

A Serious Game for Clinical Assessment of Cognitive Status

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Background

Frequent and routine testing of cognitive status is not currently undertaken, resulting in the underdiagnosis of conditions such as delirium, where cognitive status can fluctuate widely over the course of a day. This is because current cognitive screening tools used in geriatric health care are generally not designed for self-administration or for use by nonclinicians. Moreover, these clinical tools are only minimally interactive, creating little in the way of engagement or entertainment. Improved methods, which can be administered frequently and easily, are therefore needed for detecting early signs of impairment to prevent, or better manage, further decline.

Serious games are games designed primarily for applications other than entertainment. We have designed a serious game to evaluate cognitive status, which mimics features of a classic psychological assessment of differences among individuals. For healthy adults, the results from this tablet-based game showed a significant correlation with those from the Stroop test of reaction time, the latter are known to deteriorate with ageing. Our recent work sought to evaluate the clinical usefulness of the game.

Methodology

We recruited participants who were 70 years or older and who were present in the Emergency Department of Sunnybrook Health Sciences Centre for a minimum of 4 hours. Exclusion criteria included patients who were (1) critically ill, (2) in acute pain, (3) receiving psychoactive medications, (4) judged to have a psychiatric primary presenting complaint, (5) previously enrolled, (6) blind, or (7) unable to speak English, follow commands, or communicate verbally. Of patients who were assessed using four standard cognitive tests, 141 (97%) also consented to play our serious game. Feedback was also recorded from both the patients and the clinical research assistants who administered the tests.



Screenshot of the whack-a-mole game

Results and Impact

Among a battery of clinical tests that were administered, the correlations with our serious game were highest for the Mini-Mental State Examination (MMSE) and the Confusion Assessment Method (CAM). The MMSE is commonly used to clinically screen for dementia, while the CAM is used for the identification and recognition of delirium. The negative correlation between median reaction times from our serious game and scores from MMSE was statistically significant ($r = -0.558$, $P < 0.001$), as was the

correlation between game reaction time and CAM classification ($r = 0.565$, $P < 0.001$). Performance on the serious game also correlated significantly with the Montreal Cognitive Assessment (MoCA, $r = -0.339$, $P < 0.001$), the standard method to screen for mild cognitive impairment. The correlation of our serious game with existing standard methods appears to be almost as strong as the correlations of the clinical assessment methods with themselves.

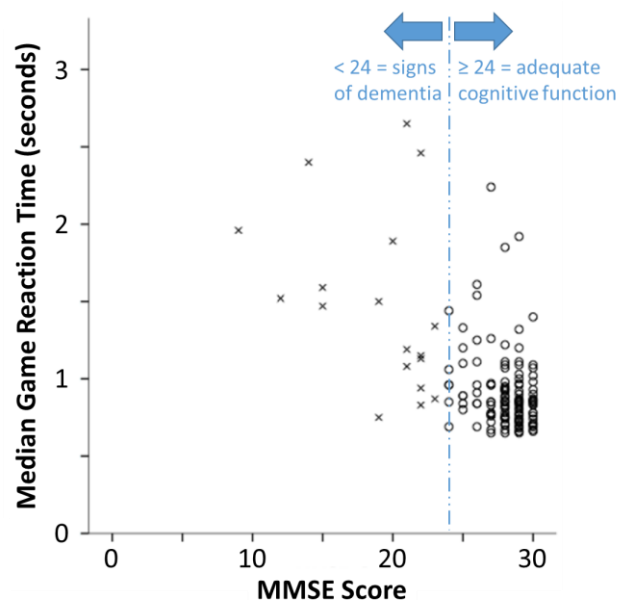
Feedback on the game was generally positive, although there were comments indicating that the game may be too easy to keep some players engaged. The tablet also presents ergonomic issues because of differences in the positioning or movement of the patient; therefore, the standardization of body or hand positioning and the enhancement of the interaction interface require further consideration.

We believe that serious games are a promising methodology for cognitive screening in clinical settings, including the high-acuity time-pressured Emergency Department environment. This research demonstrates the feasibility of using a serious game in one clinical setting. Further research is required to demonstrate the validity and reliability of game-based assessments for clinical decision making in a variety of situations, as well as for patient-administered monitoring.

Partner Profile

Sunnybrook Health Sciences Centre is a fully affiliated teaching hospital of the University of Toronto, and continuously evolves to meet the needs of its growing community. Its three campuses welcome 1.2 million patient visits each year. A budget of over \$100 million per annum supports breakthrough research conducted by over 200 scientists and clinician-scientists.

Reference: Tong, T., M. Chignell, M.C. Tierney & J. Lee (2016) A Serious Game for Clinical Assessment of Cognitive Status: Validation Study. *JMIR Serious Games* **4**(1):e7.



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