

Brainstem activation for stroke recovery?

Plasticity of Rapid Visual Reactions

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Introduction

- Reticular formation** is part of the brainstem found to play a role in the recovery of movement after stroke¹
- Startle** is a loud auditory stimulus found to activate the reticular formation¹
- Rapid Visual Reactions (RVR)** is used to measure reticular activation
- Plasticity** is the ability of neurons to adapt to changes which is an integral part of learning, memory and stroke recovery

Supervisor's findings

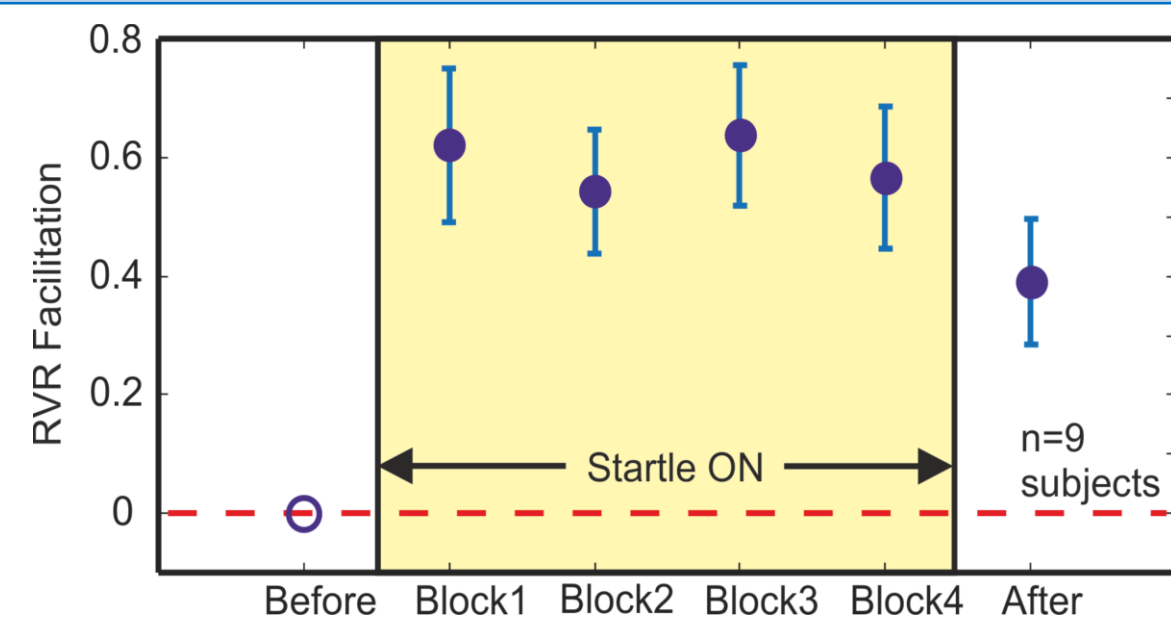


Figure 1. Shoulder muscle (deltoid) RVR increased when startle was given simultaneously ($t = 0$) with target appearance. Plasticity was found as RVR remained elevated immediately (0 mins) after startle was removed³

Aims

- To investigate if RVR exhibits plasticity with startle given at a different latency ($t = -100\text{ms}$)
- To investigate plasticity over a longer washout period (1 hour instead of immediately after)
- To introduce a control group to rule out training as a confounding factor

Methods

- Fourteen participants were recruited to do a reaction time task for two sessions with a one week gap in between

- The reaction time task involved participants moving a robotic arm towards targets appearing randomly in four directions

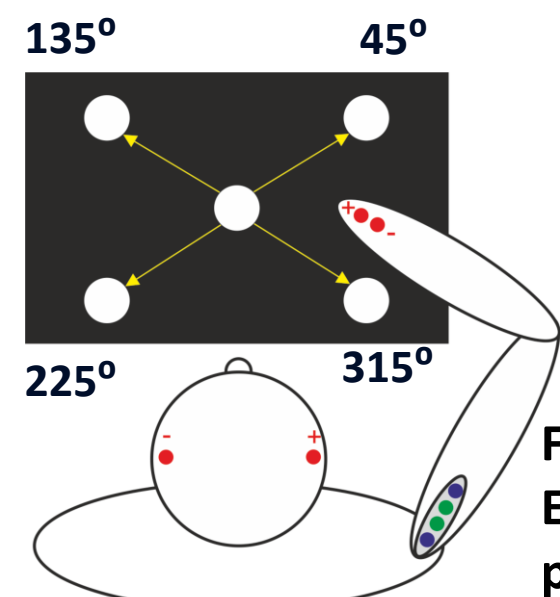
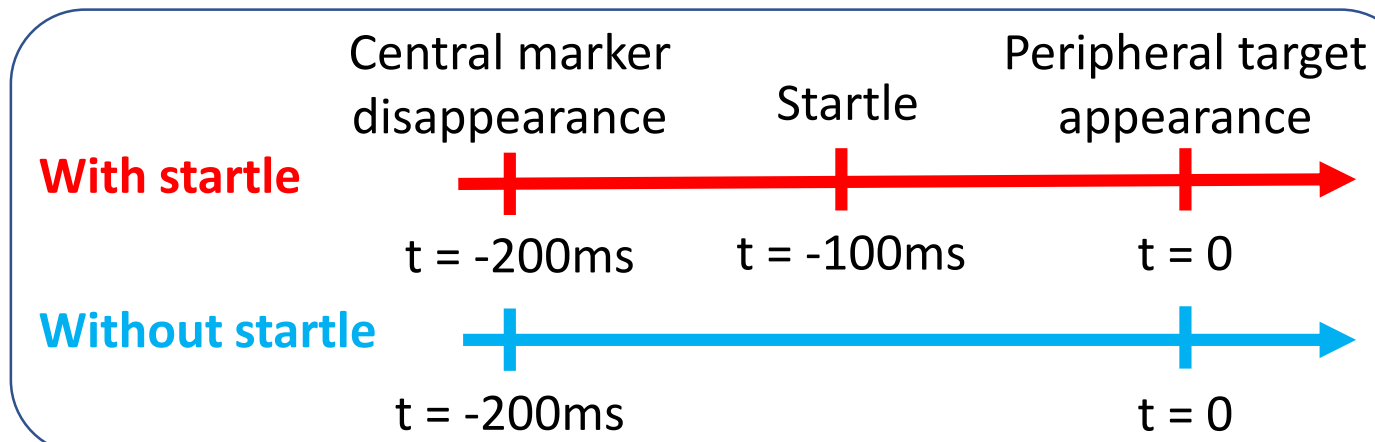


Figure 2. Experiment paradigm

- Each participant did one startle session and one control session
- Each session started with 160 baseline trials followed by 640 intervention trials and four blocks of washout trials at 0, 20, 40 and 60 minutes after intervention consisting of 160 trials each (**Figure 3**)



Session	Baseline	Intervention	Washout (mins)			
			0	20	40	60
Startle	160 trials	640 trials	160 trials	160 trials	160 trials	160 trials
Control	160 trials	640 trials	160 trials	160 trials	160 trials	160 trials

Figure 3. Experiment protocol. Central marker disappearance at 200ms before target appearance. Startle given at 100ms before target appearance. All baseline and washout trials done without startle. Intervention trials for startle session done with startle, control session done without startle.

- Surface EMG (electromyography) electrodes were attached to shoulder muscles (middle deltoid) and chest muscles (pectoralis major) while the participants performed the task (**Figure 4**)

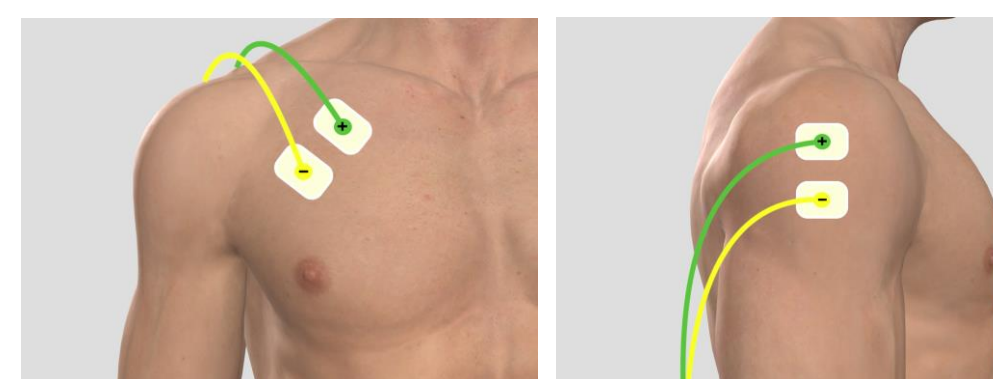


Figure 4. EMG electrode placement

- RVR was defined as muscle activity 71 to 115 milliseconds after target appearance
- Data analysis was done using MATLAB

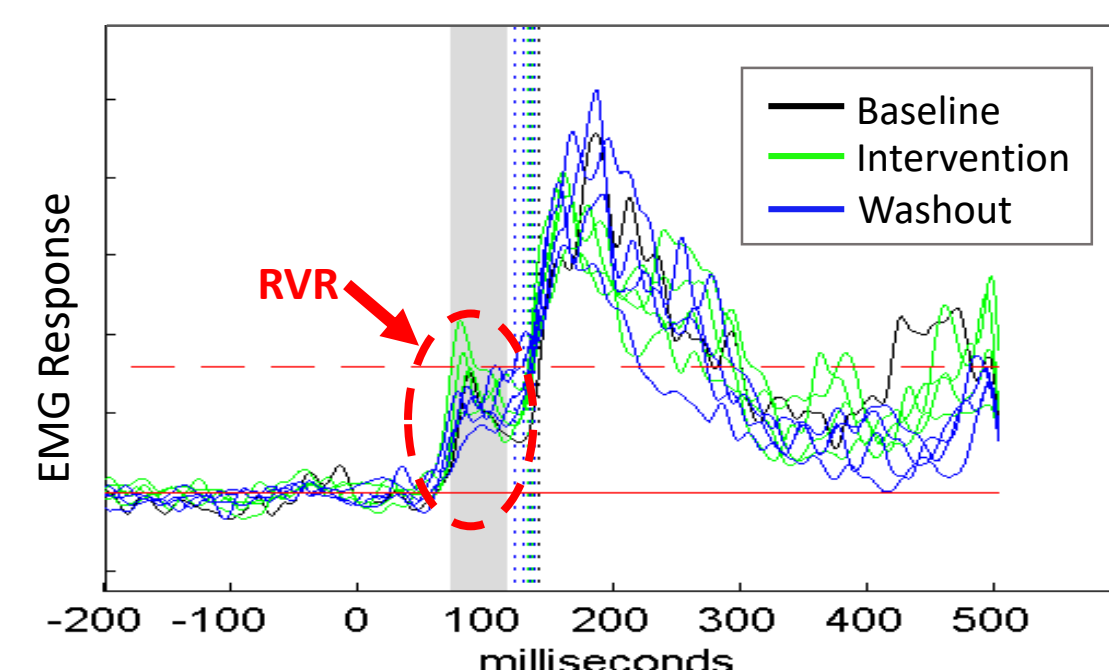


Figure 5. Example EMG response. RVR window (71 to 115ms) shown in grey

Results

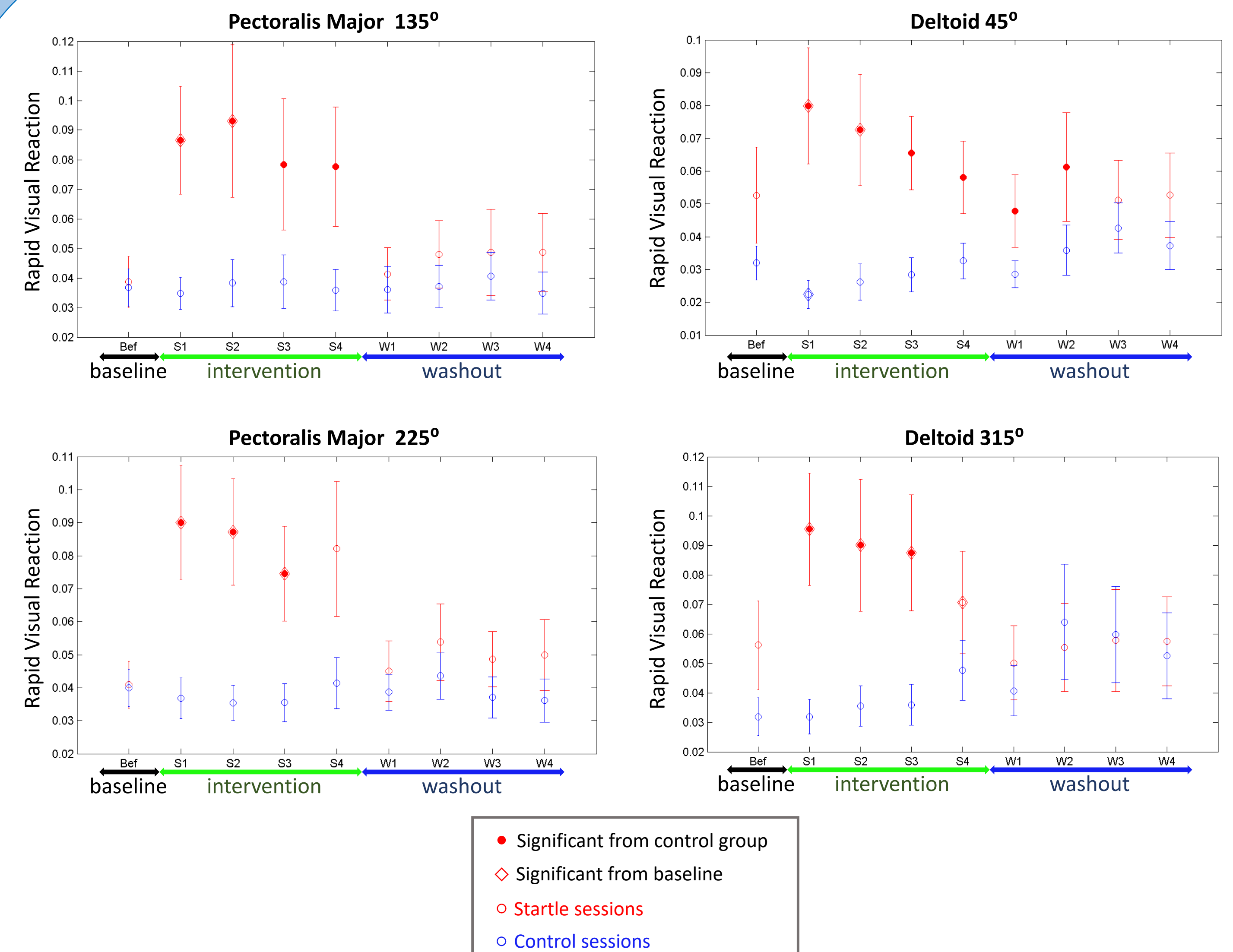


Figure 6. Group RVR responses ($n = 14$). Facilitation is observed as enhanced RVR when startle is given. Plasticity is observed as enhanced RVR during washout period. Facilitation was found in 4/4 angles (deltoid 45°, pec major 135°, pec major 225°, and deltoid 315°). Plasticity was found in 1/4 angles (deltoid 45°) at 0 and 20 minutes after startle was ceased.

Discussion

- Clear facilitation was found in arm muscles responsible for moving the arm towards target direction (deltoid for outer targets and pectoralis major for inner targets) which agrees with Pruszynski's findings²
- Plasticity was found when startle was given 100ms before target appearance, but only for deltoid 45 degrees. Future studies should investigate startle at different latencies
- These results strengthen previous findings that RVR is facilitated by startle and is not due to training

Acknowledgements

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References

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