

# The Value of Knowing When to Switch

Investigating the Interaction of Value and Control

DAVID A. BRAUN<sup>1</sup> & CATHERINE M. ARRINGTON<sup>1,2</sup>

<sup>1</sup>Lehigh University <sup>2</sup>National Science Foundation



LEHIGH  
UNIVERSITY

## Introduction

### Value and Effort

The control needed to switch to a new task is more **effortful** than continually performing the same task.

Effort acts as a **cost** when making choices

- When instructed to choose between two tasks equally often and randomly in voluntary task switching (VTS), people tend to repeat tasks more than switch. (Arrington & Logan, 2005)
- There are individual differences in the effort that is required to switch tasks. (Arrington & Yates, 2009; Butler, Weyandt, & Arrington, 2001)

**Reward** can offset the cost of effort

- People will perform more challenging tasks when given reward. (Kool & Botvinick, 2014)

### Question 1

How do people balance chasing **reward** with avoiding the cost of **effort** when choosing tasks?

## Value and Task Set

**Task set** is a representation consisting of information needed to execute tasks.

- Contains stimulus-response mappings (Gilbert & Shallice, 2002)
- Unclear what other information might be included

Task set is **activated** in order to perform a task. (Yeung, 2011)

- Task set activation persists after execution and must be inhibited before performing a new task.
- Activation is stronger for more difficult tasks.

### Question 2

Is **value** included in the **task set** representation?

## Reward-Based VTS (rVTS)

**Reward and Effort (Study 1)**

- Systematically assign value to tasks during VTS
- Do people who use more effort to switch need more reward before choosing to switch?

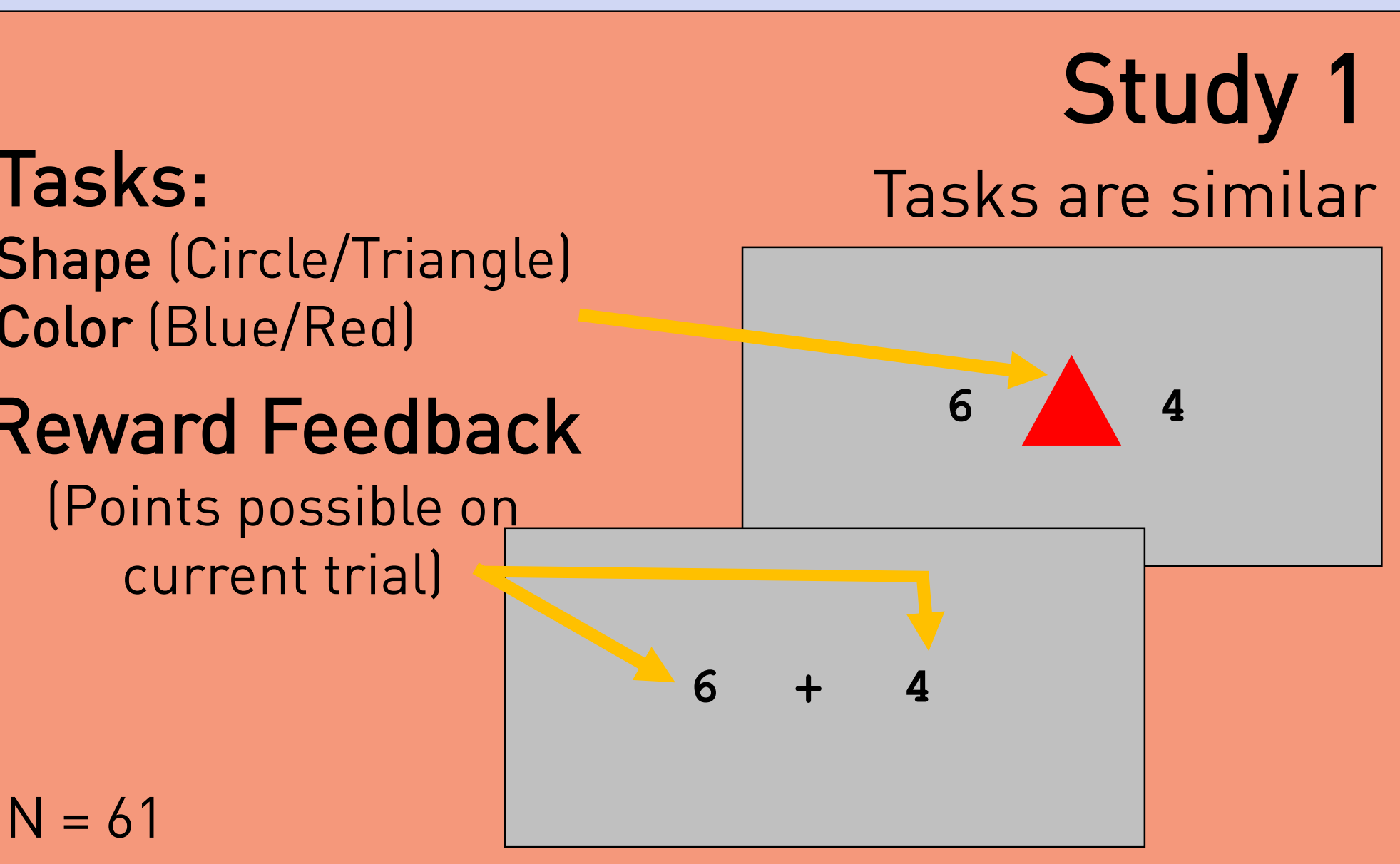
**Value and Task Set (Study 1 and 2)**

- If value is included in task set, sensitivity to value of previously performed task should be greater.
- Since a difficult task is activated more strongly, people should be more sensitive to its value.

## Method

### Reward Rules

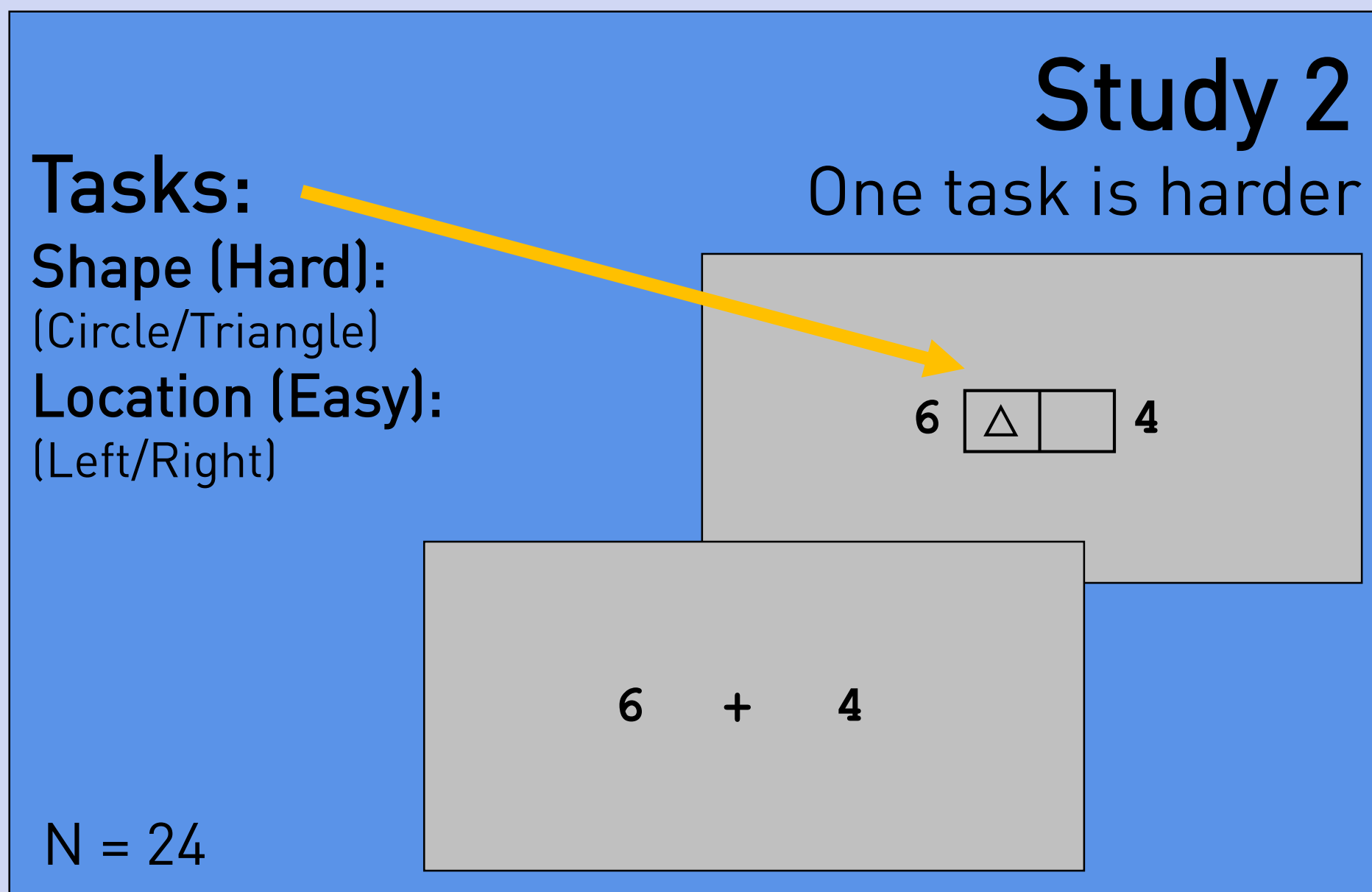
- Points (0-10) linked to each task
- For current task, 50% chance of decrease by one point on next trial
- For other task, 50% chance of increase by one point on next trial
- Reach 500 points as fast as possible



### Independent Variables

(manipulated within blocks)

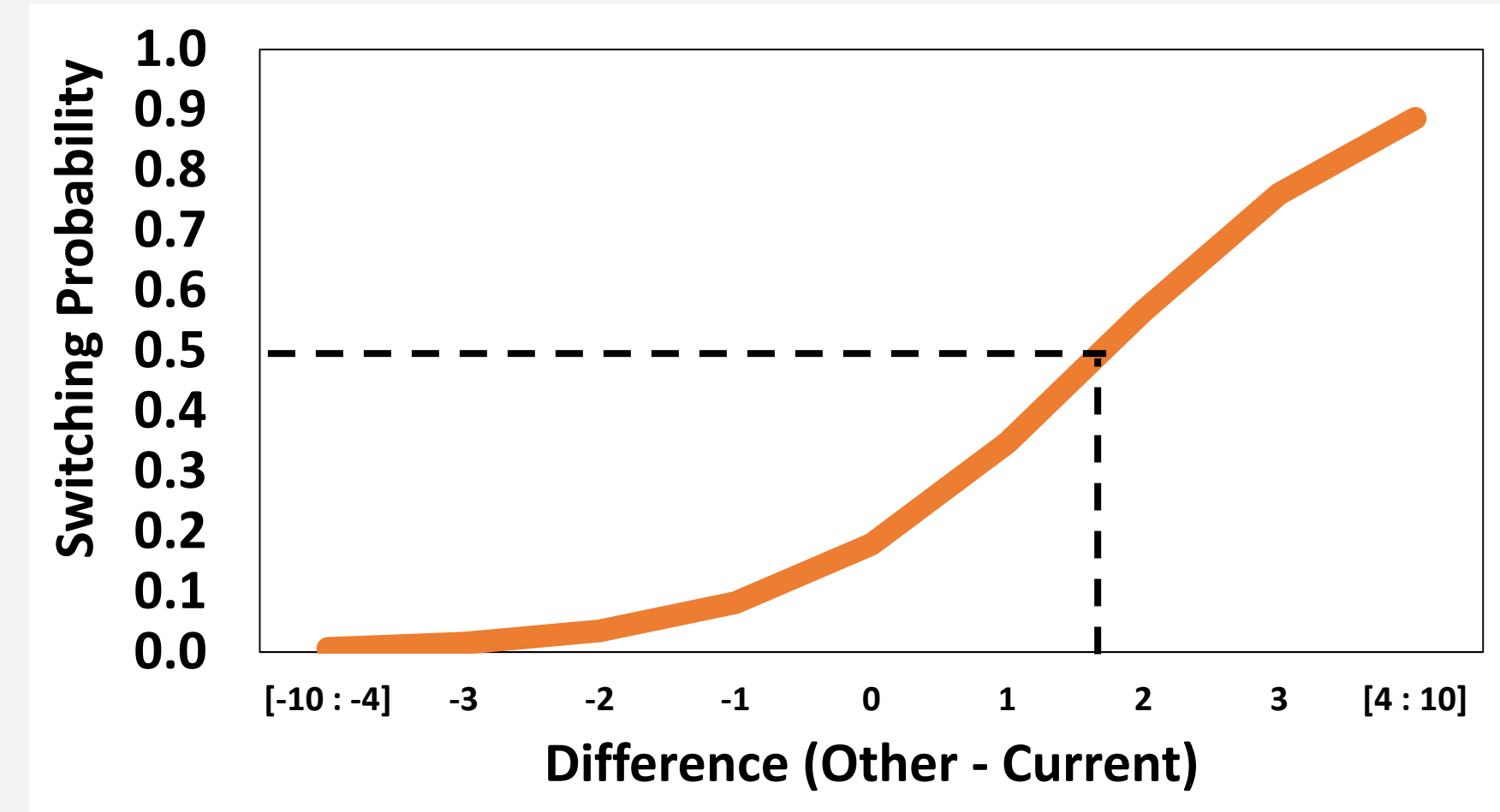
Current task	constant – remain constant change – <b>decrease</b> by one
Other task	constant – remain constant change – <b>increase</b> by one
Difference	other point value minus the <b>current</b> point value



## Study 1

How do people balance chasing **reward** with avoiding the cost of **effort** when choosing tasks?

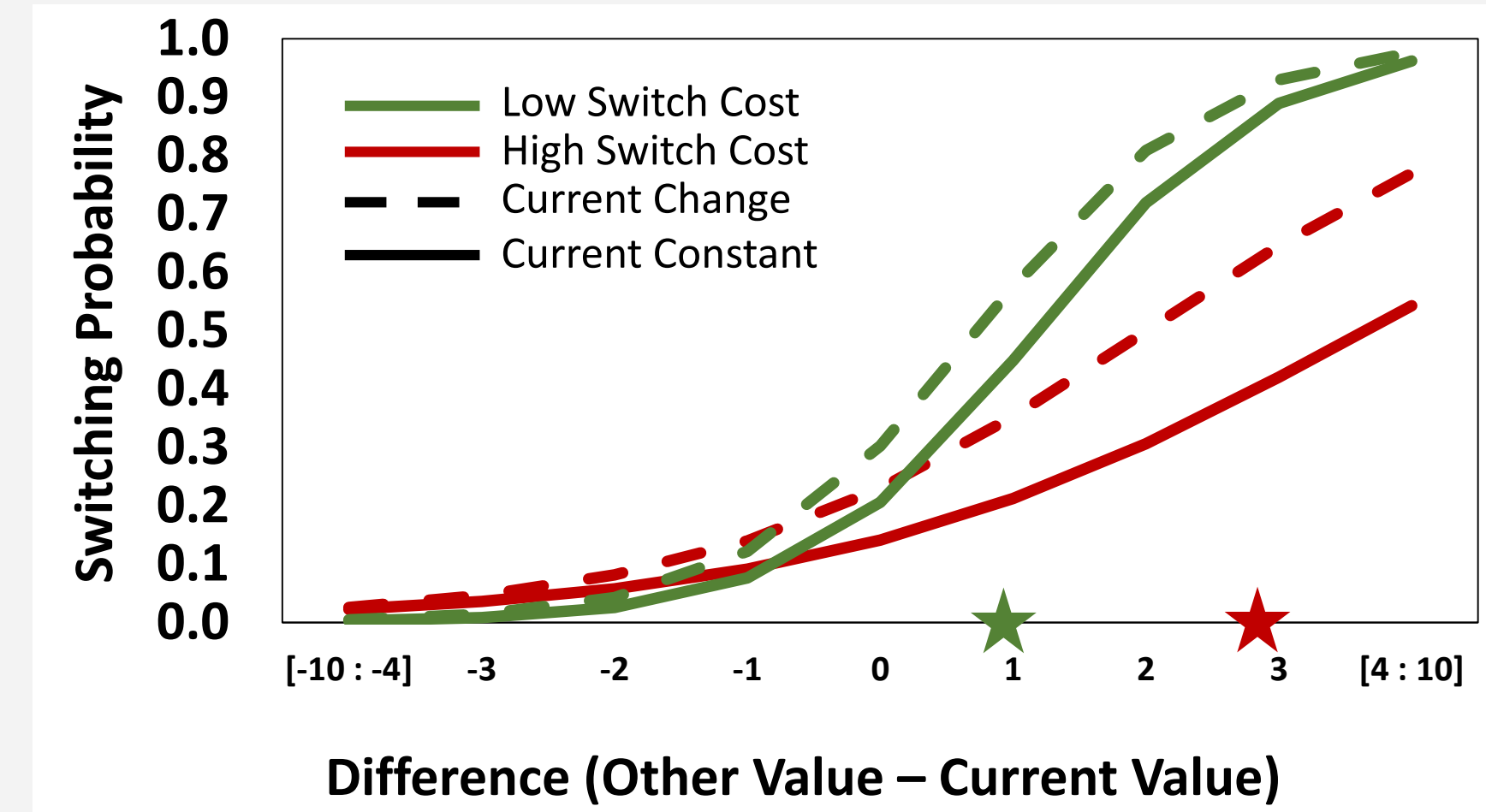
What's the value of switching?



- Equally likely to switch or repeat when other task is about two (1.71) points higher than current
- People can assign a value to the effort required in switching tasks

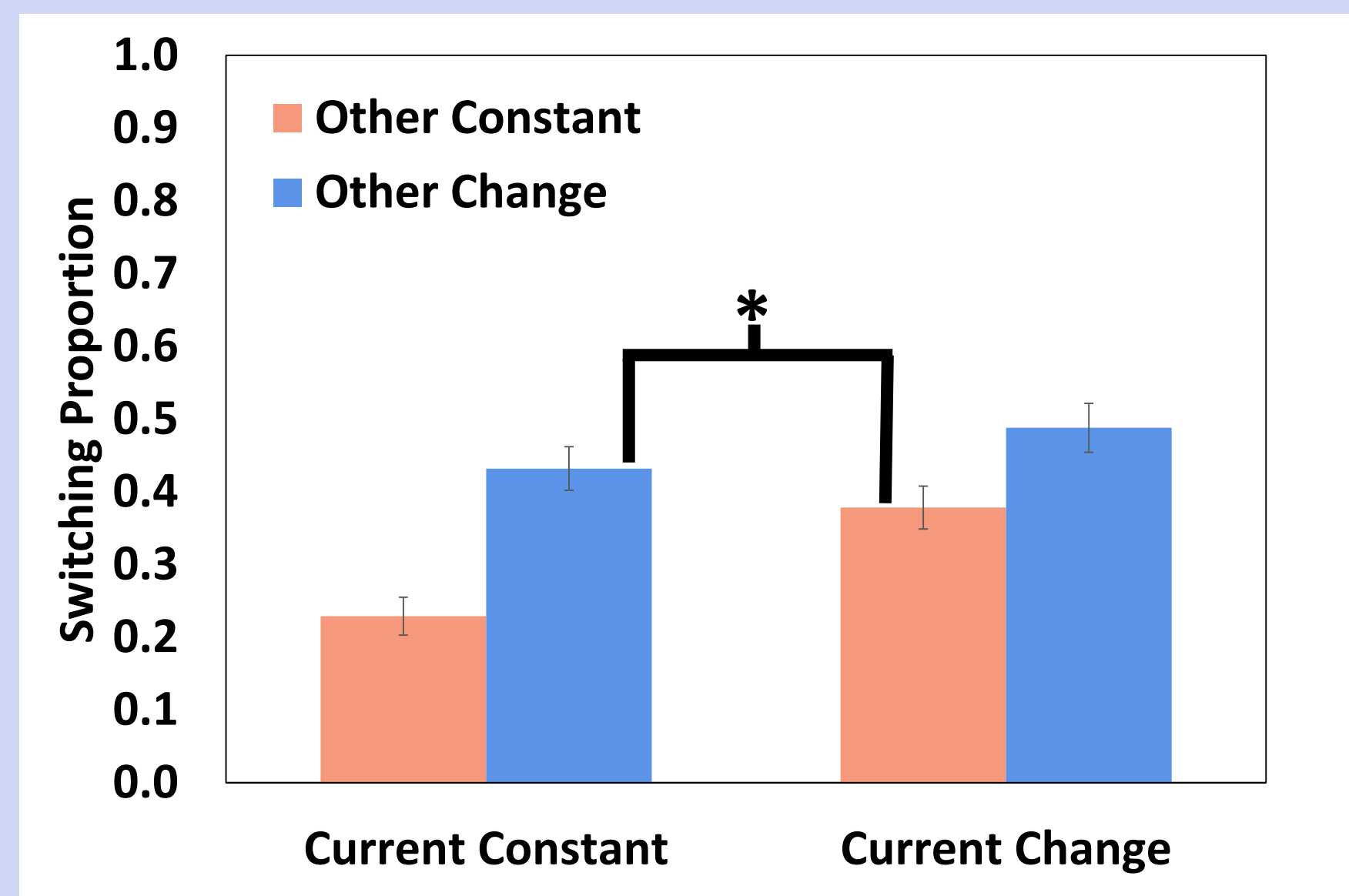
Difference:  $p < .001$

Greater value for greater effort?



- The point of equal switching varies systematically with subjects' switch costs
- People who use more effort to switch wait for greater reward when switching tasks

Current X Difference X Switch Cost:  $p = .04$



Current:  $p < .001$  Other:  $p < .001$  Current X Other:  $p < .001$

Balancing **reward** and **effort** cost

- Lowest switch rates when both values remain constant, highest when both change
- People recruit effort in response to changing values

Sensitive to **reward** and **effort** when selecting tasks.

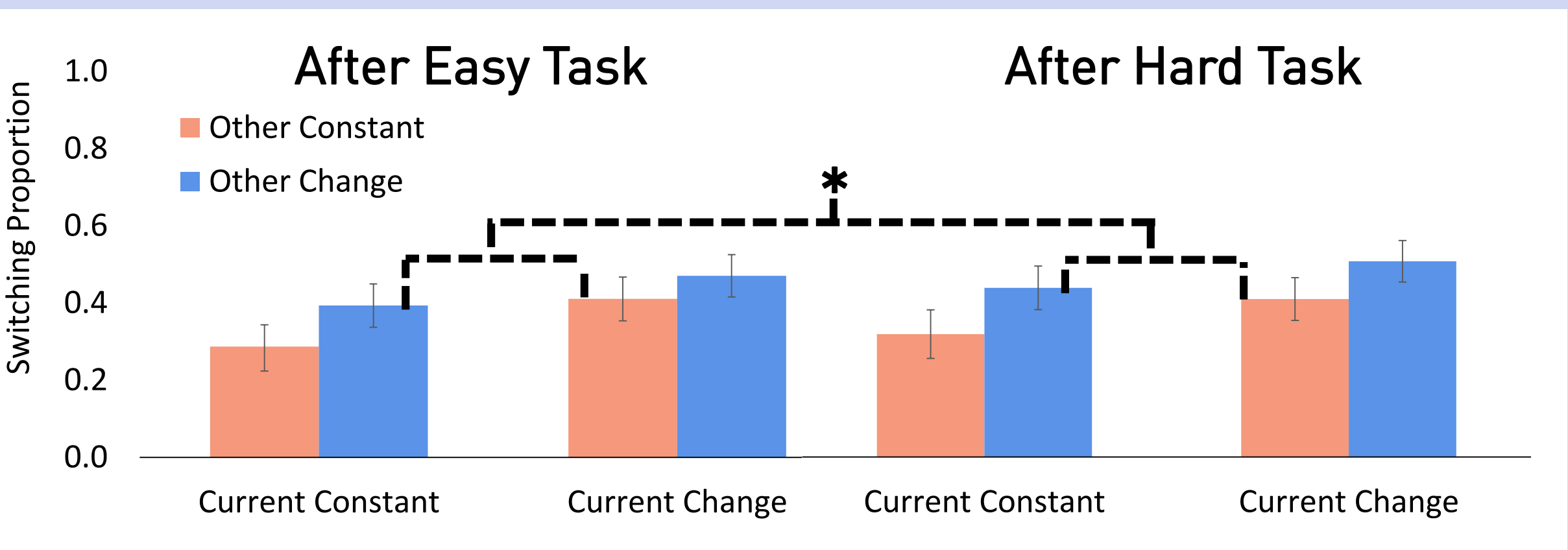
**Value and the task set**

- When only one value changes, more sensitive to changes in **other** task value
- Task execution impacts task selection, leading to greater sensitivity to **non-performed** task value.

Evidence that value **might not** be part of task set.

## Study 2

Is **value** included in the **task set** representation?



**We expected**

Sensitivity to be greatest to the value of the hard task (after performing the hard task).

**But**

Sensitivity to value was generally even across the two tasks. There was even a bias to be more sensitive to the easy task's value.

**This means that**

We found further evidence to suggest that task value is **not** part of the task set.

Task X Only Current Change X Only Other Change:  $p = .04$

## Discussion

Balancing **reward** and **effort** cost

- Although reward and effort are on completely different scales in rVTS (points versus time), people can sensibly balance pursuing reward and avoiding effort when making task selections.
- Effort may automatically impact the cost-benefit analysis in complex decision making.

**Strategic or strained?**

It is possible that high switch-cost individuals value switching more, but it is also possible that they are less effectively comparing values to make selections.

**Value and the task set**

- Evidence that value is **not** included in the task set representation
- Task execution** does impact **task selection**, but not in the way that would be expected if value were part of the task set.
  - People more sensitive to changes in other task's value

**Task-set hierarchy?**

Information needed to execute a task may be organized into a hierarchy, with procedural information represented at lower levels and goal-related information at higher levels.

**Take-away points**

- People are sensitive to both **value** and **effort** when making task selections.
- Value might **not** be included in the task set representation that is used to execute the task.