Development and Assessment of Computer-Game-Like Tests of Human Cognitive Abilities

Jason McPherson, BPsych (Hons), BA

School of Psychology, University of Adelaide

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Summary

The present thesis describes the development and assessment of two computer-game-like tests designed to measure two cognitive abilities currently of considerable interest to many researchers: processing speed (Gs) and working memory (WM). It is hoped that such tests could provide a unique and important addition to the range of tests currently employed by researchers interested in these constructs. The results of five separate studies are presented across three published papers.

In Paper 1-Study 1 ($N = 49$) a speeded computerized coding test (Symbol Digit) using the mouse as the response device was assessed. Because speeded tests are thought to be highly sensitive to response methods (Mead & Drasgow, 1994) it was deemed important to first assess how a mouse response method might affect the underlying construct validity of a speeded coding test independently of whether it was game-like. Factor analytic results indicated that the computerized coding test loaded strongly on the same factor as paper-and-pencil measures of Gs.

For Paper 2-Study 1 ($N = 68$) a more computer-game-like version of Symbol Digit was developed, Space Code. Development of Space Code involved the provision of a cover story, the replacing of code symbols with 'spaceship' graphics, the situating of the test within an overall 'spaceship cockpit', and numerous other graphical and aural embellishments to the task. Factor analytic results indicated that Space Code loaded strongly on a Gs factor but also on a factor comprised of visuo-spatial (Gv) ability tests. This finding was further investigated in the subsequent study.

Paper 2-Study 2 ($N = 74$) involved a larger battery of ability marker tests and a range of additional computer-game-like elements were added to Space Code.

Space Code included a scoring system, a timer with additional voice synthesized countdowns, aversive feedback for errors, and background music. Factor analysis indicated that after a general factor was extracted Space Code loaded on the same factor as paper-and-pencil measures of Gs and did not load on a factor comprised of non-speeded Gv tests.

Paper 3-Study 1 ($N = 74$) was aimed at assessing a computer-game-like test of WM (Space Matrix) and further assessing Space Code within a broader network of tests. Space Matrix used a dual task format combining a simple version of Space Code with a visually presented memory task based on the Dot Matrix test (Miyake, Friedman, Rettinger, Shah, & Hegarty, 2001). The cover story and scoring system for Space Code was expanded to incorporate this additional memory element. Factor analysis indicated that Space Matrix was loaded on the same first order factor as standard WM tests and the Raven's Advanced Progressive Matrices (Gf). Space Code was substantially loaded on the second order factor but was weakly loaded on each of two first order factors interpreted as Gs and WM/Gf.

A final study is presented (Paper 3-Study2) in which Space Code and Space Matrix was administered to a school aged sample (N=94). Space Matrix exhibited construct validity as well as predictive validity (as a predictor of school grades), while results for Space Code were less encouraging. Space Matrix and Raven's Progressive Matrices showed comparable relationships to school grades for Mathematics, English and Science subjects.

It is concluded that the development of computer-game-like tests represents a promising new format for research and applied assessment of known cognitive abilities.

DECLARATION

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material which has been accepted for the award of any other degree or diploma of a university or other institute of higher learning, except where due acknowledgement is made in the body of the text.

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Jason McPherson

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Dedications

To my parents and my dearly departed brother.

To my friends in all their shapes and forms.