Feature Article

Face-name memory in Alzheimer’s disease

Sunghee H. Tak, PhD, MPH, RN, Song Hee Hong, PhD

Introduction

Memory loss, such as forgetting names, is the most common early symptom of Alzheimer’s Disease (AD). Forgetfulness in AD is different from ordinary forgetfulness that a normal person may experience. For example, people with ordinary forgetfulness can still remember other facts associated with the thing they have forgotten. They may briefly forget their next-door neighbor’s name but they still know the person they are talking to is their next-door neighbor. A person with AD not only forgets her or his neighbor’s name but also does not know whom she or he is talking to. This results in embarrassment, loss of self-confidence, and social withdrawal among persons with AD. Ability to remember names and faces decreases as the disease progresses (see Table 1). Human faces are critical socio-emotional signals in everyday life. Family caregivers experience loss and grief as their loved ones increasingly have difficulties in remembering and recognizing them as daughters or a spouse. They face challenges in interacting with their loved ones in a meaningful way and in helping engage in everyday activities. Caregiver’s stress is one of the most important factors leading to institutionalization of persons with AD. The purpose of this article is to describe a conceptual model, to review assessment tools, and to explore cognitive strategies for improving face-name memory in persons with AD.

Abstract

Alzheimer’s disease (AD) affects face-name memory, the ability to recognize faces and recall names. Remembering face and name requires a sophisticated cognitive process because of the complexity and similarity among faces and also because of their arbitrary association with names. Assessments of face-name memory can measure episodic and semantic memory performance and are useful for early detection of AD. Improving face-name memory is possible through cognitive interventions targeted to promote procedural memory, which is often preserved until the late stage of AD. This article describes a conceptual model, assessment tools, and strategies for improving face-name memory in persons with AD.

Conceptual model of face-name memory

The models of face recognition and name recall were developed initially by Bruce and Yong and modified by Burton, Bruce, and Johnston. Face-name memory involves the following areas: (a) face recognition; (b) name recall; and (c) retrieval of person-related information (see Fig. 1). First, the cognitive process of face recognition involves structural encoding of the face. A face is a complex and configural representation that requires a perceptual process for face analysis where individual features (nose, eyes, etc.) are examined in order to discriminate between different faces. The analysis of the structural information of a face takes place initially. Rarely, visuo-perceptual deficits due to cortical degeneration may interfere with the analysis process and lead to failure of an integration of facial features. The face analysis includes comparison with previously stored structural representations in order to make a familiarity judgment. If the face is a representation of a familiar person, first a specific area of the brain will be activated so that recognition of face may take place. Second, name recall will occur, which involves “name access and generation.” Finally, the retrieval of person-related information occurs, which is generated from cognitive processes of retrieving the particular knowledge that one has about an individual. The knowledge may include semantic information such as the person’s occupation (e.g., teacher or politician) or a relationship with the person. In the course of face-name memory, the retrieval of both name and relevant semantic information associated with the face will occur after the successful recognition of the face.
For example, recognizing the face of a familiar famous person (e.g., J.F. Kennedy) represented by a photograph would involve the following cognitive processes: the encoding of structural information of the face, the activation of the J.F. Kennedy face recognition, the recall of the name of "J.F. Kennedy," and the retrieval of semantic information "President."

Assessment tools for face-name memory

Alzheimer’s Disease primarily affects the cortex of the brain. Magnetic resonance imaging scans and computed tomography show brain lesions with neuritic plaques, neurofibrillary tangles, and degeneration at the ends of nerve cells. Face-name memory demands a sophisticated cognitive process not only because of the complexity and similarity among faces but also because of their arbitrary association with names. Neuroimaging studies have found that face perception requires visuo-perceptual processes, which occur in the occipitotemporal cortex with interplay among a widely distributed system of cortical areas. In general, AD causes neural degeneration in mediotemporal and temporocortical brain regions that are associated with episodic and semantic memory functions. Remembering faces and names are highly associated with episodic and semantic memory performance. Table 2 presents major types and definitions of memory.

While there is limited evidence on which specific domain in the brain involves face-name memory, testing memory for faces and names can be very useful in clinical settings. Assessments of face-name memory can reveal episodic and semantic memory performance of persons with AD. Remembering ‘newly-learned faces’ and names successfully is associated with episodic memory capacity. Semantic memory can be measured by testing recognition, identification, and naming of ‘familiar faces.’

Alzheimer’s disease affects an estimated 5.4 million Americans. This number has doubled since 1980, and will continue to grow to an estimated 16 million by 2050. Alzheimer’s Disease usually begins after age 60 and risk increases with age. Approximately 3 percent of Americans between the ages of 54—74, and almost half of those 85 years and older, suffer from AD. Clinical research suggests that testing face-name memory can provide highly sensitive indices for early detection of memory deficits, in particular, in initial stages of AD. Table 3 summarizes the assessment tools that are widely used to test face-name memory. Impairment in face name memory is a significant indicator of impairment in episodic memory and an early sign of dementia. Early detection of AD may help individuals manage its symptoms and plan care decisions.

Evidence-based techniques for improving face-name memory

Two cognitive strategies, spaced retrieval and errorless learning with vanishing cues techniques, are known to be useful to improve face name memory in AD. Both techniques focus on repeated rehearsal of face name association over time and are considered to utilize intact procedural memory of persons with AD. By rehearsal or reinstatement, connections are established within the cortex independent of the hippocampus—so called long-term consolidation. Because normal hippocampal dependent learning (or relearning) is essentially abolished in AD, rehabilitation strategies may operate by slowly reestablishing links between phonological (name) and semantic (person-specific) representations in neocortical regions that are less damaged in early AD.

To date, memory training targeted to increase declarative memory (episodic and lexical memory), which requires an elder to explicitly and actively remember words and facts, has shown minimal rehabilitative value for persons with dementia. Cognitive
strategies that employ automatic and procedural memory processes have shown more promise.\textsuperscript{30–32} Self-generation of cues and various forms of cueing are emphasized for persons with AD.\textsuperscript{18,33} A recent review of memory stimulation programs in AD concludes that errorless learning, and spaced retrieval and vanishing cues techniques, are most efficacious in stimulating face-name memory in persons with AD.\textsuperscript{13,28,29,31,32,34,35}

**Spaced retrieval techniques**

The spaced retrieval technique was first introduced by Landauer and Bjork\textsuperscript{10} and used to teach the name of a person in a photograph to persons with AD. Successful applications of the technique have been demonstrated for numerous tasks such as naming, face-name associations, phone numbers, etc. Camp and his associates also demonstrated that spaced retrieval is an effective memory training technique for persons with AD.\textsuperscript{28,29,34,35,37} In this technique, persons with AD are given a specific information to remember. Immediate recall is solicited. If the recall attempt is successful, the next inter-trial interval is expanded systematically (e.g., 5, 10, 20, 40, and 60 s, increasing in 30 s intervals thereafter). Following a recall failure, the inter-trial interval is reduced to that of the previous trial. In previous studies, persons with AD generally became more proficient and made fewer failures on the spaced-retrieval task over extended training. They were able to perform face-name associations for weeks after initial acquisitions. The efficacy of spaced retrieval for persons with AD has been attributed to implicit memory processes that are thought to be spared until the later stages of AD.\textsuperscript{28,29,34,35} The repetition priming of the techniques is found to be effective across settings, materials, and procedures.\textsuperscript{13,18,32,39,40}

**Errorless learning with vanishing cues**

Another technique successfully used in AD patients for learning face-name association is errorless learning with vanishing cues, which taps into patients’ preserved implicit memory abilities.\textsuperscript{28–31,38–40} This technique consists of providing the patient with progressively fading cues. The patient is first given full cues on a name. If the patient successfully recalls the correct name, the cues are progressively withdrawn. Previous studies\textsuperscript{28–30,33} found that the vanishing cue method combined with the spaced retrieval techniques was beneficial for people with early AD in relearning names of famous persons. In Clare et al’s studies,\textsuperscript{30,33} fourteen names were learned over 20 sessions (twice weekly; one session per week was used for practice). Only 20% of the names were recalled at baseline, 100% by the end of training, and 98% over the posttests 1, 3, 6, and 9 months later. A follow-up study found that 70% of the names were retained over a 2-year period. The combined techniques were successfully used to teach AD patients face and name associations.\textsuperscript{13,28–30}

**Caregiving strategies for improving face-name memory**

Improving face-name memory is possible, particularly in early AD, if the rehabilitation effort is focused on optimizing procedural memory processes that are preserved even until the late stage of AD.\textsuperscript{5,13,18,28,29,31–35} Caregivers can use strategies that enhance procedural memory processes such as rehearsal, association, imagery and concentration in order to help persons with AD improve their face-name memory.\textsuperscript{34,36,41} Combinations of rehearsal, association, and imagery and concentration are frequently used instead of a stand-alone strategy.

Rehearsal is one of most effective strategies in remembering faces and names. Repeated presentation of a face greatly increase familiarity and activates simultaneous cognitive processes for the relevant face encoding and the recognition of the face. The next time the same face is presented, the activation of face recognition occurs more quickly. Further repetitions can lead to automaticity, which refers to a phenomenon of making the retrieval process automatic.\textsuperscript{4,38–40}

Associations are used to link a person’s name with his or her facial characteristics (e.g., hair, eyes, or nose), unique personal features (e.g., a distinctive voice or gait), and jobs or interesting facts.\textsuperscript{34,41} Using senses, words, and sentences, caregivers can assist persons with AD to come up with a verbal game that connects a face with his or her name in a memorable way (e.g., Tina Tea or Joel from Jersey). Use of multiple sensory modalities or preserved semantic knowledge are effective strategies for persons with AD to enhance the ability of remembering faces and recalling names.

Imagery entails a visual representation of associations.\textsuperscript{51} Caregivers can help persons with AD picture images that sound like a person’s name in a funny or memorable way. For example, a person whose name is Penny Keane can be visualized in an image like “She’s a penny-pincher and keen at a bargain.”

Finally, concentration involves paying attention and focusing on physical appearance and features that may help the person with AD remember a name.\textsuperscript{41} Similarity in hair, eyes or mouth can help associate names with famous people or close family and friends (e.g., Shirley with curly hair like actress Shirley Temple, or Anna like my sister). Caregivers can encourage persons with AD to use a combination of the effective strategies to improve their face-name memory.

Recently, computer-based face name training programs (e.g., Remembering Faces (RF) by Parrot Software, Recognition by Posit Science, Associating Names with Faces by Lumosity) are in demands in face-name memory trainings because of their easy and convenient access for daily use.\textsuperscript{42–45} The computer-based training
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<thead>
<tr>
<th>Instrument</th>
<th>Description</th>
<th>Administration</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Benton Facial Recognition Test (BFRT)</strong></td>
<td>Commercially available and used by clinicians and neuropsychologists. Because the test is easy to administer and has extensive normative data, it is commonly used for clinical and research purposes. Reliability and validity of BFRT has been established.</td>
<td>Participants are presented with a target face and six test faces and are asked to choose the test faces that match the target face. No time limits are placed on individual items or the test as a whole.</td>
<td>The BFRT has a short form (13 items) with 27 possible points and a long form (22 items) with 54 possible points. Short form scores can be converted to long form scores, and scores of 41 or above are classified as normal. It is useful to establish whether visuoperceptual discrimination ability of unfamiliar faces is in the normal range. A low score is strongly associated with impairment in lesions in the right posterior structures. Because the target face and the test faces are presented simultaneously, a low sensitivity for discriminability has been reported. Scores in the normal range of FRT should be interpreted cautiously, and testing needs to be supplemented by other face tests.</td>
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<td><strong>Warrington Recognition Memory Test (RMT)</strong></td>
<td>Commercially available and commonly used by both clinicians and cognitive neuropsychologists. Test-retest reliability coefficient of 0.81 along with convergent and divergent validity was reported.</td>
<td>Participants are presented with 50 target photos of unfamiliar faces at the same rate. Then, they are presented with a series of 50 faces, and are asked to identify the same faces that were presented earlier.</td>
<td>The maximum score is 50. Means range between 42.4 and 44.3 (S.D., 3.5) depending on the age group. Because of the photos in the RMT include many non-facial features (e.g., clothing and hair) which can be used to discriminate between target and distractor images, clinicians need to be cautious in interpreting scores in the normal range. Yet, evidence has shown that RMT has a high sensitivity for the discriminability of patients with mild cognitive impairment from healthy elderly.</td>
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<td><strong>Cambridge Face Memory Test (CFMT)</strong></td>
<td>Available free of charge when used for research purposes. An online version of CFMT is available for self-administration (<a href="http://www.icn.ucl.ac.uk/facetests/fsCFMT/fsCFMT.php">http://www.icn.ucl.ac.uk/facetests/fsCFMT/fsCFMT.php</a>). Reliability and validity of CFMT has been reported.</td>
<td>Participants view six target faces in a random order, and then must choose a target face among three faces. During the forced-choice tasks per target face, target faces are presented in three different views: (a) identical view (those studied in the introduction), (b) novel views (e.g., different lighting, new facial expression, etc.), and (c) novel views with Gaussian noise. In Face Recognition subtest, participants are shown 5 facial portraits (15 faces in RBMT-Extended version) one at a time for 3 s each. Later they are asked to select the original 15 from a set of 30. During the First and Second Names subtest, they are shown two photographic portraits along with their names and later asked to recall them.</td>
<td>A total of 72 items are tested, it is reported that healthy elders averaged 58 out of 72. CFMT is used as a diagnostic tool of prosopagnosia and considered to be useful to identify early signs of dementia and impairment of episodic memory to recognize newly-learned faces. RAW score of each subtest is converted subtest scaled score with a mean of 10 and a standard deviation of 3. Percentile ranks for scaled scores are also available. The Face Recognition subtest includes pictures of ethnically diverse populations. RBMT is considered as cross modal associate learning-sensitive in the earliest stages of dementia. A raw score of DPT can be converted into a scaled score. Using the test manual, a scaled index of People subtest can be derived from the overall DPT score. The People subtest is useful to test episodic memory for newly learned faces and name in association with semantic memory and identify early signs of dementia.</td>
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<td><strong>Rivermead Behavioral Memory Test (RBMT)</strong></td>
<td>Commercially available and commonly used by clinical psychologists, occupational therapists, and speech and language therapists. The inter-scorer reliability of 0.9 or higher along with construct and ecological validity was reported.</td>
<td>During the People subtest of DPT, a set of four facial portraits are shown—for each of which participants are told an occupation, first name and family name. In the test phase, they are asked for the name in each case at the presentation with the person's occupation. Unless recall is perfect on the first trial, they are given up to 2 more learning and test trials.</td>
<td>Scores are obtained for the overall total correct and for the items for each decade in each of the three test conditions (recognition, naming, and identification). The test is used to determine the temporal gradient of retrograde memory and is culture-specific with national variants. It is useful to test semantic memory and useful for preclinical stages of AD or early AD.</td>
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<td><strong>Doors and People Test (DPT)</strong></td>
<td>Commercially available and widely used both as a clinical tool and a research instrument. Reliability and validity of DPT has been reported.</td>
<td>A set of 50 target photographs of prominent public figures (10 from each of 5 decades) are used for the test. Each target photograph is presented to participants in a 2 × 2 array with its three matched non-famous people's photographs. For each target photograph, they are tested for the ability in recognition, naming, and identification.</td>
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<td><strong>Hodges and Wald Famous Faces and Names</strong></td>
<td>A full list of the famous persons used in the test is provided in published research articles for use. Reliability and validity has been reported.</td>
<td>A set of 50 target photographs of prominent public figures (10 from each of 5 decades) are used for the test. Each target photograph is presented to participants in a 2 × 2 array with its three matched non-famous people's photographs. For each target photograph, they are tested for the ability in recognition, naming, and identification.</td>
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programs may automate evidence-based strategies and offer application versatility for AD patients, families, and health care providers in a variety of care settings. However, further research is needed on their effectiveness on improving face-name memory in persons with AD.

Conclusion

In summary, face recognition and name recall involves complicated cognitive processes. Assessments of face-name memory can contribute to early detection of memory deficits in persons with initial stages of AD. Further, it is possible to improve face-name memory by implementing cognitive rehabilitation strategies that utilize preserved procedural memory systems. As a result, persons with AD may remain engaged in daily activities and retain connections to their families and friends and the world as a whole for a longer period of time.

Acknowledgment

This manuscript was supported by the Beverly Healthcare, Inc. Dr. Tak was a Claire M. Fagin Post-doctoral fellow of John A. Hartford Building Academic Geriatric Nursing Capacity program. We thank Ms. Gail Spake for editorial assistance.

References