Spring 5-14-2015

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**Effect of Digitally Enhanced Learning Tasks on Cognitive Function**

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**PSY 497 Senior Thesis**  
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### Introduction

In recent years there has been an increase in commercial cognitive training programs that claim that their program improves memory, attention, processing speed or problem-solving skills. These programs are based on the assumption that improving working memory can lead to gains in related areas of cognition. This implication that working memory can improve other areas of cognition stems from the finding that working memory is a central component of general cognition. The increased access via portable electronic devices allows these digitally enhanced learning tasks to reach a greater amount of people. However, the literature does not have a clear answer as to whether these digitally enhanced learning tasks that train working memory actually improve other areas of cognitive functioning.

Working memory (WM) is defined as a storage system that is responsible for retaining small amounts of information over brief intervals of time. A cognitive function that is related to working memory is fluid intelligence, a person's ability to reason with novel information. A person's ability to reason with novel information can be largely attributed to WM capacity and vice versa. Another cognitive function that is related to working memory is attention control. People that have a high WM capacity are less likely to have their attention drawn from a task when their WM capacity is at low WM capacity. In 2014, Hase et al. conducted a meta-analysis across 20 different studies of working memory literature and found a small but statistically significant net effect of n-back training on fluid intelligence outcome measures. However, this finding's generalizability is restricted due to the limited age range of the population. However, in 2012, Shipstead, Redick, and Engle conducted a literature review in which they concluded that the literature did not provide sufficient evidence of the efficacy of WM training impacting other areas of cognition. Therefore, the current body of literature regarding the relationship between electronically enhanced learning tasks that train working memory and its impact on other areas of cognition is inconsistent at best.

### Hypothesis

If an individual is exposed to a digitally enhanced learning task, then they will show an increase in cognitive functioning compared to an individual who is exposed to other learning task forms.

### Key Definitions

**Independent variables**

Digitally enhanced learning tasks, also known as cognitive training programs, has begun to pave a variety of programs that state that their program will lead to transfer or gains in cognitive function. A majority of these programs focus on the training of working memory due to its role in cognition.

**Dependent variable**

Cognitive Function: Cognitive function is a collection of abilities that we possess such as memory, attention, executive function, fluid intelligence, crystallized intelligence and processing speed. Due to the variety of different aspects of cognitive function, there is an array of measures for each specific realm of cognition.

### Table Note

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<th>Study Design</th>
<th>Study Design</th>
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<td>Mixed design</td>
<td>N=447 Community dwelling adults 65 and older from California and Mexico</td>
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<td>RHANS significantly greater (P&lt;.02) with 57 points, 95% confidence interval CI(2.7-2.1)</td>
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### Discussion and Conclusions

The results of the supporting articles indicate that digitally enhanced learning tasks are capable of improving cognitive functioning to a certain degree. The current literature focuses primarily on young children, children with ADHD, and older adults that may be mildly cognitively impaired. Most of the supporting articles focus on these demographics to find a cost-effective intervention suited to the individual. For instance, in children with ADHD the goal is to control the symptoms in ADHD, while in older adults the programs goal is to protect against cognitive decline. Results from the refuting articles demonstrated a difference in participants in the intervention group and active control group. The results from the mixed articles indicated that the area of cognitive function that improves is dependent on the population tested. In one article, individuals with intellectual disability who were trained in visuo-spatial tasks only showed improvements in verbal working memory and language functioning. These findings are mixed because areas of cognition that are consistent near transfer showed no effect, and there was no maintenance of improvement in the areas that did show an effect.

Based on the literature reviewed up to date, the results provide support for the thesis hypothesis. The use of digitally enhanced learning tasks can lead to improvements in measures of cognitive function. The ecological impact of these findings could lead to further discoveries in the field of cognitive science and the underlying mechanisms of cognition. Long term ecological effects in the study of working memory could lead to a better understanding of the environments influence on the brains plasticity. From a translational perspective, the general public should educate themselves about the programs they plan on subscribing to before they start a membership with a program like, Lumosity. Due to the current body of literature it is evident that not all programs are created equal, in the sense that they train different areas of cognition, therefore it is important to confirm that the program will be training the area of cognition where improvement is desired. Additionally, the cost-effective intervention programs that can be easily dispersed can reduce the impact of cognitive decline in older populations and reduce ADHD symptoms in individuals diagnosed with the disorder.

### Future Study

Future studies should identify the interaction of cognitive functions so that specific dependent measures can be created as well as precise training programs that effectively target the desired area of cognition. pending advancements in neuroscience it would be fascinating to perform a longitudinal study on the effects of digitally enhanced learning tasks on brain development.

### Acknowledgements

I would like to acknowledge my senior thesis advisor Steven Schandor, Ph.D., Professor of Psychology.

### Key References


Garel, K., Cardenas-Redick, V., & Lau, G. (2013) Computerized working memory training effective?

Jaeggi, S. M., Buschkuehl, M., Girelli, I., Fried, D., Butler, B., & Perrig, W. J. (2009) A practice effect in the study of working memory could lead to a better understanding of the environments influence on the brains plasticity. From a translational perspective, the general public should educate themselves about the programs they plan on subscribing to before they start a membership with a program like, Lumosity. Due to the current body of literature it is evident that not all programs are created equal, in the sense that they train different areas of cognition, therefore it is important to confirm that the program will be training the area of cognition where improvement is desired. Additionally, the cost-effective intervention programs that can be easily dispersed can reduce the impact of cognitive decline in older populations and reduce ADHD symptoms in individuals diagnosed with the disorder.

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