

# Attention and value integration in multi-attribute choice

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## // BACKGROUND

1. Decisions are often captured as a weighted sum over multiple attributes 1:

Summed Value =  $w_1^*a_1 + w_2^*a_2 + ... + w_n^*a_n$ 

where a is how "good" the attribute is, and w how "important". 2. Good decisions require flexibly weighting attributes according to context or goals <sup>2</sup>.

3. The neurocomputational processes enabling attribute evaluation and flexible weighting remain poorly understood

4. Unclear how value and attention interact<sup>3</sup>.

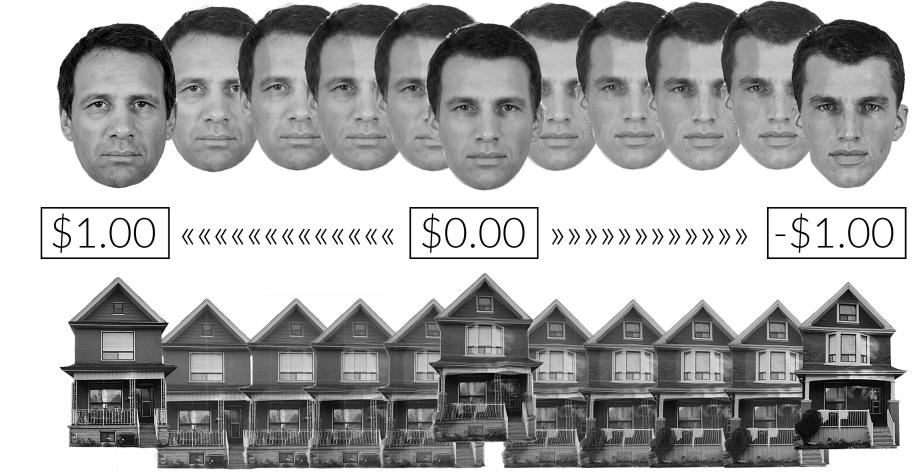
# // GOALS

- 1. Develop fMRI and EEG-compatible paradigm for tracking value and attention during multi-attribute choice.
- 2. Investigate influence of flexible attribute weighting on attention.
- 3. Investigate influence of attention on attribute valuation and weighting.

## // METHODS

- 1. Subjects (n=23) learned values from morphed pairs of images of houses and faces.
- 2. Subjects accepted or rejected a proposed combination of 2 attributes (1 face and 1 house) based on the summed value. Weights were applied to attributes on a trial-by-trial basis to affect importance.

#### Stimuli

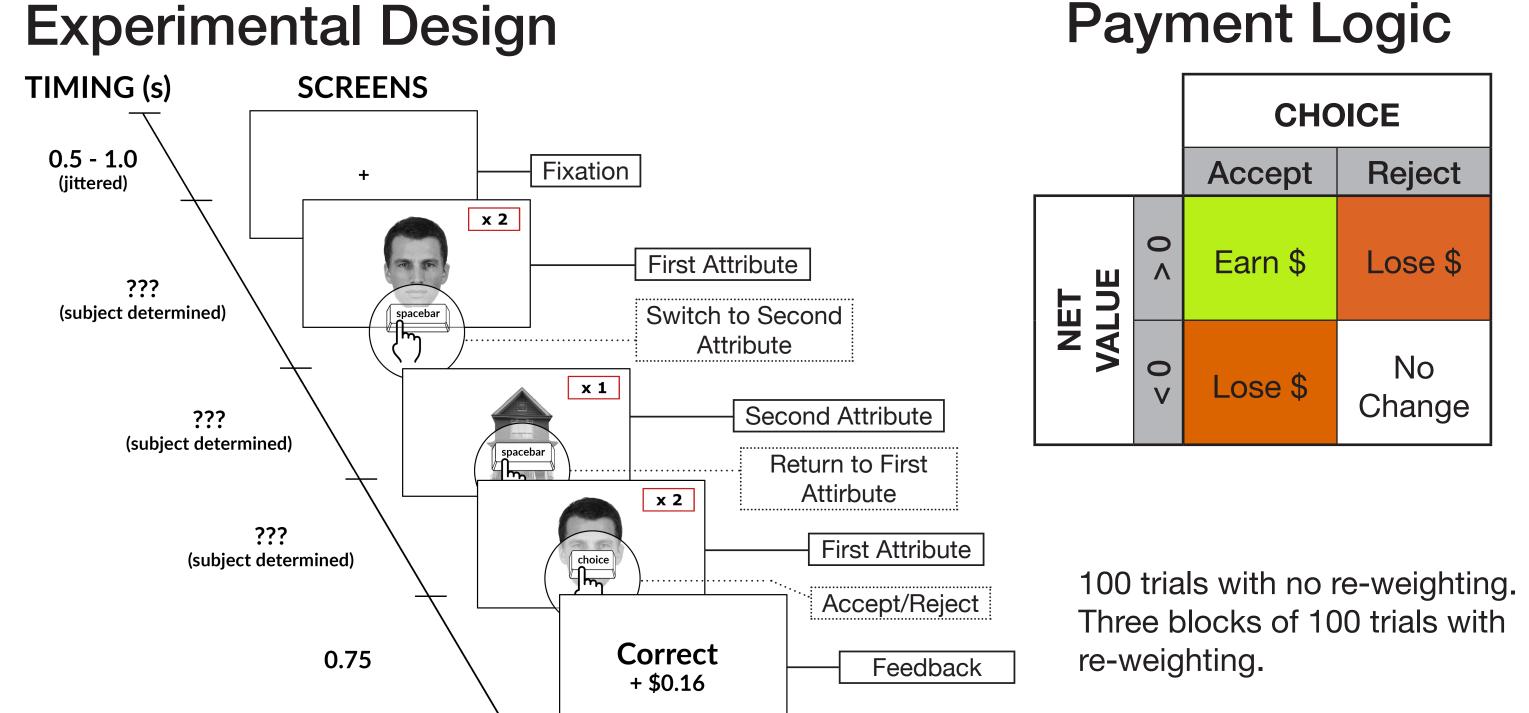


101 morphs, with values from -\$1.00 to \$1.00, were created. Morphs varied linearly in \$0.02 increments.

# weights Base Value Net Value

Attribute Pair Example

#### Payment Logic

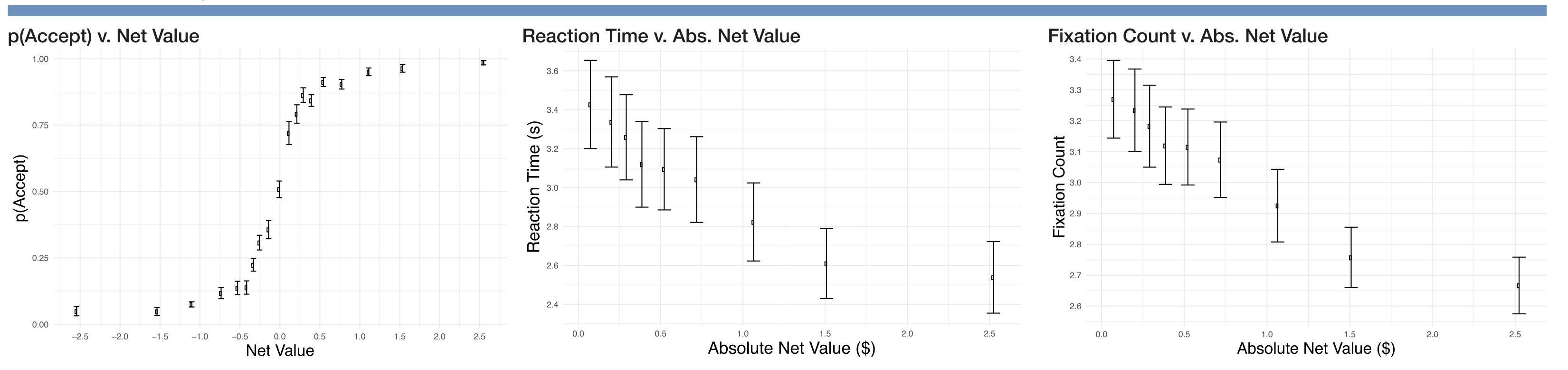


# // ANALYSIS

- 1. Mixed effects regressions to predict choice and accuracy.
- 2. Hierarchical Bayesian drift diffusion modeling (HDDM <sup>5</sup>) of the parameters:
- a (boundary): # of multipliers
- t (nondecision): # of fixations
- **V** (drift rate):  $\beta_0 + \beta_1^* Face_{M1} + \beta_2^* House_{M1} + \beta_3^* Face_{M2} + \beta_4^* House_{M2} + \beta_5^* Face_{M3} + \beta_6^* House_{M3}$ where  $\beta_1 - \beta_6$  are the attribute weightings (e.g.  $Face_{M_2}$  is a Face stimulus with a weight of 2)

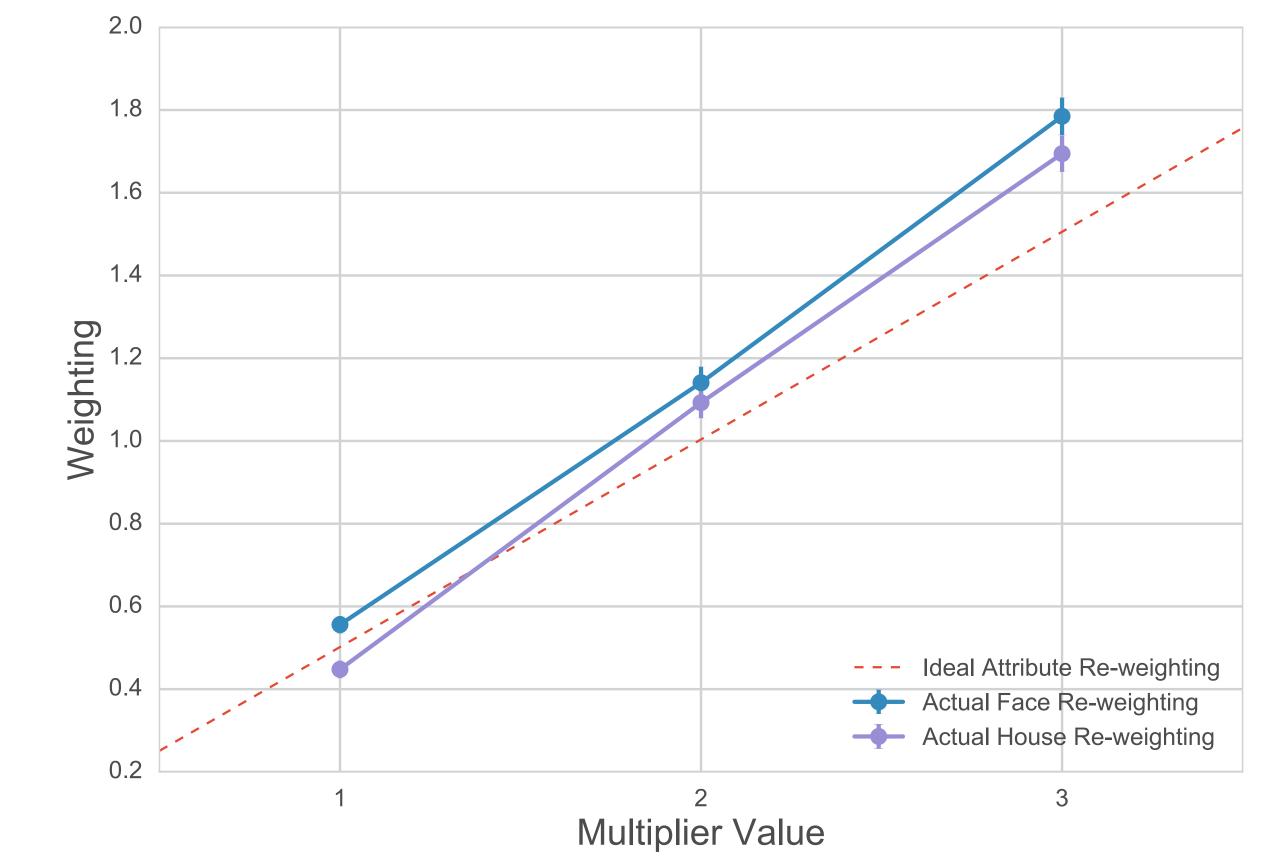
## // RESULTS

## // Basic Psychometrics



## // Attribute Re-Weighting

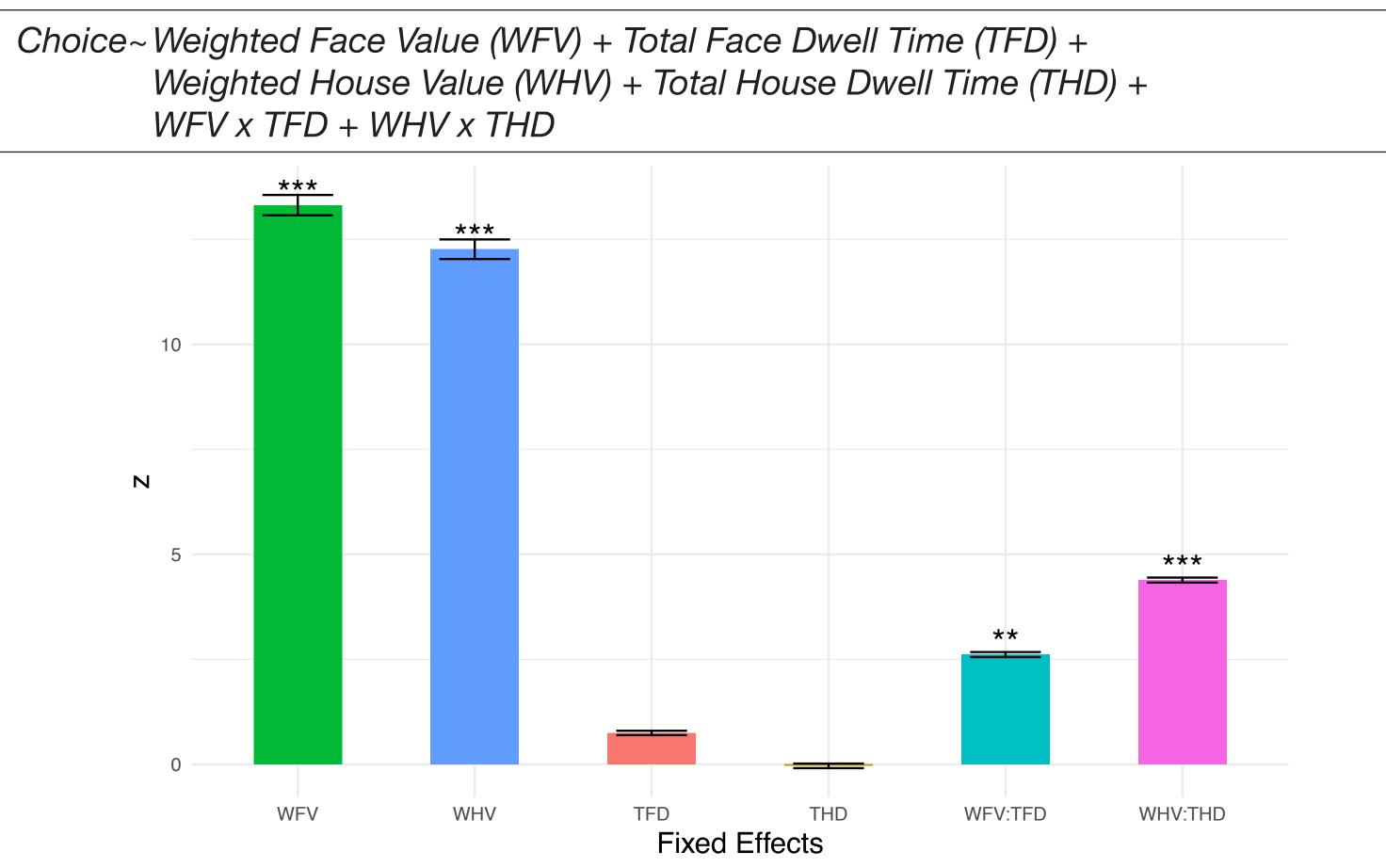
#### Ideal vs. Measured Multiplier Re-Weighting



- 1. Subjects significantly over-estimated the re-weighting effects of multipliers applied to all attributes.
- 2. Subjects weighted faces significantly more strongly than houses at all multiplier level.

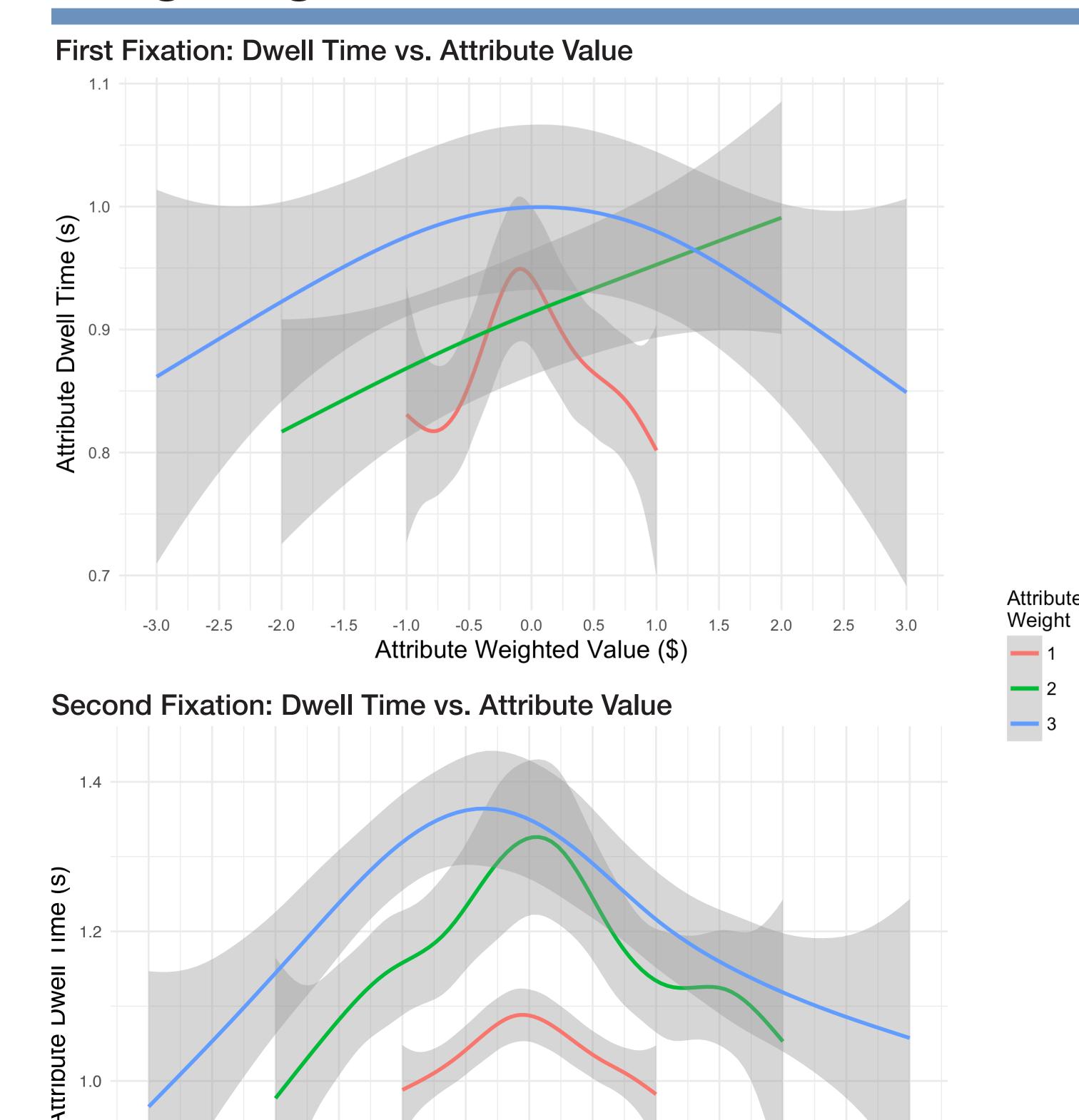
# // Attention, Value and Choice

#### Mixed Effects Logistic Regression



- Attention alone is not predictive of choice.
- The interaction between attention (total attribute dwell time) and value is a significant predictor of subject decisions.
- Results suggest that attention amplifies the influence of the target attribute.

## // Effects of Attribute Value & Weighting on Attention



Attribute attention is influenced by weighting, but only for the second fixation (when all decision information is known).

-3.0 -2.5 -2.0 -1.5 -1.0 -0.5 0.0 0.5 1.0 1.5 2.0 2.5 3.0

Attribute Weighted Value (\$)

## // ACKNOWLEDGEMENTS

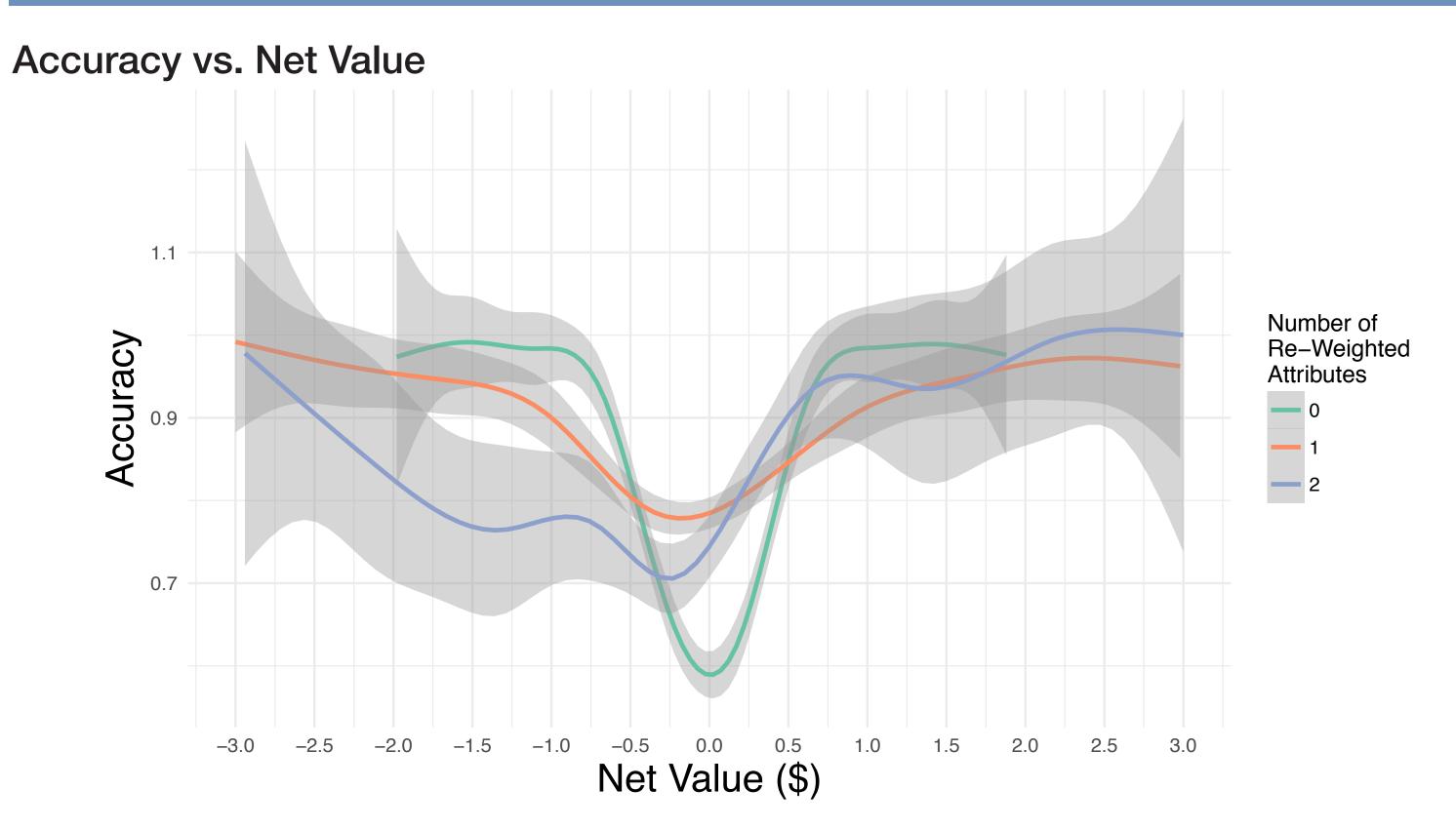
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### // FURTHER INFORMATION

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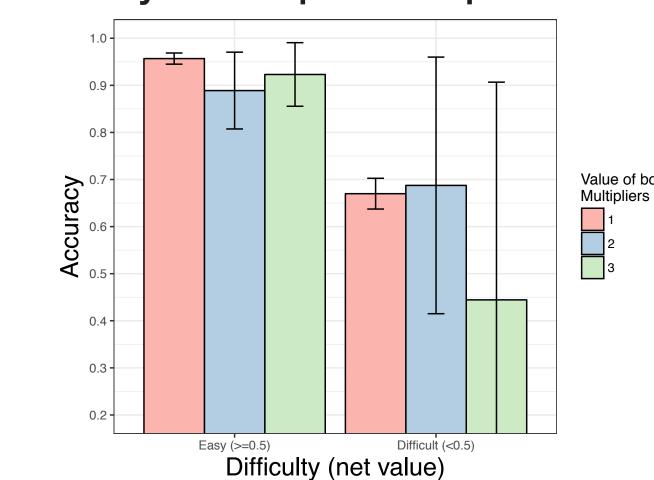
### // Weighting, Value and Accuracy

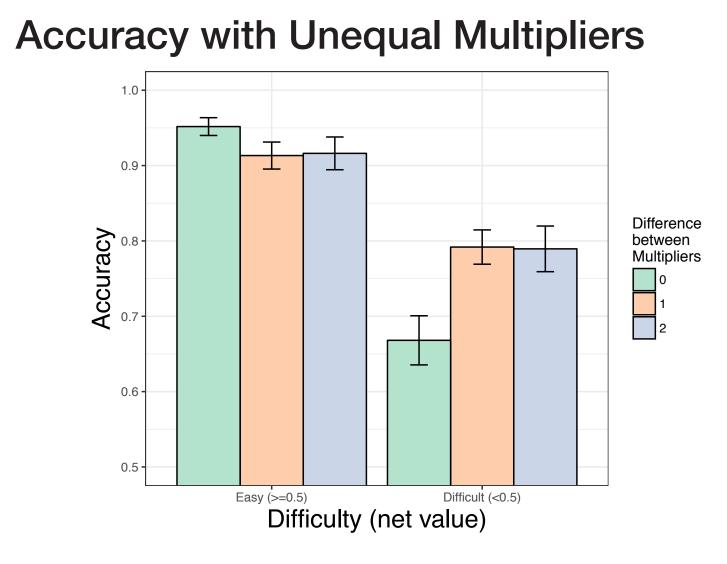


If the number of re-weighted attributes = 0 it means that both attributes had weights of x1.

- For difficult trials (-\$0.50>Net Value>\$0.50), subjects were more accurate with attribute re-weighting than without.
- For easy trials this relationship reverses.
- This effect does not exist for trials with two equivalent multipliers.

#### Accuracy with Equal Multipliers





# // DISCUSSION

- 1. The proposed paradigm can track attention while manipulating value and weighting of attributes.
- 2. Subjects are able to dynamically and flexibly re-weight attribute
- 3. More accessible or discernable attributes may tend to be overweighted.
- 4. Attention, as measured by attribute fixation duration, is not random. It is affected by value and weighting.
- 5. Going forward fMRI and EEG will be used to localize the neural correlates of attribute evaluation and weighting.

#### // REFERENCES

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