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## ABSTRACT

**BACKGROUND:** The "continuous recognition task" (CRT) paradigm is a type of assessment widely used in advanced research on memory mechanisms. CRTs are especially sensitive for early detection of memory problems, such as those caused by dementia and Alzheimer's disease, as well as for detecting changes that occur with head injury.

**METHODS:** MemTrax based on the CRT paradigm provides a short on-line cognitive assessment tool for measuring memory, as well as attention and recognition reaction time, within a period of less than three minutes. MemTrax users are provided with a set of images on any video screen, which they look at and indicate that they recognize a repeated image by a specific movement response within the shortest period of time possible. MemTrax consists of 25 unique images and 25 repeats (5 of the repeats being second repeats). The pictures occur in 5 sets of 5 images. True-positives and correct rejections are recorded, as well as reaction time for true positives.

**RESULTS:** In examining 18,282 individuals who provided ages, 21-99, took the test for the first time on-line, and performed better than random chance, age only explained 3.8% and 4.4% of the variance in reaction time and 1.6% and 1.1% of the variance in total correct for males and females respectively. No speed-accuracy trade-off was found, rather performance in reaction time and total correct varied together. Recognition time and total correct at each age may provide an estimation of performance impairment at any level of specificity chosen.

**CONCLUSION:** MemTrax is a quick, fun, widely accessible memory assessment tool providing information that can be analyzed to screen effectively and efficiently for brain dysfunction.

## BACKGROUND

Measures of memory provide the most specific assessments of the development of cognitive dysfunction in early AD [1] and many other disorders of the brain.

Unfortunately, most memory measures lack power to detect impairment in the early phases of deterioration when treatment of pathological processes would be most likely to benefit a patient.

The critical issue for measuring functional loss in early AD is to determine what memory encoding test would be best to assess individuals with very early AD [2]. The processes which are most relevant are those associated with activation of temporo-parietal regions and the hippocampus, as are targeted by certain brain imaging approaches [3].

Psychological studies, including functional-MRI, show that the most specific activation of these areas involves memory encoding by computerized tasks using "continuous recognition memory" paradigms [4-7]. Such findings indicate a potentially important role for an on-line computerized continuous recognition test (CRT). Such a tool could be used for testing subjects for clinical and research purposes, as well as for monitoring memory encoding in normal individuals [8]. Further, such a test could be used as a screening measure before or in conjunction with advanced neuroimaging to support dementia diagnosis, assessing AD severity, and evaluating treatment efficacy.

## METHODS

### Test Development

- Based on the continuous recognition task paradigm
- Database consist of 1,339 images within 54 categories (e.g. art, mountains, fountains, etc.)

**Categories**

1	Art	Mountain	Fountain	House	Birdhouse
2	Art	Mountain	Fountain	House	Birdhouse
3	Art	Mountain	Fountain	House	Birdhouse
4	Art	Mountain	Fountain	House	Birdhouse
5	Art	Mountain	Fountain	House	Birdhouse

**Test Results**

98%  
0.70 seconds

## METHODS - CONTINUED

### Test Data

- Data collection period: September 2011 - August 2013
- Collected in collaboration with HAPPYneuron, Inc. (Lyon, France)
- Analysis approved by Stanford IRB

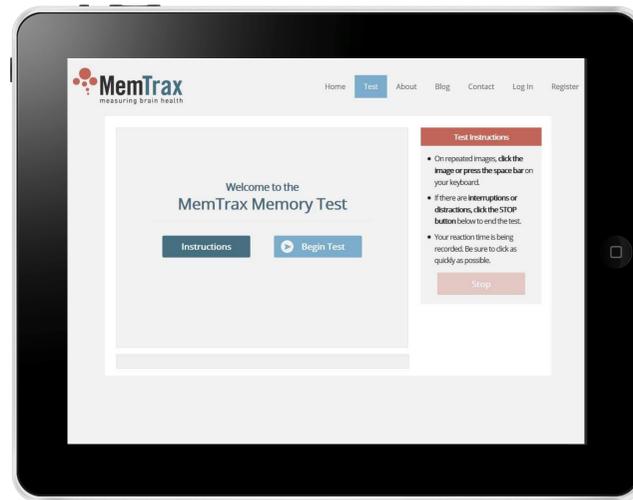
Total of tests taken  
**N = 30,435**

Total of valid & included test scores  
**N = 18,282**

Test scores excluded:

- Repeat administrations: **n = 4,800**
- Age below 21: **n = 4,999**
- Age above 100(?): **n = 1,573**
- Outliers in the data: **n = 780**

♀: **n = 12,445**      **Age: M = 50.28; SD = 15.23**  
 ♂: **n = 5,837**      **Range = 21-99**



## RESULTS - CONTINUED

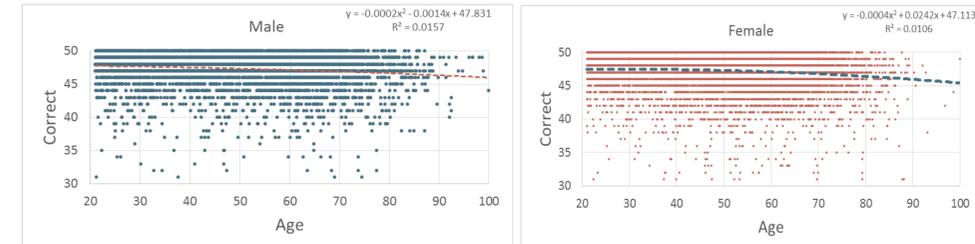


Figure 2a.

Figure 2b.

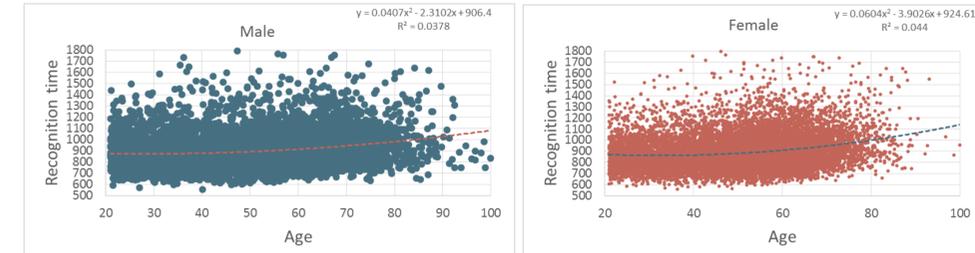


Figure 3a.

Figure 3b.

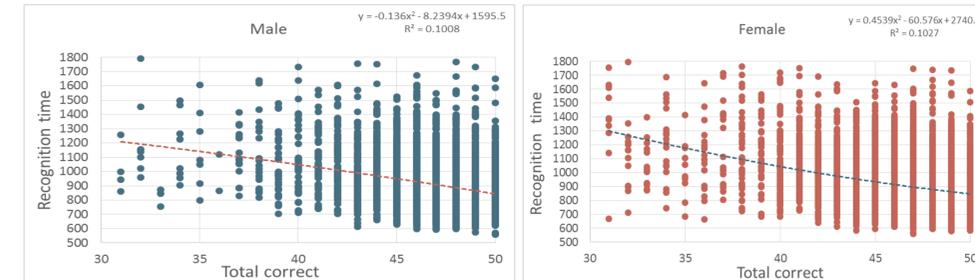


Figure 4a.

Figure 4b.

The average number of correct responses was 47.3 and 47.2 (out of 50) respectively, and recognition time was 903 msecs for males and 895 msecs for females, with decreasing number correct and increasing recognition time with age (see Figures 2a & 2b and 3a & 3b). The deterioration with age is consistent with findings in the literature. The number correct of subjects at ages over 80 years was substantially less than at younger ages, and the variability was substantially increased, but many of the older individuals had total number correct and recognition time that were in the ranges of young individuals.

However, the age effects accounted for less than 2% of the variance in total correct and less than 5% of the variance in recognition time with age.

The relationship between speed and accuracy accounted for 10% of the mutual variance, with individuals who performed more correctly having a faster recognition time, indicating that the speed-accuracy trade-off is a minor factor relative to the overall performance of individuals.

## CONCLUSIONS

The scores of the test takers lie on the plausible lines of the performance categories, including number of total responses, correct hits, correct rejections, total correct responses, and recognition reaction time. Online testing appears to provide a suitable approach to evaluating episodic memory function for large populations of individuals and could potentially be used to track the performance of memory function of individuals over time.

## REFERENCES

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## RESULTS

### Analysis

#### Variables for analysis:

- Number of hits
- Number of correct rejections
- Response time for hits
- Total responses
- Total correct

#### Statistical analysis:

- Total correct and correct recognition times were plotted against age, both as male and female groups and by specific age.
- Recognition time was plotted against total correct to determine whether there was speed-accuracy trade-off.

Figure 1a shows that women between 40 and 70 years took considerably more tests, indicating these women are concerned about memory function compared to other age groups and men. Figure 1b shows that there were in general fewer than 25 responses across the participants, with the total number of responses increasing with improvement of total correct, but falling off sharply after 25, indicating that it was easier to perceive that an image not previously seen was new than to recognize a repeated object. Figure 1c shows that more than 85% of participants scored 45 correct answers or better. 13% of individuals had between 40-44 correct responses and 2% had less than 40 correct responses.

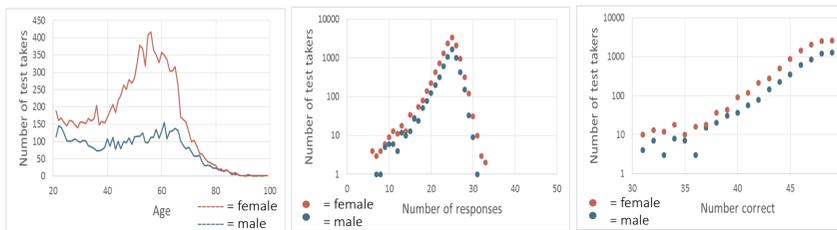


Figure 1a.

Figure 1b.

Figure 1c.

