How To Optimize Your Training For i3 Mindware v.4 And Why 2G N-Back Brain Training Works

Mark Ashton Smith, Ph.D.

CONTENTS

This eGuide has been written largely as a response to those of you who are interested in how to optimize your 2G dual n-back training using i3 Mindware's v4 increase IQ training software to maximize your IQ and working memory gains.

If this is all you are interested in, you can skip to Sections II and III.

If you are also interested in the science behind this software you can read Section I which is a great primer for why this training works.

I. KEY SCIENTIFIC BACKGROUND

Working memory definition: Our mental workspace

i3 Mindware's 2G and 2G Plus games train your brain's **working memory** circuitry.

Working memory can be defined as a brain system that helps us keep information in mind while using that information to complete a task (e.g. planned or strategic action, comprehending, problem solving, decision-making). This can involve actively inhibiting distracting information.

A useful metaphor for working memory is the 'mental workspace':

> ***"a flexible, capacity limited, mental workspace used to store and process information in the service of on-going cognition"*** Morrison & Chein, 2010

Working memory: our mental workspace

Working memory has two separate short term memory stores for verbal and visual-spatial information. **Both are active in dual n-back training**.


There is also a 'super-system' called the 'Central Executive' or 'attention control system'. This controls the flow of information into these two short term stores, and inhibits irrelevant information in order to focus on and remember information that helps with our goals and current tasks. **This is the system that keeps updating items and ignores distracting information when you train with the dual n-back**.

Working memory capacity

People differ in their working memory capacity. **Working memory capacity is the size of your mental workspace** - the quantity or number of 'chunks' of information you can hold in mind at a given time to apply to a task.

A person's n-back level is generally a good measure of their working memory capacity. This is why the n-back is the gold-standard measure in cognitive neuroscience for working memory capacity.
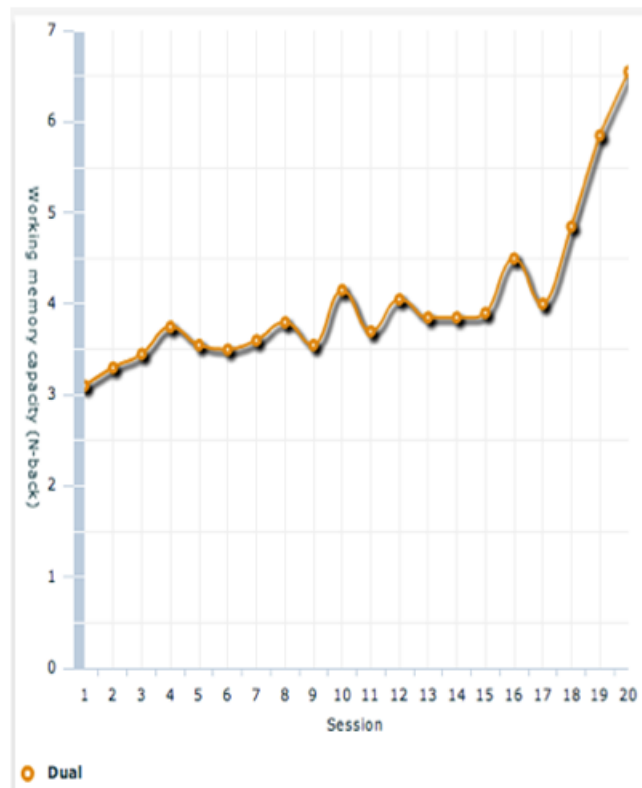
N-back level can be used as a measure of WM capacity

An information processing bottleneck

Since working memory makes information available for more advanced cognitive processing, working memory capacity is **a main limiting factor for all higher-order cognitive functions**. It is like your computer's RAM capacity. In general terms, the larger your 'mental workspace', the greater your processing power - and thus the greater chance academic and professional achievement. An example of this relationship is shown below.
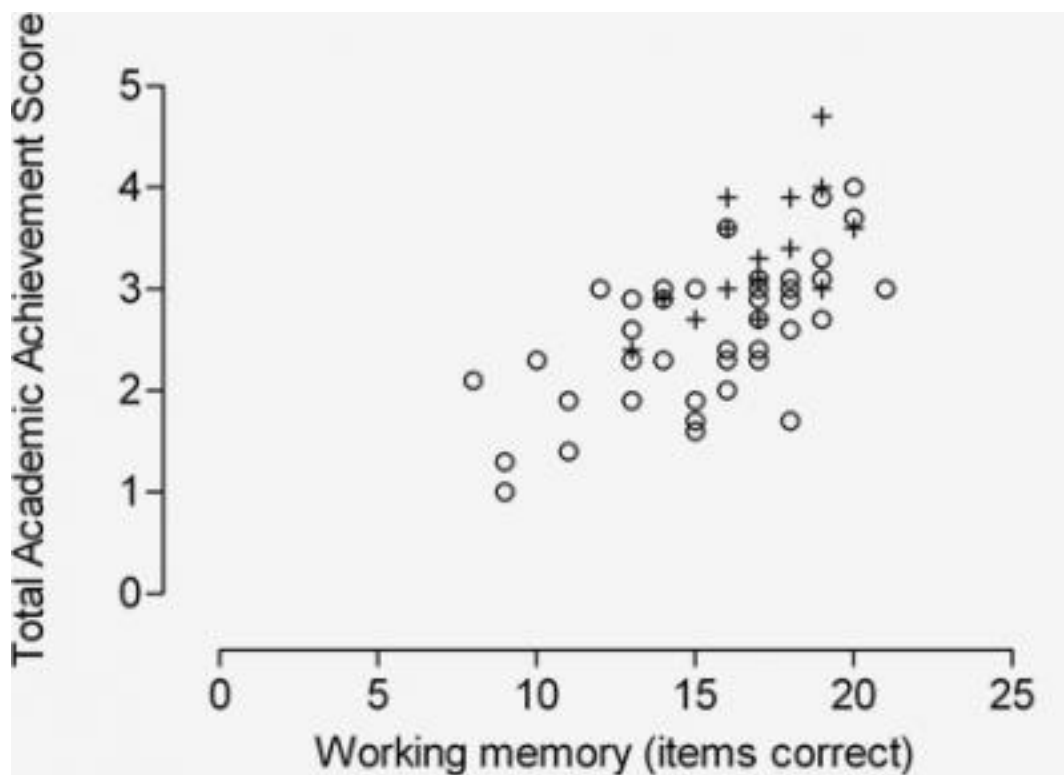
Effective working memory training: Dual n-back training

The aim of all working memory brain training programs is to expand working memory capacity and improve attentional control. The most widely studied and well-established working memory training exercise is the **dual n-back**.

The n-back game requires you view a continuous stream of items (e.g., letters) and decide whether each item matches the stimulus presented n stimuli back. In Dual N-back training, two information streams in different modalities (e.g. audio and visual) are presented simultaneously and item matches have to be detected for both types of information. This dual task requires constantly updating items in both the visual short term story and the verbal short term stores of working memory.
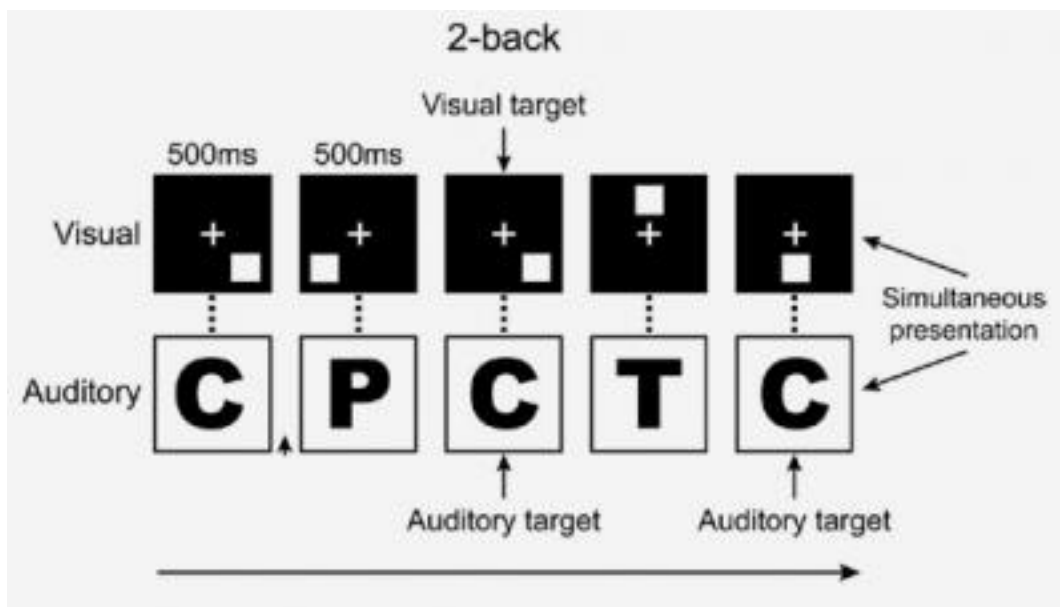
Dual n-back training to increase IQ

The dual n-back research has now been collectively analyzed in a **meta-study by Jacky Au and colleagues** in their article: Improving fluid intelligence with training on working memory: a meta-analysis.

Fluid intelligence (Gf) is a measure of IQ. Their scientifically definitive study concludes:

> "Our work demonstrates the efficacy of several weeks of n-back training in improving performance on measures of Gf. We urge that future studies move beyond attempts to answer the simple question of whether or not there is transfer and, instead, seek to explore the nature and extent of how these improved test scores may reflect "true" improvements in Gf that can translate into practical, real-world settings." (Au et al, 2014).

The authors argue that evidence suggests that dual n-back IQ increases could be **further increased by optimizing certain parameters** including:

- Ensuring program completion
- Increasing the internal motivation to engage in the exercise
- Reducing training session length to e.g. 15-20 minutes per session.

These are precisely features that have been optimized in i3 Mindware – underpinning the guarantee of a 10-20 point IQ gain from 20 days of training.

IQ Mindware products build in incentives that stimulate intrinsic motivation to complete the 20 day program, and Session lengths are half the time of the standard dual n-back games investigated in the laboratory.

Interference control and 2G n-back training

How is working memory and IQ (general intelligence) related? How does working memory training transfer to gains in intelligence? Part of the answer lies in **interference control – the ability to filter out distracting information while engaging in some cognitive task, using your attentional focus**.

Studies by Burgess, Gray, and my grad-school colleague Tod Braver (article 1, article 2) provide brain imaging evidence of a large overlap of IQ and working memory brain mechanisms **when there is need for interference control on a task – but not**

otherwise. Brain regions common to fluid intelligence and working memory became more active when there is a need to filter out distractions. Interference control is a so-called 'executive function' - the ability to use focused attention to filter out distracting information or suppress irrelevant habits or responses, when faced with cognitive challenges.

I3 Mindware 2G dual n-back training - unlike standard (1G) dual n-back training - has **built in interference requiring continual interference control to perform the task**. You may have experienced interference in the standard dual n-back when the sequence of stimuli repeats itself before the target is presented. This creates confusion where you have to 'repeat yourself' to keep the series of items in memory. In standard dual n-back this happens randomly. With i3, this is built it in as a central feature for working memory training. **Our data suggests this results in significantly better IQ gains.**

 In addition 2G n-back has two IQ enhancing options – **hyper n-back** (timer icon) and **positive feedback** (face icon).

Hyper n-back speeds up the n-back training with occasional breaks in rhythm. This increases the 'cognitive load' on working memory (similar to interval training), which transfers to greater cognitive gains. Moreover, switching on 'positive feedback' (flashing faces with correct responses) adds additional interference, enhancing training gains, even though it feels more distracting.

II. PRACTICE: WHAT STRATEGIES?

We have now reviewed the necessary background information to answer the main question of this article. What are the best strategies for optimizing your 2G n-back training i3 Mindware v4?

Optimizing 2G n-back training is not equivalent to simply increasing your n-back level as we shall see. The question 'What are the best strategies for increasing my n-back level in i3 Mindware v4 training?' should be reframed as **'What are the best strategies for increasing my working memory capacity and for improving my IQ & overall cognitive functioning?'**

A critical distinction

The first point that needs to be absorbed is that **strategies that increase your n-back level do not necessarily result in an increase in your working memory capacity.** It is working memory capacity and 'executive control' gains that you want from your n-back training - not just a high n-back level per se. We will see below that some training strategies that can be adopted artificially inflate n-back levels while not helping your working memory capacity at all.

4 different training strategies to improve n-back level: Only 1 is useful.

There are four types of strategy training that are often used with i3 Mindware training. They can all improve n-back level performance. **But only the first (rehearsal) is useful for expanding working memory capacity**.

I. Rehearsal

We can improve our n-back level on the dual n-back game through using a strategy called rehearsal. For the audio stimuli, you can use your inner voice ('sub-vocalization') to rapidly repeat the string of letters for a particular n-back level to keep them in your mental workspace. The letters may even be said aloud. **With this strategy you need to update the list one item at a time as new items are presented**. For the visuo-spatial stimuli, you 'rehearse' a location-by-location scanning of where the squares have just appeared. This may involve imagining the locations or actually moving the eyes. Both the sub-vocalization and scanning are rehearsal strategies, and they can be done simultaneously.
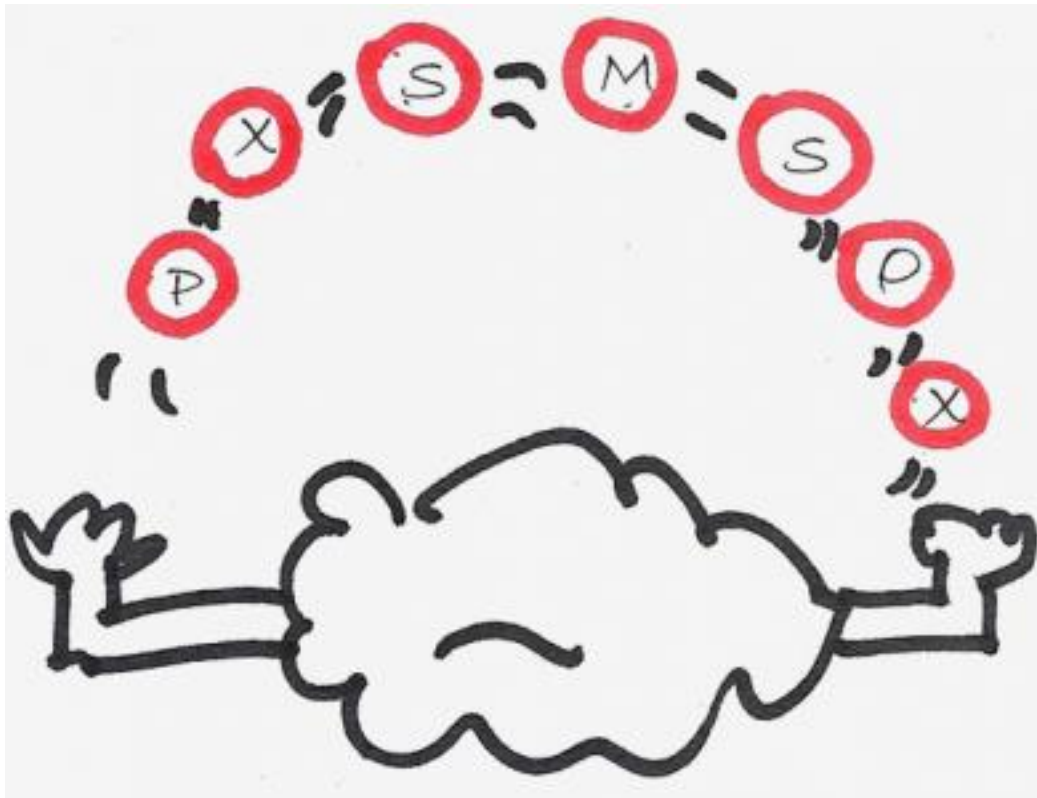
The rehearsal strategy is recommended as the strategy of choice for your 2G and 2G Plus n-back training. Rehearsal training can transfer to other working memory tasks and increase memory for types of information not directly trained in the dual n-back game. There is evidence that training with a rehearsal strategy benefits mental arithmetic and the ability to follow instructions and studies have shown that rehearsal strategy training can improve everyday memory.

II. Chunking

Sometimes during the dual n-back game, a letter or location may be repeated one two or even three times. When this happens it is easier to play the game because with only one 'place holder' **there is less information to encode to do the task**. Or at other times, there may be a meaningful string of letters that forms a word or acronym, or a sequence of locations that forms a memorable shape. When items can be grouped together like this, easing the burden on our working memory system, this is called 'chunking'. Chunking can benefit from practice and it is widely used in n-back training to increase n-back levels.
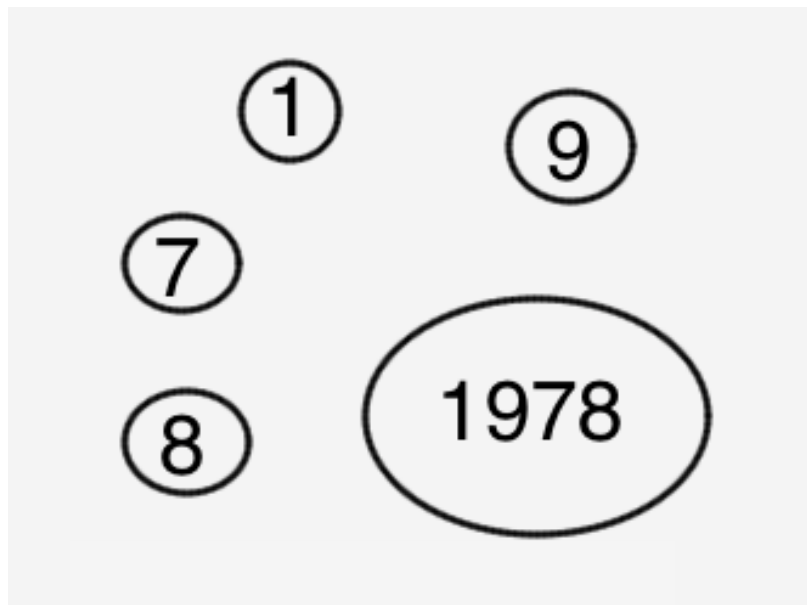
While chunking is useful in everyday life to help us encode information efficiently, it is **counter-productive for training to expand the capacity of working memory training**. It's as bad as using momentum to do sit-ups when you should be doing sustained crunches! It is actually a way of **compensating for limitations of working memory capacity** to increase your n-back performance. It's possible to have no change in your brain's actual working memory capacity while effectively using a chunking strategy to increase your n-back level a few notches, giving the false impression of neuroplasticity changes in your working memory circuitry.

2G n-back training helps to minimize this strategy when you switch on the 'hyper n-back' option (timer icon), increasing the speed and breaking the rhythm of the information flow. This increases cognitive load and reduces the

ability to chunk the information. Switching on 'positive feedback' also increases interference which improves training results, even if it seems 'irritating'!

2G Plus n-back training even more substantially reduces chunking by using stimuli that cannot easily be 'chunked' in meaningful ways - abstract 'spherical harmonics' in random locations.

III. Attention Hopping

As you get more experienced with standard dual n-back it is possible to strategically direct your attention in 'hops' or 'jumps' to useful strings of letters or square locations in order to maintain or go up an n-back level. Using this strategy, **you are not updating the letters or locations in your working memory item by item but are 'counting through' a particular string of length N and then refreshing it from the start again for the next string**, missing possible matches in between.

This strategy can work fairly well if you are playing an n-back game that has a low accuracy setting (e.g. Brain Workshop standard setting). Lower accuracy settings are chosen for n-back games on the market because they result in an easier, confidence building progression with n-back levels - but at a serious cost. **Attention hopping, like chunking, is a compensation strategy for a working memory capacity that is not**

able to process a given n-back level. As with chunking, attention hopping strategies give the illusion of brain training gains (with increasing n-back levels) without in fact expanding working memory capacity.

i3 Mindware's 2G and 2G Plus n-back games minimize attention jumping by having a higher accuracy setting that is built in, requiring that you update your mental workspace item by item, and not string by string. Attention jumping can be further reduced by switching on the 'hyper n-back' switch.

IV. Playing the Odds

As a rule there is a general trade-off between accuracy and complexity. Under pressure, as the n-back task increases in complexity with a higher n level, there is a drop in precision. **Deploying the 'playing the odds' strategy involves sacrificing accuracy to gain a higher n-back level by 'guestimating' locations or letters**.

As with chunking and attention hopping, playing the odds is a compensation-strategy when working memory is overloaded. It *eases pressure* on our working memory workspace, when what we want is the opposite: putting it under more pressure, like resistance training. Built in accuracy settings in i3 Mindware reduce the effectiveness of this strategy, as does switching on the hyper n-back switch.

Development of Intuition

While doing the n-back, intuition can mean a number of things. A sense of intuition can result when **you become well-practiced in something and you no longer need to apply a rule or strategy in a deliberate way**. If you've been practicing 'playing the odds' this can begin to feel 'intuitive'. That's not such a good thing, and may be difficult to unlearn. The same goes for attention-hopping and chunking. However, practicing the rehearsal strategy over time may result in it feeling less deliberate and more spontaneous (more intuitive), and that can be a good thing since you can now focus on optimizing your n-back performance in more subtle ways - for example, tweaking the way you focus when there is more interference and relax more when there is less interference.

If you get underway in your n-back training with an effective, intuitive approach, stick with it provided the conditions listed in the next section for 'core working memory training' are met. As a general rule, I suggest that you combine rehearsal training with 'untrained' intuition for your 2G or 2G Plus n-back training to be most efficient. If you feel like you are chunking, attention-jumping, or playing the odds, focus on rehearsal. Otherwise, see how far intuition takes you.

Train core working memory and increase 2G points

Core working memory training targets the Central Executive of your working memory system. This is 'central command' where attentional control regulates the flow of information in your mental workspace. It is **where you filter, update and monitor the information from both audio and visuo-spatial items in the dual n-back game**.

Core working memory training deliberately 'stresses' your brain's information processing capacity with high 'cognitive load'. Training is relatively energy-consuming and effortful, and **stimulates the hormesis response and the 'upregulation' of vitagenes** which results in all the neuroplasticity and health benefits described in my eBook '**The Definitive Guide to Brain Cross Training**'.

When you train with i3 Mindware's 2G or 2G Plus n-back, ensure that you maximize the 'core training' effect by adopting the following principles.

- *Use the 'hyper n-back' and 'positive feedback' options to maximize 'cognitive load' and interference. The positive feedback primes actually increase interference as well as giving feedback on accuracy, and this improves training results.*
- *Minimize going into 'automatic pilot' in the game. Ensure you are always putting in effort and the task is always challenging and absorbing.*
- *Ensure that you work at successfully ignoring distracting information – focusing on only what is needed for target 'matches'. When interference is high, focus on keeping your accuracy levels high.*
- *In the continuous stream of information, ensure that you continually update the contents of your working memory 'workspace', keeping track of the order.*
- *Monitor your ongoing performance and try to develop effective intuitions about how to channel your effort, provided you try to stay clear of chunking, attention-hopping and playing the odds strategies.*
- *Don't assume that there is a linear relationship between n-back level and IQ level, and that by doing everything you can to improve your n-back will pay off in terms of IQ gains.*
- *Don't focus on your n-back level at the expense of the principles above.*

Once you have optimized your 2G and 2G Plus training, guided by the principles outlined in this e-guide, you can expect many benefits to your overall cognition.

- *Increased IQ (fluid intelligence).*
- *Improved short term / working memory.*
- *Improved ability to ignore distractions and focus on the task at hand.*
- *Gains in reading comprehension.*
- *Improved memory for personal events and experiences.*
- *Reduced symptoms of ADHD and other attention disorders.*

III. SCHEDULING & GOAL TRACKING

Completing your full 20 Sessions with the i3 Mindware app requires a serious, sustained commitment. As this article explains, for brain training to work it requires this kind of time commitment.

For this reason, it may be helpful to sign up with a goal-tracking, scheduling app that helps you achieve your 20 day 'Profile completion' goal.

Some people use the application **Lift.** Others have used **Fluxstream** which downloads your PsiProfiler test data. We recommend signing up to **Irunurun** which is Desktop and iOS mobile compatible. Simply sign up and set your weekly training goals (e.g. '8 half sessions per week'). **Irunurun** enables you to not only track your n-back brain training progress, but also any other goals you are working on - such as an exercise routine or an alternate day fasting routine if you are doing **brain cross training**. You can also invite others by e-mail to share in tracking a particular goal.

The guidelines for your training to build into your schedule are the following:

- After a brief practice period you need to **put aside time for two half sessions of 20-30 minutes, for 20 days, making a total of 20 full Sessions. These 20 days should be completed within a maximum of 6 weeks**.
- You can combine the half sessions together in one sitting (really tough) or you can divide them into morning and afternoon/evening sessions. **This means that on average for each week, you need to train 3-4 full Sessions a week**. We do not recommend that you train for more than 5 full Sessions a week.
- After you have completed your 20 full Sessions, you are **eligible for the guarantees**. After this period, your training will have resulted in long term neuroplasticity change. However, we recommend you continue training for **1-2 hours per week to maintain the gains at their highest level**.

Information on how to combine your i3 Mindware brain training with exercise, intermittent fasting, meditation and nutrition can be found in a series of eBooks on brain cross training that you will be sent.