Report on the Effectiveness of Computer Based Working Memory Training

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INTRODUCTION

Our brain provides us with different cognitive processes used to help carry out everyday simple or complex tasks.[1] These cognitive processes may include- working memory, problem-solving and attention.[1] Working memory (WM) is the cognitive process that deals with the storing and processing of temporary information often for comprehending text and fluid intelligence.[2] As an individual age, their working memory deteriorates leading to an increased chance of Alzheimer and Dementia.[3] Therefore, many studies have been funded to investigate different methods to improve working memory. One way is to implement non-computer based WM training to your week.[2] A 2013 report[2] concluded non-computer WM training had not only improved the elderly's working memory, but the improvements remained even after training ceased.

An alternative method to improve working memory is by participating in computer-based WM training. One advantage for computer-based WM training over non-computer based training is the training task for the computer-based WM can be easily adapted for differing ability levels of the individuals. Additionally, WM computer games have improved children's WM.[4] However, just because computer-based WM training is effective for children does not necessarily mean it is also effective for the elderly. Moreover, the motivation of the elderly to learn and to persist with computer-based WM training needs to be considered when evaluating the effectiveness. Older people often face issues such as using the mouse, viruses and popups, which often demotivate them to learn and persist with computer-based technologies[5].

Therefore, the purpose of the report is to examine whether computer-based WM training is effective in improving WM for the elderly with motivation to persist with the WM training as a key factor. The findings will hopefully sway more elderly people to embrace computer-based WM training and thus allow the elderly to benefit from its advantages. Based on previous scientific studies, we hypothesised that using the computer-based memory game app would help improve the Cambridge Neuropsychological Test Automated Battery (CANTAB) paired associated learning (PAL) memory test score of the elderly. In contrast, the average weekly motivational score of the elderly on the computer-based memory app would decrease over the eight weeks.

METHODS

The aim of the CANTAB PAL memory test is to test participant's working memory.[6] When a participant is given a score out of 50 the result based on the ability of the participant to recall the locations of all visual patterns shown previously.[6] A score of 50 is reduced for any visual patterns not located.

Thirty-six adult subjects aged between 65 to 79 were gathered and divided evenly into two groups. The first group was called the standard group; this group consisted of subjects who only used non-computer-based WM weekly training. Whereas the second group was called the test group and they were subjects who used memory game app and the non-computer-based WM weekly training. During each weekly training session, the test group used their app, on a portable device, for half an hour. All the subjects in both groups had a CANTAB PAL memory test score taken at the start of the experiment called PRE, and it was recorded in table one. All subjects in both groups used their respective WM training method(s) for the eight-week experiment. Also, weekly, all of the subjects in the test group had their motivation score recorded in table two. Finally, at the end of the eight week experiment, referred to as POST, the CANTAB PAL memory test score was taken for all the subjects and then the results were recorded in table one.

For table one, the mean group's memory test scores for the pre and post columns was calculated. The calculations allowed us to graph the table using the column graph method. This graph was worked because the data could be placed into categories (categorical data) for the standard and test group. The column graph helped to answer part of the research question regarding the effectiveness of computer-based WM training on improving working memory. The standard deviation was then calculated from the pre/post groups mean test score. This result was then used to produce error bars, which helped to identify significant relationships in the data.

In contrast, table two graph was a line graph. The independent variable in the table was a time ~~variable~~ (week). Thus, a line graph, more specifically a time series graph was best suited. For table two the averages of each different week were calculated. The averages were then used to turn the data into a line graph. A trend line was also included to help shape our discussion on the effectiveness of computer-based WM training on improving working memory. The standard deviation was calculated for each week and was used to produce the error bars.

Commented [f1]: This should not be the beginning of your methods section. Rather it should be included in the paragraph below after you talk about the participants.

Commented [f2]: The wording here is misleading you calculate the St dev using the raw data but this sentence makes it sound like you calculate it using the averages.

Commented [f3]: You never explain what data is in table 2, ie you don't make it clear this is the motivational data.

Commented [f4]: Trend lines are added to scatter plots not to line graphs.

RESULTS

This study shows the average CANTAB memory test score of the pre and post-test for the two experimental groups (Fig. 1). Despite the column bars from the standard group, which shows a slight improvement for the mean CANTAB test score at the end of the experiment compared to the start. However, we can conclude from the two corresponding error bars that overlap, show that there is no significant difference for the standard group's average pre and posts test scores. The two non-overlapping error bars in the test group illustrates the significant difference for the mean pre and post-test score of the participants. Moreover, the post column bar for the test group has a greater mean test score compared to the standard group's post column bar (Figure 1).

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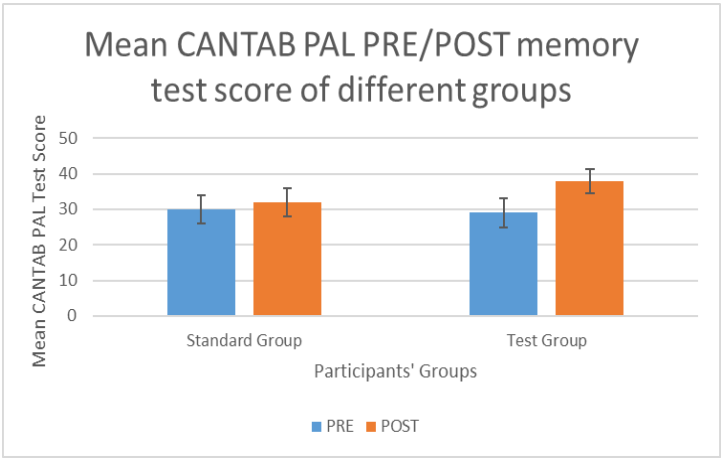

Figure 1. Mean CANTAB PAL PRE/POST memory test score for the standard group and test group.

Figure 2 ~~recorded~~ illustrates the weekly mean motivation score of the test group for the eight-week experimenting starting from week 0. Initially, the first week indicated an improvement in the motivation score. However, for the following seven weeks we observed a weekly decrease for the mean motivational score for the test group. ~~The initial improvement and immediate decrease for the mean motivation score implies the trend line as being non linear.~~\ Additionally, the weekly error bars all overlap suggesting there is no significant difference between motivational score and weeks (Figure 2).

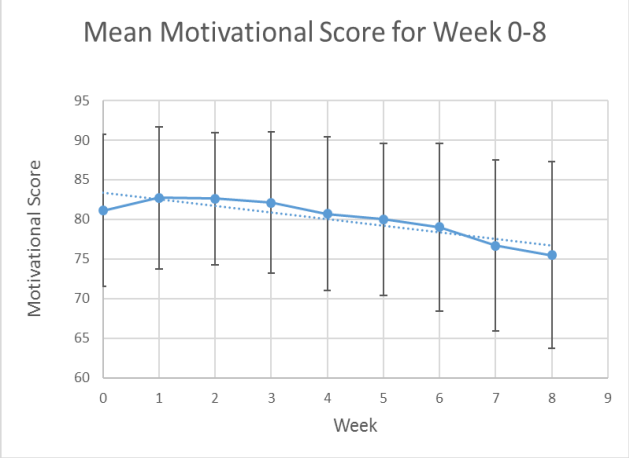

Figure 2. Mean motivation score from week 0 (PRE) to week 8 (POST)

Commented [f7]: Since you shouldn't have included a trend line deleted this sentence

Commented [f8]: Again should have been more detailed in your description of the results by including the average±standard deviation when discussing differences between average motivation scores.

Commented [f9]: You should not have added a trend line to this graph because it is a time series. Trend lines are added to scatter plots to see the relationship between two variables. As well, should have stop the x-axis at 8 weeks as there is no data for a 9th week.

DISCUSSION

The purpose of the report was to examine whether computer-based WM training was effective in improving the WM for the elderly with the motivation of the elderly to persist with the training was a key factor in the determination. ~~The experiment, which was conducted and referenced in the report would help to fulfil the report's purpose (Shown figure 1).~~ At the beginning of the experiment, we hypothesised that using the computer-based memory game app would help to improve the Cambridge Neuropsychological Test Automated Battery (CANTAB) paired associated learning (PAL) memory test score of the elderly. In contrast, the average weekly motivational score of the elderly on the computer-based memory app would decrease over the eight weeks. The results did not support the hypothesis.

Firstly, based on the error bars shown in figure 1 we can conclude there was a significant difference. Alternatively, to be more specific an improvement for WM when the participants used both the computer-based WM training and non-computer-based WM training. According to studies increased motivation enhances working memory processes and stimulates cognitive plasticity resulting in improvement of working memory.[2, 6] Thus, if the motivation was low it would result in insignificant improvements for WM. The error bars shown in figure 2 indicate how the high level of motivation didn't change throughout the eight-week period. Therefore, the consistently high motivation levels support the conclusion drawn from the error bars, as well as being the potential explanation for it. However, the errors bars conclusion alone does not validate the first part of the hypothesis that states "…computer-based… app help[s] improve … memory test score" since it's possible the non-computer-based training was the sole reason for the improvement. Although, the first part of the hypothesis is not validated this does not detract nor confirm the viewpoint of computer-based WM training as being effective.

Secondly, the error bars in figure 2 and the trend line does not support part of our hypothesis, which conclusively states that the weekly motivational score would decrease over time. The error bars indicate that there is no significant difference between the weeks and the motivation score. Also, the trend of being non-linear argues against the notion that the motivation would decrease over time. These results contrast with the 2014 study indicating the difficulty of maintaining sustained decreased engagement.[5] A potential explanation for the conflict could be related to the experimental design. The experiment conducted in this report supported the elderly with computer-based issues, whereas the 2014 study did not, creating roadblocks in sustaining motivation.[5] Nevertheless, the part of the hypothesis, which predicted the weekly motivational score would decrease over the eight weeks is unsubstantiated. Thus, these results help to affirm the view of computer-based WM training as being effective.

Lastly, a few limitations were identified in the study. One of the limitations in the experiment was it didn't test whether computer-based WM training by itself would help improve WM. Therefore, this experiment would need to be conducted in the future to definitively resolve the purpose of this report. Further research on the effectiveness of non-computer-based WM training is recommended as the results in this report does not identify any significant improvements on WM when non-computer-based WM training is only used. Also, because the motivation score was measured for a small duration the specific non-linear trend was unidentifiable. A similar additional study but for a longer duration is beneficial in fleshing out any potential trend patterns for better forecasting.

CONCLUSION

The study showed significant improvements in WM when both computer and non-computer-based WM training were utilised. Furthermore, the study did not affirm part of the hypothesis, which suggested that the motivational score would decrease over time. Unfortunately, computer-based WM training was not examined in isolation, so its effectiveness could not be determined. The report cannot conclude whether computer-based WM training is effective for the elderly based on the obtained results. Thus, further experiments but only with computer-based WM being investigated is recommended.

REFERENCES

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Report Part B Marking Guide (append this table to the end of your submission)				
†Note: Markers will look for improvements in response to feedback from Report Part A submission.				
†Introduction	1	2	3	**4**
Informative Title; Coherent background to the study; Statement of research question; Includes some justification for the project; Appropriate references used				
†Methods	1	**2**	3	
Good description of data collection process; Outline of how the data will be analysed; Comment on why this was an appropriate form of experiment/survey for this study				
†Results - Figures and Tables	1	2	**3**	4
Appropriate calculations and graphs; Suitable presentation of graphs/tables/statistics with variation shown; Figures and tables follow scientific conventions (e.g. captions, axes labelled, scientific units included, and legend only if applicable)				
Results – Description	1	**2**	3	
Written description of results referring to figures and tables; Writing in the context of the research question; Adequate explanation and interpretation of graphs/statistics				
Discussion	1	2	3	**4**
Statement of main findings; Relates findings to aim of the study; Critically evaluates, relates and compares findings with those of other studies; Discussion of any limitations of the study; Suggests further avenues of research				
Conclusion	**1**	2		
Summary of the results in the context of the research question; Link to wider context of study				
†Referencing	1	**2**	3	
In-text referencing done correctly in Vancouver style; References to figures and tables handled effectively; References list in the correct Vancouver style; Four to eight references used				
Content and Research	1	2	**3**	4
Evidence of adequate research; Terms and concepts used accurately and with confidence; Appropriate use of analysis for given research question; Discussion related to relevant themes and issues; Main points supported by evidence, examples and sources; Report shows evidence of original thought about research question				
Overall Presentation	1	**2**	3	
Fluency of writing in a clear and logical manner; Sentence and paragraph structure, grammar and spelling; Clear, neat, consistent format of document, headings, text and references; Appropriate word length; Tables and graphs of good size and placed in sensible format within the document				
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