The midbrain reticular formation controls eye vergence and forms part of a broader pathway, including the frontal and parietal regions of the cerebral cortex and cerebellum. These latter structures also represent the attention system of the brain. Our results show a correlation (both in amplitude and onset latency) between eye vergence and visual evoked potentials (vERPs) reflecting deployment of top-down attention (Sole Puig et al 2016).

Eye vergence is calculated by the change in the angle between both gaze lines.

Vergence is the movement of the eyes in opposite directions and has a role in depth perception. Recent studies show a novel role of eye vergence in cognitive processing of sensory information (Sole Puig et al 2013a,b). Vergence responses are observed during orienting visuospatial attention (Sole Puig et al 2013a), visual perception (Sole Puig et al 2013a,b) and visual working memory (Sole Puig et al., 2017).

Modulation in the angle of eye vergence while performing a cue/no cue Posner task. Subjects fixate the centre while presenting visual stimuli. In the cue condition (green curve) attention is shifted (but not gaze) when a cue stimulus (green box) is presented but not after a no-cue stimulus (red box/curve). Vergence modulation reflects this attentional shift. Time points (blue) indicate a significant difference between both conditions.

Neuro-imaging studies report brainstem abnormalities in ADHD patients and showed 93% prediction accuracy (Johnston et al., 2014). We showed altered attention related vergence in children with ADHD (Solé Puig et al., 2015). Poor binocular coordination in dyslexic children also suggest a deficiency in the visual attention processing (Bucci et al., 2012).

Using a child friendly attention task (BGaze, Braingaze, Spain), we observed relatively strong vergence responses in healthy children and weak vergence in the clinical control group. Children with ADHD showed no significant modulation in the angle of eye vergence.

Machine-learning models classified ADHD patients (N=75) from healthy controls (N=51) and clinical controls (N=33) with accuracies of 96.3% (FP: 5.12%; FN: 0%) and 85.7% (FP: 4.5%; FN: 19.2%), respectively.

In adults, we observed vergence responses in controls (N=20) but not in ADHD patients (N=16). We obtained similar classification outcomes as in children. Classification accuracy was 91.7% (FP: 6.6%; FN: 9.5%).

REFERENCES


