Waiting and working for rewards: Attention-Deficit/Hyperactivity Disorder is associated with steeper delay discounting linked to amygdala activation, but not with steeper effort discounting

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Abstract

Objective
Children and adolescents with ADHD have a relatively strong preference for smaller immediate rewards over larger delayed rewards (steep delay discounting). It is unknown whether such steep discounting of rewards is specific for delayed rewards, i.e., supporting the delay aversion account of ADHD, or whether it is also present for effortful rewards, i.e., representing general reward insensitivity. Therefore, this study examined behavioral and BOLD responses during delay discounting (DD) and effort discounting (ED) in ADHD.

Method
Thirty adolescents with ADHD and 28 controls (12-17 years) were scanned while performing a DD-ED task (fMRI findings were based on 21 and 25 participants, respectively). During DD, participants were presented with a series of choices between a small reward delivered immediately and a larger reward delivered after 5-25s. During ED, participants were presented with choices between a small reward that was delivered after exerting 15% of their maximal hand grip strength and a larger reward delivered after exerting 30-90% of their strength.

Results
Analyses on the subjective values of delayed and effortful rewards and on the Area Under the discounting Curves (AUCs) indicated that adolescents with ADHD showed steeper discounting than controls for DD, but not for ED. This was accompanied by a slightly stronger delay dose-response relationship in the amygdala for adolescents with ADHD who reported to be more delay averse in daily life.

Conclusion
Together, these results - steeper DD in the ADHD group and a stronger delay dose-response relationship in the amygdala, while no evidence for group differences in ED was found - support the delay aversion account of ADHD.