Multi-dimensional outcomes

While theories of motivation acknowledge that hedonic stimuli can provide reward across many dimensions (e.g., food, water, shock), most experimental studies use hedonic stimuli that vary across a single dimension (shock/food/juice for animals, money or points for people). However, the hedonic outcomes of many choices, especially for people, are multidimensional. The experience of going to a restaurant will be affected by the quality of the service and of the food. Choices about how much to work may affect pay, stress level, and social relationships. A hike may feature both a beautiful vista and dehydration.

Once hedonic stimuli posess multiple dimensions, the effect of experienced outcomes on future choices becomes potentially more complex. A decision-maker might come to deploy attention differentially cross the outcome dimensions, causing differences in received reward across one dimension to affect behavior more than difference in received reward across another dimension.

Attention

There's a rich literature on the determinants of attention to non-hedonic stimuli. Some aspects of the attention to a stimulus are determined by the stimulus itself. Some stimuli are more intense or salient - a bright light draws more attention than a dim one. But to an important degree attention is selective, and responds to the structure of the environment over time. In classical conditioning, a large literature shows that attention to a non-hedonic stimulus (CS) is determined by the extent to which it allows the animal to *predict* an outcome that was not otherwise predictable. When a CS is repeatedly experienced with no outcome, animals cease attending the stimulus and fail to learn later contingencies between CS and US (latent inhibition).

Richer attentional effects emerge when predictive stimuli have multiple dimensions, as in the literature on category learning. People adjust their attention across dimensions in order to distinguish categories, and come to ignore dimensions that offer no predictive value.

Attention to hedonic stimuli

Just as animals preexposed to a non-hedonic stimulus fail to later learn that the stimulus predicts an outcome, animals preexposed to an uncontrollable hedonic stimulus (such as shock or food) fail to later learn that the stimulus can be predicted and controlled. This phenomenon, termed learned helplessness, has sparked vigorous debate about its possible causes. But while it may be in part motivational or emotional in nature, there is evidence that it shares similarities with the kind of conditioned inattention that occurs during latent inhibition. And just as inattention to irrelevant discriminative stimulus dimensions aids

optimal behavior, inattention to uncontrollable hedonic stimuli may be adaptive by preventing costly superstitious learning.

The learned helplessness effect suggests that attention to hedonic stimuli may change based on the contingencies of the environment over time. But just as category learning experiments with multi-dimensional discriminative stimuli allow a fuller understanding of selective attention than latent inhibition experiments (especially with humans), so too might experiments with multi-dimensional hedonic stimuli allow a fuller understanding of the processing of hedonic stimuli than learned helplessness experiments. (And of course there may be new empirical phenomena emerging from multidimensional hedonic stimuli that are interesting in their own right.)

Experiment 1

In Experiment 1, we test whether in a task where outcomes vary on two dimensions, learned uncontrollability of one of the dimensions will cause failure/slowing of learning when that dimension is later controllable.

method

Participants perform a series of two-armed bandit tasks, where taking an action produces an outcome with two continuous dimensions that sum to produce the total reward. In each phase except the last, the values of the bandits change, but there is always a small difference in means between the actions on one dimension (low controllability) and a higher difference on the other dimension (high controllability). In the final phase, there are equal and opposite differences on the two dimensions. We predict people will be biased to choose the action where reward is higher on the dimension that was predictable in the past, even though total reward is equal across the actions.

Experiment 2

In Experiment 2, we show that even with no changes in reward controllability over time, differences in controllability between dimensions can cause behavior that differs from behavior when reward is assumed to have a single dimension.

method

Two reward dimensions with equal and opposite differences in means between actions, but where one reward dimension has a higher variance. We predict

people will prefer the action that yields higher reward on the low-variance dimension, even though mean total reward is the same for both actions.

Further Experiments

We showed that controllability affects behavior, but is it really attention? Participants might still *attend* to the outcomes but not give them any decision weight. Can we find evidence that they're encoding the outcomes less on the uncontrollable dimension, or giving them hedonic weight? It's hard to imagine people stopping encoding a shock, but maybe there are some less salient outcomes for people that they might start being more inattentive to.

Multi-step task?

Asking people to remember average values of the dimensions?

Some kind of preference questions?