

## Research Article

# Spaced Retrieval Using Static and Dynamic Images to Improve Face–Name Recognition: Alzheimer’s Dementia and Vascular Dementia

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**Purpose:** The primary objective of this study examined whether spaced retrieval (SR) using dynamic images (video clips without audio) is more effective than SR using static images to improve face–name recognition in persons with dementia. A secondary objective examined the length of time associations were retained after participants reached criterion. A final objective sought to determine if there is a relationship between SR training and dementia diagnosis.

**Method:** A repeated-measures design analyzed whether SR using dynamic images was more effective than SR using static images for face–name recognition. Twelve participants diagnosed with Alzheimer’s dementia or vascular dementia were randomly assigned to 2 experimental conditions in which the presentation of images was counterbalanced.

**Results:** All participants demonstrated improvement in face–name recognition; there was no significant difference between the dynamic and static images. Eleven of 12 participants retained the information from 1 to 4 weeks post training. Additional analysis revealed a significant interaction effect when diagnoses and images were examined together. Participants with vascular dementia demonstrated improved performance using SR with static images, whereas participants with Alzheimer’s dementia displayed improved performance using SR with dynamic images.

**Conclusions:** SR using static and/or dynamic images improved face–name recognition in persons with dementia. Further research is warranted to continue exploration of the relationship between dementia diagnosis and SR performance using static and dynamic images.

Dementia is recognized as a major neurocognitive disorder characterized by significant impairment in one or more cognitive areas, including language, attention, executive function, learning and memory, perceptual motor, or social cognition. According to the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition*, criteria (American Psychiatric Association, 2013), the diagnosis of dementia is based on concerns conveyed by the individual or a reliable informant regarding a significant cognitive decline that affects the person’s independent daily living. In addition, cognitive dysfunction should be

documented by objective measures such as neuropsychological assessments (Sachdev et al., 2014).

There are many different types and causes of dementia, including Alzheimer’s dementia (AD), Parkinson’s dementia, frontotemporal dementia, mixed dementia, and vascular dementia (VaD). The most common type of dementia is AD, accounting for 60%–80% of cases. VaD is considered the second most common form of dementia, accounting for approximately 40% of persons with dementia (PWD; Alzheimer’s Association, 2018). The diagnosis of AD requires evidence of substantial cognitive decline in at least two cognitive domains, including memory deficits (Hugo & Ganguli, 2014).

Memory dysfunction, specifically recalling names, is considered the most common initial symptom observed in persons with AD (Tak & Hong, 2014). Numerous studies revealed that deficits in face–name recognition is not only a symptom of AD or other forms of dementia but may also be present in normal aging (Werheid & Clare, 2007). This inability to remember a person’s name may result in embarrassment, loss of self-confidence, and social withdrawal

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among PWD. These individuals demonstrate a gradual decline in their ability to participate in meaningful interactions with others. In addition, family caregivers often experience loss, sadness, and frustration as their loved ones exhibit increasing difficulty remembering and recognizing their faces and names (Tak & Hong, 2014). The occurrence of AD and other dementias will rise in the United States as the population of individuals aged 65 years and older continues to grow (Alzheimer's Association, 2018). As the prevalence of dementia increases, developing new and effective cognitive-communication strategies is essential to improve face-name recognition and the quality of life for PWD and their caregivers.

### ***Spaced Retrieval Training and Face-Name Recognition***

One evidence-based memory intervention for facilitating learning and retention of face-name associations in PWD is spaced retrieval (SR; Bourgeois et al., 2003). SR is a learning method in which individuals are asked to recall specific information over increasingly longer intervals of time until this information is successfully integrated into patients' long-term memory (Camp, 1998). Initially, SR was described by Landauer and Bjork (1978) as a means of improving memory in cognitively intact individuals. Camp (1989) revised the procedure to help improve memory function in individuals diagnosed with various types of dementia, including AD, Parkinson's dementia, Korsakoff's syndrome, VaD, and mixed dementia (Hopper et al., 2005).

SR is based on the neuropsychological rehabilitation principle known as *errorless learning* (Baddeley, 1992; Wilson, Baddeley, Evans, & Shiel, 1994). Errorless learning represents a method for PWD to acquire new information by reducing error production and facilitating correct responses (Vance & Farr, 2007). Errorless learning is based on the assertion that there are two different kinds of memory systems (i.e., declarative or explicit memory and non-declarative or procedural memory). Declarative memory is a type of long-term memory in which memories of facts and knowledge are stored (Bourgeois et al., 2003). Non-declarative memory involves unconscious learning and allows individuals to easily acquire and retrieve new information. Researchers agree that nondeclarative memory is preserved to a greater extent in individuals with dementia than declarative memory (Anderson, Arens, Johnson, & Coppens, 2001).

Another procedure that is directly related to SR training is known as *repetition priming*. Repetition priming refers to the ability to improve performance after initial exposure to information (Brush & Camp, 1998, p. 4). Repetition is considered essential for individuals with memory impairment to acquire skills and information, and repeated exposure to previously known information is a simple strategy for retention and learning new information in PWD. Researchers have demonstrated that repetition enables learning of paired associations, enhances sentence comprehension, and improves picture and story recall

(Mahendra, 2001). In addition, the spacing of information appears to facilitate the retention of information (Anderson et al., 2001).

SR can be used to successfully help PWD reach a variety of goals and learn whatever information is considered important in their daily lives. Specifically, SR has successfully taught patients to remember common household items, use calendars/external aids for self-cueing of daily activities, improve eating abilities, decrease problem behaviors, and recall face-name associations (Abrahams, & Camp, 1993; Alexopoulos, 1994; Bird, Alexopoulos, & Adamowicz, 1995; Camp, Foss, O'Hanlon, & Stevens, 1996; Hawley & Cherry, 2008; Lin et al., 2010).

Several studies have reported the efficacy of SR using communication strategies for improving recall of face-name associations in PWD (Hopper et al., 2013). Hawley and Cherry (2004) trained six adults with probable mild-moderate Alzheimer's disease (AD) to recognize and recall new face-name associations and transfer that learning to a real-life person. Participants received six training sessions over a 2-week period. Nine colored photographs of unfamiliar adult faces ranging in age from 20 to 50 years were presented to the participants as stimuli. One of the pictures was identified as the target item, and the other eight pictures were considered distractors. Participants were trained to select the target photograph and recall the name of the person in the photograph using SR. Following 2 weeks of training, the number of failed trials decreased, the number of correct trials increased, and correct face-name associations were recalled at increasingly longer retention intervals by all participants. Moreover, all participants with AD were able to recall the name of the person in the photograph for longer retention intervals across training sessions. These findings demonstrate that SR training can be used to enhance the learning and recall of face-name associations in individuals with probable AD (Cherry, Simmons, & Camp, 1999).

Hopper, Drefs, Bayles, Tomoeda, and Dinu (2010) evaluated the effects of SR on learning and retention of new and previously known face-name associations by PWD. Thirty-two participants with mild-moderate dementia (30 with a diagnosis of Alzheimer's disease, two with VaD) were trained to recall two new face-name associations representing each gender (i.e., Thelma and Nathan) and two previously known celebrity associations (i.e., Marilyn Monroe and Elvis Presley). Black and white photographs were used as stimuli. During treatment sessions, participants were asked to recall information over increasingly longer intervals of time consistent with SR training procedures (Hopper et al., 2005). Results indicated that, on average, participants learned the face-name associations in fewer than four sessions and retained the information for variable amounts of time, up to a maximum of 6 weeks. Previously known associations were learned considerably faster than new associations. The learning of these previously known associations under SR was not influenced by the severity of cognitive impairment (as determined by the Mini-Mental State Examination [MMSE]). This study also

provided further evidence that persons with moderate dementia severity levels can learn and relearn information under specific treatment conditions.

Additional research supports the effectiveness of computer-assisted SR for facilitating face–name recognition in PWD. Mahendra (2011), for example, examined the use of computer-assisted SR training to recall face–name associations. Twenty-three participants diagnosed with mild–moderate dementia were trained to recall novel and familiar face–name associations using a laptop computer to display color photographs (headshots) of familiar and novel individuals. Following presentation of the image, written information was displayed sequentially, including the person’s first and last name, occupation, place of residence, and one additional biographical detail. Results revealed that 83% of participants learned the novel face–name associations and 87% of participants learned the familiar associations in five to 13 sessions. In addition, 95% of participants retained the learned information for 6 weeks post training. Surprisingly, most participants required approximately the same amount of sessions to learn previously familiar face–name associations.

Han et al. (2017) conducted another study that provides additional support for combining SR with computer technology for persons with memory dysfunction. They evaluated the Ubiquitous Spaced Retrieval–Based Memory Advancement and Rehabilitation Training (USMART), a self-administered cognitive intervention program, in 50 patients with mild cognitive impairment. A randomized controlled cross-over design was used to analyze USMART ( $n = 25$ ) for one round of trials and usual care (used as a control;  $n = 25$ ) for the other round of trials. Forty-one of the 50 participants completed the USMART training for 30 min per session (biweekly) for a total of 4 weeks. Results indicated the USMART program was more beneficial than usual care for improving memory in participants with mild cognitive impairment. Participants’ demonstrated improved performance in memory and recall; however, no significant changes were observed in depression, subjective memory complaints, or overall cognitive ability.

Despite the recent increase in combining SR with computer technology, the majority of research in the speech-language pathology field has investigated the efficacy of SR using static images (photographs) to improve face–name recognition for PWD (Cherry et al., 1999; Cherry, Walvoord, & Hawley, 2010; Clare, Wilson, Carter, Roth, & Hodges, 2002; Dunn & Clare, 2007; Hawley & Cherry, 2004, 2008; Hopper et al., 2010). In Mahendra (2011), although SR was combined with computer technology to improve face–name recognition, only static images (photographs) were presented on the computer. However, most of our experiences with faces are not with static images, but with dynamic (moving) images. There has been a growing awareness that dynamic information from the face contributes to the recognition of identity (Lander & Davies, 2007). Several studies that have examined the role of facial motion on face–name processing in persons “without” dementia report that learning a face in motion

leads to better recognition than learning static faces. This might be because moving faces convey stronger social signals (e.g., expression, mannerisms, personality), which may lead to a more identifiable image than static faces (Xiao et al., 2014).

Research has revealed that facial movement is used when static facial information is not informative or beneficial. For example, Knight and Johnston (1997) were the first to report the facilitative effects of facial motion. In their study, participants viewed static facial images (selected from moving sequences with the mouth in a closed position) and videotaped facial images of famous and unknown people (videotaped from news and talk programs) under nonoptimal conditions (negative black–white contrast). Forty participants (21 men, 19 women) between the ages of 20 and 44 years were recruited for this study. Four videotapes were constructed with each containing 80 images of 40 famous and 40 unfamiliar faces presented in random order with two example faces shown at the beginning of each videotape. In the first tape, the first 40 faces were static and the second 40 faces were moving. In the second tape, the order was reversed. Each participant was presented with 80 faces in the same order and orientation, and participants were scored on the number of famous faces correctly identified. Results indicated that recognition performance was significantly better in the dynamic condition than in the static condition. It was proposed that facial movements supply the visual system with additional information about the three-dimensional structure of the face especially when under “nonoptimal” conditions.

In addition, Lander and Davies (2007) examined the role of motion when learning faces from either static images or dynamic sequences. Forty-eight participants between the ages of 18 and 26 years were recruited for this study. Initially, participants viewed 12 unfamiliar target faces in either the static or moving condition on a computer monitor. Each facial image was preceded by a name, and participants were asked to learn the names of each face. Immediately following this learning phase, participants were shown all 12 faces again in the same presentation method in random order and asked to name the individual. In the final phase, participants were presented with 48 facial images, including 24 static and 24 dynamic images shown individually on a computer monitor. Some of the faces were learned faces, and some were new faces. Participants were instructed to name the face or respond “new” to each trial presented. Results indicated that faces learned in motion were identified significantly better than those viewed as a static image. However, participants who learned faces in the static condition demonstrated no advantage for testing in motion. Conversely, participants who learned the faces in motion exhibited a significant advantage for testing in motion. These findings indicate that the beneficial effect of motion may be dependent on the manner in which the facial images are presented.

Furthermore, Maguinness and Newell (2014) compared the role of facial movement in younger and older adults to assess whether motion can enhance recognition

when static cues are inadequate. Fifteen younger adults were recruited from a college, and 16 older adults were recruited from the community for this study. Both younger and older adults learned faces presented dynamically (a video clip) or in a sequence of three static images, which were extracted from the video. Following learning of these images, participants were instructed to match a static test image to the learned face, which varied by viewpoint or expression. Results indicated that younger participants performed better than older participants in matching the faces. However, when faces were in motion, the performance of the older participants improved across changes in viewpoint and expression. These findings provide insight into how motion may facilitate face processing and enhance representation of faces in memory. Overall, there appears to be significant evidence affirming the beneficial effects of dynamic facial images when compared to static facial images.

### *AD Versus VaD*

Numerous studies provide validation for the application of SR to improve recall of face–name associations in PWD (Oren, Willerton, & Small, 2014). In contrast to the vast amount of research examining SR training and face–name recognition in PWD, there do not appear to be any studies analyzing the potential relationship of SR training and dementia diagnosis (AD vs. VaD).

AD is characterized by a gradual decline in memory function that affects the ability to comprehend and produce linguistic information (American Speech-Language-Hearing Association, 2005). Individuals demonstrate decreased word finding, repetition of questions and statements, and difficulty in handling complex tasks. Episodic memory, reasoning skills, visual–spatial ability, orientation, and the ability to learn new information are also impaired (Knopman, Boeve, & Peterson, 2003).

VaD is defined as a loss of cognitive function resulting from ischemic, hypoperfusive, or hemorrhagic brain lesions due to cerebrovascular disease or cardiovascular pathology (Román, 2003). The vascular lesions may affect multiple locations of the brain, which leads to significant variations in clinical symptoms (Bolla, Filley, & Palmer, 2000). Many individuals with VaD demonstrate cognitive deficits related to executive function, including attention, visuospatial, mental processing speed, and constructional tasks (Kertesz & Clydesdale, 1994).

Kertesz and Clydesdale (1994) assessed neuropsychological deficits in VaD versus AD and found that participants with VaD performed significantly worse on tasks related to executive function, including attention, visuospatial, and constructional tasks. Following a comparison of neuropathology, the researchers theorized that the greater frontal cortical and subcortical involvement in participants with VaD appeared to be a logical reason. Mendez, Cherrier, and Perryman (1997) reported a possible difference in information-processing measures between AD and VaD. Researchers found some evidence of mental slowing in individuals with AD. However, individuals with VaD

demonstrated a greater decline in mental speed related to white matter involvement and cerebrovascular disease. Researchers suggested that participants with VaD were slower in decision times and processing stimuli compared to participants with AD due to their neuropathological differences.

In addition, Matsuda, Saito, and Sugishita (1998) compared the cognitive deficits of patients with mild VaD and AD. Executive function skills were assessed, including memory, attention, abstract thinking, and visuospatial function. Results demonstrated that memory was the prominent deficit in participants with VaD and participants with AD. However, participants with AD performed similarly in terms of attention and visuospatial function in comparison to the controls, whereas participants with VaD performed significantly worse in those areas. Traykov et al. (2002) investigated neuropsychological deficits in VaD compared to AD using episodic memory, attention/executive function, and language tests. Researchers reported more significant episodic memory deficits in participants with AD compared to participants with VaD. However, a “greater sustained attention deficit” was observed in participants with VaD (p. 30).

In addition, Giovanetti, Schmidt, Gallo, Sestito, and Libon (2006) conducted a study to examine the relationship between dementia diagnosis and performance of everyday activities. Twenty-five participants with mild–moderate VaD and 23 participants with mild–moderate AD were assessed using the Naturalistic Action Test, a performance-based measure using three tasks (e.g., preparing toast/coffee, wrap a gift, pack lunchbox/schoolbag). The tasks become increasingly more complex by including distractor items (e.g., target: scotch tape, distractor: stapler) that are not relevant to the specific task. Results demonstrated that participants with VaD performed worse than participants with AD when presented with distractor objects. Findings indicated that the neuropsychological differences between participants with AD and participants with VaD affected their performance of daily activities. According to Giovannetti, Schmidt, Gallo, Sestito, and Libon (2006), persons with VaD may benefit from minimal distractions and simplified workspaces, and persons with AD might perform better when tasks are supported by explicit external cues (e.g., visual/written directions).

Benedet, Montz, and Delgado-Bolton (2012) reported “the most consistent published finding” is that persons with AD exhibit different learning abilities related to neuropsychological differences when compared to persons with VaD (p. 92). Persons with AD demonstrate more severe deficits in encoding new information and episodic memory, and persons with VaD exhibit greater executive function deficits.

### *Rationale for Current Study*

Research studies have reported the efficacy of SR for improving recall of face–name associations in PWD (Hopper et al., 2013). However, there do not appear to be

any studies “comparing” SR using “dynamic” facial images and SR using “static” facial images to improve face–name recognition in PWD. Given the previous success of SR with static photos, it was predicted that PWD will demonstrate even greater success with SR using dynamic photos (silent video recordings on an iPad) to facilitate face–name associations. The inclusion of dynamic images (shown on an iPad) with SR may present a viable option for increasing interaction between caregivers, family members, and PWD within their specific environment. In addition, there appears to be significant evidence affirming the distinct cognitive differences in persons with AD versus persons with VaD (Benedet et al., 2012; Giovanetti et al., 2006; Kertesz & Clydesdale, 1994; Matsuda et al., 1998; Mendez et al., 1997; Traykov et al., 2002).

Therefore, the primary objective of this study was to (a) determine whether SR using dynamic facial images is more effective than SR using static facial images to improve face–name recognition of professional caregivers in PWD, and the secondary objective was to (b) examine the length of time face–name associations were retained after participants reached criterion. A final objective was to (c) analyze the potential relationship of SR training and the dementia diagnosis (AD vs. VaD).

## Method

### Participants

Fourteen participants diagnosed with dementia were recruited from a skilled nursing facility in Queens, New York. The facility’s social worker accessed a list of prospective participants diagnosed with either AD or VaD. Prior to initiation of the study, specific precautions were used to protect this vulnerable population. The investigator obtained meaningful informed consent by having a detailed conversation with each prospective participant regarding the purposes, risks, and benefits of the study. These individuals were also presented with the Evaluation to Sign Consent form to determine whether the PWD have sufficient understanding to provide ethically valid and informed consent (Resnick et al., 2007). In addition, a legally authorized representative was contacted in person or via phone by the social worker to provide protection when decisional capacity was diminished or in question. PWD were involved in the decision-making process to the full extent of their capabilities and level of comfort. The protocol and informed consent procedures were approved by the Adelphi University Institutional Review Board.

Participants ranged in age from 58 to 96 years ( $M_{\text{age}} = 76.25$ ) and resided in the nursing facility from 1 to 4 years, with an average of 2 years ( $SD = 1.21$ ). All of the participants had a confirmed diagnosis of AD or VaD as indicated in the patients’ medical records by their primary care physician, as well as neurology and psychiatric consultations. According to the facility’s psychiatrist, diagnoses were based on extensive clinical neuropsychological evaluations according to the classification used in the *Diagnostic*

*and Statistical Manual of Mental Disorders, Fifth Edition* criteria (American Psychiatric Association, 2013). Additional testing measures such as serological and neuroimaging techniques (computed tomography scan or magnetic resonance imaging) were completed in a hospital setting prior to admission to the facility to affirm their diagnosis. Every individual who was recruited accepted enrollment in the study. Twelve of the 14 participants met the following criteria: (a) fluent speakers of English; (b) adequate hearing/visual acuity as indicated by medical records; (c) mild, moderate, or moderate–severe AD or VaD; (d) MMSE score of less than 24; (e) passing score on the Spaced Retrieval Screening form (Brush & Camp, 1998); and (f) difficulty in recalling the names of professional caregivers who were involved in their daily care. All patients with VaD had a concomitant diagnosis of a cerebrovascular accident. Two of the 12 participants were diagnosed with depression and received treatment and follow-up assessments by the psychiatrist. Exclusion criteria included no significant history of psychiatric illness. In addition, participants with advanced dementia were excluded if they were unable to produce sufficient or appropriate verbal output during sessions.

### Screening and Testing Materials

Following receipt of consent from the participant and/or legally authorized representative, the Spaced Retrieval Screen was administered to determine the suitability and the participants’ potential to learn through the SR technique. Once appropriate candidates were identified, participants were assigned an identification number, and only this identification number was used on study materials and data sheets to ensure confidentiality. A summary of the descriptive characteristics for the 12 participants (five participants with AD and seven participants with VaD) are presented in Table 1. Overall, the participants’ age range was 58–96 years, and the mean age was 76.25 years ( $SD = 11.25$ ). In addition, participants with AD were, on average, about 17 years older than the VaD group,  $t(10) = 9.944$ ,  $p < .01$ , 95% CI [6.76, 26.67]. Although the prevalence of both AD and VaD increases with age, patients diagnosed with stroke are at increased risk for VaD with approximately 20%–25% developing a delayed dementia (O’Brien & Thomas, 2015). According to the Alzheimer’s Association (2018), one in 10 people (10%), of ages 65 years and older, has a diagnosis of AD, and 81% of persons with AD are 75 years or older.

Furthermore, baseline measures of short-term memory, general cognitive function, and determination of participants’ severity levels were obtained using the MMSE (Folstein, Folstein, & McHugh, 1975), the Global Deterioration Scale (GDS; Reisberg, Ferris, De Leon, & Crook, 1982), and the Brief Cognitive Rating Scale (BCRS; Reisberg & Ferris, 1988). Overall, participants’ dementia severity ranged from early dementia (mild) to moderate–severe dementia. The mean MMSE score of the 12 participants was 16.00 ( $SD = 4.97$ ), with a range of 9–23, and the mean

**Table 1.** Participant characteristics.

Participant	Gender	Age	Diagnosis	Education	Ethnicity	Bilingual	Language	MMSE	BCRS	GDS
1	F	83	AD	High school	Caucasian	Monolingual	English	21/30	4	4
2	F	87	AD	High school	Caucasian	Bilingual	English/German	9/30	6	6
3	F	78	AD	Master's	Caucasian	Monolingual	English	13/30	5	5
7	M	86	AD	2-year college	Caucasian	Monolingual	English	17/30	4	4
8	F	96	AD	9th grade	Caucasian	Monolingual	English	13/30	5	5
Range		78–96								
<i>M</i>		86.00								
<i>SD</i>		6.60								
4	F	78	VaD	High school	Black	Bilingual	English/Creole	16/30	5	5
5	F	69	VaD	9th grade	Latinx	Bilingual	English/Spanish	18/30	5	5
6	M	61	VaD	High school	Latinx	Bilingual	English/Spanish	20/30	4	4
9	M	58	VaD	Bachelor's	Asian	Bilingual	English/Tagalog	23/30	3	4
10	F	66	VaD	6th grade	Black	Bilingual	English/French	22/30	3	4
11	F	83	VaD	High school	Caucasian	Monolingual	English	9/30	6	6
12	F	70	VaD	Grammar	Caucasian	Monolingual	English	11/30	6	6
Range		58–83								
<i>M</i>		69.28								
<i>SD</i>		8.86								
Overall										
Range		58–96						9–23	4–6	4–6
<i>M</i>		76.5						16.00	4.83	4.83
<i>SD</i>		11.52						4.97	0.84	0.84

Note. Age,  $t(10) = 9.94, p < .01, 95\% \text{ CI } [6.76, 26.67]$ . MMSE = Mini-Mental State Examination; BCRS = Brief Cognitive Rating Scale; GDS = Global Deterioration Scale; F = female; M = male; AD = Alzheimer's dementia; VaD = vascular dementia.

GDS and BCRS scores were 4.83 ( $SD = 0.84$ ), with a range of 4–6 (early dementia to moderate–severe dementia).

### Stimuli

The stimuli consisted of a maximum of four images, which included two static (facial images presented) and two dynamic images (silent video recording) of professional caregivers (i.e., a social worker, recreation leaders, and nurses). Caregivers who provided daily care and interacted regularly with the participants were selected as the targets for the stimuli. The target question, “What’s her name,” was provided as a cue at the same time the stimulus was presented, with no further cueing. Target selection was based on the participant’s ability to recognize the caregiver as familiar but unable to provide her name when presented with the stimuli and the target question. The stimuli were presented to each participant at least two times prior to target selection. This process was used to ensure the PWD were unable to correctly name the target individual (caregiver) prior to SR training. An Apple iPad (Model A-1458, Serial DMPN8CBVF182) was used to display facial images using the camera and video features. The presentation of the static images on the iPad was the same size (6 in.  $\times$  8 in.) as the dynamic images on the iPad. The static photographs and the video clips of each caregiver were taken against a plain background wall with minimal distractions. The camera distance remained constant and presented images of the torso and above with a full frontal view of the caregiver smiling. These images were presented to each participant on the iPad to determine which two images (one static image and one dynamic image) were appropriate for SR training.

### Procedure

Participants were trained to recall the names of two professional caregivers using SR and static and dynamic images. Each participant was seen individually in a private, quiet room seated in front of the researcher. Participants were seated upright at a 90° angle in their wheelchairs or beds with a tray table placed in front of them. Treatment sessions were conducted at the same time each day (between 8:30 am and 11:30 am) and were no more than 30 min up to four times per week, for a maximum of eight sessions for each face–name association. The length of treatment sessions and general training protocol was similar to previous research by Hopper et al. (2010). Most participants in pilot studies learned face–name associations in seven or fewer sessions (Hopper et al., 2010). Therefore, a maximum of eight sessions was selected to allow for variability in time to learn consistent with previous research.

Each participant was shown one static image (photo) and one dynamic image (3-s silent video recording with visible movements such as eyes blinking, head tilting, and other natural motions of the head) in which a caregiver was smiling. The static image and the dynamic image of a caregiver were presented individually in two different time periods. A static image of a caregiver was presented for one round of trials, and a dynamic image of a different caregiver was presented for the other round of trials. Training trials were based on a predetermined expansion schedule (i.e., immediate recall, 15 s, 30 s, 1 min, 2 min, 4 min, 8 min, and 16 min). A timer app (Apple iPhone 6 Plus) was used to maintain accurate timing of the SR intervals.

At the beginning of each session, participants were presented with one of the images (dynamic or static) and asked for immediate recall using the prompt question, "What's her name?" Simultaneously with the image, each participant was permitted up to 3 s to view the video clip/ static photograph and respond to the target question. A successful trial occurred if the participant provided the verbal response stating the correct name. For failed trials, the researcher immediately corrected the participant's error and restated the target question (e.g., "No, this is Michelle. What's her name?"). A failed trial resulted in the participant returning to the previous successful time interval. In between extended time intervals, participants were presented with stimulating activities (unrelated to the target goal), such as looking at picture cards or conversing with the researcher. Subsequent training sessions started with the last successful time interval. Pertinent data were recorded on SR data sheets and participant data collection sheets. Sessions were audio-recorded (Radio Shack Voice Actuated Cassette Tape Recorder, Realistic CTR-67 Model No. 14-1152) and/or video-recorded (Apple iPad, Model A1395, Serial DLXH428XDKPH) for review.

### **Learning Criterion**

Criterion for learning was the correct recall of the face-name association at least 24 hr, but not more than 72 hr, after the participant's most recent training session. Training for the face-name association stopped when the participant provided the correct response at the beginning of the following session. If the response was incorrect and the maximum of eight sessions was not reached, then the treatment continued. If learning did not occur after eight treatment sessions, training for that face-name association was discontinued. After achieving criterion for learning the association, participants' long-term retention was also assessed. Consequently, if the participant correctly named an association at least 24 hr after the most recent session, then retention at 1 and 4 weeks was assessed following the last training session. In general, the learning criterion was similar to the protocol used by Hopper et al. (2010).

### **Research Design**

A repeated-measures design was used to assess whether SR using dynamic facial images is more effective than static facial images for face-name recognition. Participants were randomly assigned to two separate groups (Group 1 and Group 2) to determine which strategy (static or dynamic) was presented first. Participants in Group 1 received the static image first and the dynamic image second. Participants in Group 2 received the dynamic image first and the static image second. One condition (dynamic or static) was trained until criterion was met; then, the second condition was trained to criterion. Participants were given at least 48 hr, but not more than 72 hr, between the two strategies. This time delay was incorporated to reduce the

possibility of practice effects and to ensure participants did not become fatigued during SR training.

### **Interrater Reliability**

Interrater reliability was used to establish whether two different individuals (raters) assigned the same value and reached the same agreement with regard to participants' responses. Rater 1 was a professional in the speech-language pathology field, and Rater 2 was a student volunteer in the speech-language pathology field for approximately 1 year and received training on the correct implementation of the SR protocol. A random sample procedure in SPSS was used to create a sample for four of the 12 participants (33%). Participants 1, 4, 5, and 9 were randomly selected for review.

Audio and/or video recordings from the first and last sessions for both conditions (e.g., static and dynamic) were reviewed by the student volunteer (74 trials). The maximum amount of trials allotted for each participant was 12. The number of trials where criterion was reached varied by participant. Theoretically, the total number of trials could be  $2 \text{ samples} \times 12 \text{ trials} \times 12 \text{ participants} \times 2 \text{ conditions} = 576$ . The student volunteer used the same SR data sheets that the researcher used to keep track of the participants' responses. Reliability was determined by comparing the researcher's marked responses with the student's marked responses for each trial. The specific items being compared included (a) successful recall at the beginning of the session, (b) longest interval in which a correct response was given, (c) correct identification of the target name, and (d) timing of the intervals. An assessment of the data sheets indicated an agreement score of 100% for successful recall at the beginning of the session and for the longest interval in which a correct response was given. Following completion of this procedure, an overall agreement score of 98.6% was attained.

In addition, the reliability of the time intervals was calculated by comparing seconds between each interval, allowing for  $\pm 10$  s in variability for accuracy of the 74 trials. Table 2 provides a summary of the data for reliability of the time intervals. Three categories (e.g., overall, group, and type of dementia) were analyzed for differences in agreement. The differences were confined to the timing of the target question and generally occurred when the researcher had to restrict the participants' conversation or activity. Intraclass correlations and Pearson correlations were used to determine the interrater reliability. In general, there was an intraclass correlation and Pearson correlation of .999 for all three categories, indicating a very high level of agreement for the timing of the intervals.

### **Results**

A series of repeated-measures analyses of variance were conducted to determine if SR with dynamic images was more effective than SR with static images to improve face-name recognition. The dependent variables in these

**Table 2.** Interrater reliability of time intervals.

Analysis	ICC	Pearson correlation	Agreement		
			No discrepancy	R1 > R2	R2 > R1
Overall	.999	.999	88.0%	2.8%	9.5%
Group					
Static	.999	.999	92.3%	2.6%	5.1%
Dynamic	.999	.999	82.9%	2.9%	14.3%
Type					
AD	.999	.998	64.7%	11.8%	23.5%
VaD	.999	.999	94.7%	0.0%	5.3%

Note. ICC = intraclass correlation; R1 = Rater 1 (professional in the speech-language pathology field); R2 = Rater 2 (graduate student volunteer); AD = Alzheimer's dementia; VaD = vascular dementia.

analyses were the number of training sessions and the number of training trials required to reach criterion. The within-subject independent variable for each analysis was type of image (static vs. dynamic). Type of image was evaluated for possible effects on the outcomes (number of trials, number of sessions to criterion = dependent variables).

## Full Group Findings

The average number of sessions (dependent variable) needed for correct identification of dynamic images was only slightly higher than for static images (mean for dynamic = 3.00,  $SD = 2.13$ ; mean of static = 2.33,  $SD = 1.97$ ). The results were not significant,  $F(1, 11) = 1.80, p = .207, \eta^2 = .14$ . In addition, a repeated-measures analysis of variance with the number of trials (dependent variable) was conducted. The results were not significant,  $F(1, 11) = 0.25, p = .626, \eta^2 = .02$ . The number of trials required for static and dynamic images was similar (mean for static = 8.17, mean for dynamic = 8.58).

Interestingly, the researchers observed an unexpected pattern during data collection and analysis of the results. Differences in the performance outcome between participants with AD and participants with VaD appeared to be emerging. Therefore, the researchers performed an additional repeated-measures analyses of the dependent variables (i.e., number of sessions and number of trials) to determine whether the type of diagnosis (AD vs. VaD) in concurrence with the type of image (dynamic vs. static) demonstrated an effect on the participants' performance.

## Findings for AD Versus VaD

The dependent variables (the number of training sessions and the number of training trials) from the primary objective were reassessed using type of diagnosis as a between-subjects variable. The research design for the new analyses was a 1-between (diagnosis of VaD vs. diagnosis of AD) and 1-within (static vs. dynamic images) design. Thus, each analysis has two main effects (i.e., the impact of diagnosis and the impact of observing static vs.

dynamic images) and one interaction effect. The interaction effect assesses the joint effect of diagnosis (VaD vs. AD) and type of image (static vs. dynamic) on performance.

## Number of Sessions by Diagnosis

A repeated-measures analysis of variance was conducted to assess if the number of sessions for static and dynamic images differed by diagnosis. The number of sessions for each type of image (static vs. dynamic) was the within-subject variable and diagnosis (AD vs. VaD) was the between-subjects variable. The main effects for the number of sessions and diagnosis were not significant. However, the interaction effect was significant,  $F(1, 10) = 7.27, p < .05$ . A summary of the findings is presented in Table 3.

As demonstrated in the interaction diagram (see Figure 1), participants with AD required fewer sessions for dynamic images as compared to static images. In contrast, participants with VaD required fewer sessions for static images as compared to dynamic images.

## Number of Trials by Diagnosis

A repeated-measures analysis of variance was conducted to assess if the number of trials for static and dynamic images differed by diagnosis. The main effects for type of image and diagnosis on the number of trials were not significant. However, the interaction effect was significant,  $F(1, 10) = 6.22, p < .05$ . A summary of the findings is displayed in Table 4.

As demonstrated in Figure 2, participants with AD required more trials for static images than dynamic images to facilitate the correct face-name association. In contrast, participants with VaD required more trials for dynamic

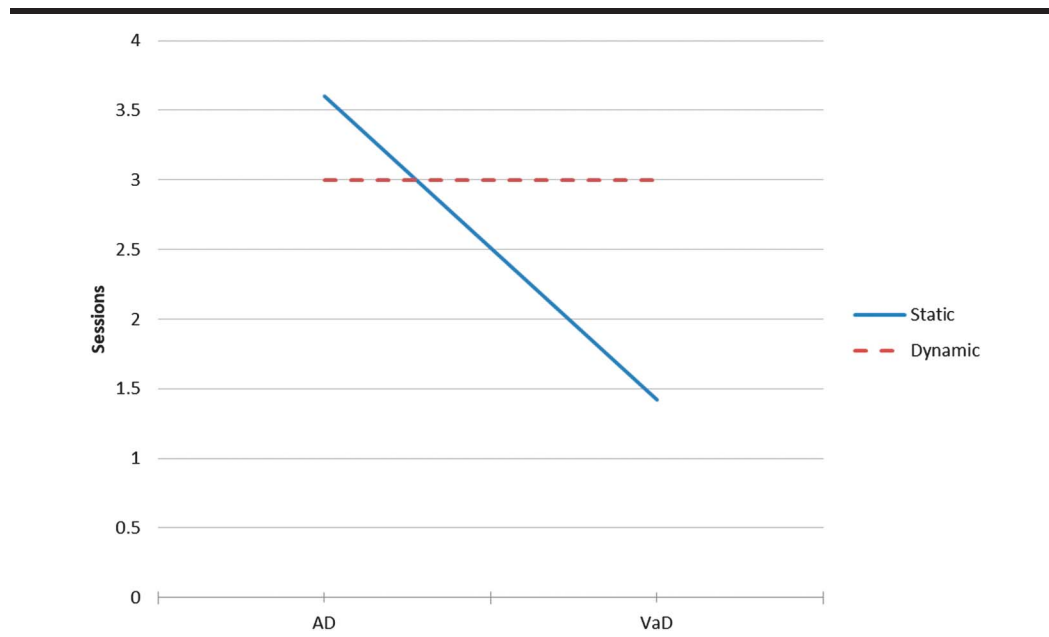
**Table 3.** Repeated-measures analysis of variance for number of sessions by diagnosis.

Diagnosis		<i>M</i>	<i>SD</i>	<i>n</i>	95% CI
Static	AD	3.60	2.61	5	[0.36, 6.84]
	VaD	1.42	0.54	7	[0.93, 1.92]
	Overall	2.33	1.97	12	[1.08, 3.58]
Dynamic	AD	3.00	2.92	5	[-0.62, 6.62]
	VaD	3.00	1.63	7	[1.49, 4.51]
	Overall	3.00	2.13	12	[1.64, 4.36]
Effect	<i>MS</i>	<i>df</i>	<i>F</i>	<i>p</i>	$\eta^2$
Diagnosis	6.88	1	0.99	.343	.09
	6.95	10			
Sessions	1.38	1	1.46	.255	.127
	6.88	1	7.27	.022	.421
Sessions × Sessions					
	0.95	10			

Note. CI = confidence interval; AD = Alzheimer's dementia; VaD = vascular dementia; MS = mean square.



**Figure 1.** Interaction diagram for impact of diagnosis and type of stimuli on number of sessions conducted. AD = Alzheimer's dementia; VaD = vascular dementia.



images than static images to facilitate the correct face-name association.

### Assessment of Long-Term Maintenance

A secondary objective examined the length of time face-name associations were retained after participants reached criterion. Do participants demonstrate a difference in long-term maintenance (i.e., 1 and 4 weeks) of learned information when comparing participants with AD versus

participants with VaD? It is important to note that one participant (Participant 2) never reached criterion due to the severity of her cognitive impairment. Therefore, long-term maintenance was assessed using only 11 participants. Table 5 demonstrates what occurred 1 and 4 weeks after criterion was reached. Two of the four (50%) participants with AD retained the static and dynamic face-name associations 1 week after criterion was reached. Subsequently, those two participants retained the face-name associations 4 weeks after criterion. Participants with AD performed the same for both static and dynamic images. Five of the seven participants with VaD (71.4%) retained the static face-name association 1 week after criterion was reached. However, only two of the five (40%) participants with VaD were able to retain the information after 4 weeks. Furthermore, three of seven (42.9%) participants with VaD retained the dynamic face-name association 1 week after criterion was reached. Subsequently, two of the three (66.7%) participants with VaD retained the information at the 4-week follow-up. Overall, the participants with VaD retained the static images better than the dynamic images.

**Table 4.** Repeated-measures analysis of variance for number of trials by diagnosis.

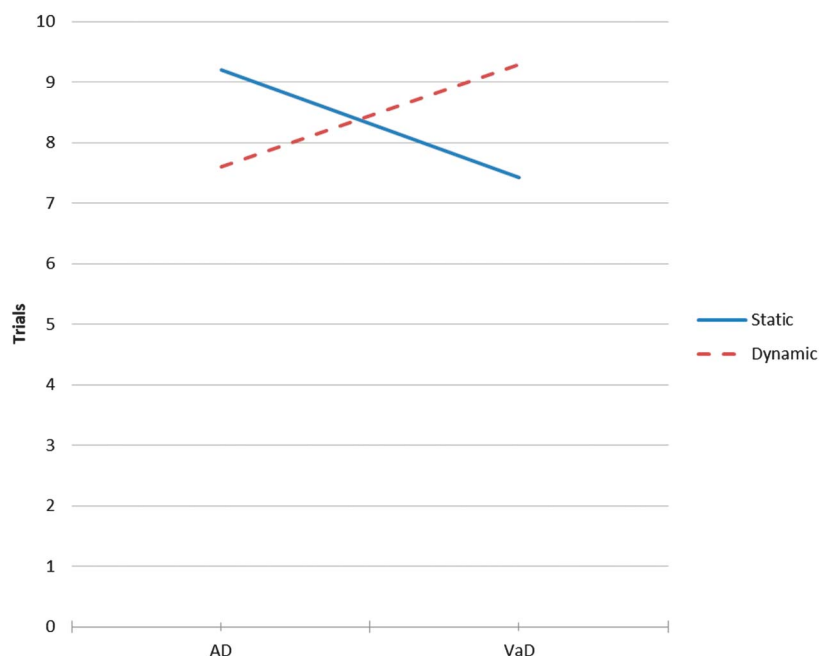
Diagnosis		<i>M</i>	<i>SD</i>	<i>n</i>	95% CI
Static	AD	9.20	3.03	5	[5.43, 12.97]
	VaD	7.43	1.51	7	[6.03, 8.83]
	Overall	8.17	2.33	12	[6.69, 9.65]
Dynamic	AD	7.60	1.67	5	[5.52, 9.68]
	VaD	9.29	2.75	7	[6.74, 11.83]
	Overall	8.58	2.43	12	[7.04, 10.13]
Effect	<i>MS</i>	<i>df</i>	<i>F</i>	<i>p</i>	$\eta^2$
Diagnosis	0.01	1	0.00	.971	.00
Error	7.91	10			
Trials	0.1	1	0.03	.857	.003
Diagnosis × Trials	17.43	1	6.22	.032	.383
Error	2.8	10			

Note. CI = confidence interval; AD = Alzheimer's dementia; VaD = vascular dementia; MS = mean square.

### Discussion

This study investigated the effects of SR using static and dynamic images to improve face-name recognition in patients with AD and patients with VaD. The study assessed whether the use of SR with dynamic images was more effective than the use of SR with static images in improving face-name recognition of caregivers in PWD. It also examined the length of time face-name associations were retained after participants reached criterion. Following

**Figure 2.** Interaction diagram for impact of diagnosis and type of stimuli on number of trials conducted. AD = Alzheimer's dementia; VaD = vascular dementia.



data collection, a third analysis examined the effect of type of dementia to determine if there was difference in performance outcome during SR training between the two groups.

### Effects of SR Training Using Static and Dynamic Images

This current study added to the literature by comparing the effects of SR using dynamic images versus static images to help PWD recall the faces and names of important people in their lives. One of the initial outcomes revealed that SR using either static or dynamic images improved face-name recognition in PWD. It was hypothesized that dynamic images would be more effective in improving face-name recognition than static images in PWD. Previous studies in the field of psychology indicated that faces presented in motion were identified better than those viewed

as static images (Lander & Davies, 2007; Xiao et al., 2014). Results revealed that participants achieved comparable proportions for static and dynamic images with no significance indicated. Contrary to the hypothesis, although improvement in face-name recognition was observed, there was no significant difference between SR using dynamic images versus static images.

### Long-Term Maintenance

The second objective of this study was to evaluate whether there is a difference in long-term maintenance of learned information when comparing both strategies. This study modeled the criterion for learning and long-term retention after Hopper et al. (2010). Hopper et al.'s criterion for learning face-name associations was set at a minimum of 24 hr, but not more than 30 hr, following the final

**Table 5.** Retention follow-up for static and dynamic stimuli by diagnosis.

Diagnosis	Static						Dynamic					
	Follow-up 1			Follow-up 2			Follow-up 1			Follow-up 2		
	n	% Cor	% Incor	n	% Cor	% Incor	n	% Cor	% Incor	n	% Cor	% Incor
AD	4	50	50	2	100	0	4	50	50	2	100	0
VaD	7	71.4	28.6	5	40	60	7	42.9	57.1	3	66.7	33.3

*Note.* Follow-up 1 denotes assessing participants' long-term retention 1 week after criterion was reached. Follow-up 2 denotes assessing participants' long-term retention 4 weeks after criterion was reached. % Cor = % correct; % Incor = % incorrect; AD = Alzheimer's dementia; VaD = vascular dementia.

training session. The researchers assessed long-term maintenance at 4 days, 2 weeks, 3 weeks, and 6 weeks following the final training session.

In the current study, the criterion for learning was the correct recall of the face–name association at least 24 hr, but not more than 72 hr, after the most recent training session. Following achievement of criterion, long-term maintenance was assessed 1 and 4 weeks after the last training session. Long-term maintenance was evaluated using only 11 participants since one participant (Participant 2) never reached criterion. Prior studies have reported long-term maintenance of face–name associations following SR training (Cherry & Simmons-D’Gerolimo, 2005; Clare et al., 2002; Hopper et al., 2010; Joltin, Camp, & McMahon, 2003). Similarly, long-term maintenance of face–name associations was observed in this study.

Overall, seven of the 11 participants successfully recalled the learned information at least 1 week after SR training. Surprisingly, one of the participants (Participant 12) with a severe degree of cognitive impairment (scored 11 on the MMSE and 6 on the BCRS and the GDS) recalled the static face–name association after 1 week of SR training. Four of 11 participants (Participants 1, 5, 7, and 10) successfully recalled the face–name association 4 weeks after SR training. These four participants scored within the mild–moderate range of cognitive impairment on the MMSE, the BCRS, and the GDS, suggesting there may be an association between long-term maintenance and dementia severity. Unfortunately, there appears to be limited research regarding a potential relationship between long-term maintenance and dementia severity. Further research is warranted in this area.

It was hypothesized that dynamic images of caregivers would be retained for longer periods of time than static images of caregivers. Although the average session at which criterion for maintenance was reached was slightly higher for the dynamic images, the magnitude of difference was not sufficient to reach significance. Despite the lack of significance, the ability of some participants to retain face–name associations for at least 4 weeks after training provides additional confirmation of the substantial benefits of the SR technique.

Overall, the results of Research Questions 1 and 2 indicated that SR training was an effective intervention using either dynamic images or static images for improving face–name recognition in PWD. There was no statistical significance in efficacy when the two strategies were compared with each other. Some participants (Participants 4, 6, 9, 11, and 12) performed better using static images, whereas others (Participants 1, 2, 3, 7, and 8) performed better using dynamic images. These findings suggest that SR training using dynamic images are at least equally efficacious for learning and retaining face–name associations when compared to SR training using static images for PWD.

In addition, these findings are consistent with many previous studies in which SR training has been shown to effectively improve face–name recognition with PWD (Cherry et al., 2010; Clare et al., 2002; Hawley & Cherry,

2004; Hawley et al., 2008; Hopper et al., 2010; Jang et al., 2015; Small, 2012). However, these studies only used SR training with static images. Therefore, the current study provides an additional treatment option (i.e., SR training with dynamic images) to improve face–name recognition for some PWD. Furthermore, these results indicated that PWD should be evaluated on an individual basis to determine which strategy would be most beneficial for improving face–name recognition.

### ***Effects of SR Training on Types of Dementia (AD vs. VaD)***

During data collection and interaction with the participants, the researchers began to observe an unanticipated pattern. Differences in the performance outcome between participants with AD and participants with VaD appeared to be emerging. Therefore, the researchers decided to re-analyze the components (i.e., number of sessions and number of trials) to determine whether the type of diagnosis in concurrence with static and dynamic images had an effect on the participants’ performance.

Overall, as displayed in the Results section, there was a significant interaction effect when diagnosis was included in the analysis. These findings indicated that participants with AD exhibited better learning capacity for face–name associations using SR with dynamic images. In contrast, participants with VaD displayed better learning capacity of face–name associations using SR with static images. This appears to be the first study to demonstrate a potential relationship between type of dementia and effects of SR using static and dynamic images. Although the explanation for these findings is not completely evident, one possibility may be related to the differences in neuropathology of the two dementias.

Compared to AD, persons with VaD demonstrate greater deficits in executive function skills, specifically visuospatial, attention, and visually processing stimuli. Due to the reported differences in these cognitive deficits, it can be speculated that SR performance may vary depending on the dementia diagnosis. Participants with VaD may have demonstrated more difficulty in visually processing and identifying dynamic images than participants with AD due to more significant executive function deficits (e.g., attention, visuospatial issues, processing stimuli). For participants with VaD, dynamic images may have appeared more distracting than static images, resulting in decreased ability to recognize the face–name associations. Conversely, participants with AD may have performed better with dynamic images due to the additional visual and real-life cues. These cues may have helped maintain their attention and provide the extra visual imagery to improve face–name recognition.

### ***Limitations and Future Research***

There were a number of limitations inherent in this study. The first limitation is associated with the sample size.

There were 12 participants included in this study. A small sample size is often used when conducting memory intervention research with PWD (Benigas & Bourgeois, 2016; Cherry et al., 2010; Hawley & Cherry, 2004). However, a larger sample size may provide more substantial information and statistical significance. Future research should include additional participants in order to extend the current findings.

The second limitation is correlated to the degree of dementia severity. A broad range of dementia severity was included in the study to help provide evidence of generalization to a larger population. Nonetheless, only three of the 12 participants scored within the moderate–severe range of dementia. The remaining nine participants scored within the mild and mild–moderate range. In general, few studies have investigated the effectiveness of SR with patients in the moderate–severe range of dementia. Oren et al. (2014) performed a systematic review on effects of SR on memory. The majority of studies demonstrated that SR was effective in training persons with very mild–mild dementia (at least 111) and mild–moderate dementia (at least 64) and a very limited number with moderate–severe dementia. These findings demonstrate the necessity for additional research inclusive of patients diagnosed within the moderate–severe range of dementia.

Additional limitations are linked to diagnosis, medication, and age range of participants. Two types of dementia (i.e., AD and VaD) were investigated in this study. There appears to be limited SR research incorporating other forms of dementia (e.g., lewy body and frontotemporal dementia) as well as other populations with brain injury. SR is a memory technique developed specifically for dementia. However, there is research suggesting SR may be efficacious for other diagnoses, such as aphasia and traumatic brain injuries (Fridriksson, Holland, Beeson, & Morrow, 2005). In addition, no data were collected regarding medication for dementia (e.g., Aricept or Namenda). Intervention outcomes may have been potentially altered if participants were receiving medication for their dementia. Furthermore, the ages of participants ranged from 58 to 96 years. Research exploring younger individuals with other neurological conditions may prove advantageous for the purpose of generalization to other populations.

A final limitation is related to the assessment of neuropathological deficits of AD versus VaD. The current study only administered the MMSE, the BCRS, and the GDS to provide a general measure of dementia severity without specifically evaluating executive dysfunction. Previous studies revealed executive function skills were significantly more impaired in persons with VaD compared to persons with AD (Kertesz & Clydesdale, 1994; Matsuda et al., 1998; Mendez et al., 1997; Traykov et al., 2002). Future research should incorporate the evaluation of neuropathological differences in VaD versus AD by means of neuroimaging techniques and/or tests to specifically measure frontal lobe and executive function deficits (i.e., attention, visuospatial issues, and processing stimuli).

## Conclusion

The results demonstrated that SR using static images and/or dynamic images were both effective techniques for improving face–name recognition in PWD. No significant differences were observed when the strategies were compared to each other. However, these findings supplement the literature by presenting another effective memory approach (using SR with dynamic facial images) to help improve face–name recognition for PWD.

Furthermore, the results revealed a significant interaction effect when the diagnosis (VaD vs. AD) and type of image (static vs. dynamic) were analyzed together on performance. Participants with VaD demonstrated improved performance using SR with static images, and participants with AD displayed improved performance using SR with dynamic images. These dementia syndromes present with variable characteristics/clinical symptoms and differ based on neuropathology (Graham, Emery, & Hodges, 2004). The current study appears to be the first to report a possible association between dementia diagnosis and SR performance using dynamic and static images. Further research is warranted to continue exploration of these preliminary findings. Confirmation of this significant relationship may reinforce the outcomes and provide additional treatment options for PWD. As the prevalence of dementia continues to rise, awareness of cognitive deficits and neuropsychological differences associated with type of dementia is vital to ensure the best treatment options.

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