foil	NR
SRT-T		Warner, Weiner – 48 hr probe Hansen – 5 day probe Hansen – 3 week probe Walter – 6 week probe		
SRT-EL	Alma – 24 hr #2	Shannon – 24 hr #1 Phoney – 6 week probe	Cheryl – 1 day #1 Sharon – 2 week probe Shirley – 3 week probe	

Appendix I. P2 Error Analysis

P2 – Within treatment session errors.

	Phonologically Similar.	Unrelated	Foil	NR
SRT-T	n/a	n/a	n/a	n/a
SRT-EL	n/a	n/a	n/a	n/a

P2 – Retention probe errors.

	Phonologically Similar.	Unrelated	Foil	NR
SRT-T	Theresa – 24 hr #1	Cynthia – 3 week probe Phyllis – 6 week probe		
SRT-EL		I don't know – 24 hr #1 Theodore – 96 hr probe Tom – 2 week probe Phillip – 3 week probe Phillip – 6 week probe		

Appendix J. P3 Error Analysis

P3 – Within treatment session errors.

	Phonologically Similar.	Unrelated	Foil	NR
SRT-T	n/a	n/a	n/a	n/a
SRT-EL	n/a	n/a	n/a	n/a

P3 – Retention probe errors.

	Phonologically Similar.	Unrelated	Foil	NR
SRT-T	n/a	n/a	n/a	n/a
SRT-EL	n/a	n/a	n/a	n/a

Appendix K. P4 Error Analysis

P4 – Within treatment session errors.

	Phonologically Similar.	Unrelated	Foil	NR
SRT-T		Gloria Martha Sandra		
SRT-EL				

P4 – Retention probe errors.

	Phonologically Similar.	Unrelated	Foil	NR
SRT-T		Gloria – 24 hr #1 Gloria – 24 hr #2 Gloria – 48 hr probe		
SRT-EL		Harold – 24 hr #1 Albert – 3 week probe Mark – 6 week probe	Walter – 24 hr #1 Walter – 24 hr #2 Robert – 2 week probe	