Graduate Research Statement

The Neural Systems of Social Influence on Risk Conformity

Background: Social influence (SI) is a critical, yet under-examined component of risky decision making. An abundance of experimental paradigms have been developed to explore SI or risky decision making independently. However, these concepts have been largely segregated and have not been explored together in relation to brain activity. Risk preference can be assessed with a probability discounting task (PDT) in which a participant is asked to make a series of choices between receiving two differing amounts of a reward at varying uncertainty levels of receiving or losing those rewards.[1] These choices represent high-risk/high-reward versus low-risk/low-reward scenarios. In the real world, variations in these choices are influenced both by one's own personality and by the decisions that others are perceived to make in the same scenario. Like many decisions one makes, knowing others' choices provides a social cue. However, not all social cues lead to beneficial decisions. Since SI is a strong risk factor for engaging in gang violence, unprotected sex, underage drinking, hazing, and more serious criminal offenses,[2] the PDT, with social cues, may be a vital measure of SI on risk conformity.

Functional magnetic resonance imaging (fMRI) is a tool used for assessing how brain regions co-activate according to the blood oxygen level dependent (BOLD) signal. BOLD signal can be measured while one performs a task. Higher than average BOLD signal in regions suggests their importance at the time measured in the task. fMRI studies on the neural correlates of risk preference link BOLD activity in "reward regions" like the striatum, anterior cingulate, insula, and prefrontal cortex.[3] Studies examining the neural correlates of knowledge of others' thoughts implicate the temporo-parietal junction (TPJ).[4] Critically, these fMRI measures may help clarify subtle influences on choices that are not always behaviorally expressed.

No study to date has examined the relation between SI effects on risk conformity and brain activity. This study proposes to use a novel fMRI PDT to address this gap in the literature. Specifically, this study hypothesizes that when shown others' choices, participants' risk conformity will be associated with higher brain activity in the TPJ and reward regions.

Methods: Participants: This study will recruit a sample of 30 right-handed college students (ages 18-22) with equal numbers of males and females. Upon consent, participants will be screened for exclusion criteria such as psychiatric conditions and history of head trauma. Questionnaires: In addition to completing a neurocognitive battery to assess working memory, IQ, and anxiety on the day of the task, participants will complete questionnaires that assess social agreeableness, socioeconomic status, locus of control, and impulsivity. These questionnaires will help isolate effects related to personality from task-induced effects as they have previously been linked to risky decision making and SI. fMRI Paradigm: During the visit, participants will complete an fMRI version of the PDT that will consist of four blocks of 90 trials with 36 unique presentations. Each trial will consist of a 4000 ms fixation cross, followed by an 8000 ms choice presentation and 1000 ms choice indication. Whereas typically, participants are only asked to choose between receiving different amounts of money at varying probabilities (e.g. "would you rather have $10 at a 75% chance or $20 at a 50% chance"), this task will sometimes simultaneously show a percentage of past purported participants (PPs) who selected an option (e.g. "80 percent of other participants chose $10 today"). Chances of winning or losing various amounts of money will be fixed at 25%, 50%, 75%, and 100%. Throughout the task, participants will either see no percentage of PPs cue (control trials), 0%, 20%, 50%, 80%, or 100% with a choice presentation. These percentages will vary for all likelihood options. Showing varying percentages of PPs enables a thorough analysis of individual differences in sensitivity to aggregate SI. To prevent attempts to learn from non-existent patterns across the duration of the

task, participants will not be shown whether they won or lost money until the task ends. This allows isolation of the decision process from learning strategies across time. To ensure that participants believe PPs' choices are real, during consent, they will be asked whether the researchers can include their task results with future participants. At the end of the study, participants will complete a questionnaire assessing suspicion of the task. Suspicious participants will be removed from analysis. Image Acquisition: To aid spatial alignment to a standard coordinate system, a T1-weighted anatomical scan will be acquired. For fMRI scanning, T2*-weighted sequences will be acquired for each task block. Image processing: Following artifact inspection, fMRI scans will be prepared with FSL software. Separate regressors for each PP cue type will be fit with a temporal derivative for each subject to the task timing. An average difference score will be computed between the proportion of risky choices under SI trials and control trials. The resultant coefficients will be used as participant control variables to account for decision agreement not due to SI. Statistical Analysis: FSL will be used for inference testing with a general linear model fit with personality and battery measures discussed earlier as nuisance covariates. Brain activation strength maps will be compared with task choice responses.

Anticipated Results: It is expected that participants, regardless of their impulsivity, will be more likely to choose an option when a higher percentage of PPs also chose that option. Conversely, participants will be less likely to choose an option when a low percentage of PPs also chose that option. Conformity increases with the percentage of PPs choices should correlate with increasing activity in the reward regions and TPJ. Lastly, whereas no cue should only elicit activity in reward regions, seeing PPs choices should elicit additional activation in the TPJ.

Project Qualifications, Broader Impacts, and Dissemination of Knowledge: Through my independent work examining the social contagion of memory at USC, where I developed a novel form of a memory paradigm to include "virtual confederates," and my experience analyzing brain activity and impulsivity at Vanderbilt University, I have gained the necessary technical skills to complete this project. This project is at the forefront of research on risk taking because it bridges the gap between social and decision neuroscience and would elucidate a ubiquitous component of the pressures many face in risky situations. Untangling these effects can help clarify how the brain integrates information from others with one's own knowledge. This points us toward broad implications for legal interpretation of social mediators of criminal behavior and the interplay between one's biology and their social environment driving poor choices. Should I be accepted to [redacted], I would disseminate findings to colleagues locally at the [redacted] and globally through conferences and policy workgroups like the White House Social and Behavioral Sciences Team. For future directions, I would programmatically explore how other features of the reward system (like dopamine neurotransmission) affect resiliency to SI and tests ways of improving this resiliency.

References

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