



NASSET ADHD SERIES

Part # 17 - Brain Training May Bolster Visual Attention

People are bad at staying focused. We've all had our minds wander when we try to concentrate on a task that requires paying close attention but isn't all that engaging. But a new NIH-funded study suggests that one's capacity to stay focused can improve with real-time feedback.

"The reason we are bad at staying focused is because we are bad at monitoring our attentional state," explained Nicholas Turk-Browne, Ph.D., associate professor in the Department of Psychology at Princeton University. Dr. Turk-Browne's lab led the study published in *Nature Neuroscience*.

"Normally, the only way we know that our attention is drifting is when we make a mistake. But by then it's too late." For example, the root cause of driving off a road – a lapse in attention – happens well before any ensuing accident.

So Dr. Turk-Browne and his team asked: What if people could be warned about their waning attention long *before* they made a mistake? And could they use this feedback to learn to stay more focused, even when no longer provided with feedback?

To answer this question, the researchers recruited several adults to participate in a three-day experiment. Each day, study participants were rapidly shown photographs of male or female faces superimposed on indoor or outdoor scenes. After viewing each image, the participants pushed a button if the image met preset criteria, for example if it showed a male face. In this case, they had to pay attention to the face and ignore the scene.

On the second day, participants were scanned with functional magnetic resonance imaging (fMRI), which can measure patterns of activity in the brain. With fMRI, the investigators were able to monitor the attentional state of participants – that is, whether they were attending to faces or scenes – because these categories trigger different patterns of brain activity.

Participants then received real-time feedback about their attentional state via a continuous closed-loop, reward/punishment system, meaning that each photograph shown was determined by the participant's attentional state, which in turn determined the next photograph shown, and so on. If their attention lapsed, as measured in their brains, the target image became more difficult to see and the task got harder. For example, if they were supposed to pay attention to faces but instead got distracted by the background scenes, then the faces started fading away. Conversely, if they stayed focused on faces, the faces became more prominent and the task got easier.

On the third day no feedback was given, but the people who had received fMRI feedback on the second day had significantly few lapses in attention compared with a control group that had received random fMRI feedback, Dr. Turk-Browne explained.

"This research sheds light on attention-related behavior and the role of plasticity, the brain's ability to change and adapt to circumstances," said Houmam Araj, Ph.D., acting director of the strabismus, amblyopia and visual processing program at the National Eye Institute, which funded the study in part.

"Attention is fundamental to vision. It determines what you see and how well you see it," Dr. Turk-Browne added. The results add to our understanding of how attention works, specifically how different brain regions contribute to attentiveness.

Certain regions, for example, are critical for focusing on relevant information, while others bolster one's ability to ignore distractions. In his study, still other regions turned out to be associated with the training process itself, Dr. Turk-Browne said. When we monitor our attention more closely, not only does behavior change, but so does the brain. "That's an area of plasticity that is not well understood," he said.

The findings have widespread implications. They suggest that it might be possible to develop strategies for enhancing attentiveness among people with occupations such as truck driving or baggage screening. They could also lead to new behavioral interventions for people with attention deficit disorder or depression, Dr. Turk-Browne said.

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References

deBettencourt et al. "Closed-loop training of attention with real-time brain imaging." *Nature Neuroscience*, 09 February 2015. DOI:10.1038/nn.3940

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