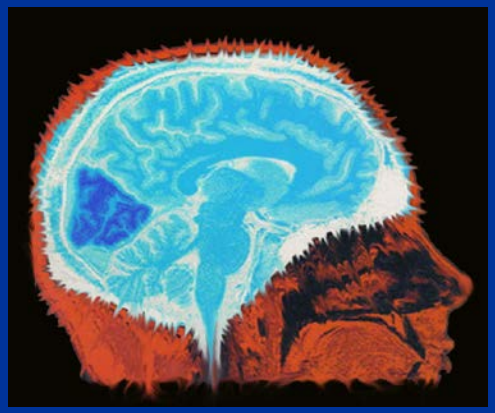
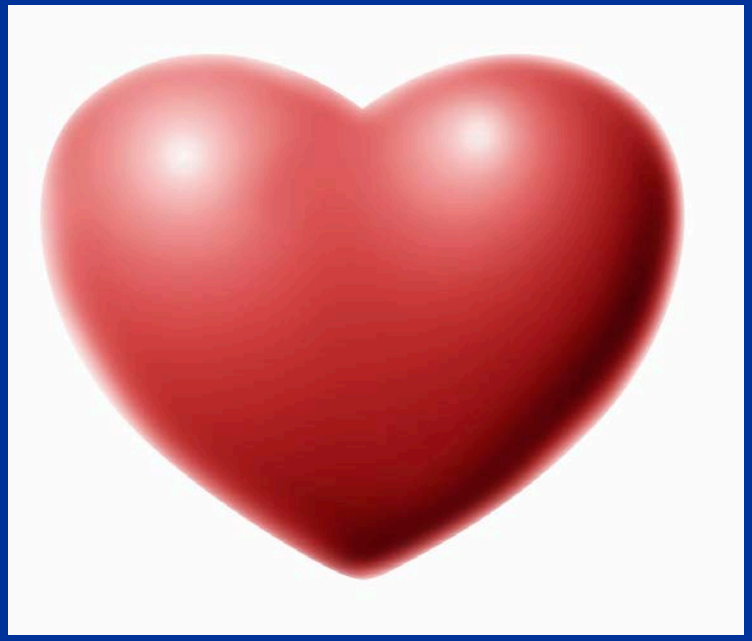


Emotion and Decision Making

Elizabeth A. Phelps
Silver Professor of Psychology and Neural Science
New York University

Emotion and Decision Making

Competing processes?

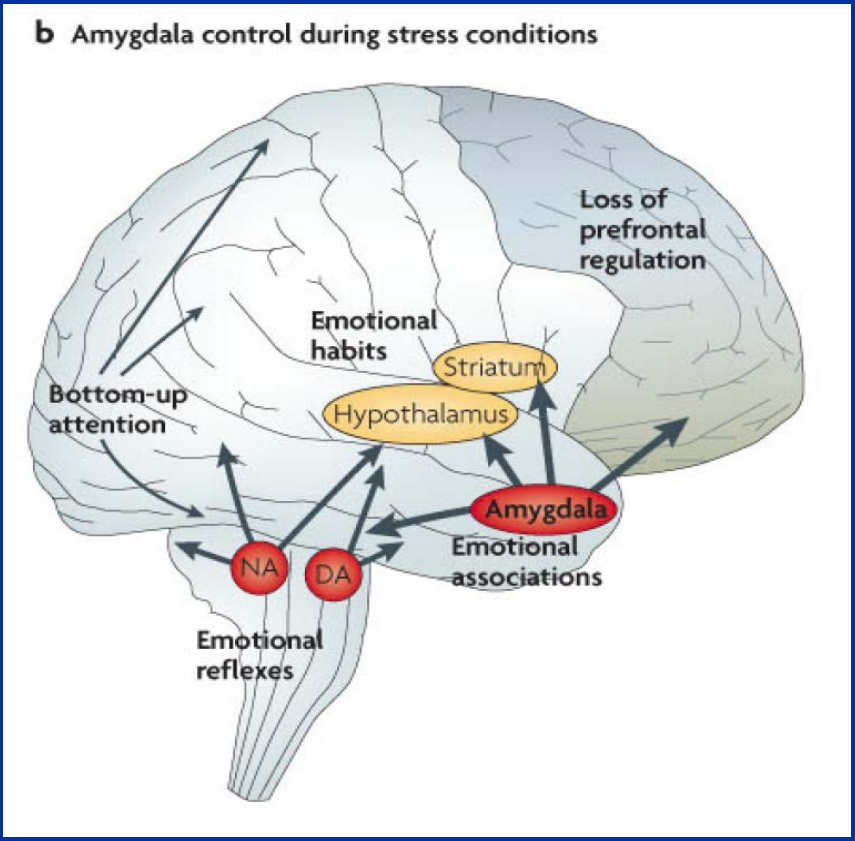


The influence of emotion or affect on decisions is modulatory and can be *integral* or *incidental* (Phelps et al., 2014; Lerner et al. 2015)

Stress

Body's response to real or implied threat induced by novel, unpredictable, or uncontrollable situations (Lupien et al, 2007)

Arnsten, 2009



Stress

- **Attribution Decisions**
- **Model-based – Model free Choice**
- **Sequential Decisions (Foraging)**

Inducing *stress*

- Cold Pressor Test (CPT)

  - **Cortisol** response
    - ~10 minutes rise time, 30-45 minutes to baseline
    - Salivary cotton swab

Attribution Decisions

Default to Dispositional Person Attributions

Behavior

Dispositional Factors: Personality

Situational Factors: Context

Cognitive Control

Disposition "Rude"

Situation "Rushed"

Time

Fundamental Attribution Error:
Overweighing dispositional explanations for behavior

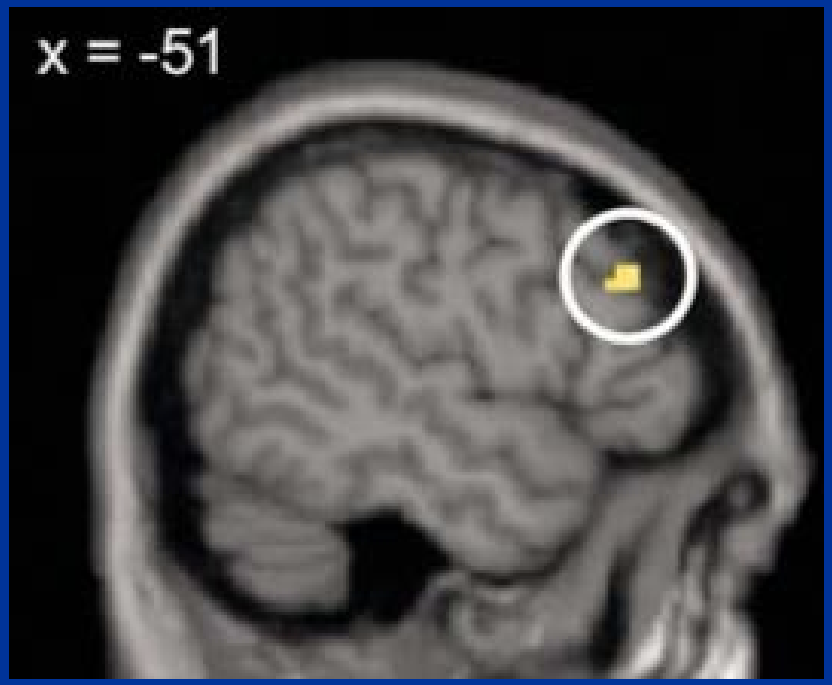
Tom left the restaurant in a hurry without tipping the waitress.

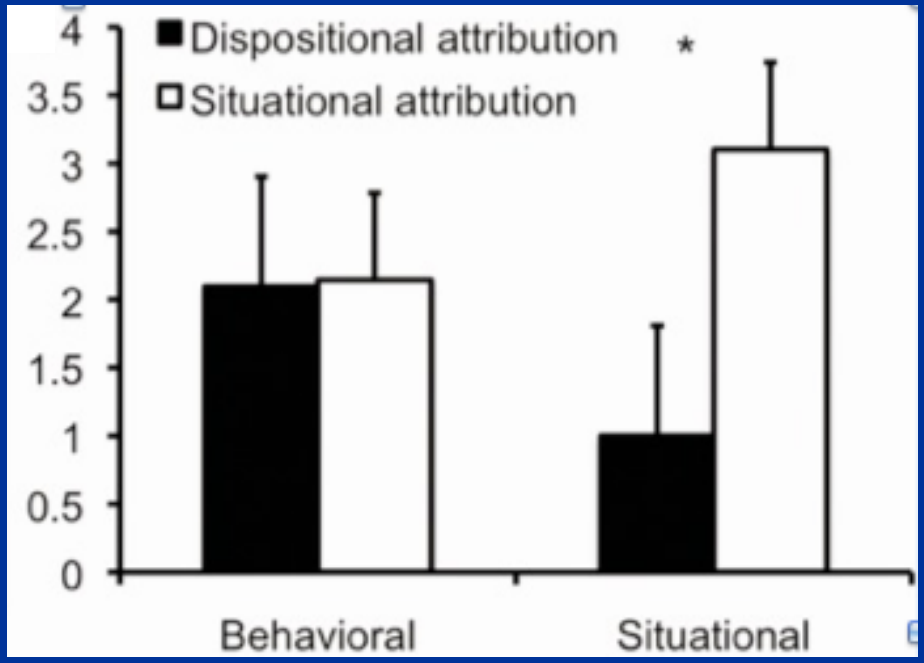
Tom’s baby was screaming.

The behavior was caused by

Situational factors 1 2 3 4 5 6 7 8 Dispositional factors

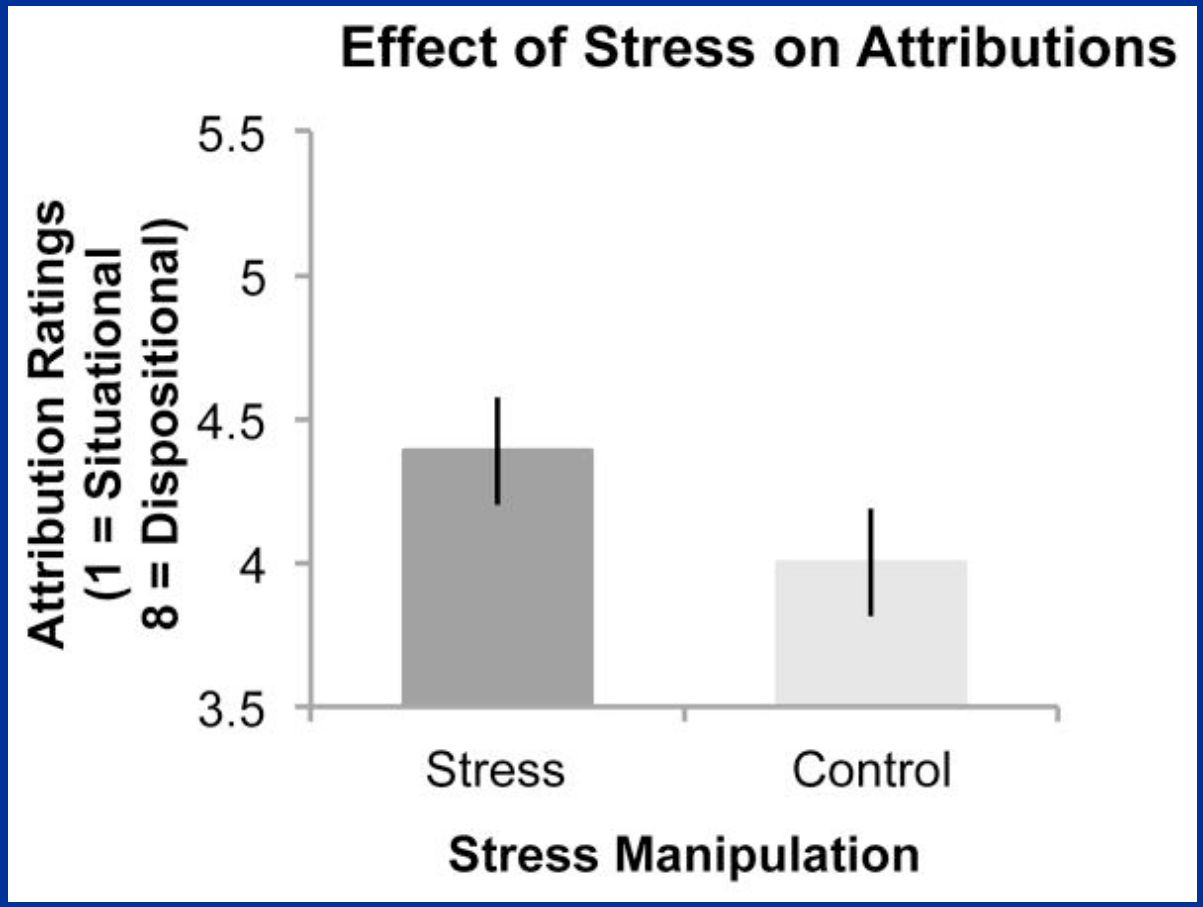
Situational attributions engage prefrontal cortex





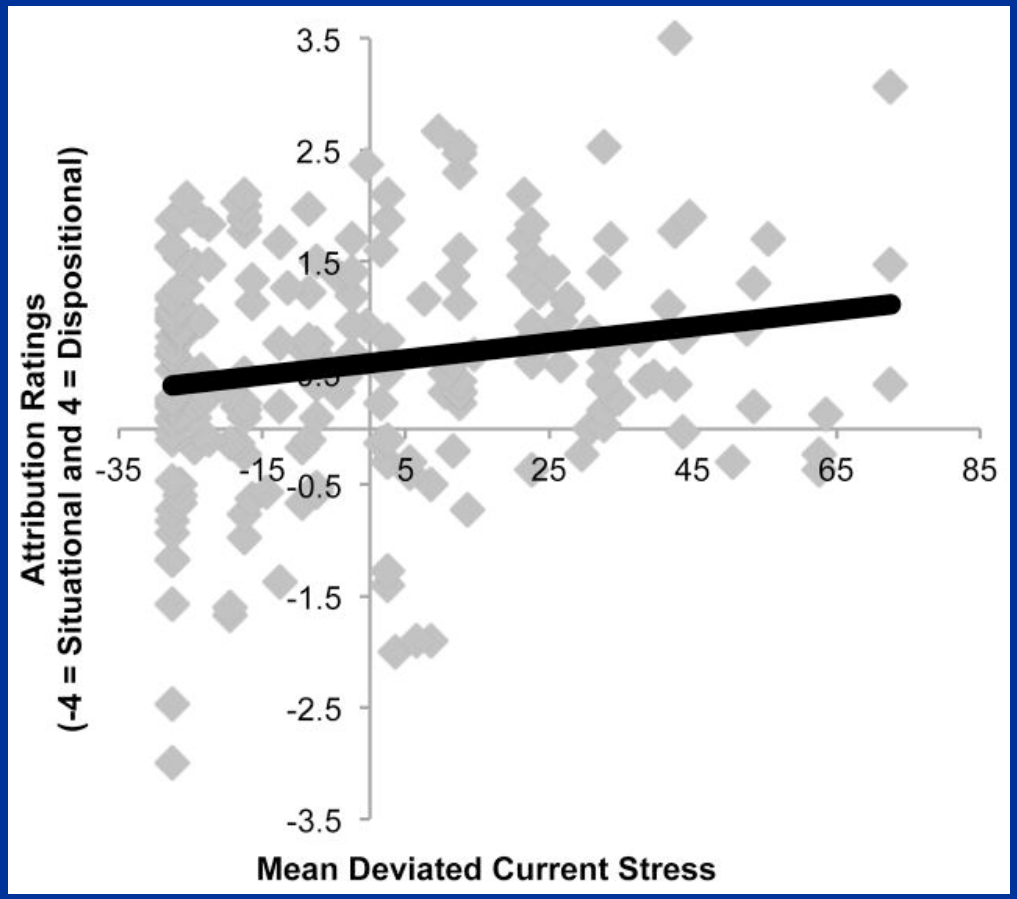
Brosch et al., 2014

Acute stress results in more dispositional attributions



Kubota et al., 2014

Current subjective stress correlates with more dispositional attributions for legal decisions (mturk)

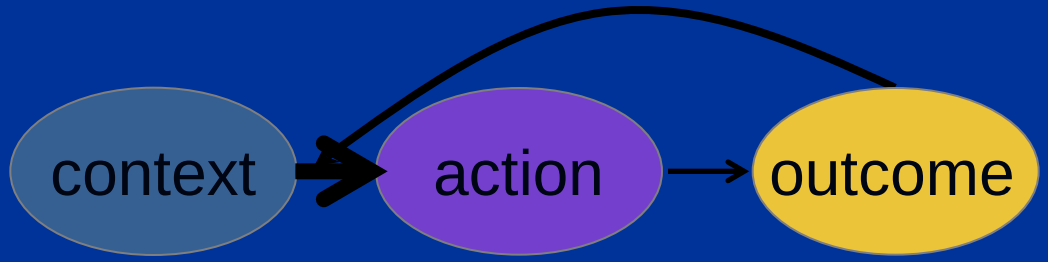


Kubota et al., 2014

Stress

- **Attribution Decisions**
  - **Biases decisions about the *cause* of behavior**
  - **Incidental stress biases one to (further) underestimate the role of the situation in determining behavior**
- **Model-based – Model free Choice**
- **Sequential Decisions (Foraging)**

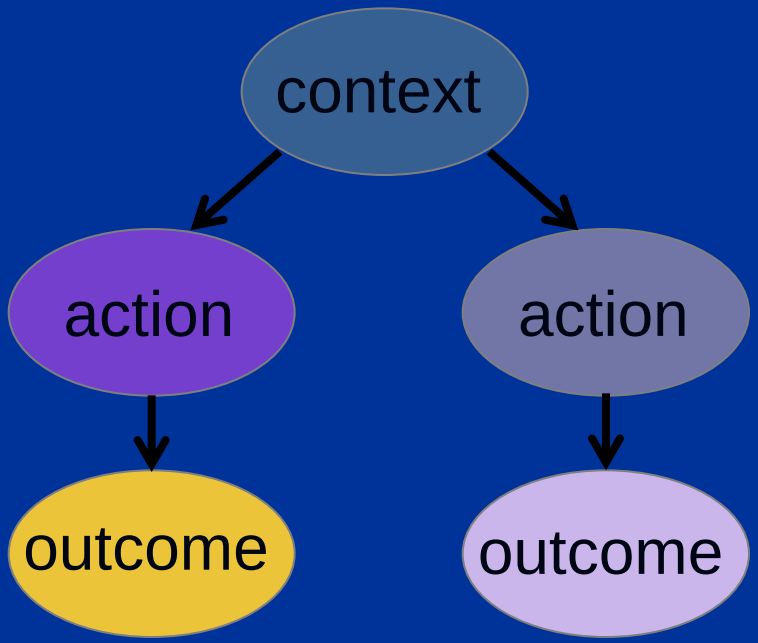
model-free learning



enables reflexive repetition of previously successful actions

- promotes action without forethought or attention
- is insensitive to changes in outcome value or contingency

model-based learning

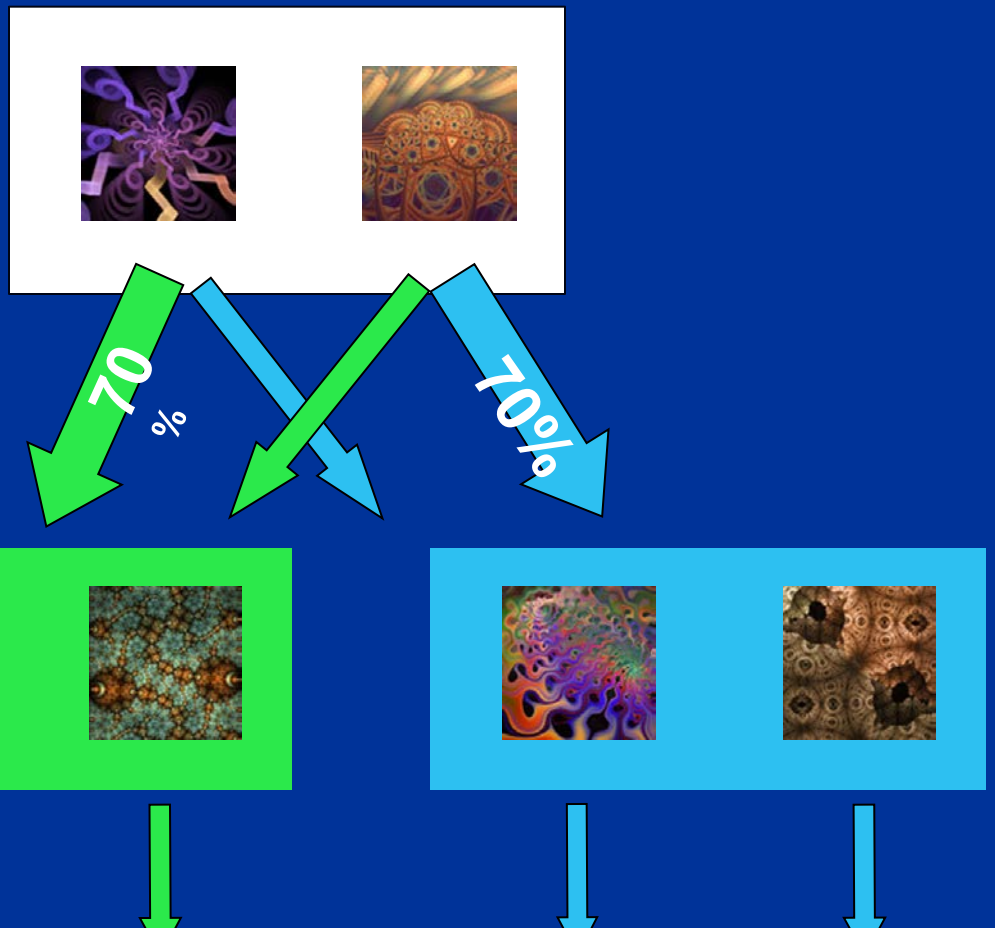


cognitive model

enables prospective choice of actions likely to obtain a goal

- supports flexible adaptation to changes in the environment
- requires costly cognitive resources, including working memory (Otto et al., 2013)
- involves prefrontal cortex

Two-Step Task



with prob:

26%

57%

41%

28%

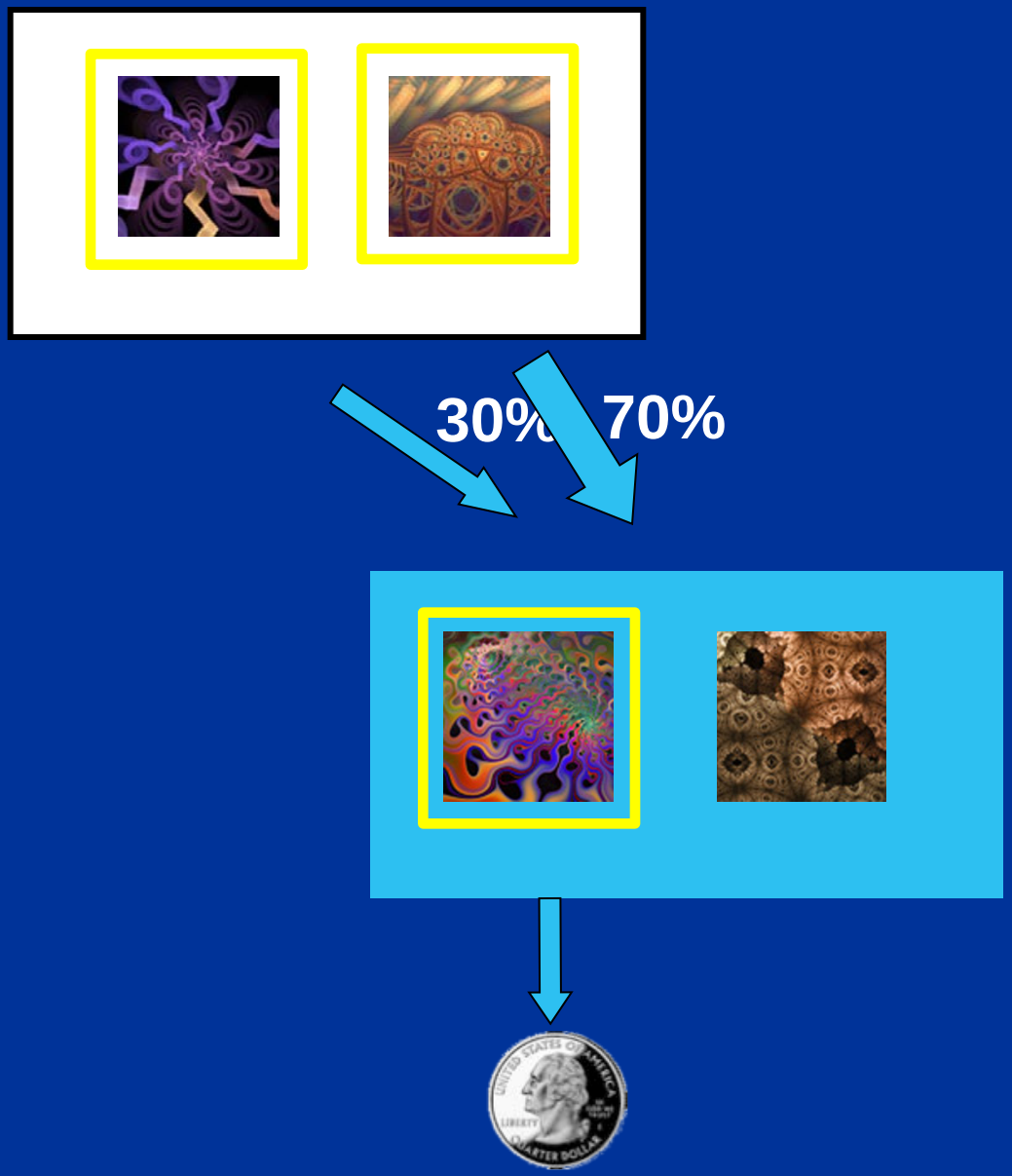
(*all slowly changing*)

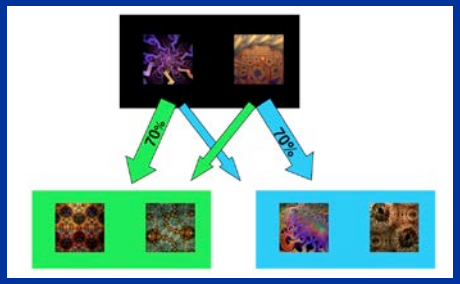
Two-Step Task

How does bottom-stage feedback affect top-stage choices?

Example: **rare transition** at top level, followed by win

- Which top-stage action is now favored?

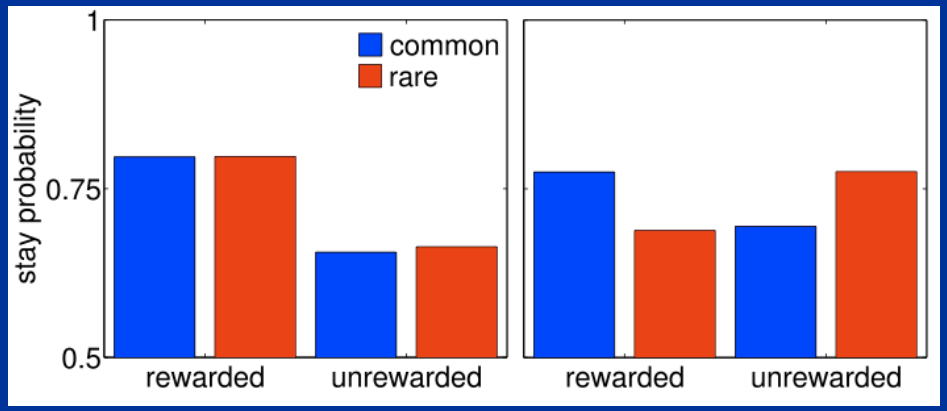




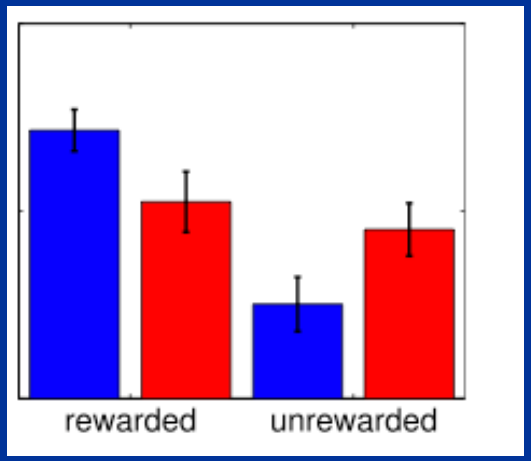
Two-Step Task

Model-Free
Ignores transition structure

Model-Based
Cares about transition structure



Human Subjects



Model-Based Index = size of individual's **reward x transition** interaction

Model-Free Index = size of individual's main effect of **reward**

Daw et al. (2011)

Design

N=56

0 min → + ~25 min → + ~43 min → + ~79 min

measure cortisol

OSPAN

measure cortisol

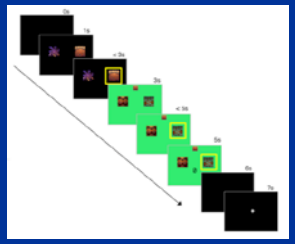
CPT

Cold Pressor [**stress**]
Room Temp [**control**]

[3 min]

measure cortisol

Two-Step Task (200 Trials)

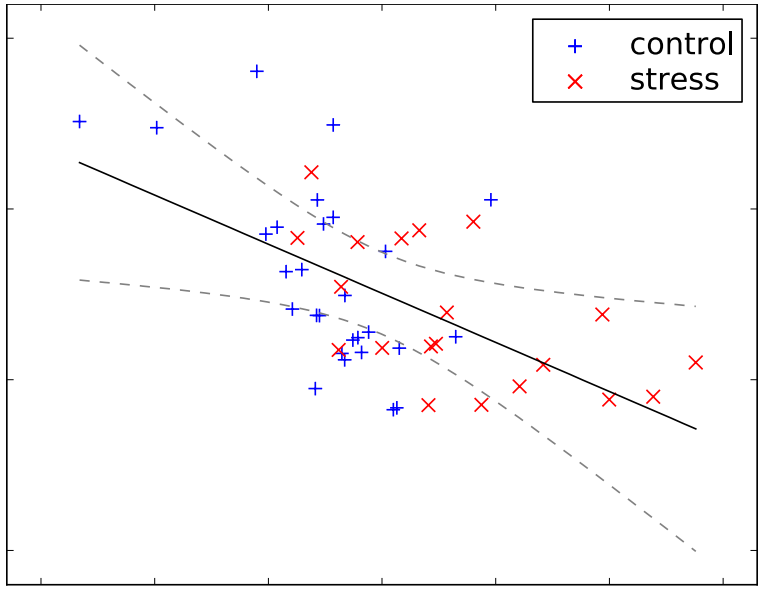


measure cortisol

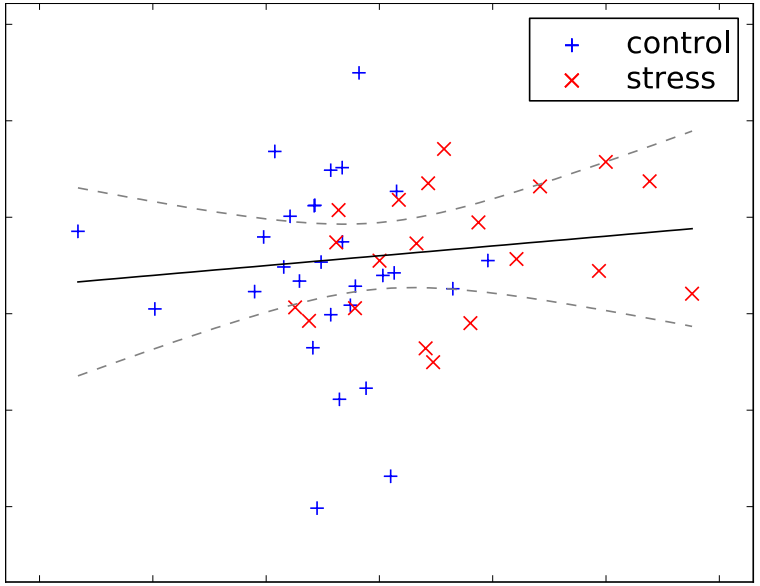
Otto et al., 2015

Greater cortisol increase with acute stress, less model-based choice

Model-Based Choice Contribution



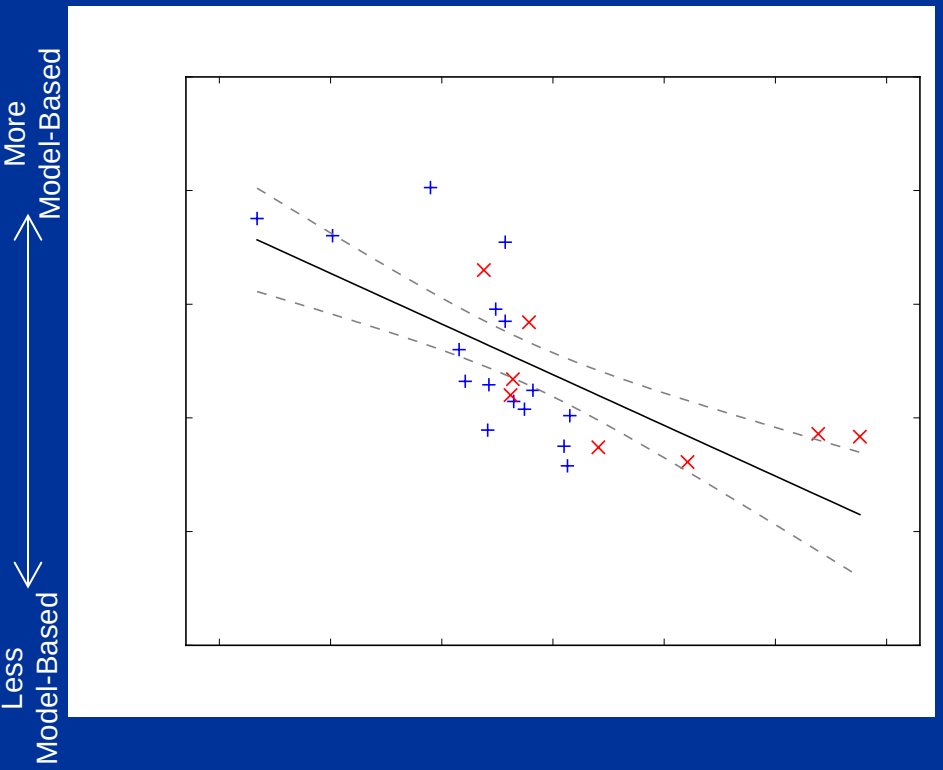
Model-Free Choice Contribution



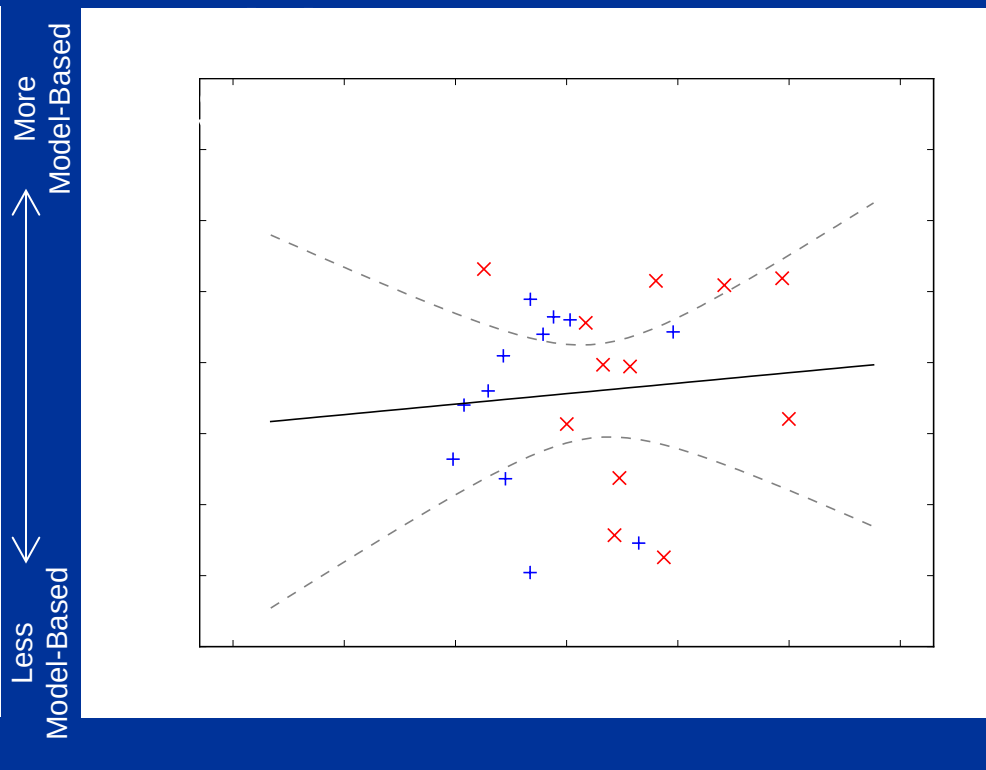
Otto et al., 2015

High working memory capacity protects against stress effects on model-based choice

Low O-span



High O-span

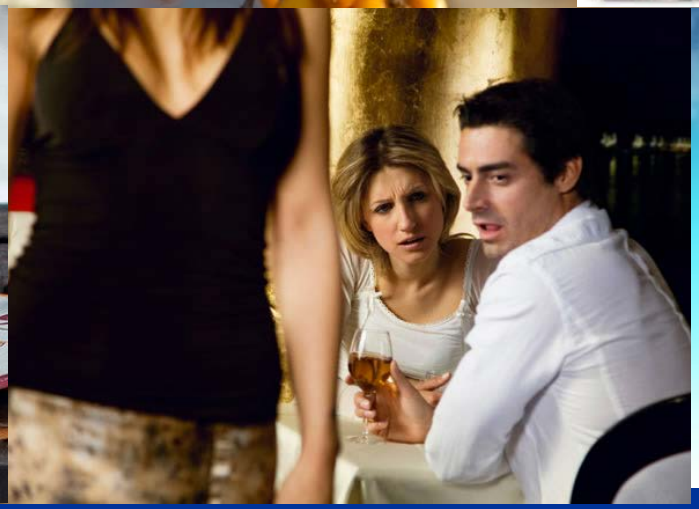


Otto et al., 2015

Stress

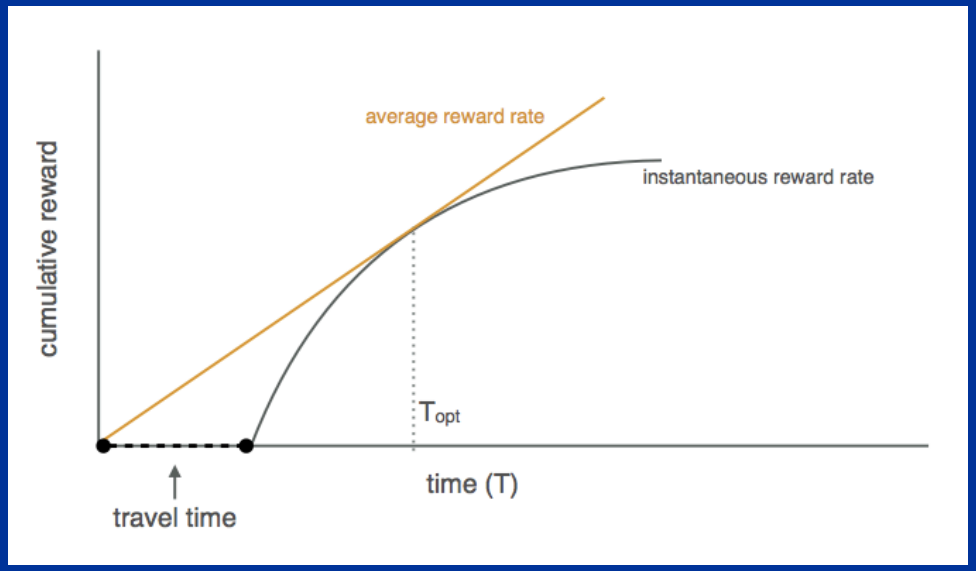
- Attribution Decisions
  - Biases decisions about the *cause* of behavior
- Model-based – Model free Choice
  - Biases decisions to rely *less* on a complex model of the decision context
  - More automatic, less goal directed
  - Working memory capacity may protect against impact of stress
- Sequential Decisions (Foraging)

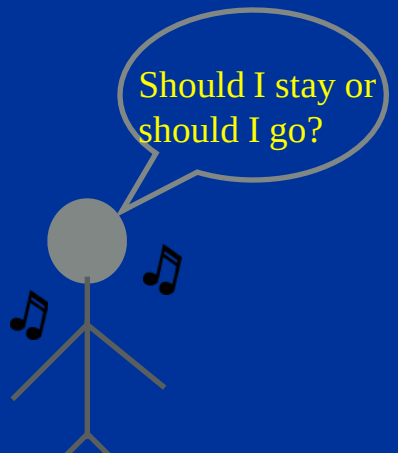
Foraging decisions underlie real-world sequential decisions

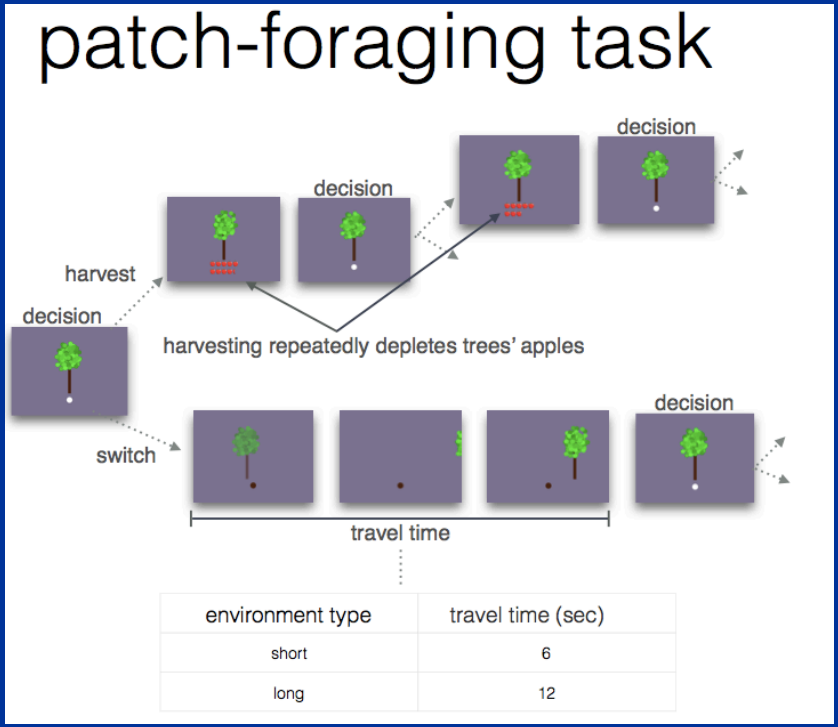


Foraging

- compare quality of current option (instantaneous reward rate) v. overall quality of environment (average reward rate)
- when instantaneous reward rate falls below average reward rate (plus cost of time), it is optimal to leave (Marginal Value Theorem)







- goal to accumulate as many apples as possible within fixed amount of time

- requiring tradeoff between using this time to exploit current depleting trees or travel to new unharvested trees

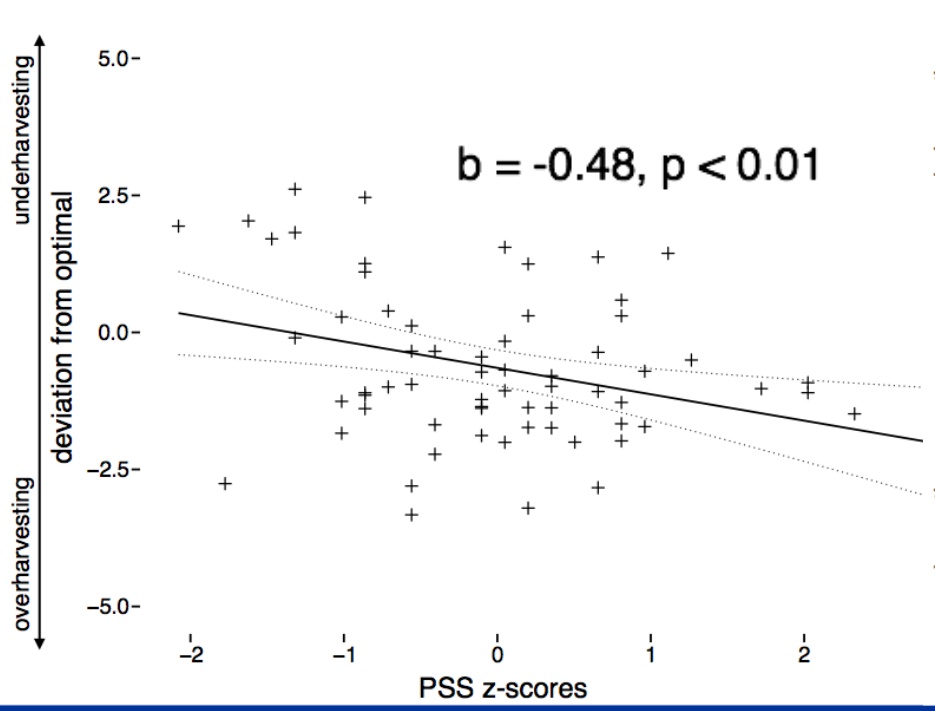
foraging under stress

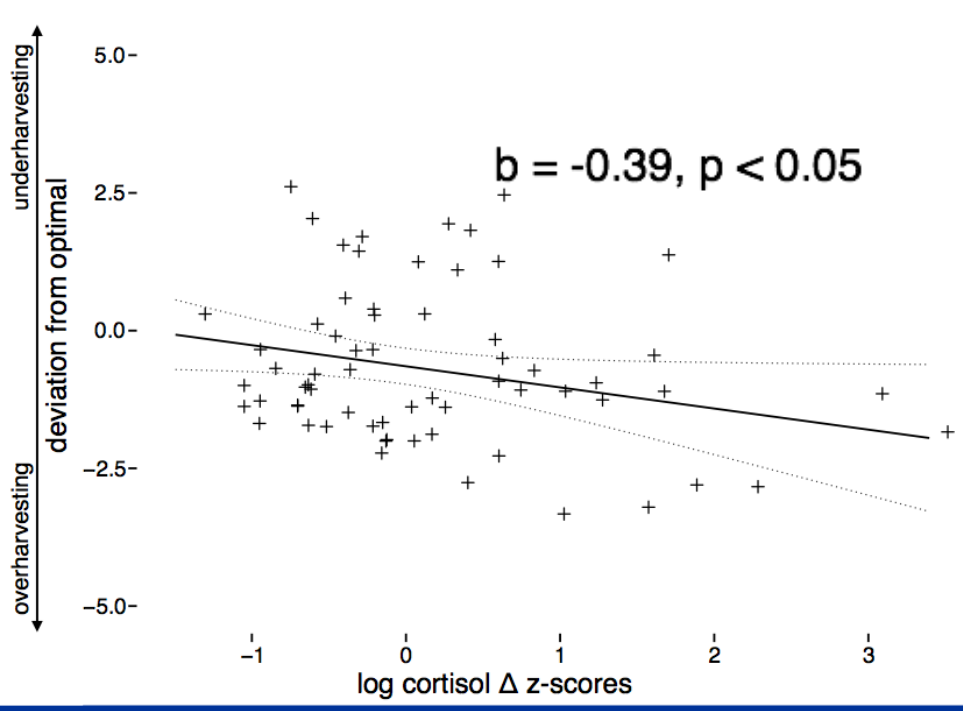
How does stress influence when we leave currently diminishing options in order to forage for better options?

-- Acute Stress

-- Perceived stress over the last month

Change in cortisol (acute stress) and subjective perceived stress both predict more deviation from optimal (over-exploitation)





Stress & Foraging

- stress biases decision-makers toward exploitative behavior, indicating less positive appraisal of overall environment quality, less optimal behavior

- this could be adaptive in stressful situations in which resources are genuinely threatened but maladaptive in inappropriate contexts

Stress

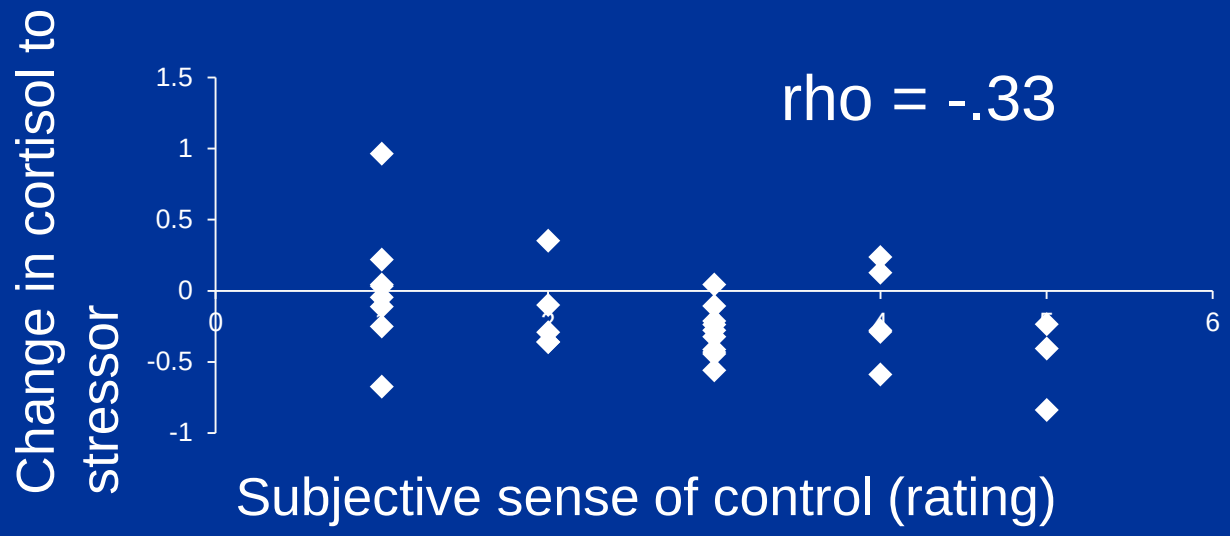
- **Attribution Decisions**
  - **Biases decisions about the *cause* of behavior**
- **Model-based – Model free Choice**
  - **Biases decisions to rely *less* on a complex model of the decision context**
- **Sequential Decisions (Foraging)**
  - Biases decision-makers toward exploitative behavior, makes them less optimal

How might we reduce the unintended consequences of incidental stress on decisions?

Stress

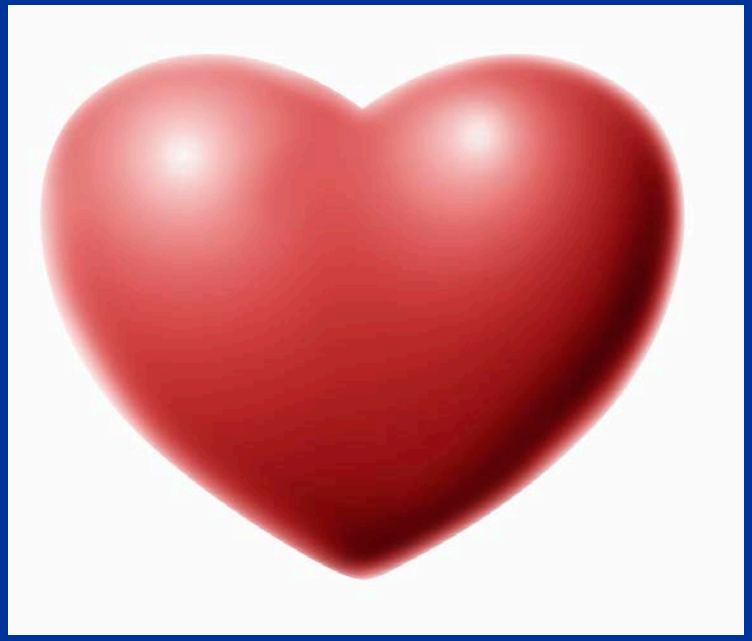
Body's response to real or implied threat induced by novel, unpredictable, or *uncontrollable* situations (Lupien et al, 2007)

Control may reduce future stress response (Maier & Watkins, 2005)
Also, perception of control?



Can we build resilience to stress and reduce the detrimental effects of incidental stress on decisions?

Emotion and Decision Making



By understanding the relation between emotion and decisions (for better or worse), we may be able change emotion to change choice

Thank You