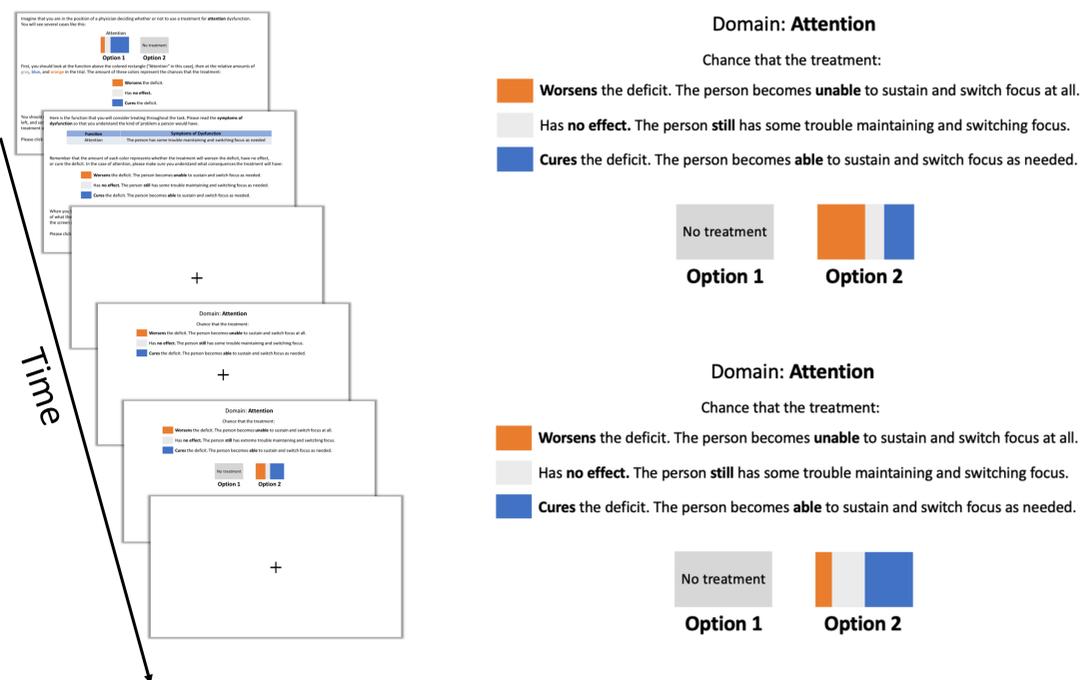


Background

- Risk and benefit sensitivity have been studied in medical decision making for many years, including in choices involving treatment recommendation across the public (1, 2, 3). Though with neuromodulation technologies rapidly emerging, little is known about how individual differences in risk and benefit sensitivity influence neuroethical choices such as when to administer treatments.
- Drawing from prospect theory (4), we test the tendency of individuals to weigh losses (risks) more heavily than gains (benefits) to examine the influence of risk and benefit sensitivity on the public's choices to recommend treating cognition with hypothetical neuromodulation technologies.
- We expected the participants would be more sensitive to risks of losses than potential gains, would nonlinearly weigh probabilities when assessing treatments and be more risk-sensitive when evaluating technologies that influenced cognitive functions like mood, self-control, and long-term memory.

Methods

Figure A: Neuroethical judgment paradigm



We administered a neuroethical judgment paradigms (see Figure A) to 425 participants recruited via Amazon Mechanical Turk. Participants were asked to choose whether to recommend hypothetical neuromodulation treatments with varying degrees of associated risks and benefits in seven different cognitive domains. Risk and benefit sensitivity were quantified by the subject specific random effects for risks and gains extracted from a mixed effect logistics regression model.

Results

Figure B: Inter-domain stability

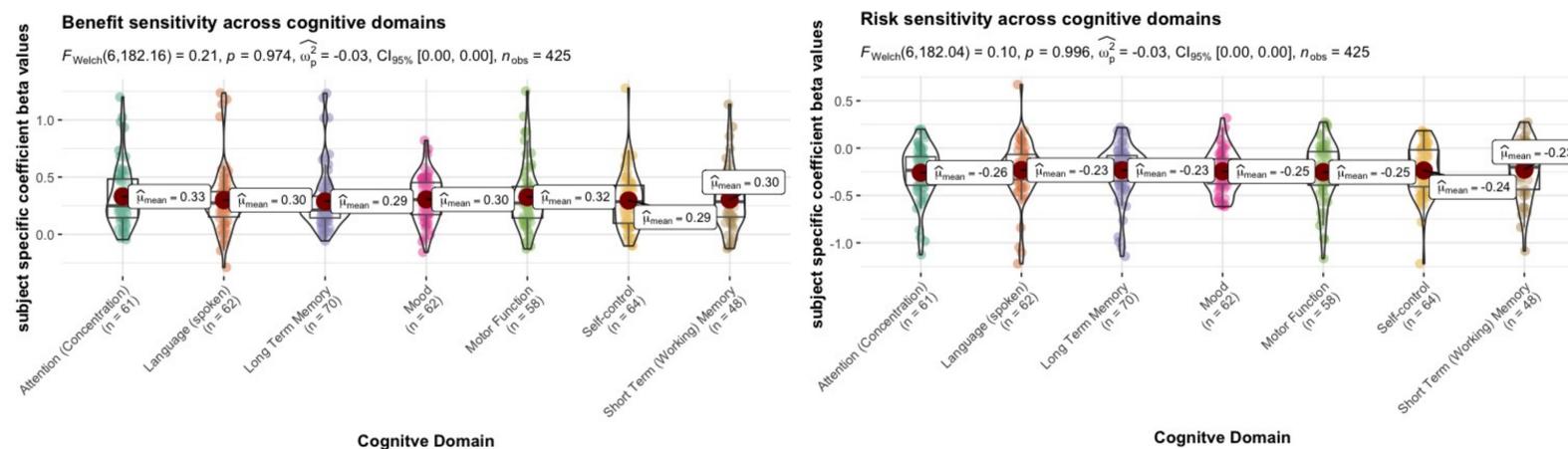


Figure C: Difference between risks and benefits

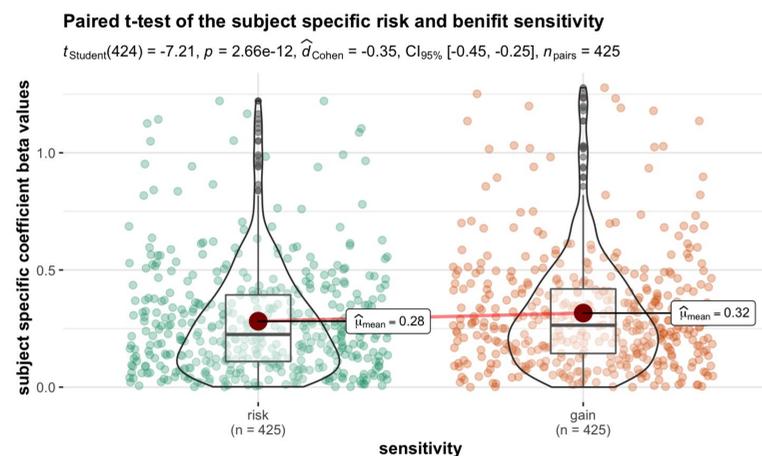
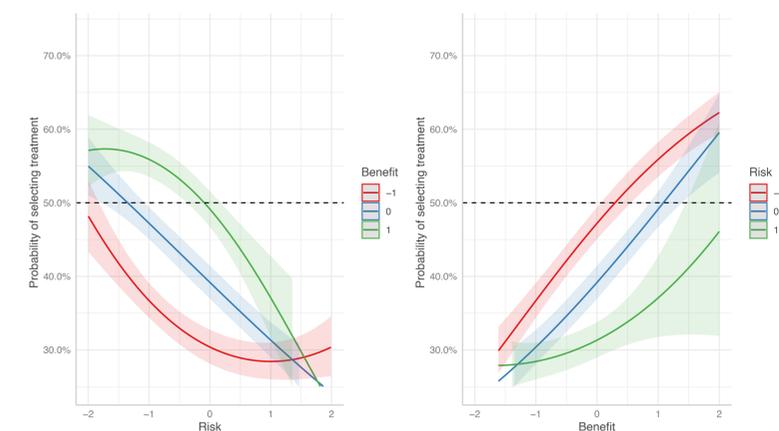


Figure D: Curvilinear weighting of risks and benefits



Conclusions

This study suggests that judgment tasks can be adapted to study psychological neuroethical choices. We found unexpected inter-domain stability in risk and benefit sensitivity across cognitive dysfunctions (see Figure B). Per prospect theory, the relatively higher weight placed on benefits (see Figure C) might be due to reference points being set by cognitive deficits rather than a normal baseline. Lastly, as predicted by prospect theory we did find some evidence that participants made choices using nonlinear weighting of the probabilities for risks and benefits (see Figure D).

References

- Hauber, B., Fairchild, A., & Johnson, R. (2013). Quantifying Benefit-Risk Preferences for Medical Interventions: An Overview of a Growing Empirical Literature. *Applied Health Economics and Health Policy*, 11(4).
- Rasiel, E. B., Weinfurt, K. P., & Schulman, K. A. (2005). Can Prospect Theory Explain Risk-Seeking Behavior by Terminally Ill Patients? *Medical Decision Making*, 25(6), 609–613.
- Waters, E. A., Weinstein, N. D., Colditz, G. A., & Emmons, K. M. (2007). Reducing aversion to side effects in preventive medical treatment decisions. *Journal of Experimental Psychology: Applied*, 13(1), 11–21.
- Kahneman, D., & Tversky, A. (1979). Prospect Theory: An Analysis of Decision under Risk. *Econometrica*, 47(2), 263–291.