Risk, Rewards and Cognitive Control in Adolescence: Testing Behavioral Predictions of the Dual Systems Model

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In two experimental studies we tested behavioral predictions of the dual systems model. The model explains adolescent risk-taking as a result of divergent developmental courses of the two brain subsystems: incentive processing and cognitive control. Although many studies find neural evidence for systems imbalance, the additive effects of reward sensitivity and cognitive control on risk-taking awaits to be tested on behavioral level.

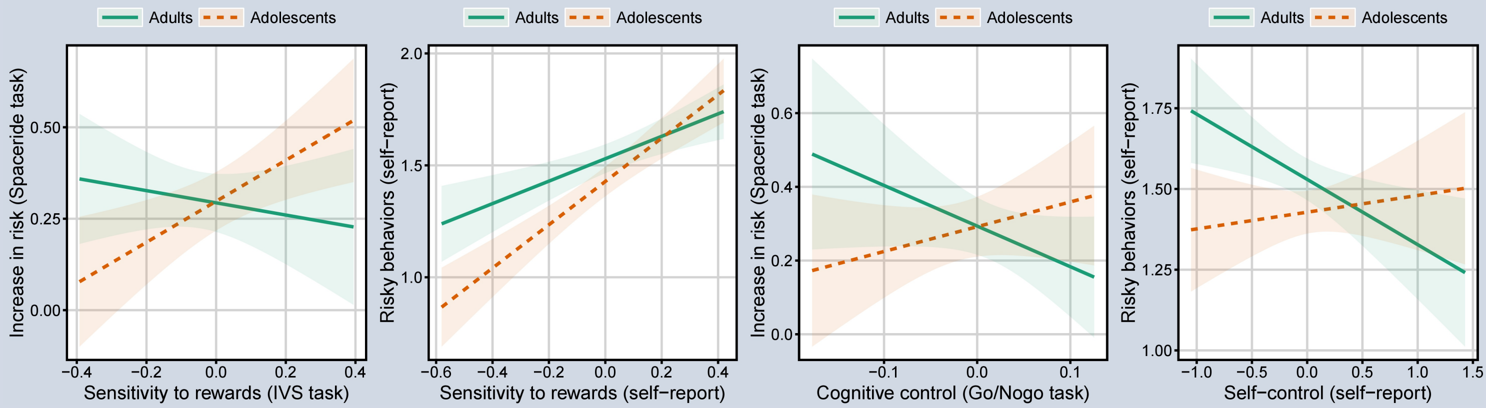
Study One

In the first study we aimed to determine the influence of rewards on both risk-taking and cognitive control in adolescents (*N* = 90, age 13 - 16) and young adults (*N* = 96, age 18 - 35). We used four tasks ("hot" Spaceride task and "cold" Stock Market task for risk-taking, Antisaccade task and Stroop task for cognitive control) and designed both controlled and incentivized condition within each task by rewarding participants' performance. We also tested self-reported arousal as a possible mediator between rewards, cognitive control, and risk-taking.

We found increase in adolescent but not adult risk-taking in the "hot" task when rewarded and less risk-taking in adolescents than in adults in the "cold" task, regardless of rewards presence. In cognitive control tasks we found that rewards influenced the latencies but not the efficiency of control processes. We did not confirm mediating role of arousal.

Study Two

In the second study we aimed to determine whether sensitivity to rewards and cognitive control contribute to adolescent (*N* = 88, age 13 - 16) and young adults' (*N* = 95, age 20 - 28) risk-taking in additive manner. We designed a model testing sensitivity to rewards (in incentivized visual search task), cognitive control (in Go/Nogo task), and impulsivity (in Kagan's MFF Test) as possible predictors of the increase of risk-taking in the rewarded compared to non-rewarded Spaceride task. Such an increase of risk-taking was observed in one third of participants. We also designed a model testing self-reported sensitivity to rewards and self-control as possible predictors of risky behaviors (in Risk-Taking Questionnaire). Both in behavioral tasks and self-reports we found similar results (Fig.) The increase of risk-taking in the Spaceride task was predicted by high sensitivity to rewards and such effect was greater in adolescents. The effects of cognitive control on risk-taking, however, were different in adolescents and adults. In adults the increase of risk-taking was favored by weak cognitive control, while in adolescents it was predicted by highly efficient control. Similar results revealed on self-report level. In adults risky behaviors were predicted by high sensitivity to rewards and weak self-control; in adolescents they were predicted by high sensitivity to rewards and high self-control.



Conclusions

The results indicate that risk-taking in adolescents is not increased comparing to young adults and that it is reward-driven rather than impulsive. Contrary to adult's view, Iin adolescent life small but certain benefits of risky behaviors (e.g. excitement, winning, peer approval) can balance severe, but relatively rare negative consequences (e.g. accidents). Possibly, apart from clinical cases risk-taking in youth should be seen rather as a strategy adopted in the face of incentives than a result of self-control deficiency.

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