Exercising Rationality: Effects of Caffeine and Exercise on Economic Decision Making

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Caffeine

Introduction:

- Risky decision making is prevalent in the age group 18-25, an age group that also consumes large amount of caffeine, on average.
- Stimulants can reduce impulsivity and risky decision making (e.g. in ADHD) and delay discounting.

Hypotheses:

- **Caffeine** application would result in **more optimal choices** and **higher gains** on **measures of risky decision making**:
  - Iowa Gambling Task (IGT)
  - Balloon Analogue Risk Task (BART)
- **Individual differences** would influence caffeine's impact on task performance:
  - decision making style
  - impulsivity
  - risk propensity
  - demographic variables

Methods:

→ Double-blind, placebo-controlled experimental design

→ Stroop task administered first to deplete cognitive resources

→ IV: 200mg caffeine vs. placebo

→ DV: Iowa Gambling Task (IGT) and Balloon Analogue Risk Task (BART)

→ Individual Difference Measures

- → General Decision Making Style (GDMS)
- → Abbreviated Barrat Impulsiveness Scale (ABIS)
- → Domain Specific Risk Taking Scale (DOSPERT)
- → Demographic Survey

Conclusions:

Caffeine is one of the most ubiquitous drugs in the world, and is often consumed for its cognitive enhancing properties.

Findings indicated that caffeine, in tandem with individual differences in decision making style, impulsivity, risk propensity and gender, significantly improved performance on the IGT. However, caffeine had no reliable effect on BART performance.

Further research should investigate potential applications (and limitations) of caffeine in populations prone to risky decisions. The differential impact on the two tasks offer hints that caffeine's impact may be more specific than predicted. Further studies are needed to isolate which cognitive processes respond to the drug and thus enhanced only IGT performance. Our findings also suggest that interventions to improve decision making performance and reduce risk-taking may be differentially effective for individuals with particular personality traits and for men vs. women.

References:

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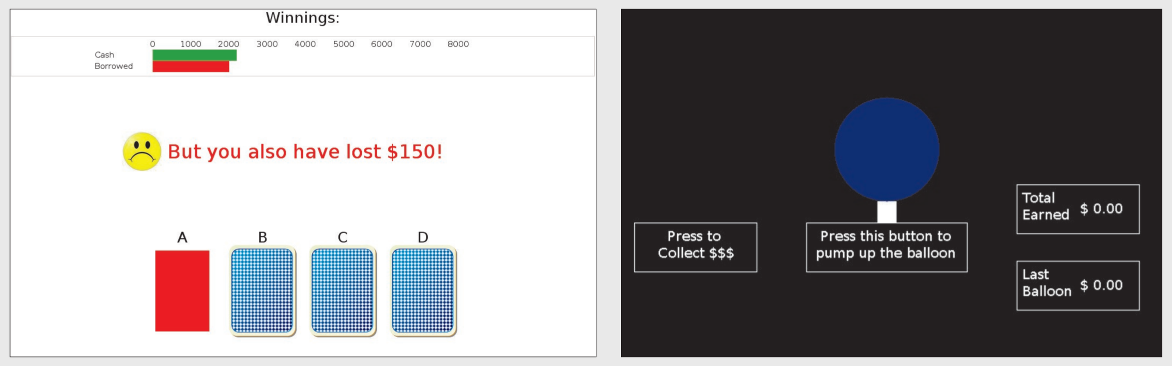
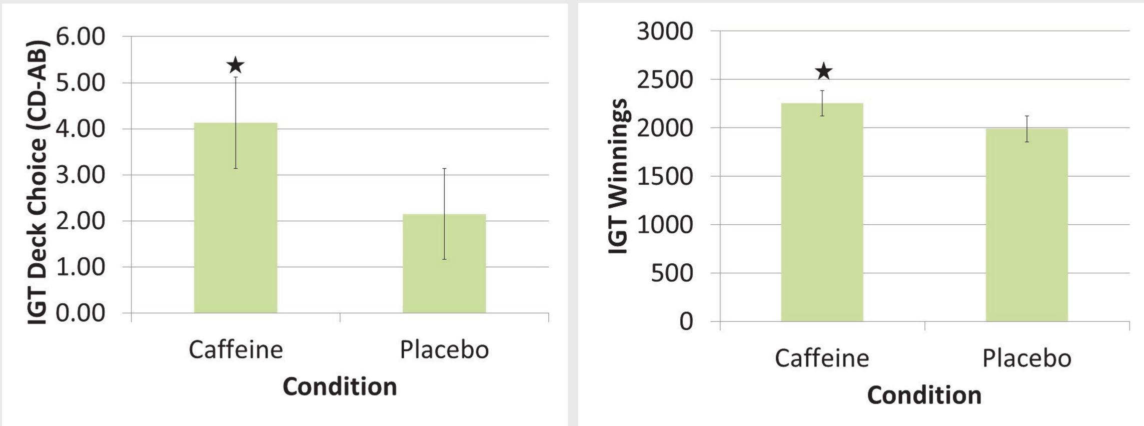
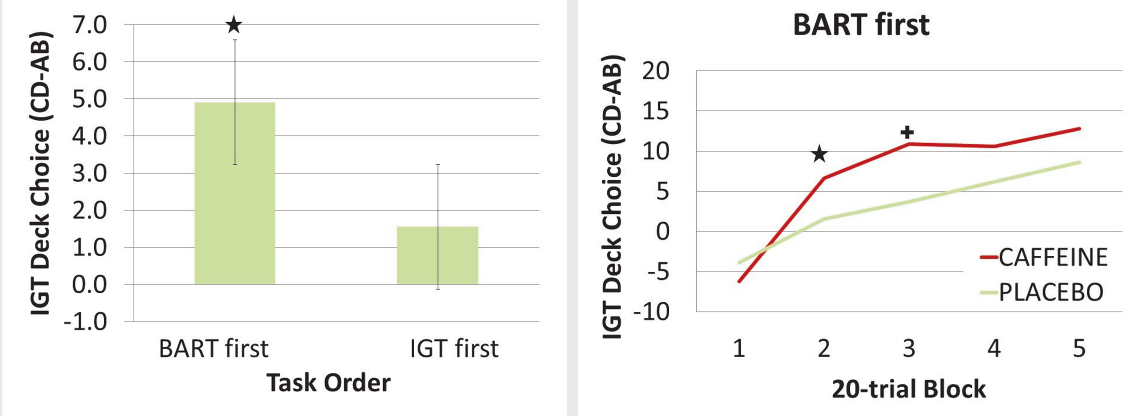


Screenshots of PEBL versions of IGT and BART tasks.



Left: Mean (±SEM) IGT deck choices by condition (p=0.049).
Right: Mean (±SEM) IGT winnings by condition (p=0.047).



Left: Mean (±SEM) IGT deck choices by task order (p=0.002). Task order was counterbalanced, and we saw that caffeine's effects were far more prominent when the IGT was the second task: caffeine had more time to take effect. Right: Mean IGT deck choices for BART first order only (* p<.05 for caffeine vs. placebo; ⁺ p<.05 for caffeine x order interaction).

Dependent Variable	Variables in Best Fit Model	R^2
IGT winnings	GDMS Avoidant, ABIS Non-Planning, Condition x Order, Order x Gender	0.16*
IGT deck choice	DOSPERT Ethical, GDMS Avoidant, Condition x Order, Order x Gender	0.19**
BART winnings	GDMS Rational, GDMS Intuitive, Condition x Order, Order x Gender	0.21*
BART pumps	GDMS Intuitive, ABIS Motor, Condition x Order, Order x Gender	0.21**
Adjusted BART pumps	GDMS Intuitive, ABIS Motor, Condition x Order, Order x Gender	0.16*

Individual differences in risky decision making were explored using best-fit regression models for each DV. Each of the listed models explained a significant proportion of variance. Along with experimental condition, a variety of variables combined to contribute explanatory power with regards to task performance: decision making style (GDMS), impulsivity (ABIS), risk propensity (DOSPERT), and gender (* p<.05, ** p<.01).

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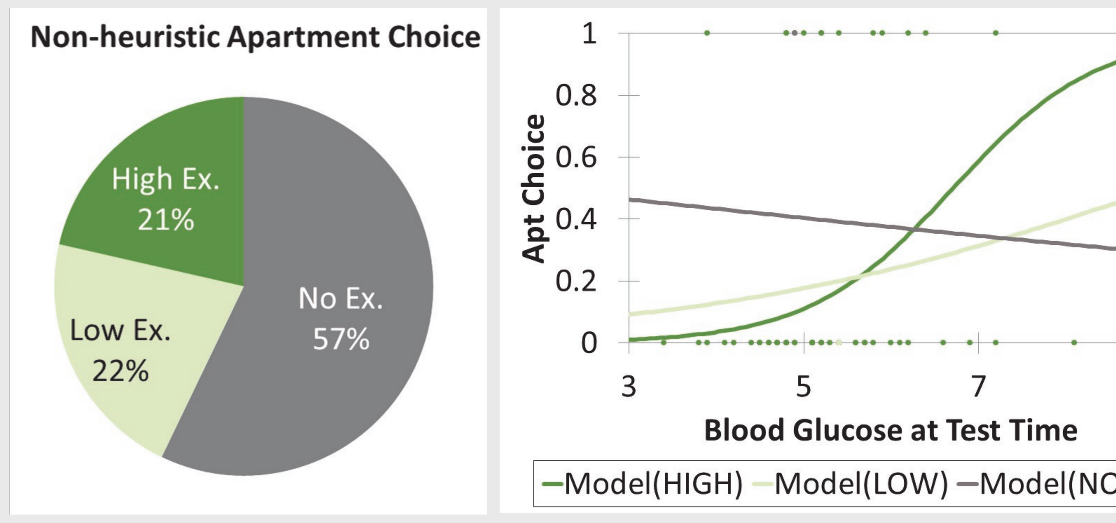
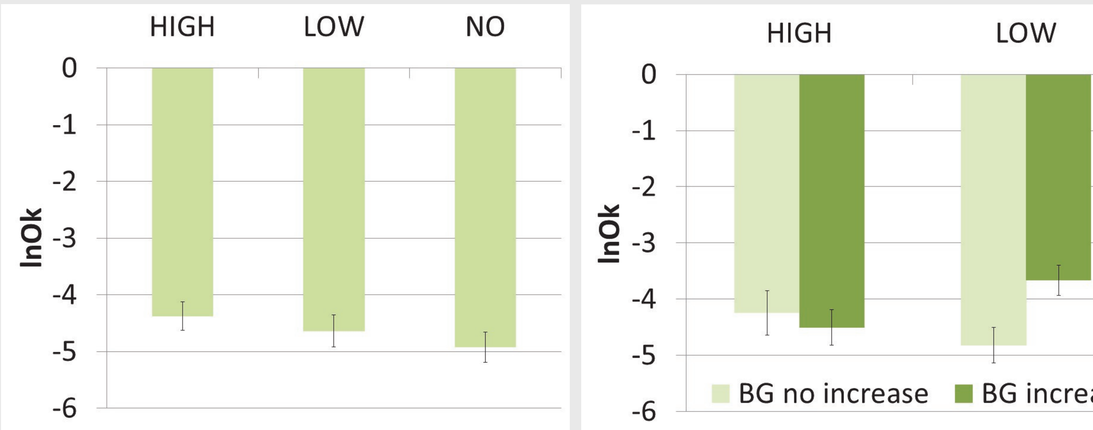
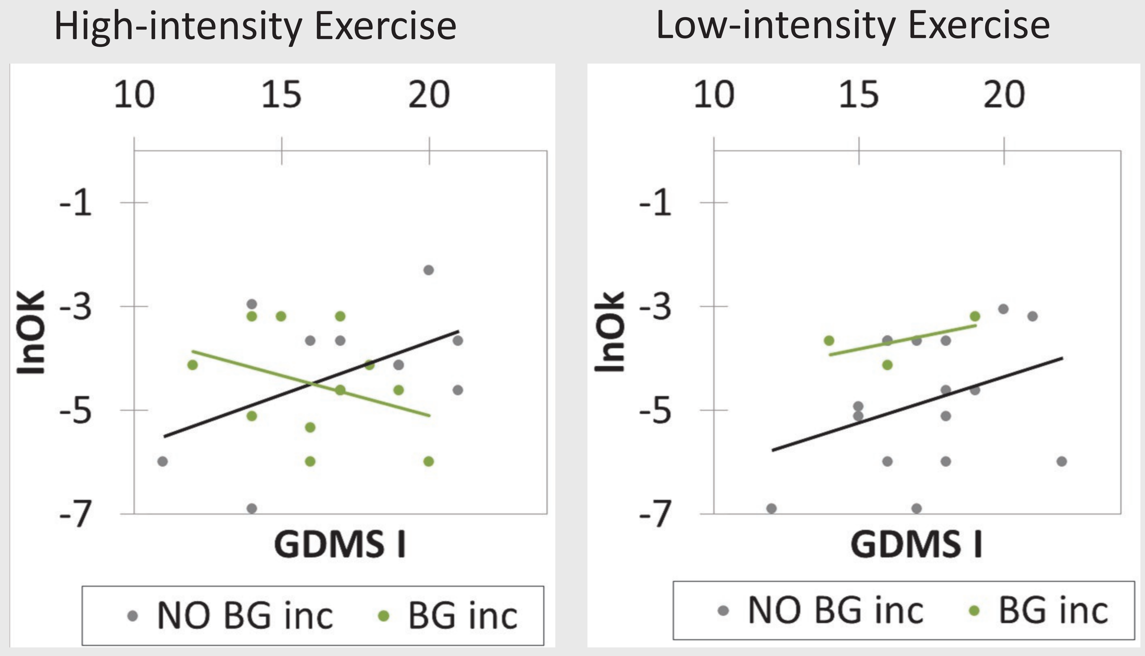
Exercise and glucose



Left: No significant prediction by exercise group of non-heuristic choice (p=0.09). In fact, the pattern suggests that no exercise participants seem best able to resist the heuristic. Right: However, when logistic regression took post-exercise blood glucose level into account, for the high-intensity exercise group apartment choice was significantly predicted (p = 0.03).



Left: No significant difference among exercise groups in delay discounting (p=0.33). Note that higher k values indicate greater levels of discounting. Right: When exercise-induced increase in blood glucose level is into account, a there is still no significant difference (p=0.13 for BG increase; p=0.13 for BG increase x group).



Individual differences in decision making style were explored using best-fit multiple regression models for the delay discounting index. A model including exercise condition, intuitive decision-making tendencies, and blood glucose increase significantly predicted k values (R^2=.36, p<.01). Left: For participants in the high-intensity exercise condition whose blood glucose levels increased, those reporting more intuitive decision-making tendencies were able to resist delay discounting. Right: No such "rescue" trend was apparent for the few low-intensity exercise participants whose glucose increased.

Introduction:

- Manipulation of blood glucose can impact decision making.
- Exercise offers many benefits, but its impact on decision making is unknown.
- High-intensity exercise can boost blood glucose, suggesting it may be particularly beneficial for decision making.

Hypotheses:

- **High intensity exercise will increase blood glucose and improve decision making** relative to low-intensity exercise and no exercise controls as measured by:
  - Apartment Choice Task (attraction effect)
  - Kirby Monetary Choice Questionnaire (delay discounting)
- **Individual differences** in decision making style (GDMS) would influence the impact of exercise on task performance.

Methods:

→ Experimental design with random assignment into

→ IV: High-intensity exercise (>80% VO2 Max) vs. low-intensity exercise vs. no exercise (on a cycle ergometer)

→ DV: Apartment Choice Task (attraction effect) and Kirby Monetary Choice Questionnaire (delay discounting)

→ Individual Difference Measures

- → Blood Glucose level (pre– and post-exercise)
- → General Decision Making Style (GDMS)
- → Demographic survey

Conclusions:

The benefits of exercise, including in the cognitive realm are often touted, but little is known about the effects of exercise on decision making. The fact that different exercise intensities produce distinct effects on blood glucose levels suggest the potential for differential cognitive impact.

Findings indicated that high-intensity exercise increased blood glucose in half the participants. Those participants were resistant to the attraction effect in the apartment task. When intuitive decision-making styles were taken into account, the blood glucose increase also appeared to predict resistance to delay discounting. The results were complex, however, and statistical power was limited by the small number of people in our sample who managed to achieve the blood glucose boost following intense exercise.

Further research should investigate how internally generated changes in blood glucose could impact judgment in real world conditions. Our findings also suggest that decision making styles may complicate our interpretation of delay discounting measures.

References:

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