Effects of 3D multiple-object tracking on off-the-block reaction time in University of Victoria varsity swimmers: A pilot study.

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INTRODUCTION

High-level swimming is one of the most competitive sports in the world. Often less than one second separates first through last place, and commonly races are won in just hundredths of seconds. Along with physical training, cognitive training is also used in order to gain an edge over the competition. Three-dimensional multiple object tracking (3D-MOT) has been used to enhance attention and decision making capabilities in visually dominated sports (*e.g.* soccer, basketball), but has been relatively unstudied in regards to non-visually dominated sports (*e.g.* swimming). Training one attentional modality has been shown to improve attention in other modalities, and in this way 3D-MOT may be able to enhance performance in non-visually dominated sports.

OBJECTIVES

This study examined if training visual selective attention on the Neurotracker (a 3D-MOT training tool) had an effect on off-the-block reaction times of varsity swimmers at the University of Victoria. This study was performed using participants (n = 15), aged 18-25 years old, who had completed a total of ten 3D-MOT training sessions over a five-week period. Participants completed ten sessions of Neurotracker training, and off-the-block reaction times were measured before and after training. Off-the-block reaction time was considered an auditory selective attention task, and is defined as the time between the start gun firing and the swimmer's front foot leaving the blocks.

HIGH-PERFORMANCE SWIMMING

While improvements of a mere few hundredths of a second may not seem game changing, in high-performance swimming it can be the difference between winning and losing.

- At the Rio 2016 Olympics, a difference of just 0.1 seconds would have caused 30 medals to change hands
- Between the 1972 and 2004 Olympic Sprinting events (50 m – 200 m), a total of 65 Olympic medals would have exchanged hands
- At the 2018 Men's NCAA Division 1 Championships 50 m freestyle finals, with the exception of first place, which was a world record performance, only 0.53 seconds separated second through last place

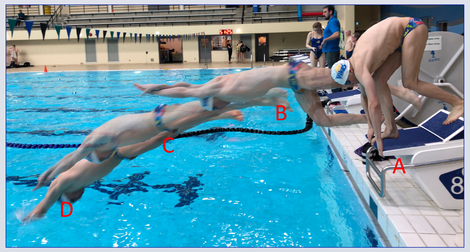

Figure 1. Stages of a swim start. The swimmer starts in position A. Upon hearing the start signal the swimmer progresses through the stages to stage D, and then water entry. Off-the-block reaction time is considered the time between the starting signal, and the swimmer's front foot leaving the blocks (stage B).

METHODS

Participants

- 15 University of Victoria varsity swimmers aged 18 – 25 (*M = 20.3)*
- 9 males, 6 females

Inclusion criteria

- A member of the University of Victoria Swim Team
- Aged between 18 – 25 years

Exclusion criteria

- Sustained concussion or head injury during the study period
- Colour blindness
- Presence of any injuries that may prevent the diving movement, including knee, shoulder and ankle injuries

Apparatus

Neurotracker

- 3D-multiple object tracking training software

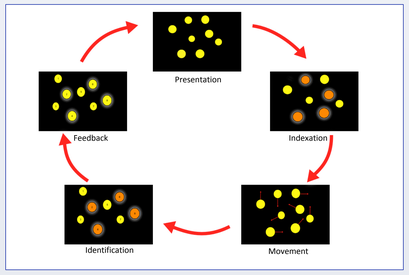

Figure 2. Stages of a Neurotracker trial. There are 20 trials per session, and three sessions per appointment. Each appointment takes approximately 21 minutes.

Ares Omega Timing System

- Aquatic timing system to record off-the-block reaction time

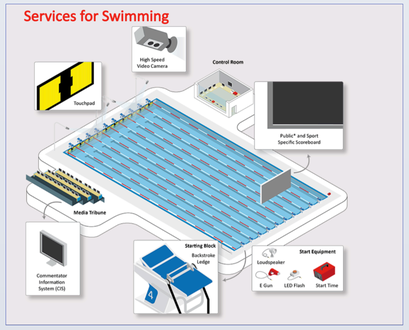

Figure 3. Ares-Omega Timing System. The starting equipment, starting blocks and the control room were used in this study.

Procedure

- First off-the-block reaction time collection session: A series of three reaction times was taken for each participant and control to establish a baseline
- Appointment 1: Establish a baseline assessment on the ruler task and the Neurotracker for the participant group
- Appointment 2-9: Participant group completed 8 3D-MOT training sessions on the Neurotracker
- Appointment 10: Repeat administration of the ruler task and final session of Neurotracker training for the participant group
- Second off-the-block reaction time collection session: A second series of three reaction times was taken for each participant and control (7 weeks later)

RESULTS

Participant group:

Following Neurotracker training, average off-the-block reaction time had significantly improved (M = 0.0813 seconds, SD = 0.0428, p = 0.00072) in the participant group.

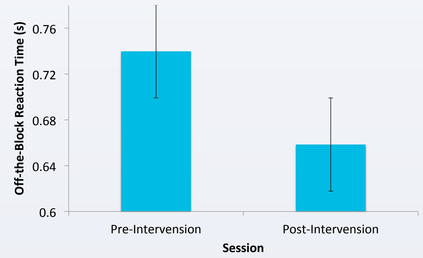

Figure 3. Changes in off-the-block reaction time in the participant group before and after 10 sessions of Neurotracker training sessions.

Control group:

Average off-the-block reaction time significantly improved (M = 0.034 seconds, SD = 0.0171, $p < 0.01$, p = 0.0039) during the study period.

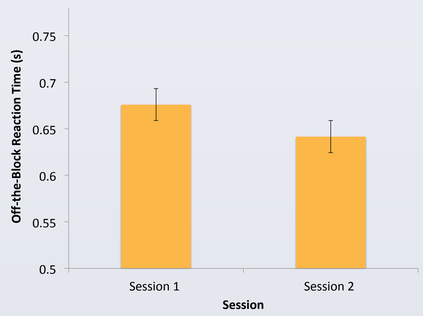

Figure 4. Changes in off-the-block reaction time in the control group between session 1 and session 2.

Difference:

The participant group improved their off-the-block reaction times significantly more than the control group (M = 0.0469, p = 0.00059).

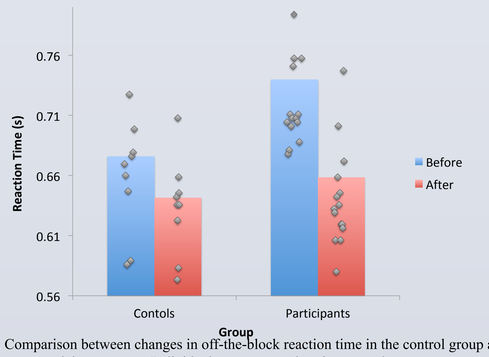

Figure 5. Comparison between changes in off-the-block reaction time in the control group and participant group. Individual average reaction times are shown.

CONCLUSIONS

This study demonstrated significant improvements in off-the-block reaction time after 10 Sessions of 3D-MOT training, suggesting that the Neurotracker program may be an effective cognitive training tool for high-level swimmers. These results are consistent with other research that has demonstrated attentional improvements following Neurotracker training (Parsons *et al.*, 2014), as well as enhanced performance in sport (Mangine *et al.*, 2014; Romeas, Guldner & Faubert, 2016). Enhancements in off-the-block reaction time (auditory attention task) after 3D-MOT training (visual attention task) are consistent with research on attention resource pools (Wickens, 2008).

As this was a pilot study, replication with a larger sample size is needed to ensure validity and reliability of the results. Future research should investigate whether the benefits of 3D-MOT to this population extend past the current study's period. This research also opens the door to using 3D-MOT training as a cognitive training tool for other non-visually dominated sports (*e.g.* rowing, cycling, running).

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