

A research summary from the School of Psychology and the Brain & Behaviour Research Institute at the University of Wollongong (visit www.uow.edu.au/health/psyc/research/bbri)

The School of Psychology at the University of Wollongong would like to thank everyone who has participated in this ongoing research project. As you may be aware this project has been made possible due to an Australian Research Council grant received for 3 years to Dr Stuart Johnstone. The studies have been examining brain mechanisms underlying symptoms and problems in Attention-deficit Hyperactivity Disorder (ADHD). The research is specifically focusing on a particular process known as *inhibition* - this process allows us to focus attention and ignore distracting information, as well as "stop and think" before acting. This newsletter talks about research into one aspect of inhibition, interference control, a process we all use every day.

ADHD and Inhibition

Current influential theories of ADHD suggest that many of the symptoms that are observed stem from a deficiency in the inhibition process. Inhibition is vital for the performance of everyday tasks that we often take for granted. For example, in adults, inhibition allows us to 'stop' ourselves from blurting out an inappropriate comment in a social setting. While inhibition is seen as a contributing factor to ADHD symptoms, there is also some evidence that motivational or energetic factors may play a role. This large-scale research project is making it possible to obtain much-needed information about (a) group differences in task performance b) optimal workload rates, c) effort levels, and d) the influence of external feedback for children with ADHD. Such investigations will assist to further identify the contributing role of these factors to the behaviours observed in children with ADHD.

Interference control study

Previous newsletters have summarised research focussed on response inhibition - that is, the ability to stop a response when it is no longer appropriate. Our research also looks at interference control - that is, the ability to focus on things that are relevant and ignore those that are not. In the lab, we use a task called a **flanker task** to mimic real-life situations, by developing computer tasks that will engage children in interference control.

The kids task is a simple one - press one of two buttons when you see either a left or right facing arrow, such as this < or this >, this is called the target. However, the target is "flanked" by some other characters to try to distract the child.

Typically, when the flankers are like this ==>== there is no effect on how quickly and accurately the child presses to the target, while these flankers >><>> are very distracting and lead to slower presses and more errors. These flankers >>>>> actually help the child choose the correct response quickly and accurately. We measure brain activity during the task to determine what was occurring when each child was seeing and responding to the stimuli discussed above.

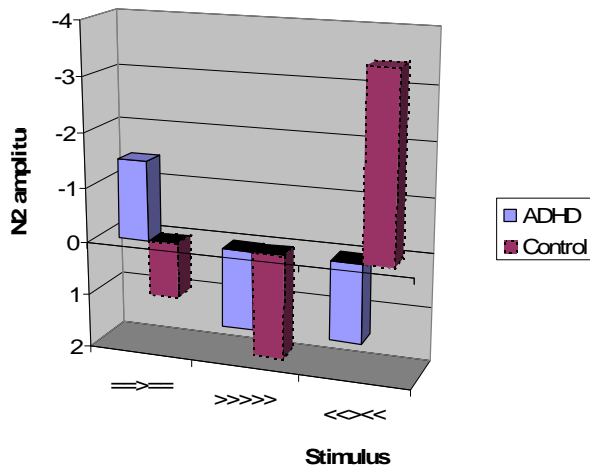
Summary of results

Children with ADHD aged from 8 to 14 years were compared with children without ADHD in performance and electrical brain activity. We found that:

1. Errors were more frequent in the children with ADHD than age-matched control children. This was found for all distracter types, indicating a general problem with ignoring any type of distracter, whether it was related to the target or not.

2. The speed at which children pressed the button to identify the target was the same for children with or without ADHD. Given the result above, this seems to indicate that the children with ADHD were making impulsive responses and would need to slow down to more fully consider the direction of the target and ignore the distracters.

3. The N2 peak in the brain electrical response indicated poor interference control in children with ADHD. As shown in the figure below, for controls the N2 was smaller when interference control WAS NOT required (for ==>==) and much larger when it WAS (for <<><<). Importantly, for children with ADHD the N2 to <<><< was dramatically reduced, indicating that the brain process which blocks the interference from the distracters was not activated efficiently. Problems have been reported in the N2 peak for response inhibition tasks also.



Recent Research

Currently we are investigating factors that might influence the interference control and response inhibition problems in children with ADHD. We are focusing on factors such as the amount of effort being put into the task by the children, as well as the influence of positive reinforcing statements during the task.

We have just completed a pilot study testing the effectiveness of a computer-based game as an alternative treatment for ADHD. This was the first investigation of its type in Australia and we are looking at the results over the next few months.

For your information, below are a few references to articles that may be of interest to you in this area. If you would like a photocopy of any of these articles, please email us.

Johnstone, S. J., Barry, R. J. and Clarke, A. R. (2007). Behavioural and ERP indices of response inhibition during a stop-signal task in children with two subtypes of Attention-Deficit Hyperactivity Disorder. *International Journal of Psychophysiology*, 66, 37-47.

Lawrence, C. A., Barry, R. J., Clarke, A. R., Johnstone, S. J. McCarthy, R., Selikowitz, M. & Broyd., S. J. (2005). Methylphenidate effects in Attention-Deficit/Hyperactivity Disorder: Electrodermal and ERP measures during a Continuous Performance Task. *Psychopharmacology*, 183, 81-91.

Broyd, S. J., Johnstone, S. J., Barry, R. J., Clarke, A. R., McCarthy, R., Selikowitz, M. & Lawrence, C. A. (2005). The effect of methylphenidate on response inhibition and the event-related potentials of children with Attention-Deficit/Hyperactivity Disorder. *International Journal of Psychophysiology*. 58, 47-58.

Smith J. L., Johnstone, S. J., Barry, R. J. (2004). Inhibitory processing during the Go/NoGo task: An ERP analysis of children with Attention-Deficit/Hyperactivity Disorder. *Clinical Neurophysiology*, 115, 1320-1331.

Dimoska, A., Johnstone, S. J., Barry, R. J. and Clarke, A. R. (2003). Inhibitory motor control in children with attention-deficit/hyperactivity disorder: Event-related potential in the stop-signal paradigm. *Biological Psychiatry*, 54, 1340-1349.

Thank you again for your participation – this research would not happen without your help!

Dr Stuart Johnstone (sjohnsto@uow.edu.au) and Val Markovska (valm@uow.edu.au).