Chronic and Acute Stress Promote Overexploitation in Serial Decision Making

Hypothesis: Stress signals aversive information about one's environment and is hence associated with a lower perceived average reward rate, resulting in greater exploitation of current options. Hence it was hypothesized that in a virtual patch foraging task, participants under stress would either overexploit the current patches or leave the patch early, at a lower reward threshold.

Findings: Both acute physiological and chronic subjective stress are associated with greater overexploitation or staying at current options for longer than optimal.

Methods used to study the hypothesis:

1. **Questionnaire**: Before the task was performed, stress levels in the participants were identified by collecting subjective responses to a self-assessment questionnaire about chronic perceived life stress (the PSS).
2. **Participants:** The test subjects consisted of 29 and 36 people in the healthy group and the stress group respectively. They were given monetary rewards for participating and for performing well on the task.
3. **Task:** Sequential patch-foraging task in which they spent a fixed amount of time in 4 patches (7 min each) of 2 environment types (differing by the spacing between the patches i.e the travel time was 6 seconds and 12 seconds respectively). The harvest time was 3 seconds on all patches. On each trial, subjects decided whether to harvest the current tree or move to a different tree. On each trial, if the subject did not make a response in the allotted 1 s response window, a warning message was displayed and a timeout was incurred. The decrease in reward rate at each trial was given by the random Beta distribution function.
4. **Induction of stress:** Stress induction was done using the cold pressor task in which subjects in the stress group were asked to submerge their nondominant arm in ice-cold water for 3 minutes and as a control, warm water was used instead. This induced an acute stress response in the subjects.
5. **Saliva samples:** Cortisol levels were measured by collecting saliva samples once at the start, once after the cold pressor task, once in the middle of the foraging task, and once at the end of the task. These samples were used to identify stress levels at different stages.
6. **Normative model to analyze suboptimality in gain:** The individual results were compared with the optimal strategy as proposed by the MVT. According to the MVT, the optimal decision rule is to leave when the expected reward from one more harvest is smaller than the average expected reward in a given environment.

Results:

1. All participants, on average, showed close to optimal behavior in leaving the patch as predicted by the MVT, i.e., they adopted lower thresholds in sparse environments and higher thresholds in rich environments.
2. Participants with higher indices of stress (both acute and chronic) harvested trees for longer despite diminishing returns i.e., they had lower exit thresholds (overexploitation).

Other parameters that come into the picture while analyzing the role of emotion in foraging behavior are:

- Temporal discounting of monetary reward
- Risk preferences (diminishing marginal utility)
- Negative evaluative biases such as fear and sadness

These aspects must also be analyzed in future research to understand the mechanisms underlying the role of stress in foraging behavior.