

Pupillometry reveals changes in cognitive control dynamics as a function of motivational incentives.

Kimberly S. Chiew, Renaldo Gacad, Timothy B. Brown, Todd S. Braver
Department of Psychology, Washington University in St. Louis

Behavioural and neural evidence suggests that motivational incentives can influence cognitive performance through enhancement of proactive control processes. The present study examines the influence of reward on cognitive control dynamics in the AX-Continuous Performance Task (AX-CPT), a cue-probe task permitting relative characterization of proactive and reactive control processes, using task performance and high-resolution pupillometry (as a performance-independent measure of mental effort). Changes in task performance were consistent with the idea that incentive is associated with a shift to relatively more proactive control. This shift was also reflected in pupil dilation, which increased in incentive relative to non-incentive trials. Importantly, this increase in dilation occurred during active maintenance of cue information, where it may be interpreted as reflecting enhancement of proactive control processing. We also observed incentive-related changes in pupil constriction when perceptual factors were controlled, suggesting that constriction may be a novel marker of affective influences on cognition as well as reflexively indexing changes in luminosity. Finally, through trial-by-trial examination of pupil timecourses, we present preliminary evidence that pupil dilation is a physiological marker of both incentive status and reaction time and that these influences can be dissociated from one another, with unique incentive-related effects on pupil dilation observed even when performance is matched to non-incentive trials. Pupillometry may thus provide a useful, performance-independent measure by which to examine dynamic shifts in cognitive control as well as indexing changes in motivation separate from cognitive demands.