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Screening Memory In A Large Group Setting

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ABSTRACT

Background:

Screening for memory problems, particularly those associated with dementia and Alzheimer's disease, has presented a significant logistical problem. The currently available memory tests are time-consuming and generally must be administered by a psychometrician in a one-to-one interaction with a participant in a confidential and quiet environment. Such tests must trade duration and participant burden with poor accuracy and a low ceiling effect making assessment of normal individuals problematic. There is a need for a simple, accurate memory test that can be administered in a group setting that is feasible for testing older individuals.

Methods:

The MEMTRAX Memory Game was adapted to a slide show format and an approach reminiscent of college aptitude testing for a large group. Over the course of two years, this format was used over forty times at various community events, senior citizen centers, and retirement living communities, with over 1500 participants tested. Between July 1, 2007 and June 30, 2008, the test was administered at 26 sites using a single sheet, demographic information on one side and on the other, an answer sheet on which participants could indicate recognition of repeated pictures, in a format that could be scanned for data entry and analysis. The answer sheet had pre-assigned identification numbers and columns with numbers and single adjacent circles. Participants were shown a series of numbered slides, 5 seconds for each. Participants were asked to fill in the circle next to the number on a repeated slide. After a brief introduction and a short practice test of 10 slides, the participants completed a 50-slide test, that had 25 unique pictures 15 repeated once, and 10 of those repeated a second time. After the test, the participants handed their papers to the rater to be scored. While the rater scored each participant's answer sheet, a presenter answered audience questions, after which the scores were returned anonymously to each participant. (Protocol approved by Stanford University Institutional Review Board.)

Results:

Data were obtained on 1063 participants at the 26 sites (average 41 participants per site, range 8 to 142), mean age (for 697 participants) was 74.5 + 14.5 years, range 20 to 95, with 41 participants over 90 years of age and 52 participants less than 50 years of age. For individual participants, test results were scored as the overall percent correct, the number of false-positive errors, and the number of false-negative errors. Of 708 scored tests, 540 participants (76%) scored 90% correct or better, with 48 participants (7%) having perfect scores and only 8% scoring below 80% correct. There were 67 participants (10%) who had more than 5 false-positive errors (incorrectly indicating an image was a repeat), while the same number of participants, 67, had more than 5 false-negative errors (failure to recognize a repeated picture). Performance on individual images was also analyzed. Of the new images, 2 were missed 64% and 58% of the time (false-positives), with 7 being missed between 5% and 27% of the time (all in previously shown categories), and the remaining 16 of the new images were missed less than 5%. Of the repeated images, 2 were missed 33% and 20% of the time (complex images) and all the rest were missed 16% or less. Only 3 repeated images were missed less than 5%. Thus, the repeated image errors showed less variability than the variability of the errors on new pictures. These results suggest that particular items triggered false recognitions, but recognition failures occurred more uniformly across pictures. The effects of age were also analyzed. Percent true negatives decreased from 95% at age 50 to 85% at 95 years of age. Percent true positives decreased from 100% at age 50 to 80% at age 90 years. There were statistically significant associations of performance with age.

Conclusions:

While the accuracy, reliability, and validity of this testing format has not been conclusively determined, generally, participants getting more than five false-negative responses are of concern for the presence of Alzheimer's type dementia and those getting more than five false-positive responses are suspected of having problems with attention or disinhibition suggestive of fronto-temporal dementia. The MEMTRAX slide-test is not reliable for those participants with visual impairment or problems limiting their ability to fill in a circle with a writing implement. However, the experience with this format is that it is well accepted by audiences and has the potential to provide highly accurate and cost-effective screening for memory problems.

BACKGROUND

In an era of increasing pressure to detect and manage prevalent disorders as early in their course as possible, screening has become an accepted norm for many conditions. If medical professionals and the public accept screening for hypertension, diabetes, breast cancer, and colon cancer, why is there no widespread demand to screen for dementia? Detection of dementia - the most disabling common condition of later life (Aguero-Torres H et al., 2001) - is currently left to chance (Ashford et al., 2006; 2007).

Numerous approaches have been advocated to screen for memory problems, dementia, and Alzheimer's disease (Ashford, 2008). However, most of the approaches involve direct testing of potential cases or questioning of reliable sources (case-finding). Many of the tests have poor sensitivity and specificity for dementia, are cumbersome to administer, and are generally unpleasant for the patients. There is a clear need for a screening system that is attractive to prospective users, both patients and clinicians, which can provide reliable information, including baseline evaluation and frequent repetitions. By focusing on memory function, a screening test can address the issue most important for recognizing the earliest indications of Alzheimer's disease, new-learning memory difficulties. Visual information provides an essentially unlimited challenge to the brain's memory storage mechanisms. Performance information can be used to determine when further testing is appropriate.

The purpose of this presentation is to report on the experience with a computerized memory test system that was adapted to a Power-Point slide presentation to be administered to a group of subjects. Results are presented from administrations between 7/11/07 - 8/14/08.

METHODS

CONCEPT

The principle psycho-pathological factor in Alzheimer's disease is the attack of the formation of new memory traces that can be retrieved after distraction (neuroplasticity, Ashford & Jarvik, 1985; Teter & Ashford, 2002). For example, recall of learned words after an interval is the earliest problem seen in Alzheimer patients (Ashford et al., 1989; Ashford & Schmitt, 2001). This process is commonly tested using several different memory challenges. However, providing complex stimuli that are easy for a normal person to remember would provide the most effective test for the Alzheimer process.

IMPLEMENTATION

MemTrax was developed based on the concept of providing a large volume of easily remembered information to a subject, then testing the recollection. The format used is referred to a "long-N-back" paradigm, with multiple complex visual stimuli, based on work by Shepard, 1961. Generally the images are of discrete objects, though similar objects and difficult to name objects were used to avoid strict reliance on verbal cues and to provide a challenge and maintain the interest of the subjects.

VENUE

The initial paradigm used a computerized administration format and then a web-based format. However, due to the difficulty in getting older individuals to participate in web-based games, particularly those individuals with mild cognitive problems, the MemTrax game was reformatted to a PowerPoint slide show, running automatically with 5 seconds presentations for each stimulus. 25 discrete objects are shown, with 20 of them repeated, 5 repeated a second time, making a total of 50 objects, requiring 250 seconds to display. The audience is given a formatted answer sheet and instructed to fill in the circles next to the numbers on the images which are repetitions.

LOCALES

The MemTrax test has been under progressive development since 2000. The current version was given between 7/11/2007 - 8/14/2008 on 26 occasions to senior citizen groups and health-fair participants, with a total of 1018 subjects filling out the questionnaire and submitting it for scoring (at most venues, a few subjects watched without taking the test or did not hand in their answer sheet, but no count was made of these individuals). There were an average of 39 subjects completing the form at each site (range 9 - 142, stdev=34).

DATA PROCESSING

Data were entered with a scanner into a spreadsheet format (REMARK software and EXCEL spreadsheet, results triple checked by hand). Analyses were computed from the EXCEL spreadsheet, which was also used to produce the graphs.

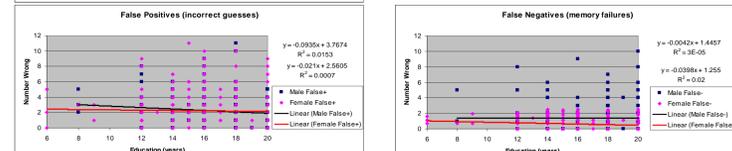
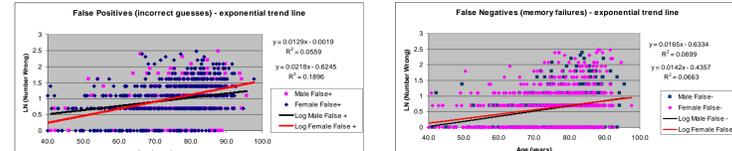
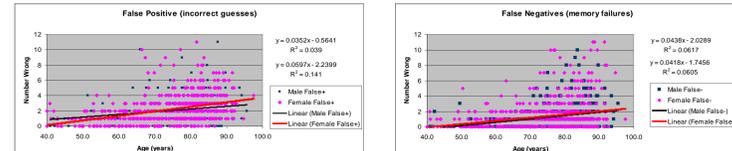
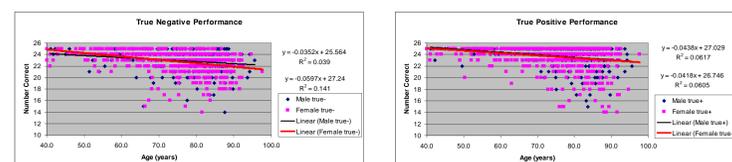
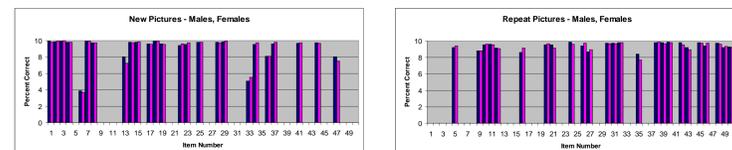
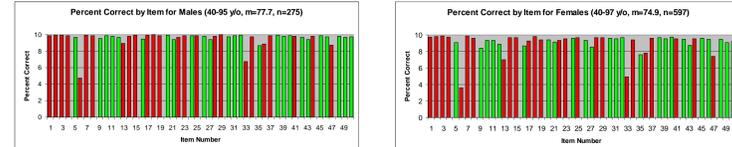
RESULTS

Data entered as of 12/2/2008 - 1018 individuals from 26 sites collected and considered that the individual had been able to perform the test. 805 reported being "white". 31<40y/o

	AGE (years)	Gender m/f	Ed (years)	Group Size	True-%	True+%
#reports	971	947	941	1018	1018	1018
Mean	74.6	295/652	16	39/site	90.2%	92.3%
StDev	13.8		2.5	34	10.3%	13.7%
Range	20-98		6-21	9 - 142	0-100	0-100

Of the 1018 individuals that were considered to have taken the test in a fashion that could be scored (about 20 were eliminated, 31 were below chance (12.25 or less) on the true negative or true positive score (True-:3 males, 10 females True+8 males, 11 females) (not included in graphs). Of these 1018 individuals, those scoring less than 80% correct for True-, 19 males, 51 females; for True+, 25 males, 54 females. Of these 1018 individuals, those scoring better than 80% for True-, 276 male (93.6%), 602 female (92.3%); for True+, 270 male (91.5%), 598 female (91.7%). Only 82 subjects had perfect scores, 230 made 1 error, 700 made 5 or fewer errors (about 70%), and 132 made 6 - 10 errors. Plots are shown for the 858 individuals with age, gender, ed data, red is first presentation, green is repeat, males in blue, females in pink.

MEMTRAX Memory Test (Power-Point Presentation)



SUMMARY

- Performance on new images (True-) was more variable than performance on old images (True+).
- There is minimal difference in performance of individual items between males and females, in spite of significant "male-role" and "female-role" items.
- There is a significant decline of function with age, with the age-effect best explained by an exponential increase of errors with age ("Failure Theory").
- Females had a greater association of false-positive errors with age than males, while the false-negative error association with age was similar by gender.
- Education was not significant in performance.

IMPLICATIONS

- MemTrax is a brief, convenient, fun test of the type of complex memory affected by Alzheimer pathology.
- Recognition failure (False-) indicates failure of learning circuits - typical of Alzheimer's disease.
- False-recognition (False+) responses are indicative that the subject is not paying attention and is failing to inhibit the recognition response, thus more suggestive of other types of psychopathology, including fronto-temporal dementia.
- MemTrax can be test many levels of memory impairment accurately, validly, and reliability.
- Alzheimer's disease is not a dichotomous diagnosis but a continuum of impairment best assessed probabilistically using Item Response Theory (Modern Test Theory) - (Ashford & Schmitt, 2001).

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