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Effectiveness of techniques for the learning of face-name associations

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EFFECTIVENESS OF TECHNIQUES FOR THE LEARNING OF FACE-NAME ASSOCIATIONS

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Abstract

Research has shown that people have a particular difficulty recalling the names of faces, (McWenney, Young, Hay, & Ellis, 1987). This study compares four mnemonic techniques created for learning and remembering face name associations in healthy young adults: basic repetition, repetition with presentation of the face at different angles, spaced retrieval, and pre-exposure technique. The results of the study indicated that learning names under spaced retrieval, in which information is learned and retained through increasing or stable intervals of time dependent on individual performance, produced the greatest recall of names. Combining the pre-exposure technique with spaced retrieval did not improve recall of names. This study also found correlations between face name recall performance and performance on various neuropsychological measures. Face name learning and recall was positively associated with measures of facial recognition, attention, verbal and figural fluency, word memory, and executive functioning.

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Introduction

Context of the Problem

People are often faced with the task of remembering the names and faces of family members, friends, co-workers, and clients during social interactions. But there are times when we see a familiar face yet we are unable to put a name to it. Given the social expectations of recalling names on cue, forgetting the names of people we have met can be embarrassing and may result in a loss of confidence in daily interactions. The inability to recall names of familiar people may have negative social consequences such as avoidance of the person whose name we forgot or becoming stressed in thinking of creative substitutes for the person's name (e.g. hey you) so that the person is unaware we cannot remember his/her name. This difficulty with recalling names seems to increase as we age regardless of cognitive functioning level (Larson, Nyberg, Backman, & Nilsson, 2003). In fact, the most common memory complaint with normal aging is forgetting proper names (Reese & Cherry, 2004).

The question is why do we have difficulty with retrieving face name associations? It has been proposed that the successful production of a person's name as belonging to that person's face consists of 4 components (Groninger, 2006). The first component is to recognize that a person's face is familiar. The second component is to identify a familiar name. The next component is to determine that a particular name belongs to a particular person. The final component consists of successfully generating the name when a face is used as a cue. When these components are examined separately, we have relatively few difficulties with the first two components. We are capable of identifying a large number of unfamiliar faces viewed only once from a set of faces; we are able to immediately recognize over 90% of faces studied once and 80% to 95% of the faces studied once two days later with less than 5% false identifications (Courtois & Mueller, 1981). Likewise studies have shown that we have superior memory for name recognition, even greater than our memory for faces (Faw, 1990; Warrington & Taylor, 1973). Furthermore recognition memory for names and faces separately are durable even after a 12-14 day delay (Faw, 1990).

Memory for Face Name Associations

However, learning face and name associations is particularly difficult, especially recalling a person's name when we see the person's face. When young and old adults are taught to remember new names and faces, they do poorer at matching the face to a name or vice versa than simply recognizing if they had seen a face or name before (Naveh-Benjamin, Guez, Kilb, & Reedy, 2004). Research demonstrates that retrieving proper names of faces is more difficult than recalling other personal information associated with faces (Cohen, 1990; Stanhope & Cohen, 1993; McWenney et al., 1987). When normal healthy people have to learn a proper name, the occupation, or a possession of new faces, they recalled fewer names than occupations or possessions (Cohen, 1990; Stanhope & Cohen, 1993). The same pattern is true for patients with memory impairments (Milders, 1998; Moran, Seidenberg, Sabsevitz, Swanson, & Hermann, 2005). In addition, it takes longer to give the proper name of a face than to categorize the occupation or nationality of a face (Sergent, 1985; Young, Ellis, Flude, McWeeny, & Hay, 1986).

Word frequency or concreteness does not explain the advantage for other types of semantic information over names because it occurs even if proper names and occupations are described by the same words such as baker as an occupation and Baker as name in young and older adults (Cohen & Faulkner, 1986; McCluney & Krauter, 1997; McWeeny et al., 1987; Rendell, Castel, & Craik, 2005). In addition, producing a name takes longer than producing an occupation even if the response requirements are equated such as having to decide if two people have the same occupation or if they have the same common first name (Young, Ellis, & Flude, 1988). Similarly, Johnston and Bruce (1990) found that name retrieval takes longer than retrieving property semantic information such as nationality of a person and whether the person is alive or dead.

The reason for our difficulty may be that proper names are considered less meaningful and less likely to be represented in semantic memory (Cohen, 1990; McCluney & Krauter, 1997). When people were asked to recall names and personal possessions, the rate of names recalled was less than meaningful possessions (e.g. dog) and similar to the recall rate of meaningless, non-word possessions (e.g. wesp). However this pattern may be dependent on the frequency of exposure to or the familiarity of semantic information to be remembered. Adults and children are faster at recalling proper names than information belonging to familiar semantic dimensions (occupations and nationality) that are uncommon, for example remembering the occupations "Hafner" (a stovefitter) and "Sphragist" (a sigillograph) (Rahman, Sommer, & Olada, 2004). Moreover, the time taken to produce names is faster than the time taken to give descriptive information such as nationality or educational qualifications for very familiar personal acquaintances (Bredart, Brennen, Delchambre, McNeill, & Burton, 2005). It has been shown that students can recognize and match at a 90% accuracy rate the names and faces of their classmates in yearbooks 15 years later (Bahrick, Bahrick, & Wittlinger, 1975).

Techniques for Improving Learning Face Name Associations

Our unique difficulty in remembering face name associations has resulted in the development of different techniques to improve our memory for face name associations. Various techniques will be described including encoding facial features, verbalizing faces, the pre-exposure technique, and spaced retrieval.

Encoding Facial Features

Studies have demonstrated that the greater number of features processed for a face, the better the memory for that face (Groninger, 2006). Similarly, visually distinct faces are recognized more accurately and quickly than typical faces (Cohen & Carr, 1975; Valentine & Bruce, 1986). Visual distinctiveness is dependent on both single features and global features, such as face shape or eyebrow thickness, and the relationship or configuration of features with respect to each other (Leder & Bruce, 1998). Clarity of faces impacts the long term recall of names associated with faces; faces that are rated higher on clarity had greater name recall than faces rated less clear (Groninger, 2000; 2006).

A simple way of increasing the number of features processed for the face is to view the face at different angles to allow various features to be seen. As previously mentioned, the ability to successfully recall a name from a face requires the recognition that a person's face is familiar. According to Bruce and Young model of face name associations (1986), there is a facial recognition unit (FRU) that contains the structural visual descriptions of a face, which allows a face to be recognized regardless of changes in head angle, lighting, or emotional expressions. When a face is viewed, it is encoded structurally and compared to a set of facial descriptions stored in the FRU. If the encoded facial representation matches a stored set of face descriptions in the FRU, the viewed face is recognized as familiar; otherwise it is deemed to be unfamiliar. If a face is viewed at many angles, it should strengthen the FRU for the face and thereby facilitating face recognition and face name recall.

Verbalizing Faces

Encoding facial features is a strategy that focuses on the first step of recalling face name associations: improving our memory for faces. Another strategy with a similar aim is verbalizing faces. Research showed that learning takes place best when a pictorial stimulus is paired with a verbal response (Brainerd, Desrochers, & Howe, 1981). Studies have indicated the facilitative effects of verbalizing faces (Bloom & Mudd, 1991; Bower & Karlin, 1974; Mueller, Courtois, & Bailis, 1981). Describing faces is thought to enhance the quantity (Courtois & Mueller, 1979) and/or quality of the information processed (Berman & Cutler, 1998) such that more features of the face are attended to (resulting in a greater number of pathways for later recall) or the face is encoded as more visually distinct or mentally clear (leading to better impression of the face in memory for later recall). Others have suggested that describing faces increases the level of semantic processing that leads to richer semantic associations of the described faces to facilitate retrieval (Brown & Lloyd-Jones, 2006).

A method of verbalizing faces is making trait judgments of faces (such as if the person looks honest or caring); making such judgments to unfamiliar faces at encoding leads to better face recognition than making physical judgments such as sex of the person or the person's thickness of lips (Berman & Cutler, 1998; Bower & Karlin, 1974; Mueller et al., 1981). In fact, it has been found that faces judged for traits show the same recognition performance as faces judged for visual distinctiveness (Daw & Parkin, 1981; Parkin & Goodwin, 1983). Judgments made on personality traits require more time than judgments about facial features (Daw & Parkin, 1981). Personality trait judgments also resulted in more eye movements than making feature judgments and more eye movement is related to greater effort (Bloom & Mudd, 1991). Making trait judgments has been suggested to increase the level of processing performed on faces through semantic associations leading to a deeper and holistic encoding of the faces for easier retrieval (Bower & Karlin, 1974).

Pre-exposure Technique

A recent verbalizing faces method described by Downes, Kalla, Davies, & Flynn (1997) is the pre-exposure technique. According to these authors, pre-exposure refers to viewing a component of the to-be learned association alone first before learning the association. In learning face name associations, the first component of the association is the face. The pre-exposure technique involves presenting a face and making evaluative trait judgments of the face before presenting the name associated with the face. This technique has been proposed to aid in face name recall by allowing the face to be encoded adequately through evaluative judgments to create a more stable and meaningful representation of the face. Research indicated that it is not just the pre exposure of the face but a combination of showing the face and making evaluative judgments of the face prior to name presentation that makes this technique effective (Kalla, Downes, & Van der Broek, 2001). Once the face has been encoded deeply and internally represented, it can be paired with a name solely or through the use of a mnemonic process for name retrieval so that the name can be superimposed onto that face's perceptual representation.

Downes et al. (1997) compared the pre-exposure technique, visual mediation technique, pre-exposure technique with the visual mediation, and two control conditions. Patients with memory impairments were asked to learn names associated with ten easily imaginable faces in three different experimental conditions. In the pre-exposure condition, a face was shown for 6 seconds and participants were asked to make 2-3 evaluative judgments about the face such as whether the person looked pleasant, honest, or intelligent before being shown the name of the face for 4 seconds and asked to memorize the face name association. In the visual mediation condition, the face was shown with the name and the experimenter provided the participants a link between the name and a specific feature of the face. In the pre-exposure with imagery condition, the two conditions were combined such that the face was judged alone first without the name and then the face and name were linked together in a visual imagery. The control conditions involved the face and name shown simultaneously for either 4 or 10 seconds and participants were asked to memorize the face name associations. Experimental conditions were terminated when participants met the learning criterion of accurately recalling 80% of the faces shown.

Face name associations were then tested with a face displayed without the name and participants were asked to recall the name of the face. Although the recall performance of the pre- exposure technique was not significantly different than the two control conditions, the pre- exposure with imagery condition produced the highest level of name recall, the fewest trials to reach criterion and the slowest forgetting at a 24 hour delay test compared to the pre-exposure and visual imagery conditions. In fact combining pre exposure with visual mediation resulted in a name recall increase by almost 100% and reduced the number of trials to reach learning criterion by 50% compared to the visual mediation technique alone. However, the results obtained may have been affected by practice effects given that the combined pre-exposure and visual mediation condition was always the last condition for participants.

In a follow up study, Kalla et al. (2001) asked memory impaired participants to remember 20 face name pairs using 4 different conditions: pre-exposure technique, errorless learning, errorful learning, and errorless learning combined with pre- exposure. The order of conditions was counterbalanced. The pre-exposure condition was similar to the one used by Downes et al. (1997). The errorful learning condition involved participants being shown a face for 6 seconds and then given the surname but asked to guess what the first name would be; if the participant guessed the name on the first try, the name of the face was replaced with another name. This method was used to ensure that errors were made for each face name association. In contrast, the errorless learning condition involved participants being shown a face for 6 seconds and then presented with the first and last name. This method of showing the name of the face was considered errorless because it did not allow errors to occur since there was no guessing by the participants. In the combined condition, the face was presented for 6 seconds in which participants were asked to make evaluative judgments and then they were shown the full name. During the test phase, participants were shown the face without the name and asked to provide the full name associated with the face. Results of the study indicated that the combined condition enhanced recall of names (first names, surnames, and full names) and required fewer trials to attain the learning criterion than the errorful and errorless conditions. Using pre exposure with errorless learning doubled the number of names recalled in the standard errorless learning.

Spaced Retrieval

The techniques mentioned thus far focus on improving memory for faces, spaced retrieval is a technique that often targets name recall. Spaced retrieval is a mnemonic technique in which information is learned and retained through testing at increasingly longer periods of time. A piece of information (e.g. a name) is taught and tested repeatedly at intervals that systematically lengthen if recall is successful. On the other hand, if recall is unsuccessful, the information is restated or repeated and the next recall interval is reduced to the previous successful interval (Camp, Foss, Stevens, & O'Hanlon, 1996). Spaced retrieval incorporates the shaping procedure, errorless learning principle, spacing effect, testing effect, and expanding rehearsal.

Spaced retrieval can be viewed as a shaping procedure applied to acquiring and retaining information in memory (Abrahams & Camp, 1993). Originated from the behavior modification literature, shaping refers to reinforcing consecutive events to achieve a specific, target behavior. In the case of spaced retrieval, the target behavior is to retain information in long term memory and the testing intervals are adjusted based on the participant's memory performance to produce successive approximations to long term retention.

Spaced retrieval is likely effective, in part, because it involves errorless learning. Errorless learning refers to a principle in which errors are reduced or eliminated when an individual is initially learning information (Terrace, 1963). The principle assumes that errors produced during learning interfere with the correct responses. If errors are not eliminated, reinforcement of errors can occur and be strengthened over time according to the Hebbian learning rule (Hebb, 1961). The Hebbian rule states that if two neurons fire together from temporal input (such as erroneous response to a question), the strength of connection between them increases and thereby also makes the likelihood of making the same response (an erroneous response) again higher. In spaced retrieval, a person who produces an erroneous response during testing is immediately corrected, thereby reducing errors. Reducing or eliminating errors has been found to be beneficial in remembering names compared to traditional trial and error methods (Evans et al., 2000; Haslam, Gilroy, Black, & Beesley, 2006; Metzler-Baddeley & Snowden, 2005).

As the name suggests, spaced retrieval includes the spacing effect. The spacing effect refers to a memory advantage for the same action performed at widely separated times rather than the same action performed consecutively repeatedly (mass repetitions). Information has been found to be retained better if it is repeated in a separated and distributed fashion than in a continuous, massed fashion (Hintzman & Block, 1973; Kausler, Wiley, & Phillips, 1990; Melton, 1970). There are many theories as to how the spacing effect occurs including increased consolidation, deficient processing, encoding specificity, and increased semantic processing (for a review see Bjork & Allen, 1970; Challis, 1993; Greene, 1989).

In spaced retrieval, information is repeated in a distributed fashion through testing. The testing effect is the advantage of retention for information that is tested compared to information that is merely presented for additional study. The testing effect has been found to be robust (Allen, Mahler, & Estes, 1969; Hogan & Kintsch, 1971; Kuo & Hirshman, 1996; Landauer & Bjork, 1978). Testing can promote learning even when feedback is not provided (Langer, Keenan, & Medosch-Schonbeck, 1986; Postman, 1982; Roediger & Karpicke, 2006) and can improve the person's understanding of that information (Carrier & Pashler, 1992). The act of retrieval in testing has been hypothesized to create a retrieval context similar to later retrieval attempts (Landauer & Bjork, 1978) or strengthen existing memory routes (Birnbaum & Eichner, 1971). Research revealed that tested information showed an advantage in delayed recall but not immediate recall (Landauer & Eldridge, 1967; Whitten & Bjork, 1977). Testing and spacing improve memory independently (Carpenter & DeLosh, 2005; Landauer & Bjork, 1978); testing was found to double the rate that names are recalled over just studying names and names repeated at spaced intervals were retained three times more than at mass intervals (Carpenter & DeLosh, 2005). But the highest retention rate is for items tested at spaced intervals (Carpenter & DeLosh, 2005; Cull, 2000; Cull, Shaughnessy, & Zechmeister, 1996; Landauer & Eldrigde, 1967).

The testing of learned material in spaced retrieval is conducted at increasing or expanding intervals in time. For example, when learning new information, the first test is given after a short time interval, the second test is given after a longer time interval, and then the third test is given after an even longer time interval. Expanding retrieval intervals have been hypothesized to maximize the potential for preventative maintenance in memory by preventing information from being forgotten but also making retrieval difficult enough to allow elaborate processing (Carpenter & DeLosh, 2005). Thus, the most optimal expanded interval would be one in which an individual is tested just at the point when information would have been forgotten (Bjork, 1988). It has been shown that learning information under expanding retrieval conditions produces greater recall than uniformed or mass retrieval (Landauer & Bjork, 1978; Rea & Modigliani, 1985). The expanding retrieval may also aid recall by using the transfer appropriate effect because the best practice for a long delay retention is to retrieve information after increasingly long delays.

However, there is some evidence that expanding retrieval is not always superior to other retrieval schedules. Research found that expanding testing intervals show an advantage over uniform testing intervals when feedback is not given but this advantage disappears when feedback is given (Cull et al., 1996). In addition, Cull (2000) found that there was no difference between uniform or expanded spaced intervals in learning a list of words. The lack of significant findings in the studies may be related to the difficulty level such that the expanding spaced intervals were not spaced far enough to appear more difficult than uniformly spaced intervals. The proposed advantage for expanded over uniform intervals is when there is preventative maintenance but this advantage may be eliminated when preventative maintenance is suppressed and instead corrective maintenance is used. Furthermore, Morrow and Fridriksson (2006) compared teaching aphasic patients to name items using fixed spaced retrieval (in which retrieval intervals were expanding if person responds correctly) and randomized spaced retrieval (in which retrieval intervals occurred at random). Interestingly, they found no statistically significant differences between fixed and randomized spaced retrieval in terms of the number of sessions required to master naming items and the retention rate at which items were recalled. Further research is needed to examine the difference between fixed and random spaced retrieval.

Although research on spaced retrieval in healthy people have been scarce, it has been shown to be successful in teaching people to remember word lists (Glenberg, 1977; Rea & Modigliani, 1985), word pairs (Bellezza & Young, 1989; Whitten & Bjork, 1977), brief actions with objects (Kausler, et al., 1990), and names of objects (Toppino, Kasserman, & Mracek, 1991). On the other hand, spaced retrieval has been often studied in clinical populations. Older adults with dementia were successfully trained to remember different types of information using spaced retrieval intervention including: recalling personal information (Davis, Massman, & Doody, 2001), remembering to give a colored coupon to the experimenter after a one week delay (McKitrick, Camp, & Black, 1992), using a calendar as an external memory aid (Camp et al., 1996), remembering to drink some liquid while swallowing food (Brush & Camp, 1998), recalling where objects were placed (Camp & Stevens, 1990), and recalling names of common objects (Abrahams & Camp, 1993; McKitrick & Camp, 1993). This technique has also been found to be successful in teaching people with aphasia to name objects (Brush & Camp, 1998; Fridriksson, Holland, Beeson, & Morrow, 2005; Morrow & Fridriksson, 2006).

The spaced retrieval technique has also been found to improve memory for face name associations. Learning names to faces appear to be compatible with spaced retrieval because real life encounters in which face name associations must be remembered are often spaced and possess multiple opportunities for testing (Carpenter & DeLosh, 2005).

Landauer and Bjork (1978) showed students pictures of unfamiliar faces with first and last names. They either studied the full name or were shown the first name and asked to recall the last name. Face and name associations were presented either in uniform (3-3-3-3) or expanding spaced retrieval (0-1-3-8) formats. After a 30 minute delay, students were then shown faces with either the first or last name and asked to recall the other name not shown. Retention for names was found to be better when they were tested than studied. In addition, tested names were better retained under an expanded repetition schedule than a uniform repetition schedule. But it is uncertain whether names recalled were due to name face associations or first and last name associations because of the testing methodology used in this study.

Carpenter and DeLosh (2005) conducted a series of studies to determine the separate and combined effects of testing and spacing in learning face name associations when only faces served as cues for names. University students learned surnames along with unfamiliar faces in photographs either in a study or a test condition with and without feedback. A greater number of names were retained under the test conditions of a single test and multiple tests without feedback than in the study conditions. Furthermore, they compared different repetition schedules and found retention was better using spaced repetition than mass repetition; in fact mass repetition was statistically similar to a single presentation of name. Although a spacing advantage was found, they did not find any difference between uniform and expanding schedules for both study and test conditions. However the intervals used for expanding schedule (3-5-7) compared to uniform schedules (3-3-3) may not have been difficult enough to demonstrate the preventative maintenance of expanding spaced retrieval.

Spaced retrieval has been applied to remembering names of faces for older adults. Camp and Schaller (1989) successfully taught a man with memory impairments the name of a daycare staff member. After 2 sessions, the man was able to retain the name at a 6 month follow-up testing. Carruth (1997) integrated the spaced retrieval technique with music therapy to improve the naming abilities of healthy older adults at a nursing home. More than half of the participants in the study were able to retain the learned names of nursing home staff members in photographs. In addition, these gains extended to the real world as one of the participants began calling one of the staff members by her name after learning it in the spaced retrieval music condition. Likewise patients with probable Alzheimer-type dementia (AD) were able to relearn the names of familiar faces using spaced retrieval (Clare, Wilson, Carter, & Hodges, 2003; Clare, Wilson, Carter, Roth, & Hodges, 2002). Most of these patients demonstrated improvement in recalling names and remembered more names compared to baseline after 6 and 12 months. Hawley and Cherry (2004) taught older adults with probable AD to recognize and recall new face name associations. Participants in this study were trained to select the target photograph from distracters and recall the name of the person in the photograph at the sound of the beeper. After 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. Moreover, by the end of the training, all AD participants were able to recognize the actual live person in the photograph they were being trained on that week. Some AD patients were able to recall the name of the target live person by the end of the second week.

Face name associations and neuropsychological tests

Since learning faces name associations is a memory task, it is not surprising that research has found that recall rates for newly learned faces and names is related to recall scores on other memory tests (Hux, Manasse, Wright, & Snell, 2000). But learning and remembering face name associations was found to be correlated with other cognitive measures in addition to memory. It was shown that performance in learning new face name associations was positively correlated with learning pairs of common words, remembering visual complex designs, and word fluency performance in older adults (Neils-Strunjas, Krikorian, Shidler, & Likoy, 2001). In errorless learning studies, learning the names of objects was significantly correlated with performance in executive functioning and recognition memory tests in patients with memory and word finding difficulties (Fillingham, Sage, & Lambon-Ralph, 2006). In addition, dementia patients who do better on attention tests such as Digit Span showed greater benefit in using errorless learning for remembering novel face name and occupation associations than dementia patients who scored lower on attention tasks (Haslam et al., 2006).

Purposes of proposed research

Rationale and Background

Although many mnemonic techniques have been found to be effective, there are few studies that compare various techniques for learning face name associations in non-clinical populations. The majority of the current studies has focused on clinical populations with memory difficulties (Komatsu, Mimura, Kato, Wakamatsu, & Kashima, 2000; Manasse, Hux, & Snell, 2005) and has neglected the healthy population. Yet healthy people without clinical memory problems have difficulties recalling a name to a face and would benefit from mnemonic techniques. This study attempts to fill this gap by comparing and contrasting the effectiveness of several mnemonic techniques in learning and remembering novel face name associations for young healthy adults.

The research on using spaced retrieval for helping healthy adults recall names of faces has been scarce. Spaced retrieval has been shown to improve recall of words and names of objects for healthy people and several studies conducted thus far have shown that it can also be beneficial in learning name and face associations. Given the limited number of studies that has examined spaced retrieval in learning face name associations, additional research in this area is warranted. The present study aims to evaluate spaced retrieval as mnemonic technique for learning face name associations in a non-clinical, undergraduate student population. The two studies previously mentioned (Carpenter & DeLosh, 2005; Landauer & Bjork, 1978) that used face name associations as learning stimuli separated the intervals by intervening pictures of faces, and the accuracy of responses did not affect the spacing of the intervals. This study used the spaced retrieval method often employed in clinical populations described by Camp et al. (1996) and applied it to a healthy adult population. In this method, the retrieval intervals are dependent on individual performance in which successful recall of information is tested at longer intervals whereas unsuccessful recall of information is corrected and tested at the last successful interval. Therefore the exact spacing of the intervals for each stimulus varied across participants because it was dependent on the accuracy of the participant's responses. Even though the spacing intervals for the stimulus differed for each person, the number of intervals given for each stimulus was the same across participants so that each stimulus was presented and tested an equal number of times. In addition, the past studies evaluating spaced retrieval in normal adults often used only three or four intervals. The present study used five retrieval intervals for each stimulus to increase the opportunity of observing the maximum potential of this technique. The study attempts to replicate previous findings that spaced retrieval facilitates greater face name associations than mass retrieval.

Studies have demonstrated spaced retrieval as a useful mnemonic technique, but it has rarely been combined with other techniques. Research shows that combining mnemonic techniques can have additive facilitation effects beyond using either technique alone (Downes et al., 1997; Kalla et al., 2001). Integrating spaced retrieval with other mnemonic strategies may enhance the strength of this method. Another aim of the present study is to determine whether the facilitation of spaced retrieval in face name associations would be enhanced with the pre-exposure technique. The pre-exposure technique has been found to enhance other mnemonic techniques including visual mediation and errorless learning. But as far as we know, the combination of the pre-exposure technique and spaced retrieval has never been conducted. This is the first study to examine the effects of the combination of these two mnemonic techniques on memory for face name associations. The pre-exposure technique is used to improve the acquisition of faces in memory whereas the spaced retrieval method is used to facilitate successful retrieval of the name associated with the face. Therefore theoretically it may be useful to combine these two methods since one technique focuses on one component of the association (the face) and the second technique focuses on the other component of the association (the name). If these two techniques used together demonstrate improvement in memory for face name associations in healthy adults, it could have implications for helping clinical populations with memory difficulties.

Four experimental conditions were compared: (1) continuous repetition of the same face orientation presented each time with the name (mass retrieval condition), (2) continuous repetition with a different orientation of the face presented with the name (mass retrieval with encoding features condition), (3) spaced retrieval with the same face presented each time before name retrieval (spaced retrieval condition), and (4) pre exposure and spaced retrieval (combined condition) with the same face presented and judged each time before free recall of name (half of the faces were judged for the same trait at each presentation whereas the other half of the faces were judged for different traits at each presentation). Given that the aim of mnemonic techniques is to improve long term retention of name face associations, a delay period of thirty minutes between immediate testing session and delayed testing session was chosen because normal retention of information thirty minutes after learning has been considered to be consolidated information and a part of long term episodic memory (Bell, Fine, Dow, Seidenberg & Hermann, 2005). During the thirty minutes delay, participants completed several neuropsychological tests. Past studies have found that learning and remembering face name associations was significantly correlated with cognitive domains such as memory for words, executive functioning, attention, and verbal fluency in older healthy adults and patients with memory difficulties. The last aim of this study is to determine whether performance in recalling faces and names would be correlated with performance in various neuropsychological measures that involved memory, attention, fluency, and executive functioning for young adult students.

Hypotheses

Hypothesis 1.

Since the current literature shows that memory for faces involves a structural visual description of a face that allows a face to be recognized regardless of changes in head angle and that memory for faces has been shown to improve with greater number of features processed for a face, we would expect that viewing the face at various angles during the learning session in the Mass retrieval with encoding features condition will result in greater number of names learned and recalled than viewing the face at only one angle in the Mass retrieval condition.

Hypothesis 2.

Given that spaced retrieval using intervening stimuli has been found in past studies to facilitate name face recall over mass retrieval for students, we would expect the number of names recalled under the spaced retrieval conditions which alters the testing intervals according to individual performance will be greater at the immediate and delayed testing sessions than the number of names recalled under mass retrieval conditions.

Hypothesis 3.

The techniques of pre-exposure and spaced retrieval have been found be effective in teaching face name associations. These two techniques target separate components in learning face name associations so combining them should be beneficial in the retention of name retrieval in response to faces. We would predict that names learned using the combined pre-exposure with spaced retrieval will result in greater number of names learned and recalled during the immediate and delayed testing sessions than names learned using the spaced retrieval method alone.

Hypothesis 4.

Past studies have found that memory for words, executive functioning, attention, and word fluency were significantly correlated with recalling face name associations in older adults and patients with memory difficulties. We would predict that cognitive neuropsychological measures that assess attention, facial recognition, executive functioning, and memory for words would be significantly positively correlated with learning and recalling unfamiliar face name associations.

Method

Participants

The participants were psychology students at the University of Windsor. The sample size was 126 participants (23 males and 103 females) recruited through a participant pool for psychology students to attain course credits for their participation. Participants were between 18 to 51 years old with the mean age of 22. A majority of the students (60%) were psychology majors or minors. Students completed a short screening questionnaire to determine if they met any exclusion criteria. Participants were excluded if they did not have normal or corrected to normal vision, were ever diagnosed with a learning disability, were diagnosed with depression or an anxiety disorder and currently feeling depressed or anxious, or had a history of neurological conditions. Participation was completely voluntary and informed consent was obtained from all participants prior to their participation. Participants received extra credits towards a psychology course of their choice for their participation. This study obtained ethics approval from the University of Windsor Research Ethics and participants were treated according to standard ethical principles.

Design

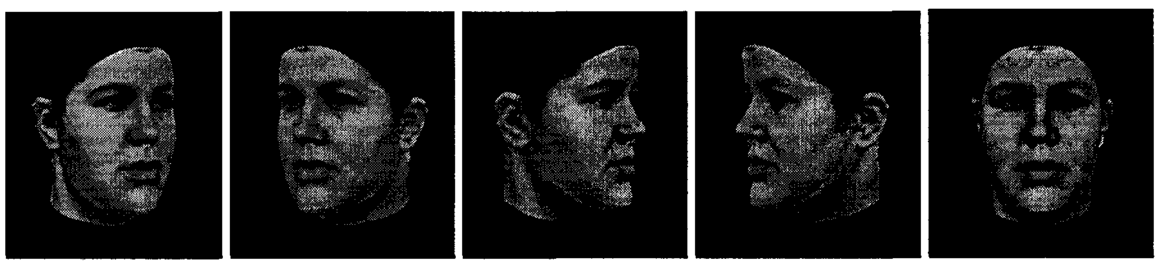
A between subjects design was used in which participants were randomly assigned to one of the four conditions: the mass retrieval condition, the mass retrieval with encoding features condition, the spaced retrieval condition, or the combined condition.

Materials

Seventeen black and white photographs of faces (8 male and 8 female experimental faces and one androgynous practice face) were sampled from the face database of Max Planck Institute for Biological Cybernetics. Each photograph had a black background and was approximately 9.03 cm by 9.03 cm in size. Faces were laser-scanned heads without hair. All the faces selected were adult Caucasians with no emotional expressions or distinctive facial features. For the learning trials of Mass retrieval, Spaced retrieval and Combined conditions the faces were presented in a ¾ view; an intermediate view between profile and full frontal views in which in both eyes and one of ear is visible (see Figure 1). This view was chosen because it was found to be the optimal view for processing faces (Laeng & Rouw, 2001). For the learning trials of Mass retrieval with encoding features condition, the faces were presented in multiple views including the intermediate view facing right and left, the profile view facing right and left, and the full frontal view (see Figure 2). Faces in the immediate and delayed testing trials were presented in a ¾ view.

My name is Morgan

Figure 1. Procedure for the Learning Conditions



Trial 1 Trial 2 Trial 3 Trial 4 Trial 5

Figure 2. Face stimuli for the Mass Retrieval with Encoding Features Condition

Seventeen surnames were sampled from normative data published by Zechmeister, King, Gude, and Opera-Nadi (1975). Selected surnames had similar ratings for frequency, familiarity, orthographic distinctiveness, and pronounceability. Seventeen first names were sampled from popular first names listed by the Social Security Administration of United States. Selected first names had similar frequency according to the data pool from Social Security card applications for births that occurred in the United

States from the year 2000 to 2007. All names chosen were between five and eight letters in length.

Each of the seventeen first names was randomly assigned to one of the seventeen surnames to make a full name (see Appendix A). Each face was randomly assigned to one of the full names so that each face is associated with a full name. One of the face name pairs was randomly chosen to be the practice face and the other sixteen faces were randomly placed in an ordered sequence.

Neuropsychological Measures

Verbal Fluency Test (Benton, Hamsher, & Sivan, 1994).

The Verbal Fluency Test is a measure of a person's fluency in verbal language or the ease in which a person can think of different words. This test consists of two subtests: letter fluency, and category fluency. In letter fluency, the participant was asked to name as many words as possible that start with a certain letter in 60 seconds to measure phonemic fluency. In category fluency, the participant was asked to name as many words as possible that belong to a certain category such as animals in 60 seconds to measure semantic fluency.

Five Point Test (Regard, Strauss, & Knapp, 1982).

The Five Point Test is a measure of a person's spatial fluency or the ease in which a person can think of different designs. This test requires the participant to produce as many new original abstract designs in three minutes. The participant was given a piece of paper in which there were boxes with five dots inside and asked to make as many different designs by connecting the dots in each box using straight line(s) in which a line must start at a dot and end at a dot; but participants did not need to use all the dots to make a design but at minimum need to use two dots.

Trail Making Test (TMT) (Reitan, 1955).

The Trail Making Test measures visual scanning, visual spatial ability, visuomotor speed, set switching ability, and cognitive flexibility. There are two parts to this test: Trails A and B. In Trails A, the participant was asked to connect numbers in order on a page of randomly placed numbers as quickly as possible. In Trails B, the participant was asked to connect numbers and letters by switching between a letter and a number (e.g. A-1-B-2) in alphabetical and numerical order on a page of randomly placed numbers and letters as quickly as possible.

Digit Span Test (The Psychological Corporation, 1997).

The Digit Span Test from the Wechsler Adult Intelligence Scale –III (WAIS-III) measures attention, concentration, and working memory. This test consists of two subtests: forward and backwards conditions. In the forward condition, the participant repeated a number sequence in the same order as presented by the examiner. In the backward condition, the participant repeated a number sequence in the reverse order as presented by the examiner. In both conditions, the length of the number sequence increased until the participant can no longer repeat the sequence.

California Verbal Learning Test 2nd edition (CVLT--II) (Delis, Kramer, Kaplan, & Ober, 2000).

The CVLT-II measures verbal list learning and memory by assessing recall and recognition of two words lists over immediate and delayed trials. In the learning trial, the participant was presented with a list of 16 words (List A) and asked to recall as many words as possible immediately after the presentation of the list. List A is composed of four words from four different categories (furniture, vegetables, ways of travelling, and animals). There were five learning trials before another16 word interference list (List B) was presented for one trial and the participant was asked to recall as many words as possible from the interference list. Immediately after List B, the participant was given a short delay free recall trial (recall as many words as possible) and a short delay cued recall trial (recall as many words that belong to each category e.g. furniture) for List A. Then, twenty minutes later, the participant was given a long delay free recall, long delay cued recall and yes/no recognition (presented with List A, List B and distracter words and asked whether each word was on List A) trials for List A.

Recognition Memory Test (RMT) (Warrington, 1984).

The RMT measures a person's ability to recognize photographs of faces. The participant was shown 50 photographs of faces one at time and asked to engage in an alternative forced choice recognition task in which each of the 50 faces are paired with a distracter face and the participant was asked to select the target face that was shown before.

Procedure

For each condition, participants read the instructions presented on the computer and completed a practice trial with guidance from the examiner. After the practice trial, the learning session was given (see Figure 1). The learning session involved presenting the information to be learned (a face presented in the middle of the computer screen with the name typed underneath the face) and testing the information being learned (the learned face presented for six seconds without the name and the words "What is my name?" appeared on the screen and participants were asked to type in the full name associated with the face and then press the enter key). Participants were instructed to press enter if they did not know the name. If participants typed in the wrong name or just pressed the enter key, the computer screen displayed the face and the correct name for two seconds: "My name is _____". This procedure was repeated for the same face five times sequentially before the next face name pair was presented. The specific instructions for the learning session differed according to the condition and are provided later in this paper.

After participants saw and attempted to recall all sixteen face name associations, they engaged in a short mathematic distracter task for five minutes: adding together as many two randomly chosen double digit numbers (e.g. 45 and 32) as possible within five minutes. The two numbers were shown for one second before a text box was displayed asking participants to type in the sum of the two numbers. Following the distracter task was the immediate testing session in which participants were shown all the sixteen faces previously learned one at a time in random order. Each face was presented in the middle of the screen for six seconds, followed by the words "What is my name?" presented on the screen and the participants were instructed to type in the name associated with the face or press enter if they could not recall the name.

Following the immediate testing session, the participants completed a demographic questionnaire and various cognitive neuropsychological tasks (Verbal Fluency Test, Five Point Test, Trail Making Test, Digit Span Test) for thirty minutes. After thirty minutes, participants completed the delayed testing session similar to the immediate testing session. Participants were again shown all sixteen faces one at a time in random order. Each face was presented for six seconds and participants had to type in names associated with the face or press enter if they could not recall the name. When participants finished the delayed testing session, they completed the California Verbal Learning Test and the Recognition Memory Test. Lastly, participants were debriefed on the purpose of the study.

Mass Retrieval Condition

A face was presented in the middle of the computer screen with the name printed underneath the face for six seconds before a blank screen was shown for two seconds. The same face again was presented for six seconds without the name. Then the face disappeared and the words "What is my name?" appeared on the screen and the participant was asked to type in the full name associated with the face. This procedure was repeated for the same face five times sequentially before the next face name pair was presented.

Mass Retrieval with Encoding Features Condition

This condition is similar to the mass retrieval condition. A face was presented in the middle of the computer screen with the name printed underneath the face for six seconds before a blank screen was shown for two seconds. The same face was presented again for six seconds without the name. Then the face disappeared and the words "What is my name?" appeared on the screen and the participant was asked to type in the full name associated with the face. Then the participant was shown the same face oriented at a different angle for six seconds. This is the only difference between the mass retrieval condition and mass retrieval with encoding features condition: in the mass retrieval condition, the same face at the same angle was shown five times for each face name pair whereas in the mass retrieval with encoding features condition, the same face was shown at five different angles for each face name pair to promote greater encoding of facial features. Thus, every time the participant was tested for the face name pair in this condition, a different view of the face was presented. The rest of the learning session procedure was exactly the same as for mass retrieval condition.

Spaced Retrieval Condition

A face was presented in the middle of the computer screen with the name printed underneath the face for six seconds before a blank screen was shown for two seconds. The participant was asked to do a distracter activity of adding two double digit numbers together. The numbers appeared on the screen for one second and the participant was instructed to type in the sum of the two numbers. Participants engaged in the distracter task for five seconds before the same face was presented again for six seconds, followed by a blank screen for two seconds and the words "What is my name?" appeared on the screen. The participant was asked to type in the full name associated with the face. Next, the participant engaged in the same distracter task described earlier until it was time for the next testing interval. The intervals were determined by the accuracy of the participant's name recall responses. If the participant responded correctly, the next testing interval was expanded: 10 seconds, 30 seconds, 60 seconds and 120 seconds. If the participant responded incorrectly, the next testing interval remained the same as the last previous successful recall interval. Previous studies using dementia patients participants have used expanding intervals of 0, 20, 40, 60, 90 and 120 seconds (Camp et al., 1996) or 5, 10, 20, 40, and 60 seconds (Hawley & Cherry, 2004). We decided to use longer intervals because the participants are healthy adults who do not have memory impairments. After each face was tested five times, a blank screen appeared for 2 seconds and participants performed the distracter activity of adding numbers for 10 seconds before the next face name association was presented and tested in the same procedure.

Pre Exposure and Spaced Retrieval: The Combined Condition

A face was presented in the middle of the computer screen for four seconds. A blank screen appeared for two seconds before the words "Does this person look _____?" was presented on the screen. The participant was instructed to make evaluative judgments of the face by answering one of five possible questions: does this person look honest/pleasant/intelligent/ responsible/friendly? The participant typed Y for yes and N for no. The same face was then presented in the middle of the screen for six seconds with the name typed underneath the face. After a blank screen was shown for two seconds, the participant was asked to do a distracter activity of adding two double digit numbers together. The numbers appeared on the screen for one second and the participant was instructed to type in the sum of the two numbers. The participant did the distracter task for five seconds before the same face was presented again for six seconds, followed by a blank screen for two seconds and the words "What is my name?" appeared on the screen. The participant was asked to type in the full name associated with the face. Next, the participant engaged in the same distracter task described earlier until it was time for the next testing interval. Like the spaced retrieval condition, these intervals were determined by the accuracy of the participant's name recall response: if the participant responded correctly, the next testing interval was expanded: 10 seconds, 30 seconds, 60 seconds and

120 seconds and if the participant responded incorrectly, the next testing interval remained the same as the previous successful recall interval.

The participant did the distracter task until the next testing interval time was up before the same face was presented again for six seconds, and a blank screen appeared for two seconds. The participant was instructed to make evaluative judgments of the face by typing in Y for yes or N for no to the question "Does this person look ____?" presented on the screen. For half of the faces, the participant judged the face on the same trait every time, e.g. "does this person look honest?" appeared at each interval. For the other half of the faces, the participant judged the faces on different traits every time, e.g. "does this person look honest?" appeared on one interval and "does this person look intelligent?" appeared on the next interval. After the participant made the judgment, a blank screen appeared for two seconds and the words "What is my name?" appeared on the screen and the participant was asked to type in the full name associated with the face. Then the participant engaged in the same distracter task described earlier until it was time for the next testing interval. After each face was judged and tested five times, a blank screen appeared for 2 seconds and participants performed the distracter activity of adding numbers for 10 seconds. Then the next face was presented, judged, and tested in the same procedure.

Results

Demographics

A chi square analysis revealed that males and females were distributed fairly evenly across the four conditions ($X^2(3) = 3.13$, p = .37). There were no significant difference in the ages of participants across the four conditions ($F(3, 122) = 0.18$, p = .91). Although our study used psychology students, there was a mixture of students from different majors such as business, communications, sociology, and neuroscience. A chi square analysis found no difference in the distribution of psychology and non psychology major students between the four conditions ($X^2(3) = 3.69$, $p = .30$).

Self-reported ethnicity of the participants was grouped according to Caucasian and Non Caucasian. A participant was considered Caucasian if he or she indicated as being Caucasian or reported to be a person from a European descent (Oxford Pocket Dictionary of Current English, 2008). More than half of the participants were considered Caucasian (74%). Research has demonstrated the existence of an own race bias in which, people tend to have better memory for faces that share their ethnicity, such that Caucasians are more likely than non -Caucasians to remember Caucasian faces (Anthony, Copper, & Mullen, 1992). Since this study used exclusively Caucasian faces, it is important to determine if there is a difference in ethnicity membership across the four groups that may be contributing to the performance in learning and remembering face name associations. Chi square results showed no significant differences between ethnicity across the four conditions ($X^2(6) = 9.28$, $p = .16$).

Face Name Learning and Memory

Performance was judged according to the accuracy of each participant's response for the first name, last name, and full name of the faces. The name of the face had to be spelled correctly with no errors to obtain a score of 1. For example if a participant got the first name correct and the last name incorrect, he/she would get a score of 1 for the first name, and 0 for last name and full name. On the other hand, if a participant got the full name correct, he/she would get a score of 1 for first name, last name, and full name. The data were analyzed using the Mann-Whitney and Kruskal-Wallis tests due to the skewness of the distributions. Post hoc tests were run using the Mann-Whitney test with a Bonferroni correction. The median, range, and standard deviations for each condition are shown in Table 1.

Table 1

Median, Standard Deviation and Range of Face Name Associations Scores for Each Condition

Correct Score by Trial Type		Condition			
		Mass Retrieval	Mass Retrieval with Encoding Features	Spaced Retrieval	Combined
LT First Name	Median (SD)	78 (2.219)	77 (2.219)	78 (2.107)	78 (4.718)
	Range	72-80	71-80	70-80	56-80
LT Last Name	Median (SD)	79 (2.362)	79 (3.475)	78 (2.874)	77.5 (5.025)
	Range	72-80	67-80	65-80	55-80
LT Full Name	Median (SD)	77 (3.695)	76 (4.594)	76 (3.734)	74 (6.718)
	Range	68-80	63-80	61-80	46-80
IT First Name	Median (SD)	2 (2.080)	1 (1.637)	2 (2.332)	2 (2.125)
	Range	0-8	0-6	0-12	0-9
IT Last Name	Median (SD)	1 (1.670)	1 (1.067)	2 (1.912)	1 (1.736)
	Range	0-7	0-4	0-10	0-8
IT Full Name	Median (SD)	0 (1.528)	0 (0.942)	1 (1.936)	1 (1.722)
	Range	0-7	0-3	0-10	0-7
DT First Name	Median (SD)	2 (2.336)	1 (1.659)	3 (2.474)	2 (1.807)
	Range	0-8	0-7	0-13	0-9
DT Last Name	Median (SD)	1 (1.841)	1 (0.774)	1 (2.363)	1 (1.796)
	Range	0-8	0-3	0-12	0-9
DT Full Name	Median (SD)	0 (1.720)	0 (0.568)	1 (2.238)	1 (1.768)
	Range	0-8	0-2	0-12	0-9

LT = Learning Trial

IT = Immediate Testing Trial

DT = Delayed Testing Trial

Learning Trial

In general, there was no significant difference between conditions in learning first names (H(3) = 2.34, p = .51), last names (H(3) = 2.64, p = .46), or full names (H(3) = 1.99, p = .57). Interestingly, a Mann Whitney test showed that females (Mdn = 78.00, sd

= 3.07 for first names and Mdn = 76.00, sd = 4.76 for full names) were slightly better than males (Mdn = 77.00, sd = 3.14 for first names and Mdn = 74.00, sd = 5.00 for full names) at learning the first names (U = 751.00, r = -.02) and full names (U = 855.50, r = -.02) of faces independent of the condition to which they are assigned. In addition, Caucasians (Mdn = 79.00, sd = 2.38) were slightly more accurate at learning the last names (U = 1030.50, r = .02) of faces than non Caucasians (Mdn = 77.00, sd = 5.43).

Immediate Recall Testing Trial

There was a significance difference between conditions in recall of the last names (H(3) = 9.88, $p < .05$) and full names (H(3) = 12.33, $p < .05$) of faces at the immediate delay trial. Post hoc tests revealed a significant difference between Mass retrieval with encoding features condition and Spaced retrieval condition for last names (U = 312.00, $r = -.37$) and full names (U = 283.00, $r = -.36$). As predicted, participants in Mass retrieval with encoding features condition (Mdn = 1.00, sd = 1.07 for last names and Mdn = 0.00, sd = 0.94 for full names) had lower scores than participants in Spaced retrieval condition (Mdn = 2.00, sd = 1.91 for last names and Mdn = 1.00, sd = 1.94 for full names) when recalling names of faces. Participants performed significantly better in the Combined condition (Mdn = 1.00, sd = 1.74 for last names and Mdn = 1.00, sd = 1.72 for full names) than participants in the Mass retrieval with encoding features condition in recalling last names (U = 287.50, $r = -.31$) and full names (U = 299.00, $r = -.37$).

A Mann-Whitney test was conducted to compare the scores of participants that learned faces using mass retrieval (Mass retrieval condition and Mass retrieval with encoding features condition) and participants that learned faces using spaced retrieval (Spaced retrieval condition and Combined condition). There was a significant difference between these two groups in recalling last names (U = 1426.50, *r* = -.25) and full names (U = 1326.50, *r* = -.30) in the immediate trial. Participants who used spaced retrieval to learn faces remembered more names than participants who used mass retrieval (see Figure 3).

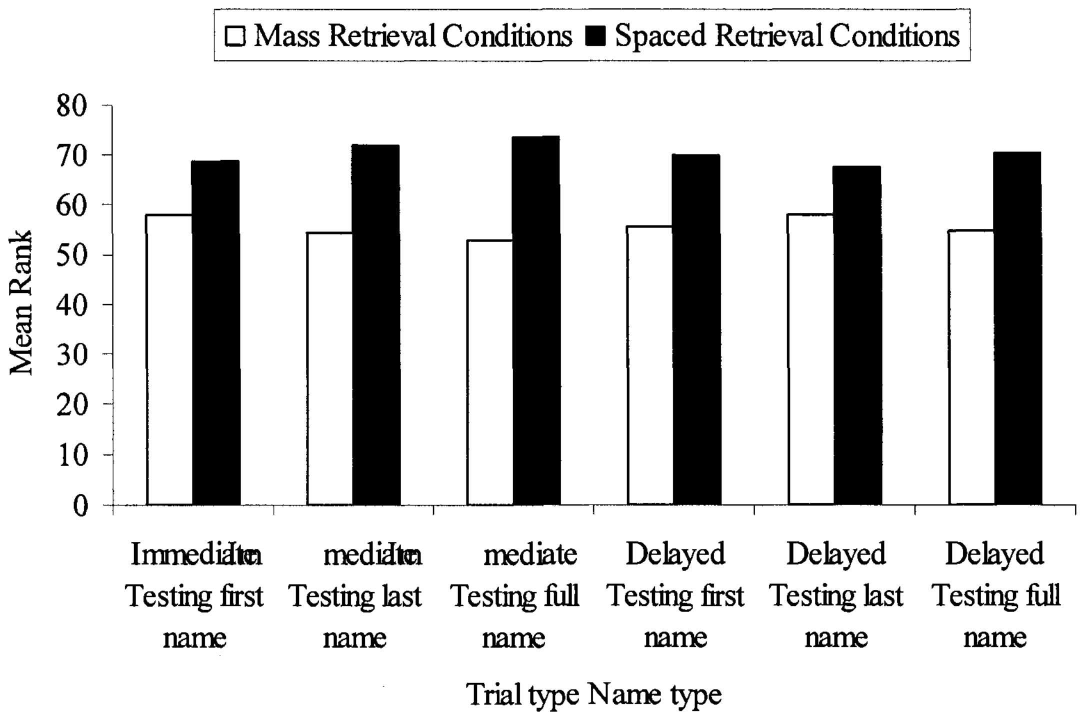


Figure 3. Mean Rank Recall Difference Between Mass Retrieval Conditions and Spaced Retrieval Conditions

Delayed Recall Testing Trial

A significant difference was found between conditions for recall of first names (H(3) = 10.22, $p < .05$) and full names (H(3) = 8.84, $p < .05$) during the delayed recall trial.

Further analysis demonstrated that participants in the Mass retrieval with encoding features condition (Mdn = 1.00, sd = 1.66 for first names and Mdn = 0.00, sd = 0.57 for full names) recalled fewer names compared to participants in the Spaced retrieval condition (Mdn = 3.00, sd =2.47 for first names and Mdn = 1.00, sd = 2.24 for full names) (U = 317.50, r = -.39 for first names and U = 302.00, r = -.35 for full names) and participants in the Combined condition (Mdn = 2.00, sd = 1.81 for first names and Mdn = 1.00, sd = 1.77 for last names) (U = 263.50, r = -.28 for first names and U = 297.00, r = -.33 for full names). A Mann-Whitney test revealed significantly greater recall of first names (U = 1497.50, r = -.20) and full names in the delayed testing trial (U = 1465.50, r = -.23) for participants who learned faces using spaced retrieval (Spaced retrieval condition and Combined condition) compared to participants who learned faces using mass retrieval conditions (Mass retrieval condition and Mass retrieval with encoding features). Please see Figure 3.

Correlations with Neuropsychological Tests

Participants' mean performance on neuropsychological measures and the percentile of their performance according to normative data of participants with a similar education level and age range is presented in Table 2. The normative data for these measures were based on data presented in Strauss, Sherman, & Spreen (2006), Warrington (1984), and Wechsler (2001).

The relationships between the number of correct names in the learning and testing trials and the neuropsychological tests results were analyzed using the Spearman's r due to non-normality of the data. Given the multiple correlations examined in this study, a

Bonferroni correction with an alpha level of 0.002 could have been used to reduce the likelihood of Type 1 error. However, an alpha level of 0.05 was used despite multiple correlations performed because all analyses were planned and hypothesis-driven to allow for a less conservative alpha level. In addition, a less conservative alpha level would compensate for the loss of power from the low face name recall scores for the immediate and delayed testing trials.,

Table 2

Means, Standard Deviations and Percentile for Neuropsychological Tests Performance

Neuropsychological Test Score	Study Participants M (SD)	Percentile based on Normative Data
Digit Span Forward Span	7.00 (1.07)	42
Digit Span Backward Span	4.89 (1.40)	52
Digit Span Test Total Score	17.71 (3.51)	43
Letter Fluency Test Score	37.01 (8.25)	37
Category Fluency Test Score	20.43 (4.44)	49
Five Point Test Score	34.14 (8.34)	60
Trail Making Test Part A Time	25.88 (8.51)	35
Trail Making Test Part B Time	53.81 (14.69)	35
Recognition Memory Test Score	41.39 (4.03)	43

The correlations between scores on the face name association task and scores on various neuropsychological measures are presented in Table 3. Significant correlations presented in the table are in bold font with one asterisk (*) indicating $p < .05$ and two asterisks (*) indicating $p < .002$. In terms of attention and working memory, a positive relationship was found between the total digit span score and the number of correct names recalled in the learning trial ($r = .195$, $p < .05$ for first names; $r = .285$, $p < .002$ for last names; and $r = .287$, $p < .002$ for full names), immediate testing trial ($r = .214$, $p < .05$ for last names; $r = .232$, $p < .05$ for full names), and delayed testing trial ($r = .207$, $p < .05$ for last names; $r = .215$, $p < .05$ for full names). The number of digits that a person can hold in the forward condition was significantly correlated with learning last names ($r = 2.12$, $p < .05$) and full names ($r = .234$, $p < .05$). Working memory as measured by the number of digits that a person can hold in the backward condition of Digit Span was significantly correlated with learning last names ($r = .200$, $p < .05$) and remembering last names in the delayed testing trial ($r = .185$, $p < .05$.

Table 3

Correlations Between Neuropsychology Tests Scores and Face Name Association Scores

		Learning trial first name	Learning trial last name	Learning trial full name	Immediate trial first name	Immediate trial last name	Immediate trial full name	Delayed trial first name	Delayed trial last name	Delayed trial full name
Letter fluency total score	Spearman's r	.031	**.236***	**.215***	.141	**.194***	.151	**.203***	**.247***	.136
	P value	.143	**.008**	**.016**	.116	**.030**	.091	**.023**	**.006**	.131
Category fluency score	Spearman's r	.137	**.192***	.173	.160	**.247***	.137	.164	.143	.087
	P value	.126	**.031**	.052	.073	**.005**	.125	.068	.112	.333
Five Point Test score	Spearman's r	.018	.070	.052	**.196***	**.238***	.145	.164	.044	.034
	P value	.843	.436	.566	**.028**	**.007**	.106	.068	.623	.706
TMT A time	Spearman's r	.069	-.010	.000	-.146	-.045	-.024	-.115	.102	.106
	P value	.442	.911	1.000	.102	.613	.794	.203	.256	.238
TMT B time	Spearman's r	**-.307****	**-.301****	**-.336****	**-.258***	**-.218***	**-.246***	**-.200***	-.162	-.167
	P value	**.000**	**.001**	**.000**	**.004**	**.014**	**.006**	**.025**	.072	.063
Digit span forward	Spearman's r	.111	**.212***	**.234***	.097	.088	.154	.022	.025	.123
	P value	.217	**.017**	**.008**	.282	.326	.086	.805	.779	.171
Digit span backward	Spearman's r	.116	**.200***	.162	.124	.161	.140	.088	**.185***	.159
	P value	.195	**.025**	.070	.166	.071	.117	.331	**.039**	.077
Digit span total score	Spearman's r	**.195***	**.285****	**.287****	.169	**.214***	**.232***	.103	**.207***	**.215***
	P value	**.029**	**.001**	**.001**	.058	**.016**	**.009**	.252	**.021**	**.016**
RMT score	Spearman's r	.150	.130	**.178***	**.215***	**.330****	**.327****	.125	**.238***	**.188***
	P value	.093	.147	**.046**	**.016**	**.000**	**.000**	.165	**.007**	**.036**

Table 4

Correlations Between CVLT-II Scores and Face Name Association Scores

		CVLT Trials 1-5	CVLT List B	CVLT Short Delay Free Recall	CVLT Short Delay Cued Recall	CVLT Long Delay Free Recall	CVLT Long Delay Cued Recall	CVLT Semantic Clustering	CVLT Intrusions	CVLT Recognition Hits
Learning trial first name	Spearman's r	**.184***	**.218***	**.201***	**.193***	**.210***	**.194***	.110	-.061	.078
	P value	**.041**	**.015**	**.025**	**.031**	**.019**	**.031**	.225	.503	.386
Learning trial last name	Spearman's r	.158	**.239***	.059	.070	.082	.125	.015	-.104	.069
	P value	.079	**.007**	.514	.437	.363	.167	.866	.251	.443
Learning trial full name	Spearman's r	.152	**.265***	.117	.140	.145	**.179***	.047	-.079	.066
	P value	.092	**.003**	.194	.122	.108	**.046**	.607	.381	.465
Immediate trial first name	Spearman's r	**.371****	**.305****	**.289****	**.303****	**.230***	**.340****	.130	-.156	**.245***
	P value	**.000**	**.001**	**.001**	**.001**	**.010**	**.000**	.150	.083	**.006**
Immediate trial last name	Spearman's r	**.291****	**.212***	**.253***	**.308****	**.243***	**.326****	.122	**-.205***	.166
	P value	**.001**	**.018**	**.005**	**.001**	**.006**	**.000**	.177	**.023**	.066
Immediate trial full name	Spearman's r	**.253***	**.217***	**.229***	**.294****	**.206***	**.306****	.128	**-.221***	**.223***
	P value	**.005**	**.016**	**.010**	**.001**	**.022**	**.001**	.157	**.014**	**.013**
Delayed trial first name	Spearman's r	**.373****	**.260***	**.327****	**.373****	**.309****	**.387****	**.212***	-.127	**.187***
	P value	**.000**	**.004**	**.000**	**.000**	**.000**	**.000**	**.019**	.162	**.039**
Delayed trial last name	Spearman's r	**.276****	**.251***	**.247***	**.313****	**.265***	**.328****	.151	-.119	.120
	P value	**.002**	**.005**	**.006**	**.000**	**.003**	**.000**	.097	.189	.184
Delayed trial full name	Spearman's r	**.308****	**.210***	**.257***	**.289****	**.275****	**.307****	**.198***	-.096	.133
	P value	**.001**	**.020**	**.004**	**.001**	**.002**	**.001**	**.028**	.289	.142

The ability to learn and recall new face name associations was found to be related to other memory measures. Scores on the Recognition Memory Test, measuring memory for faces, was positively related to scores for learning full names ($r = .178$, $p < .05$), recalling first, last and full names in the immediate testing trial ($r = .215$, $p < .05$ for first name, $r = .330$, $p < .002$ for last name, and $r = .327$, $p < .002$ for, full names), and recalling last names ($r = .238$, $p < .05$) and full names ($r = .188$, $p < .05$) in the delayed trial. Several significant correlations were found between scores on the CVLT-II and the number of face name associations learned and recalled. These correlations between scores on the face name association task and scores on the CVLT-II are presented in Table 4. Significant correlations presented in the table are in bold font with one asterisk (*) indicating $p < .05$ and two asterisks (*) indicating $p < .002$.The total score for the number of words recalled in 5 learning trials was positively correlated with learning first names ($r = .184$, $p < .05$) and recalling first ($r = .371$, $p < .002$), last ($r = .291$, $p < .002$) and full ($r = .253$, $p < .05$) names in the immediate testing trial and recalling first ($r = .373$, $p < .002$), last ($r = .276$, $p = .002$), and full ($r = .308$, $p < .002$) names in the delayed testing trials. The number of words recalled on List B (the interference list) was positively correlated with learning first ($r = .218$, $p < .05$), last ($r = .239$, $p < .05$), and full ($r = .265$, $p < .05$) names and remembering first ($r = .305$, $p < .002$), last ($r = .212$, $p < .05$) and full ($r = .217$, $p < .05$) names for the immediate testing session, and remembering first ($r = .260$, $p < .05$), last ($r = .251$, $p < .05$) and full ($r = .210$, $p < .05$) names in the delayed testing session Regardless of whether it was short or long delay, free and cued recall scores on the CVLT-II were significantly correlated with scores from learning first names, immediate recall of first, last and full names, and delayed recall of first, last and full names (please see Table 4). Long delay recognition hits for the target words in CVLT-II were positively correlated with recall of first ($r = .245$, $p < .05$) and last ($r = .223$, $p < .05$) names in the immediate testing trial, and first names ($r = .187$, $p < .05$) in the delayed testing trial. The words from the target list of CVLT-II can be categorized into 4 different groups (animals, ways of traveling, vegetables, furniture) and the words can be grouped together to facilitate recall. This semantic clustering can be calculated by adding the number of times a person recalls words from the same group together. There was a positive relationship found between the semantic clustering score and recall of first names ($r = .212$, $p < .05$) and full names ($r = .198$, $p < .05$) in the delayed testing trial. Thus people who used the semantic grouping strategy tended to remember more face name associations in the delay testing trial.

Indices of executive functioning from various measures were significantly correlated with performance in learning and recalling face name associations. A negative relationship was found between the time taken to complete Trails B task and the number of correct names in the learning trial ($r = -.307$ for first names, $r = -.301$ for last names, and $r = -.336$ for full names, all $ps < .002$), immediate testing trial ($r = -.258$ for first names, $r = -.218$ for last names, and $r = -.246$ for full names, all $ps < .05$), and delayed testing trial first names ($r = -.200$, $p < .05$). Self monitoring ability as measured by the number of intrusion words (words not on the target list) given during the learning trials or delayed recall trials on the CVLT-II was negatively related to the number of last names and full names recalled during the immediate testing trial ($r = -.205$, $p < .05$ for last names; $r = -.221$, $p < .05$ for full names). Several significant correlations were found for the fluency measures. Phonemic fluency was correlated with learning last names ($r = .236$, $p < .05$) and full names ($r = .215$, $p < .05$), and recalling last names ($r = .194$, $p < .05$) in the immediate testing trial, and recalling first names ($r = 203$, $p < .05$) and last names ($r = .247$, $p < .05$) in the delayed testing trial. Semantic fluency was also positively correlated with learning last names ($r = .192$, $p < .05$) and recalling last names in the immediate testing trial ($r = .247$, $p < .05$). Figural fluency as measured by the Five Point test was significantly correlated with recalling first names ($r = .196$, $p < .05$) and last names ($r = .238$, $p < .05$) in the immediate trial.

Discussion

Overview

The purpose of the current study was to compare different techniques for learning and remembering new face name associations for young healthy adults. We compared basic repetition, repetition with faces presented at different angles to promote facial encoding, spaced retrieval, and spaced retrieval with pre-exposure technique. This study used the spaced retrieval method in which retrieval intervals were determined by individual performance rather than spacing intervals with intervening stimuli that was often used in past studies. The next section of the discussion reviews this study's findings for memory techniques in learning names of faces. In addition to memory techniques, the relationship between remembering novel face name associations and performance on neuropsychological tests was explored. The second section examines the correlations found between the cognitive domains measured by neuropsychological tests and the recall for names of novel faces. The last sections evaluate the potential limitations of the methodology of this study and the practical implications suggested from the study findings.

Memory Techniques and Face Name Learning

Contrary to our hypothesis, there was no significant difference in the number of correct names learned and recalled between the Mass retrieval condition and the Mass retrieval with encoding features condition. In fact, the recall of first names in the immediate trial approached significance ($U = 333.5$, $r = -0.25$) but in the opposite direction of the prediction with participants in Mass retrieval condition doing better than participants from Mass retrieval with encoding features condition. Previous studies have found that memory for faces improve when more facial features are processed (Groninger, 2006). In the Mass retrieval with encoding features condition, a face is presented at various different angles to promote greater encoding of facial features, but greater encoding likely requires greater cognitive effort. The amount of cognitive effort invested in a task has been found to be a function of perceived difficulty of the task such that effort increases with task difficulty. That is, when the task is perceived to be easy, people will only invest little effort in solving the task whereas when the task is perceived to be difficult, people will spend greater effort on the task (Roets, Hiel, Cornelis, & Soetens, 2008). The participants in the Mass retrieval conditions may have perceived the task to be easy and may have given little cognitive effort during the learning trial. There is evidence that less effort occurs with information learned through mass retrieval than spaced retrieval; it has been suggested that information tested in a massed fashion will seem familiar to the person and the person will mistakenly believe information is already learned and therefore will not rehearse information (Bregman, 1967). Past studies found participants were mistakenly more confident of their memory for information despite remembering fewer items, (Zechmeister & Shaughnessy, 1980), engaged in fewer rehearsals (Ciccone & Brelsford, 1976; Rundus, 1971), spent less time when allowed to self pace (Shaughnessy, Zimmerman, & Underwood, 1972) and showed less pupil dilation, which corresponds to poor attention and decreased mental activity (Magliero, 1983) when learning information through mass retrieval compared to spaced retrieval. In support for this theory, participants in the Mass retrieval and Mass retrieval with encoding features conditions often commented at the end of the study that learning the names was very easy. Thus participants in these two conditions likely perceived learning face name associations to be easy and did not exert optimal effort for the task. In a situation of requiring them to repeatedly enter the same name, participants are unlikely to exert maximal effort, though, as in the Mass retrieval with encoding features condition, the task likely requires greater effort to effectively process the different facial features than participants in the Mass retrieval condition. Thus, participants in the Mass retrieval condition were better off because their low level of effort was matched by a task with a low degree of difficulty whereas the participants in the Mass retrieval with encoding features condition had a mismatch between their level of effort and the deceptively more difficult task.

On the other hand, we found that a greater number of face name associations were recalled under the spaced retrieval conditions (Spaced retrieval and Combined conditions) than the mass retrieval conditions (Mass retrieval and Mass retrieval with encoding features conditions). Previous studies using spaced retrieval to teach face name associations in young adults have separated testing intervals by other face name associations without having accuracy of participants' performance determine the intervals. This study used simple arithmetic problems to separate testing intervals and utilized the spaced retrieval method exercised in clinical populations in which the retrieval intervals were dependent on accuracy of responses (Camp et al., 1996). The results of the study demonstrate that using spaced retrieval to teach new face name associations in which testing intervals were adjusted according to response accuracy led to a greater number of face name associations recalled after a short and long delay than using mass retrieval. Although significant differences were found specifically between the Spaced retrieval condition and the Mass retrieval with encoding features condition, there was also an insignificant discrepancy in performance between the Spaced retrieval condition and the Mass retrieval condition in the immediate and delayed testing trials. This discrepancy between the latter two conditions was insignificant because, at least partially, of the floor effect evident from the low scores in the immediate and delayed testing trials for all conditions.

This is the first known study to combine spaced retrieval with pre-exposure technique to teach people new face name associations. Theoretically, these two techniques target different aspects of learning face name associations: the pre-exposure technique promotes deeper semantic processing of faces by making evaluative trait judgments of them whereas the spaced retrieval method focuses on facilitating retrieval of names associated with faces through testing intervals and feedback. But the results of this study did not find any significant differences in recalling names of faces between the Spaced retrieval condition and the Combined condition. Moreover, opposite to our predictions, participants in the Combined condition learned and recalled fewer face name associations than participants in the Spaced retrieval condition (see Table 1). Adding the pre-exposure technique in our study actually impeded rather than facilitated recall of face name associations learned by using spaced retrieval method alone. The reason for this finding is unclear as this is the first study to combine these two techniques. There are several possible reasons. One possibility may be inherent in the methodology for pre-exposure used in the current study. In past studies (Downes et al., 1997; Kalla et al., 2001) the trait judgments were made at the same time as participants were viewing the faces. In our study, to ensure equal face viewing time between participants the face was shown alone first and then participants were asked to make trait judgments after the face has disappeared. This may have made it difficult for participants to make accurate trait judgments because instead of using the physical faces presented on the computer screen they would have to use their memory for the faces to make these judgments. On the other hand, the pre exposure condition in our study may have been affected by the additional viewing time (4 seconds) of the face compared to the other conditions. However, this should theoretically aid in recall rather than impede it. In addition, participants in previous pre-exposure studies were aware that they would be tested for the names of the faces learned (intentional learning) but in our study participants were not told that they would be tested later (incidental learning). This difference may have an impact on the way participants approached the task when they were making trait judgments. Memory for new information is greater when learning is intentional rather than incidental (Peynircioglu & Moro, 1995).

Future studies should examine the effectiveness of using pre-exposure with spaced retrieval in remembering names of faces when later recall of names is expected. Previous studies have found that the pre-exposure technique combined with other memory techniques improve name recall for memory impaired individuals. Since our study used healthy young undergraduate students, it is possible that these students do not need to use evaluative judgments in order to create a meaningful, stable encoding of the face. They may use their own techniques. Numerous participants in our study reported using various ways to learn new face name associations such as linking the name to a celebrity or linking the face or name to a friend with a similar name. Qualitative studies regarding memory techniques young adults use to learn names of new faces should be conducted and compared to memory techniques used by people with memory impairment. Alternatively, trait judgments may create a more meaningful representation of the face that would improve face recognition but it may not aid in name retrieval for the face.

Given that this is the first study to combine spaced retrieval with the pre-exposure technique, greater research is needed to determine the efficacy of using these two techniques together to aid in learning new information including face name associations.

Face Name Learning and Neuropsychological Measures

The results of this study supported previous findings in past studies (Neils-Strunjas et al., 2001) and found new correlations between face name learning performance and performance on neuropsychological measures. Specifically, face name learning was positively associated with measures of facial recognition (RMT), attention (digit span), fluency (verbal and figural fluency), memory for words (CVLT-II), and aspects of executive functioning, such as self-monitoring and cognitive flexibility (Trails B, CVLT-II intrusions, and fluency measures) as predicted. Although the measures of working memory (digit span backward span), fluency (verbal and figural fluency scores), and self monitoring (fluency scores and CVLT-II intrusions) had statistically significant correlations with scores on the face name association task only if a less conservative alpha was used and not when a Bonferroni correction was used, these cognitive skills are likely to be theoretically important in learning and recalling unfamiliar face name associations.

There was a positive relationship found between the recall scores for face name associations and scores on the RMT. This finding makes sense intuitively, since the first step in recalling a name to face is to recognize the face as familiar (Bruce & Young, 1986). In terms of attention, a significant relationship was found between the recall scores for face name associations and digit span scores. The forward condition of digit span measures attentional span, so a positive correlation with name learning and recall scores indicates that the greater attention span a person has, the more correct names a person can learn and hold in memory for recall. In addition to being a measure of memory, the number of words recalled on List B of the CVLT-II is also a measure of attention span and was found to be positively correlated with learning and recalling first, last and full names for all trials. Attention is a crucial cognitive ability in learning and memory; if no attention is paid to the learning stimuli, then it would be difficult to encode the information to be learned and it would be impossible to recall information that was not encoded in the first place.

Scores on the digit span backward condition, which measures working memory, were also positively correlated with performance on the face name association task. Working memory is a limited capacity store for retaining information over a short period of time and performing mental operations on the contents of stored information (Strauss, Sherman, & Spreen, 2006). The greater working memory capacity, the more correct last names a person can learn and recall after a 30 minute delay. The finding that memory for face name associations is related to working memory capacity makes logical sense. Working memory is important in ensuring that information is available in the brain until it can be effectively encoded into long term memory and has been found to be a moderating variable of learning (Strauss, Sherman, & Spreen, 2006). However, it is unclear why only the recall of last names but not first names was associated with working memory. Further research is needed to replicate this finding and to determine the rationale for it.

In addition to working memory for numbers, memory for newly learned face name associations was found to be correlated with memory for a newly learned list of words. There was significant one on one corresponding correlations between face name associations and word lists: the ability to learn face name associations was correlated with the ability to learn a list of words, the ability to recall names of faces after a short interfering task was correlated with the ability to recall words on the target list after an interference list, and the ability to remember names after a long delay was correlated with the ability to recall words after a similar amount of time. The score for recognizing words following a long delay was positively related to the ability to recall face name associations after a short and long delay. These results suggest that memory for names of faces is associated with verbal memory for words in neurologically intact participants.

Furthermore, a significant positive correlation using an alpha level of 0.05 was found between the semantic clustering score and recall of names of faces in the delayed testing trial. As previously mentioned, the semantic clustering refers to a person's ability to categorize words into groups when learning them in that a higher semantic clustering score indicates a greater ability to categorize and group words. Categorizing words on the CVLT-II as a method of semantically organizing information can be thought of as a verbal association strategy to link words that belong together. This supports past studies that found learning biographical information such as names of people is strongly related to indices of associative verbal and nonverbal memory (Moran et al., 2005). Thus, people who frequently used the semantic association strategy were likely to recall more face name associations in the delayed testing trial. It is likely that people who use semantic associations for words were also using such a strategy in remembering faces and names by linking them in some manner (i.e. the name is similar to a celebrity, the face looks like my friend's face). However this is a speculation that needs to be confirmed in future studies.

Although this study did not provide a thorough assessment of executive functioning, there are indications of executive abilities from some measures. Executive functioning refers to the metacognitive capacities of an individual to perceive stimuli in the environment, respond adaptively, flexibly change direction, anticipate future goals, consider consequences, and respond in an integrated or common sense way to serve a common purposive goal (Baron, 2004). A positive relationship was found between memory for face name associations and verbal fluency performance. Fluency measures require effortful word search which is also used when trying to recall a name to face (Neils-Strunjas et al., 2001). Figural fluency was also significantly correlated with recalling names in the immediate testing trial. Measures of figural fluency, such as the Five Point test, have been found to be related to executive control measures such as the Wisconsin Card Sorting Test (Strauss, Sherman, & Spreen, 2006). A high score on the Five Point test involves problem solving ability to come up with different ways to make designs using five dots; people who score high on this test usually produces a single design and then repeat the same design using different dots. In addition, good performance on both verbal and figural fluency requires self-monitoring of previously drawn designs or words to ensure that the same responses are not repeated. A relationship was also found between the number of intrusion errors made on the CVLT-II and the number of correctly recalled names of faces. Those who made more intrusion errors during the learning and delayed trial of the CVLT-II are either not actively engaging in or poor at self monitoring of their performance, especially in the learning trial when the list of words is repeated by the examiner and thus could easily allow for correction of errors. These people also tend to recall fewer correct names in the immediate testing trial. These findings are consistent with past research demonstrating that learning names was related to self monitoring ability (Fillingham et al., 2006).

Cognitive flexibility is another executive ability that was related to recalling face name associations. The time taken to complete Trails B was negatively correlated with the scores for face name associations. That is, the shorter amount of time a person takes to finish Trails B, the more correct names a person remembers. Performance on Trails B is thought to reflect cognitive flexibility and set switching ability, among many things (Strauss, Sherman, & Spreen, 2006). Cognitive flexibility is an executive functioning skill that encompasses the ability to adapt cognitive processing strategies in response to face new conditions in the environment (Canas, Quesada, Antoli, & Fajardo, 2003). If cognitive flexibility is associated with greater ability to learn new names of faces, performance on other measures of cognitive flexibility such as the Wisconsin Card Sorting Test should also be positively related to face name recall performance. Additional research in this area should be conducted in the future.

Overall, the results of our study suggests that people who demonstrate greater verbal memory, attention/working memory, facial recognition memory and executive functioning will do better at learning and recalling novel face name associations.

Limitations

When interpreting the results of this study, it is important to keep in mind that there was a low representation of male and non Caucasian participants in the sample. Thus, the findings of the study may be less generalizable to these populations. Participants had low scores in recalling names of faces in the immediate and delayed testing trials across all conditions reflecting a floor effect. Floor effects make it more difficult to find statistically significant results. Low scores may have been a result of the face stimuli we used. Although we used black and white photographs of faces with no hair, emotional expression or distinctive facial features to ensure that faces were encoded without such visual cues, these faces may have been difficult to encode. Most participants stated that the faces looked homogenous and that they had difficulty distinguishing one from another. They also indicated that they often could not even tell whether the face was male or female during recall trials. Poor performance in this study may be due to the large number of faces coupled with the requirement to learn both first names and last names of faces. Although Carpenter and Delosh (2005) used 40 experimental names of faces, they only used last names. The study by Kalla and collegues (2001) required memory impaired participants to recall 20 full names of faces. This study also showed a floor effect. In addition, the long time period (ranging from 1.5 to 2 hours) required to complete the spaced retrieval and combined conditions may have caused fatigue for participants and a reduction in effort. Majority of participants in these conditions stated that the task was too long and tiring for the eyes to stare at the computer. Lastly, the fact that I used a incidental memory rather than a deliberate memory design may have contributed to the low performance across all conditions. Many participants were surprised when they were told to recall the face name associations especially in the delayed testing trial and they indicated that the immediate and delayed recall trials were difficult and admitted to struggling through them when giving feedback to the examiner. Future studies should make the memory task of remembering names of faces easier for participants to reduce the likelihood of a floor effect.

Practical Implications

The present study's results have several practical implications for learning names of faces in everyday life for young healthy adults. The best way to remember names of faces is to use the spaced retrieval method: helping the person learn the name of the face when viewing the actual face of the person or a photograph of the person's face and testing the person for the name of the face with a real face or photograph of face after a short period of time to ensure that the person can recall the name. If the person cannot recall the name or incorrectly recalls the name, the person should be taught to seek out the correct name such as directly asking the individual whose name he or she is attempting to remember, looking up the individual's name, or asking a friend or family member for the name. Then the person should be repeatedly tested for the name at increasing intervals in times (i.e. 1 minute, 2 minutes, 5 minutes etc) if recall is successful. On the other hand, if recall of the name is unsuccessful the person should seek out the correct name before being tested at shorter intervals in time until recall is successful. Performance of face name recall should be monitored to ensure future successful name retrieval. The findings of this study suggests that making trait judgments of faces while using spaced retrieval to retrieve the name do not improve memory for names and in fact may even be detrimental to recall of names compared to just using spaced retrieval alone. Moreover, simply looking at faces in different angles repeatedly also does not aid in later retrieval of the names of faces.

In terms of rehabilitation for memory impaired individuals such as dementia or brain injury patients, correlations found in this study suggest that people who have attention difficulties, reduced fluency, poor self monitoring, a lack of problem solving skills, and are cognitively inflexible are likely to have increased difficulty in learning and recalling new face name associations. Future research should be conducted to determine which cognitive domains are necessary and sufficient and which are useful but not necessary for face name learning. This would be important for rehabilitation of memory impaired patients; patients who have difficulty on useful but unnecessary cognitive skill(s) may benefit directly from learning mnemonic techniques to aid in recall of names. Alternatively, a patient with a deficit in the necessary cognitive skill(s) might benefit from examining and rebuilding the cognitive skill(s) before moving onto techniques for remembering new face name associations. In terms of mnemonic techniques, given that spaced retrieval is an effective strategy for healthy adults, it is likely a good strategy for memory impaired individuals to recall new face name associations. Previous research supports the efficacy of spaced retrieval for learning names of faces for older adults and patients with dementia (Carruth, 1997; Hawley & Cherry, 2004).

References

Abrahams, J. P., & Camp, C. J. (1993). Maintenance and generalization of object naming training in anomia associated with degenerative dementia. *Clinical Gerontologist, 12*(3), 57-72.

Allen, G. A., Mahler, W. A., & Estes, W. K. (1969). Effects of recall tests on long-term retention of paired associates. *Journal of Verbal Learning & Verbal Behavior, 8*(4), 463-470.

Anthony, T., Copper, C., & Mullen, B. (1992). Cross-racial facial identification: A social cognitive integration. *Personality and Social Psychology Bulletin, 18,* 296-301

Bahrick, H. P., Bahrick, P. O., & Wittlinger, R. P. (1975). Fifty years of memory for names and faces: A cross-sectional approach. *Journal of Experimental Psychology: General, 104*(1), 54-75.

Baron, I. S. (2004). *Neuropsychological evaluation of the child.* (First Ed.) Oxford: University Press,

Bell, B. D., Fine, J., Dow, C., Seidenberg, M., & Hermann, B. P. (2005). Temporal lobe epilepsy and the selective reminding test: The conventional 30-minute delay suffices. *Psychological Assessment, 17(*1), 103-109.

Bellezza, F. S., & Young, D. R. (1989). Chunking of repeated events in memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 15*(5), 990-997.

Benton, A. L., Hamsher, K. & Sivan, A. B. (1994). *Multilingual Aphasia Examination (3rd ed.)* San Antonio: TX: Psychological Corporation

Berman, G. L., & Cutler, B. L. (1998). The influence of processing instructions at encoding and retrieval on face recognition accuracy. *Psychology, Crime & Law, 4*(2), 89-106.

Birnbaum, I. M., & Eichner, J. T. (1971). Study versus test trials and long term retention in free recall learning. *Journal of Verbal Learning & Verbal Behavior, 10*(5), 516-521.

Bjork, R. A. (1988). *Retrieval practice and the maintenance of knowledge*. Oxford, England: John Wiley & Sons.

Bjork, R. A., & Allen, T. W. (1970). The spacing effect: Consolidation or differential encoding. *Journal of Verbal Learning & Verbal Behavior, 9*(5), 567-572.

Bloom, L. C. & Mudd, S. A. (1991). Depth of processing approach to face recognition: A test of two theories. *Journal of Experimental Psychology: Learning, 17*(3), 556-565.

Bower, G. H., & Karlin, M. B. (1974). Depth of processing pictures of faces and recognition memory. *Journal of Experimental Psychology, 103*(4), 751-757.

Brainerd, C. J., Desrochers, A., & Howe, M. L. (1981). Stages-of-learning analysis of picture-word effects in associative memory. *Journal of Experimental Psychology: Human Learning & Memory, 7*(1), 1-14.

Brédart, S., Brennen, T., Delchambre, M., McNeill, A., & Burton, A. M. (2005). Naming very familiar people: When retrieving names is faster than retrieving semantic biographical information. *British Journal of Psychology, 96*(2), 205-214.

Bregman, A. S. (1967). Distribution of practice and between-trials interference. *Canadian Journal of Psychology Revue Canadienne de Psychologie, 21*(1), 1-14.

Brown, C., & Lloyd-Jones, T. J. (2006). Beneficial effects of verbalization and visual distinctiveness on remembering and knowing faces. *Memory & Cognition, 34*(2), 277-286.

Bruce, V., & Young, A. (1986). Understanding face recognition. *British Journal of Psychology, 77*(3), 305-327.

Brush, J. A., & Camp, C. J. (1998). Spaced retrieval during dysphagia therapy: A case study. *Clinical Gerontologist, 19*(2), 96-99.

Camp, C. J., Foss, J. W., Stevens, A. B., & O'Hanlon, A. M. (1996). *Improving prospective memory task performance in persons with alzheimer's disease*. Mahwah, NJ, US: Lawrence Erlbaum Associates Publishers.

Camp, C. J., & Schaller, J. R. (1989). Epilogue: Spaced-retrieval memory training in an adult day-care center. *Educational Gerontology, 15*(6), 641-648.

Camp, C. J., & Stevens, A. B. (1990). Spaced-retrieval: A memory intervention for dementia of the alzheimer's type. *Clinical Gerontologist, 10*(1), 58-61.

Cañas, J. J., Quesada, J. F., Antolí, A., & Fajardo, I. (2003). Cognitive flexibility and adaptability to environmental changes in dynamic complex problem-solving tasks. *Ergonomics, 46*(5), 482-501,

Carpenter, S. K., & DeLosh, E. L. (2005). Application of the testing and spacing effects to name learning. *Applied Cognitive Psychology, 19*(5), 619-636.

Carrier, M., & Pashler, H. (1992). The influence of retrieval on retention. *Memory & Cognition, 20*(6), 633-642.

Carruth, E. K. (1997). The effects of singing and the spaced retrieval technique on improving face-name recognition in nursing home residents with memory loss. *Journal of Music Therapy, 34*(3), 165-186.

Challis, B. H. (1993). Spacing effects on cued-memory tests depend on level of processing. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 19*(2), 389-396.

Ciccone, D. S., & Brelsford, J. W. (1976). Spacing repetitions in paired-associate learning: Experimenter versus subject control. *Journal of Experimental Psychology: Human Learning & Memory, 2*(4), 446-455.

Clare, L., Wilson, B. A., Carter, G., & Hodges, J. R. (2003). Cognitive rehabilitation as a component of early intervention in alzheimer's disease: A single case study. *Aging & Mental Health, 7*(1), 15-21.

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

Cohen, G. (1990). Why is it difficult to put names to faces? *British Journal of Psychology, 81*(3), 287-297.

Cohen, G., & Faulkner, D. (1986). Memory for proper names: Age differences in retrieval. *British Journal of Developmental Psychology, 4*(2), 187-197.

Cohen, M. E., & Carr, W. J. (1975). Facial recognition and the von restorff effect. *Bulletin of the Psychonomic Society, 6*(4A), 383-384.

Courtois, M. R., & Mueller, J. H. (1979). Processing multiple physical features in facial recognition. *Bulletin of the Psychonomic Society, 14*(1), 74-76.

Courtois, M. R., & Mueller, J. H. (1981). Target and distractor typicality in facial recognition? *Journal of Applied Psychology, 66*(5), 639-645.

Cull, W. L. (2000). Untangling the benefits of multiple study opportunities and repeated testing for cued recall. *Applied Cognitive Psychology, 14*(3), 215-235.

Cull, W. L., Shaughnessy, J. J., & Zechmeister, E. B. (1996). Expanding understanding of the expanding-pattern-of-retrieval mnemonic: Toward confidence in applicability. *Journal of Experimental Psychology: Applied, 2*(4), 365-378.

Davis, R. N., Massman, P. J., & Doody, R. S. (2001). Cognitive intervention in alzheimer disease: A randomized placebo-controlled study. *Alzheimer Disease & Associated Disorders, 15*(1), 1-9.

Daw, P. S., & Parkin, A. J. (1981). Observations on the efficiency of two different processing strategies for remembering faces. *Canadian Journal of Psychology Revue Canadienne de Psychologie, 35*(4), 351-355.

Delis, D. C., Kramer, J. H., Kaplan, E, & Ober, B. A. (2000). *California Verbal Learning Test-Second Edition, Adult Version.* San Antonio, TX: The Psychological Corporation

Downes, J. J., Kalla, T., Davies, A. D. M., & Flynn, A. (1997). The pre-exposure technique: A novel method for enhancing the effects of imagery in face-name association learning. *Neuropsychological Rehabilitation, 7*(3), 195-214.

Evans, J., Wilson, B. A., Schuri, U., Andrade, J., Baddeley, A., Bruna, O. et al. (2000). A comparison of "errorless" and "trial-and-error" learning methods for teaching individuals with acquired memory deficits. *Neuropsychological Rehabilitation, 10*(1), 67-101.

Faw, H. W. (1990). Memory for names and faces: A fair comparison. *American Journal of Psychology, 103*(3), 317-326.

Fillingham, J. K., Sage, K., & Lambon-Ralph, M. A. (2006). The treatment of anomia using errorless learning. *Neuropsychological Rehabilitation, 16(*2), 129-154.

Fridriksson, J., Holland, A. L., Beeson, P., & Morrow, L. (2005). Spaced retrieval treatment of anomia. *Aphasiology, 19*(2), 99-109.

Glenberg, A. M. (1977). Influences of retrieval processes on the spacing effect in free recall. *Journal of Experimental Psychology: Human Learning & Memory, 3*(3), 282-294.

Greene, R. L. (1989). Spacing effects in memory: Evidence for a two-process account. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 15*(3), 371-377.

Groninger, L. (2006). Variables influencing memory over long periods of time for recently learned face-name pairs. *American Journal of Psychology, 119*(2), 175-191.

Groninger, L. D. (2000). Face-name mediated learning and long-term retention: The role of images and imagery processes. *American Journal of Psychology, 113*(2), 199-219.

Haslam, C., Gilroy, D., Black, S., & Beesley, T. (2006). How successful is errorless learning in supporting memory for high and low-level knowledge in dementia? *Neuropsychological Rehabilitation, 16*(5), 505-536.

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

Hebb, D. O. (1961). *The organization of behavior: A neuropsychological theory. Stimulus and response-and what occurs in the brain in the interval between them.* New York: Science Editions, Inc.

Hintzman, D. L., & Block, R. A. (1973). Memory for the spacing of repetitions. *Journal of Experimental Psychology, 99*(1), 70-74.

Hogan, R. M., & Kintsch, W. (1971). Differential effects of study and test trials on long-term recognition and recall. *Journal of Verbal Learning & Verbal Behavior, 10*(5), 562-567.

Hux, K., Manasse, N., Wright, S., & Snell, J. (2000). Effect of training frequency on face-name recall by adults with traumatic brain injury. *Brain Injury, 14*(10), 907-920.

Johnston, R. A., & Bruce, V. (1990). Lost properties? Retrieval differences between name codes and semantic codes for familiar people. *Psychological Research, 52*(1), 62-67.

Kalla, J. J., Downes, M., & Van den Broek, T. (2001). The pre-exposure technique: Enhancing the effects of errorless learning in the acquisition of face–name associations. *Neuropsychological Rehabilitation, 11*(1), 1-16.

Kausler, D. H., Wiley, J. G., & Phillips, P. L. (1990). Adult age differences in memory for massed and distributed repeated actions. *Psychology and Aging, 5*(4), 530-534.

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*(2), 113-132.

Kuo, T., & Hirshman, E. (1996). Investigations of the testing effect. *American Journal of Psychology, 109*(3), 451-464.

Laeng, B., & Rouw, R. (2001). Canonical views of faces and the cerebral hemispheres. *Laterality: Asymmetries of Body, Brain and Cognition, 6*(3), 193 – 224.

Landauer, T. K., & Bjork, R. A. (1978). Optimum rehearsal patterns and name learning.

In M.

M. Gruneberg, P. E. Morris, & R. N. Sykes (Eds.), Practical aspects of memory (pp. 625–
632). New York: Academic Press.

Landauer, T. K., & Eldridge, L. (1967). Effect of tests without feedback and presentation-test interval in paired-associate learning. *Journal of Experimental Psychology, 75*(3), 290-298.

Langer, P., Keenan, V., & Medosch-Schonbeck, C. M. (1986). Reconstruction of text and feedback. *Psychological Reports, 58*(1), 259-268.

Larsson, M., Nyberg, L., Bäckman, L., & Nilsson, L. (2003). Effects on episodic memory of stimulus richness, intention to learn, and extra-study repetition: Similar profiles across the adult life span. *Journal of Adult Development, 10*(2), 67-73.

Leder, H., & Bruce, V. (1998). Local and relational aspects of face distinctiveness. *The Quarterly Journal of Experimental Psychology A: Human Experimental Psychology, 51*(3), 449-473.

Magliero, A. (1983). Pupil dilations following pairs of identical and related to-be-remembered words. *Memory & Cognition, 11*(6), 609-615.

Manasse, N. J., Hux, K., & Snell, J. (2005). Teaching face-name associations to survivors of traumatic brain injury: A sequential treatment approach. *Brain Injury, 19*(8), 633-641.

McCluney, M. M., & Krauter, E. E. (1997). Mr. barber or a barber: Remembering names and occupations. *Psychological Reports, 81*(3, Pt 1), 847-863.

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

McKitrick, L. A., Camp, C. J., & Black, F. W. (1992). Prospective memory intervention in alzheimer's disease. *Journals of Gerontology, 47*(5), 337-343.

McWeeny, K. H., Young, A. W., Hay, D. C., & Ellis, A. W. (1987). Putting names to faces. *British Journal of Psychology, 78*(2), 143-149.

Melton, A. W. (1970). The situation with respect to the spacing of repetitions and memory. *Journal of Verbal Learning & Verbal Behavior, 9*(5), 596-606.

Metzler-Baddeley, C., & Snowden, J. S. (2005). Brief report: Errorless versus errorful learning as a memory rehabilitation approach in alzheimer's disease. *Journal of Clinical and Experimental Neuropsychology, 27*(8), 1070-1079.

Milders, M. (1998). Learning people's names following severe closed-head injury. *Journal of Clinical and Experimental Neuropsychology, 20*(2), 237-244.

Moran, M., Seidenberg, M., Sabsevitz, D., Swanson, S., & Hermann, B. (2005). The acquisition of face and person identity information following anterior temporal lobectomy. *Journal of the International Neuropsychological Society, 11*(3), 237-248.

Morrow, K. L., & Fridriksson, J. (2006). Comparing fixed- and randomized-interval spaced retrieval in anomia treatment. *Journal of Communication Disorders, 39*(1), 2-11.

Mueller, J. H., Courtois, M. R., & Bailis, K. L. (1981). Self-reference in facial recognition. *Bulletin of the Psychonomic Society, 17*(2), 85-88.

Naveh-Benjamin, M., Guez, J., Kilb, A., & Reedy, S. (2004). The associative memory deficit of older adults: Further support using face-name associations. *Psychology and Aging, 19*(3), 541-546.

Neils-Strunjas, J., Krikorian, R., Shidler, M., & Likoy, S. (2001). The influence of learning style and cognitive ability on recall of names and faces in an older population. *The Journal of General Psychology, 128*(4), 433-445.

Oxford Pocket Dictionary of Current English. (2008). *Caucasian-Dictionary definition of Caucasian*. Retrieved June 20, 2008, from http://www.encyclopedia.com/doc/1O999-caucasian.html

Parkin, A. J., & Goodwin, E. (1983). The influence of different processing strategies on the recognition of transformed and untransformed faces. *Canadian Journal of Psychology Revue Canadienne de Psychologie, 37*(2), 272-277.

Peynircioglu, Z. F., & Moro, C. (1995). Part-Set Cuing in Incidental and Implicit Memory. *The American Journal of Psychology, 108(*1), 1-11.

Postman, L. (1982). An examination of practice effects in recognition. *Memory & Cognition, 10*(4), 333-340.

Regard, M., Strauss, E., & Knapp, P. (1982). Children's productions of verbal and nonverbal fluency tasks. *Perceptual and Motor Skills, 55*, 839-844.

Reitan, R. M. (1955). The relation of the trail making test to organic brain damage. *Journal of Consulting Psychology, 19*, 393-394.

Rahman, R. A., Sommer, W., & Olada, E. (2004). I recognize your face, but I can't remember your name: A question of expertise? *The Quarterly Journal of Experimental Psychology A: Human Experimental Psychology, 57*(5), 819-834.

Rea, C. P., & Modigliani, V. (1985). The effect of expanded versus massed practice on the retention of multiplication facts and spelling lists. *Human Learning: Journal of Practical Research & Applications, 4*(1), 11-18.

Reese, C. M., & Cherry, K. E. (2004). Practical memory concerns in adulthood. *International Journal of Aging & Human Development, 59*(3), 235-253.

Rendell, P. G., Castel, A. D., & Craik, F. I. M. (2005). Memory for proper names in old age: A disproportionate impairment? *The Quarterly Journal of Experimental Psychology A: Human Experimental Psychology. 58A*(1), 54-71.

Roediger, H. L., & Karpicke, J. D. (2006). Test-enhanced learning: Taking memory tests improves long-term retention. *Psychological Science, 17*(3), 249-255.

Roets, A., Hiel, A. V., Cornelis, I, & Soetens, B. (2008). Determinants of task performance and invested effort: A need for closure by relative cognitive capacity interaction analysis. *Personality and Social Psycholology Bulletin, 34*(6), 779-792.

Rundus, D. (1971). Analysis of rehearsal processes in free recall. *Journal of Experimental Psychology, 89*(1), 63-77.

Sergent, J. (1985). Influence of task and input factors on hemispheric involvement in face processing. *Journal of Experimental Psychology: Human Perception and Performance, 11*(6), 846-861.

Shaughnessy, J. J., Zimmerman, J., & Underwood, B. J. (1972). Further evidence on the MP-DP effect in free-recall learning. *Journal of Verbal Learning & Verbal Behavior, 11*(1), 1-12.

Stanhope, N., & Cohen, G. (1993). Retrieval of proper names: Testing the models. *British Journal of Psychology, 84*(1), 51-65.

Strauss, E., Sherman, E. M. S., & Spreen, O. (2006). *A Compendium of Neuropsychological Tests: Administration, Norms, and Commentary* 3rd ed. Oxford: University Press.

Terrace, H. S. (1963). Discrimination learning with and without "errors.". *Journal of the Experimental Analysis of Behavior, 6*(1), 1-27.

The Psychological Corporation. (1997). *WAIS-III Technical Manual.* San Antonio: Author.

Toppino, T. C., Kasserman, J. E., & Mracek, W. A. (1991). The effect of spacing repetitions on the recognition memory of young children and adults. *Journal of Experimental Child Psychology, 51*(1), 123-138.

Valentine, T., & Bruce, V. (1986). The effects of distinctiveness in recognising and classifying faces. *Perception, 15*(5), 525-535.

Warrington, E. K. (1984). *Recognition Memory Test manual.* Windsor, England: NFER-Nelson.

Warrington, E. K., & Taylor, A. M. (1973). Immediate memory for faces: Long- or short-term memory? *The Quarterly Journal of Experimental Psychology, 25*(3), 316-322.

Wechsler, D. (2001). *WAIS-III: Wechsler Adult Intelligence Scale, third edition. Canadian Technical Manual*. Toronto, ON: The Psychology Corporation.

Whitten, W. B., & Bjork, R. A. (1977). Learning from tests: Effects of spacing. *Journal of Verbal Learning & Verbal Behavior, 16*(4), 465-478.

Young, A. W., Ellis, A. W., & Flude, B. M. (1988). Accessing stored information about familiar people. *Psychological Research, 50*(2), 111-115.

Young, A. W., Ellis, A. W., Flude, B. M., McWeeny, K. H., & Hay, D. C. (1986). Face-name interference. *Journal of Experimental Psychology: Human Perception and Performance, 12*(4), 466-475.

Zechmeister, E. B., King, J., Gude, C., & Opera-Nadi, B. (1975). Ratings of frequency, familiarity, orthographic distinctiveness and pronunciability for 192 surnames. *Behavior Research Methods & Instrumentation, 7*(6), 531-533.

Zechmeister, E. B., & Shaughnessy, J. J. (1980). When you know that you know and when you think that you know but you don't. *Bulletin of the Psychonomic Society, 15*(1), 41-44.

Appendix A

Names of Faces Stimuli

1. Aaron Barnett
2. Nicole Quinlan
3. Brian Caldwell
4. Rachel Alvarez
5. Kaitlyn Richmond
6. Julia Darby
7. Megan Epstein
8. Mason Layton
9. Gavin Wight
10. Brooke Crone
11. Jackson Jones
12. Lucas Abraham
13. Haley Chapman
14. Allison Kaplan
15. Aidan Jansen
16. Charles Springer

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