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Using Eye-tracking to Examine Information Gathering and Arousal in Effort-Related Decision-Making

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Abstract

Purpose

Eye-tracking and pupillometry are common measures of attention and arousal. We explored changes in pupil dilation, gaze duration and switching during a decision-making task to determine whether these measures were responsive to task parameters expected to change attention and arousal: decision difficulty, reward size and imagined effort to earn reward associated with each choice.

Methods

We recruited 36 participants aged 16-21, who completed two Cognitive Effort Discounting Tasks. For one task, the cognitive effort involved sustaining attention and, for the other, it involved remembering items. Each task posed 144 questions, asking participants to choose between a small, no-effort reward and a large reward that required effort to earn (exerting effort for 1, 5, 10 or 20 min). Throughout, we recorded eye-tracking and pupillometry data as participants looked at each alternative, as well as which was the preferred alternative and time to make a choice. For each effort level, we calculated a point of equi-preference (“indifference point”), when the preferred alternative switched from the large, effortful reward to the smaller no-effort reward

Results

At indifference, participants required longer to answer, suggesting increased difficulty. Gaze duration, pupil dilation and gaze switches were highest for those “hard” questions close to the indifference point. Both gaze duration and switches increased as value of the effortful reward and the effort requirement increased. In addition, participants tended to look at the chosen alternative longer than the non-chosen alternative, and also looked at the effortful alternative more than the no-effort one.

Discussion

Data suggest the more difficult questions, ones featuring larger rewards and higher effort requirements were associated with heightened arousal and attention (larger pupil sizes, gaze durations and switches). However, our data cannot distinguish between arousal and attention, and future manipulations will be incorporated to disambiguate these factors.