**Restricted Funds Proposal – Spring 2017**

**Section 1**

Applicant’s Name: **Adam Morris**

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Program: **Psychology**  
Advisor: **Fiery Cushman**

Year in program: **2**

Application history (prior awards received from Restricted Funds): **None**

Is this related to my overall research program? **Yes**

Title of Project: **Value and choice set construction**

Amount Requested: **$3,500**

Other sources of funding: **None**

**Section 2**

Humans are bombarded with immensely complicated decisions. Imagine a psychology student – Sally – deciding where to eat lunch. Sally has certain preferences (e.g. she likes Mexican food, dislikes walking long distances) and constraints (e.g. she’s deathly allergic to walnuts) that she should factor into their decision. Ideally, she would carefully evaluate all her options, and choose the one with maximal positive outcomes. For example, she might score each option based on how close it is to William James Hall, how Mexican its cuisine is, the likelihood that it uses walnuts, etc., and then choose the option with the highest score. This kind of planning has been intensively studied, and we have some understanding of how it could be accomplished (Doll et al. 2012).

But in any real-world decision, there are an overwhelming number of potential options. There are hundreds of restaurants in Harvard Square, and thousands in the greater Boston area. And the problem is even worse than this, because Sally has more options than just restaurants: She could also grow the crops herself, or catch a wild animal to eat, or steal food from the communal refrigerator, etc. She couldn’t possibly evaluate all her options – she would die of starvation before she finished.

Yet people like Sally are able to make these decisions with speed and ease. How? Intuitively, people don’t consider all possible options – they construct a small set of options to evaluate, and ignore all the rest. For instance, Sally might only consider Darwin’s and Felipe’s, and choose one of those. The process by which people narrow down the enormous set of potential options to a small set of relevant choices is known as *choice set construction*.

The aim of this project is to characterize how choice sets are constructed. Not all options are equally likely to make it into someone’s choice set; people clearly favor some options (e.g. Darwin’s) over others (e.g. catching a wild animal). What determines which options make the cut? One potentially important factor is how good an option has been in the past (i.e. the option’s past value). Options that have been good in the past tend to be good in the future. Thus, the mechanism that constructs choice sets might be designed to propose options with high past values.

To test this, I will employ an experiment with two stages. The idea is to expose people to a large set of different-value options in Stage 1, and then ask them to make decisions using those options in Stage 2. The resulting decision patterns can be tested for signatures of value-based choice set construction.

Specifically, in Stage 1, participants will be exposed to a large set of pseudowords (e.g. “blicket”, “zug”). Each word will be associated with some amount of bonus points. For instance, “blicket” might be worth 5 points. In order to learn these word-value associations, participants will play a game where they repeatedly choose between a pseudoword and a fixed number of points. For instance, on one trial, a person might have to choose between “blicket” and 3 points. If they choose the pseudoword, they earn however many points it’s worth. If they choose the fixed number of points, they receive that many points. (Points translate to bonus money at the end of the experiment.) As participants play the game, they will learn the word-value associations and use that knowledge to win more bonus points.

Then, in Stage 2, participants will face a series of decisions like: “Give us a word from Stage 1 with the most number of vertical lines in its letters. You’ll win 10 points for each vertical line in the letter of your word.” In these questions, the potential options are the pseudowords from Stage 1, and each option is difficult to evaluate. (This is analogous to the situation facing Sally, with her restaurants and food preferences.) I hypothesize that people will construct a small set of words to evaluate, and that words with high Stage 1 point values will be more likely to enter the choice set.

If I’m right, then regressing participant’s choices on the Stage 1 value (e.g. “blicket” = 5 points) and Stage 2 value (e.g. number of vertical lines in “blicket”) of each word will reveal a positive interaction. Intuitively, if people are constructing a set of choices that have high Stage 1 value and choosing among them based on their Stage 2 value, then an increase in one variable will have a larger effect on choice when the other variable is high. Hence, the positive interaction. (Using simulations, I confirmed this intuition: the interaction appears if and only if simulated agents are constructing choice sets based on Stage 1 value.) Moreover, I will fit a full computational model of choice set construction to participant choices, and compare it to two alternative models: one where people construct choice sets randomly (i.e. without using Stage 1 value), and another where people don’t use choice sets at all and instead evaluate each word. Using Bayesian model selection, I will test whether our preferred model is the best fit to participant choices.

Experiment 1 would provide evidence that people construct choice sets using the past value of options. What is the representational status of the low-value options that don’t make it into choice sets? An intriguing hypothesis is suggested by Phillips & Cushman (in press). These authors identify a broad set of cognitive functions that depend on representing sets of alternative possibilities (e.g. causal judgments, judgments of force). Phillips & Cushman argue that, to make these judgments, people employ a mechanism that implicitly represents moral, rational alternatives as possible and immoral or irrational alternatives as impossible. The signature of this mechanism is that, when asked to make judgments under extreme time pressure, people claim that immoral/irrational alternatives are impossible (in the same sense that literally impossible alternatives, like those that defy physics, are impossible).

The mechanism that Phillips & Cushman identify might also underlie value-based choice set construction. People might go beyond excluding options from a choice set; they might actually represent low-value options as impossible.

To test this, I will run a second experiment that combines Experiment 1 with the method of Phillips & Cushman. In Experiment 2, Stage 1 will be the same as before, except some words will be literally impossible to choose. They will be greyed out during choice, and on those trials people will be forced to pick the fixed point alternative. These words will form the baseline of literally impossible options (like the physics-defying alternatives in Phillips & Cushman). Then, in Stage 2, instead of making choices, people will make speeded possibility judgments about the different words. For example, people might be asked: “Imagine that you are playing the game from Stage 1. Would it be possible to choose ‘blicket’?” I expect people to rate choosing the high-value words as possible and choosing the unavailable words as impossible. The critical test is the low-value words. If low-value options are implicitly represented as impossible, then under time pressure people will rate choosing the low-value words as impossible, just like the unavailable words. This result would suggest that low-value options in decision making do not enter choice sets because they are implicitly represented as impossible.

These findings would significantly expand our understanding of how people make decisions in complex environments. The experiments would be incorporated in second-year project, and if successful, would likely form the basis for my future dissertation research.

**References**

Doll, B. B., Simon, D. A., & Daw, N. D. (2012). The ubiquity of model-based reinforcement learning. *Current opinion in neurobiology*, 22(6), 1075-1081.

Phillips, J., & Cushman, F. (in press). Morality constrains the default representation of what is possible. *Proceedings of the National Academy of Sciences*.

**Section 3**

I intend to run both experiments at the Decision Science Laboratory, with a subject payment rate of $15 per hour (as per SONA guidelines) and an average bonus payment of $2.50 per participant. I intend to run 100 subjects for each experiment, and each experiment will take an hour. My proposed budget is therefore:

1. 100 subjects in Experiment 1 X an average of $17.50 per subject = $1,750.
2. 100 subjects in Experiment 2 X an average of $17.50 per subject = $1,750.

Thus, the total budget is $3,500, all for subject payments.

**Section 4**

Both the IRB approval document and my CITI certificate are attached. These studies would all be covered under Dr. Cushman’s “A computational approach to human moral judgment” protocol.

**Section 5**

See email from Dr. Cushman.