Brain Cross Training
Computerized Cognitive Training: Lumosity

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CONTENTS

Foreword

My background is in cognitive neuroscience. I earned my doctorate from Carnegie Mellon and the University of Pittsburgh's flagship Center for the Neural Basis of Cognition program. I have since worked as a Lecturer/Assistant Professor at the University of Cambridge's Experimental Psychology Department – the top ranking Psychology Department in the top ranking University in the UK - where the basis of IQ Mindware's training program was devised.

In this series of eBooks I present you with the most effective, evidence-based cognitive interventions within a brain 'cross training' paradigm that combines computerized brain training with other strategies to improve brain health, resilience, performance and creativity.

Enjoy your training!

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Abstract

- Brain training is effective.
- Brain training only works with 10+ hours of training time.
- Lumosity training results in small (1.5-3 point) brain performance benefits.
- IQ Mindware apps result in more than double the maximum Lumosity IQ gains.

In this eBook, I'll be reviewing Lumosity's one and only comprehensive scientific study into the effectiveness of its brain training exercises. The research findings were published in 2015 in the journal PLoS One ([full paper here](#)).

The Study Setup

The study can't be faulted for the number of participants in the study. There were 4,715 online participants, covering all age groups. With this number of participants the study had good **statistical power** – its ability to detect a real effect from the training, and not miss one due to chance scores.

Participants were divided into a brain training group and a control group. The brain training group completed a 15-minute Lumosity session at least 5 days per week for 10 weeks (a total of 12.5 hours of training) while the control group completed crossword puzzles for the same duration.

The following cognitive abilities were assessed before and after training on psychometric tests:

- **Short term** and **working memory** with the **Forward Span** and **Reverse Memory Span** tests.
- Two different types of **logical reasoning** using **Grammatical Reasoning** and **Arithmetic Reasoning** tests.
- **IQ** using a **Progressive Matrices** test.
- A type of '**attention for quick decisions**' using the **Go/No-Go** test.
- Visual attention using a **Two-Target Search** test.

These measures were also combined into a summed score they called the **Grand Index** for cognitive performance.

What Benefits from Training?

Overall, the Lumosity training compared to doing crossword puzzles improved performance in the 'Grand Index' of cognitive performance. This improvement was real. There were significant improvements in all cognitive abilities except for two: 1.The visual attention measure where there was not enough of a difference to count as meaningful. 2. The grammatical reasoning measure where doing cross-words actually resulted in a bigger improvement than Lumosity brain training.

This data is shown in the graph below, taken straight out of their published paper.
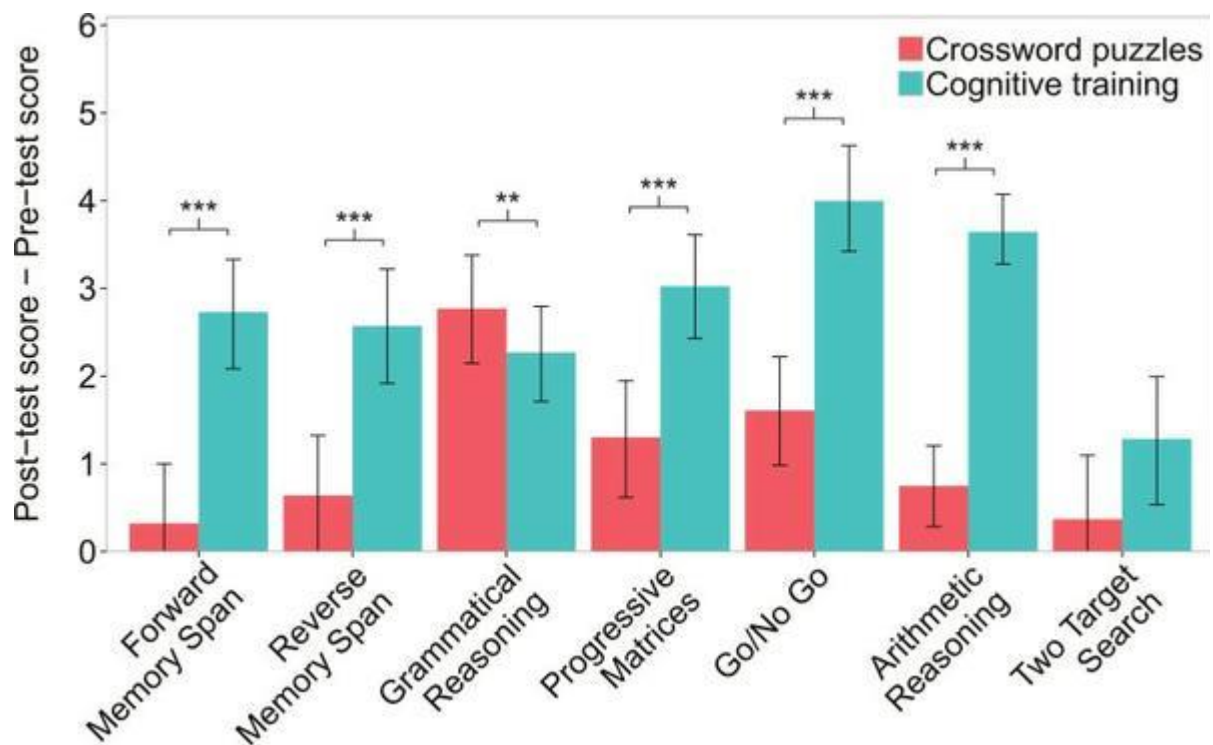
But how meaningful are these brain training improvements?

The graph shows that there are improvements in most of the test scores, including IQ. There was an overall improvement in the 'Grand Index' for cognitive performance. But what does this mean for practical purposes? How meaningful are the improvements for helping us perform better cognitively?

To answer this we need some measure of what is called the 'effect size' - i.e. how **big** are the improvements on a scale that makes sense to us?

Something that makes sense to many of us are **points** on an IQ scale. The study reports effect sizes on exactly this kind of scale for all the cognitive abilities – not just IQ. These are the point gains from Lumosity brain training compared to doing crosswords.

- **Forward Span......................2.3 points**
- **Working memory................1.7 points**
- **Grammatical Reasoning..... -1.2 points**
- **Arithmetic Reasoning..........3.7 points**
- **Progressive Matrices (IQ)....1.7 points**
- **Speeded Decision-making....2.4 points**
- **Visual attention....................0.5 points**

IQ and Working Memory Gains

A good measure of general cognitive ability is IQ measured in this study by Raven's Matrices type tests. What did Lumosity brain training do for IQ?

- ***Compared to doing cross-word puzzles, 10 weeks of Lumosity training results in a 1.7 point IQ gain.***

So yes, there is an IQ gain, but put in these more meaningful terms, the **size** of the gain – for that duration of training - is not too impressive.

We get exactly the same small gain for working memory – another critical element of general brain performance. Working memory is our 'mental workspace' and is important for attention control and ability to ***multi-task.***

But here we are looking at the brain training gains compared to doing crossword puzzles. It could be that doing crosswords is good for IQ, so we might want to look at the **absolute IQ gain** - not relative to some other kind of mental task. After all, this is what we are interested in from our training.

- ***The absolute IQ gain from Lumosity training was 3 IQ points.***

For working memory, the absolute gain was 2.6 points.

However, there is a problem with this measure since the IQ gain may have been due to having **practiced** the IQ test or working memory test the first time round. What is learned from the test-taking the first time round may carry over to doing it a second time. We don't know if the extra 1.3 IQ points was due to test practice or not. All we can say is that **at most**, the absolute IQ gain is 3

points, and at most the absolute working memory gain is 2.6 points (assuming there is no practice effect).

How does Lumosity Training Compare to IQ Mindware Training?

IQ Mindware apps (e.g. [i9 Mindware](#)) are based on optimized dual n-back training with interference control. N-back training is a type of working memory training - a well established brain training method in the scientific literature ([reference](#)).

- ***Basic (non-optimized) n-back training has been shown in meta-reviews of 30 independent studies to result in an absolute IQ gain from pre- to post-training of 6.2 IQ points.[1]***

Compared to Lumosity training for a similar duration, that's more than **twice the IQ gain**. And there are even more impressive results for working memory gains.

And with IQ Mindware apps, the dual n-back is optimized for IQ and working memory gains, incorporating interference control which is the primary ability linking working memory with IQ ([reference](#)).

Summary

1. Brain training works

The comprehensive study on Lumosity training, shows that the brain training does in fact result in brain performance gains. This puts rest to the idea that computer-based brain training is ineffective.

2. Brain training only works with a lot of time invested

12 and a half hours over 10 weeks of Lumosity training is a lot of training, and more than is typical of Lumosity users. This could explain why studies looking

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[1] The reference for this 'effect size' result can be found in Table 1 [here](#) - the relevant statistic is TxES. This figure is a standard deviation unit, and thus is multiplied by 15.

at more typical Lumosity training patterns have found no benefits whatsoever (e.g. [Nature article](#)).

IQ Mindware training also requires a similar training duration – 20 minutes a day, for a minimum of 20 days.

Real neuroplasticity change in the brain, with real-world benefits, requires time and commitment - much as real gains in cardiovascular fitness or strength require time and commitment.

3. Lumosity training results in small brain benefits

Lumosity training results in IQ, working memory and other cognitive ability improvements on the order of 1.5 - 3 points - provided you train for 12 and a half hours over many weeks.

4. Working memory based training (e.g. IQ Mindware apps) results in greater than twice the training effects of Lumosity

Training effects for standard, lab based working memory training such as the dual n-back result in a greater than 6 point IQ gain. When this training method is **optimized** for cognitive performance gains by improving player incentives (gamification), and adding **interference control**, the gains are found to be significantly higher than this. It is for this reason that IQ Mindware guarantees a 10-20 point IQ gain on standardized IQ tests.

Combining IQ Mindware training with other strategies such as exercise and intermittent fasting can further optimize brain performance gains, as we will learn in subsequent eGuides.

If you are interested in finding out more about the IQ Mindware app **i3** for brain performance and resilience, you can do so at [this website](#).