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Proceedings of the Annual Meeting of the Cognitive Science Society

Title

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Permalink

<https://escholarship.org/uc/item/52h984v8>

Journal

Proceedings of the Annual Meeting of the Cognitive Science Society, 26(26)

ISSN

1069-7977

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Publication Date

2004

Peer reviewed

Working Memory and Virtual Endoscopy Simulation

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Introduction

We report on a study that investigates the relationship between visual working memory and verbal working memory and a performance measure in endoscopic instrument navigation in GI Mentor II (a simulator for gastroscopic surgery). Baddeley's (1998) three-component model of the working memory contains a central executive and two subsidiary slave systems – the phonological loop and the visuo-spatial sketchpad. Both the visual working memory, rehearsal processed based, and the verbal working memory falls within the phonological loop category – when using digit span tasks. We hypothesize that the visual working memory test scores will correlate with the simulator performance measure. We also predict that tasks involving a higher degree of central executive functions will be more discriminate in correlation with the performance measure. We have added the verbal working memory task to distinguish and rule out verbal working memory as a major factor for predicting endoscopic simulator performance – and thus define and elucidate the visual working memory phonological loop function for predicting endoscopic simulator performance.

Method

22 medical students (novices, 11 women and 11 men), ranging in age between 22 and 40 years at Karolinska Institutet, Huddinge University Hospital in Sweden, participated in the study. All participants completed a one hour session in the MIST-VR simulator and the GI Mentor II simulator. We will only present findings from the GI Mentor II simulator. The selected GI Mentor performance score measures the efficiency of screening (ES). The working memory (WM) tasks were taken from the WAIS III test battery (Wechsler, 2003): Forward digit span task (FDS), backward digit span task (BDS) and an alphanumeric task (ANT) – with the forward digit span being the least demanding on the central executive function and with the alphanumeric task being the most demanding.

Results & Discussion

There were significant Pearson's r correlations found between the visual working memory test scores and the simulator performance score and between the verbal visual working memory test score ANT and the simulator performance score.

Table 1. Pearson's r correlations between performance score (ES) in the GI Mentor II simulator, Visual Working Memory scores and Verbal Working Memory Scores.

Visual WM task	Verbal WM task
Fds $r=.607$, $p=.031$	Fds $r=.306$, $p=.166$
Bds $r=.570$, $p=.043$	Bds $r=.324$, $p=.152$
Ant $r=.617$, $p=.029$	Ant $r=.639$, $p=.013$
ES	ES

Our findings suggest that visual working memory correlates with the simulation performance measure. The verbal working memory is dependent on more advanced central executive functions to discriminate significant differences for the performance tasks while the visual working memory tasks show a more uniform result regardless of central executive effort. An extension of this study is currently exploring these findings further

Acknowledgment

The first and second authors were supported by grant No. 220-155600 from EU Goal 1 North of Sweden.

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