Measuring Working Memory Capacity through the Use of Game Pexeso

Zuzana BENÍČKOVÁ*

Slovak University of Technology in Bratislava
Faculty of Informatics and Information Technologies
Ilkovičova 2, 842 16 Bratislava, Slovakia
zuzana.benicko@gmail.com

Working memory capacity plays an important role in our everyday life. The higher capacity of working memory we have, the more information we are able to process in a respective task and context. It can be said that working memory capacity (WMC) is a measure of comprehension in a given moment and is also highly in correlation with our fluid intelligence [1] and response to cognitive load. For these reasons, the capacity of the working memory is an important factor in many fields such as evaluation of respondents in experiments as well as when dealing with students in the context of teaching.

WMC can be measured through many different spans, for instance counting span, spatial span, complex span, etc. Principles of every WMC span test are to combine remembering of elements and cognitive load such as counting. Many of these tests are taken in person, and respondents and scientists spend many hours testing and evaluating the results. One of the few online and automatically resolving measures of WMC is test Aospan – automatic operation span [2] which is in this paper considered as the base score for respondent's WMC.

In this study, we aim to find a new way of measuring working memory by using a modified memory game Pexeso with mathematical problems as pairs to be looked for. The application will take less time for the respondent to fulfil its aim, gamified with the game principles of Pexeso, and educational in the subject of mathematic problems. We chose to study the correlation of WMC and Pexeso game because as a rule, it focuses on different parts of working memory. Visuo-spatial Sketchpad is responsible for remembering the position of the tile in a board, and Phonological Loop is responsible for remembering the element in the tile. When mathematical problems are added to the process, the Central Executive part of WM is also activated, as it is responsible for dealing with cognitive tasks and is also the central connector of all parts of working memory.

* Supervisor: Jozef Tvarožek, Institute of Informatics, Information Systems and Software Engineering

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The application will consist of several games of Pexeso without mathematical problems and the same number of games with mathematical problems. The game will have 3 different modes:

1. Regular Pexeso
2. Pexeso with firstly seeing one half of pairs for 3 seconds
3. Pexeso where after each successfully found pair, a letter will be shown and the respondent will have to remember the sequence of shown letters for the respective game.

Each mode will be set for five rounds in size of: 4x2, 6x2, 6x2, 8x2, and 8x2 tiles. If the first games' (4x2) results in each type will be out of measures, it can be considered a tutorial for the respondent and the data will not be included in the final valid results. The test will be carried out in 3 rounds of five games without mathematical problems and afterwards, 3 rounds of five games with mathematical problems, which altogether makes 30 games (3x5 and 3x5 games). The goal is also to find the smallest number of games needed to be played for valid results. During the experiment, the respondent has to take an Aospan test and insert the results into the form in the application.

The metrics I will study are the results of both the Aospan test and Pexeso game. The application records data from Pexeso such as the number of moves, the time each round takes, the number of remembered elements (if needed) and differentiations in time between clicks on tiles. Based on the number of moves, time of each round, and the remembered elements, I will aim to create two lists, one ranking the respondent's results in Pexeso game and the other in Aospan. If the lists correlate, it can be said that our application reflects WMC. Potential differences between clicks can show us the dynamic side of the user play and we can assume which moves were spontaneous and which were thought through ahead, which is also a quality of WMC we would like to consider. If we successfully prove our hypothesis that Pexeso with mathematical problems measure WMC, we would also like to study the participant's reaction in Pexeso through Eye tracker to look for patterns of play according to the volume of WMC.

The application was created in .NET technology as a Client-Server application with the use of SQL server. The client side was programmed in HTML, JavaScript with use of JQuery and Node.js functions in a form of ASPX. The server side was programmed in C# working with SQL database.

References

[1] Andrew R.A Conwaya, Nelson Cowanb, Michael F Buntinga, David J Therriaulta, Scott R.B Minkoffa a Department of Psychology (M/C 285), University of Illinois at Chicago, 1007 West Harrison Street, Chicago, IL 60607-7137, USA

[2] Unsworth, Heitz, Schirock, Engle, et al: An automated version of the operation span task. In: Behavior Research Methods, vol 37(3), 2005, pp. 498-505.