Neural and Behavioral Patterns of Proactive Interference for Emotional and Neutral Information in Working Memory

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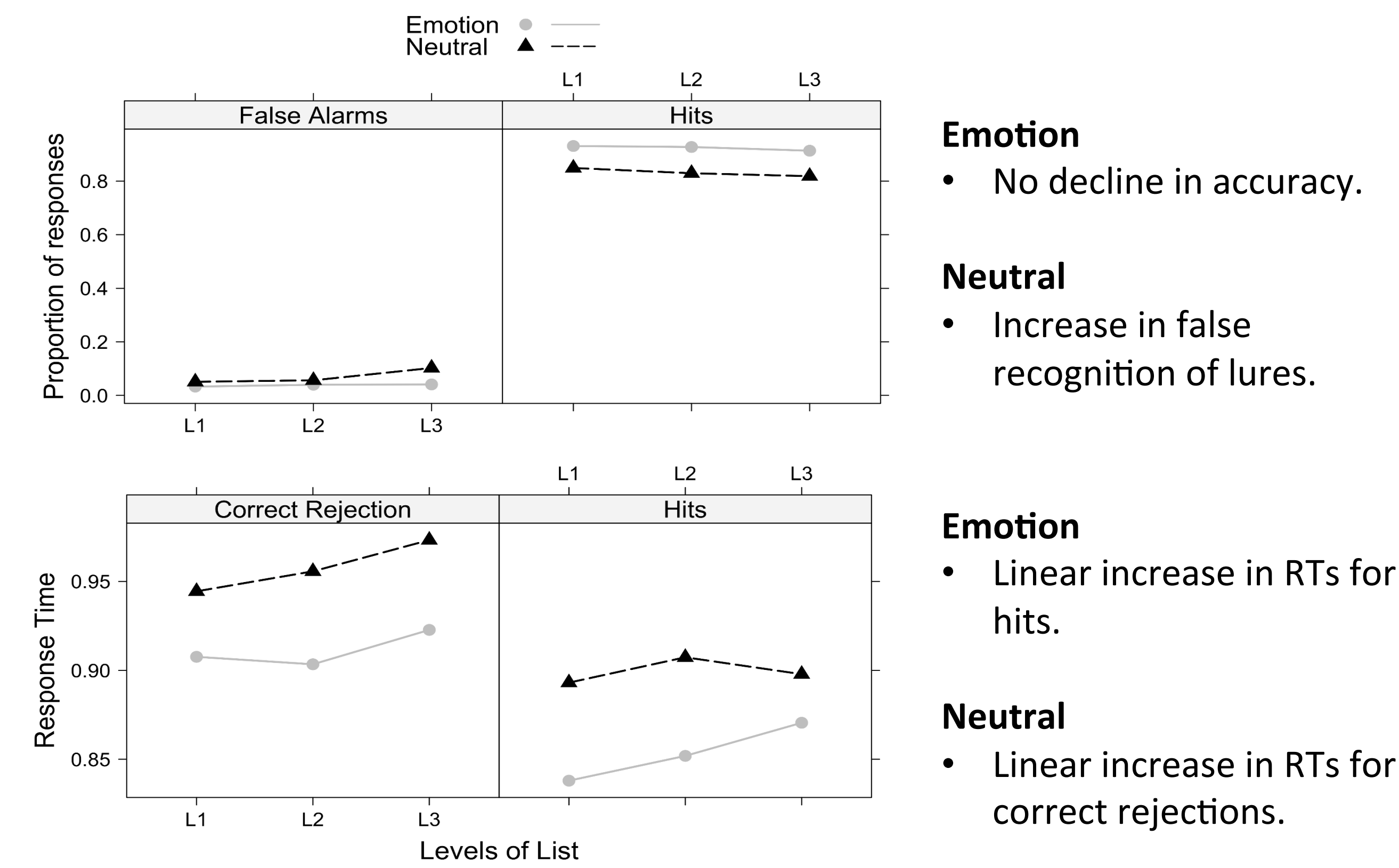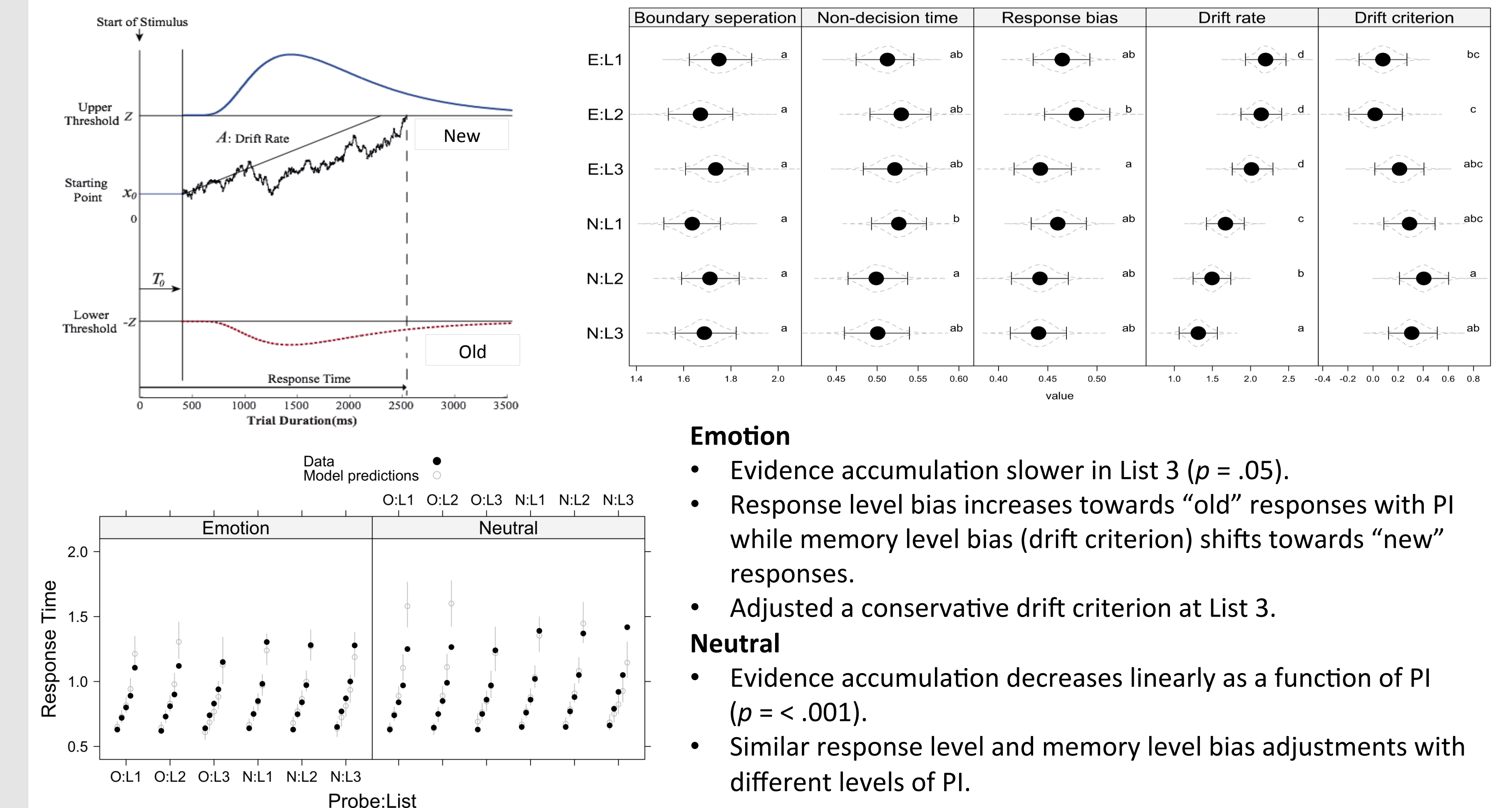
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BACKGROUND

- Proactive interference (PI): the tendency for information learned earlier to interfere with more recently learned information.

- The medial temporal lobe (MTL), specifically parahippocampal regions, and anterior ventrolateral prefrontal cortex (aVLPFC) are known to be involved in the recovery from the PI effects (Oztekin, & Badre, 2011).

- Previous research showed differential impact of emotion for the build up and resolution of PI in working memory (Mizrak, & Oztekin, 2015).

- We applied a hierarchical Bayesian diffusion model to model behavioral responses and corresponding response times, providing detailed evidence about the impact of PI on latent processes that contribute to recognition decision.

- We hypothesize that PI effects will be exhibited differently for emotion and neutral trials which will be reflected in estimated model parameters, behavioral measures, and neural responses.

- We expect to observe differential activation of MTL and aVLPFC to emotion and neutral trials with changing levels of PI.
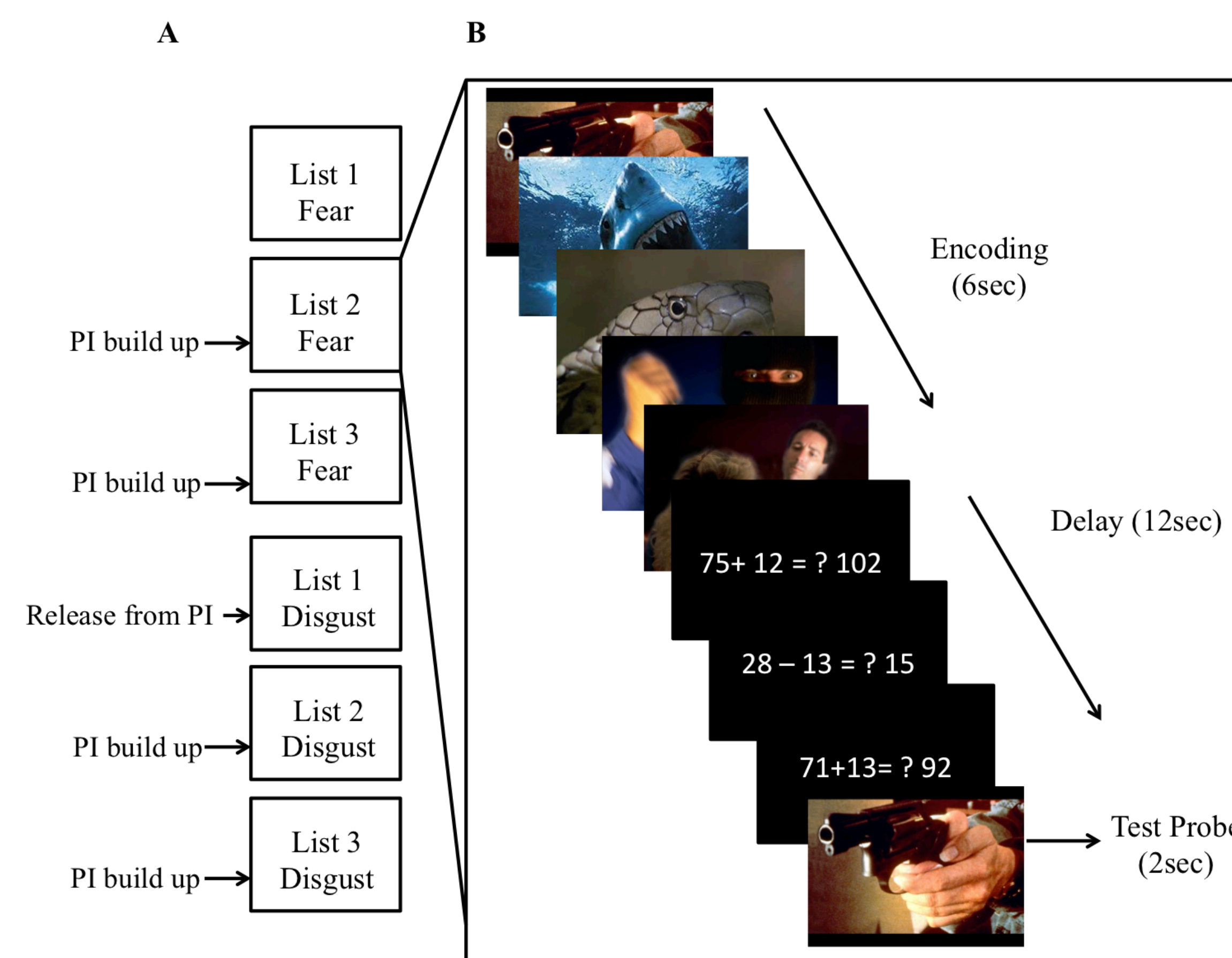
BEHAVIORAL RESULTS

Emotion
- No decline in accuracy.

Neutral
- Increase in false recognition of lures.

Emotion
- Linear increase in RTs for hits.

Neutral
- Linear increase in RTs for correct rejections.

HIERARCHICAL DIFFUSION MODEL

Emotion
- Evidence accumulation slower in List 3 ($p = .05$).
- Response level bias increases towards "old" responses with PI while memory level bias (drift criterion) shifts towards "new" responses.
- Adjusted a conservative drift criterion at List 3.

Neutral
- Evidence accumulation decreases linearly as a function of PI ($p = < .001$).
- Similar response level and memory level bias adjustments with different levels of PI.

DESIGN

METHODS

Stimuli
- Some of the emotion images were selected from IAPS (Lang, Bradley, & Cuthbert, 2005).
- Neutral categories: Kitchen utensils and Furniture
- Emotion categories: Disgust and Fear
- Images with no arousal and valence values were rated by individuals who did not participate in this study.

fMRI Data Acquisition
- 19 participants
- Siemens 3T Magnetom Trio, 32 channel
- 3 mm voxels, TR = 2sec

Preprocessing
- Slice timing correction, realignment, normalization, and smoothing (SPM8)

Design and Modeling in SPM8
- Event related design, fixed ITI (12sec)
- Two experimental sessions modeled together
- Separate regressors for; each retrieval condition, emotion and neutral delay trials, stimuli type * list for encoding

Regions of interests (ROIs)
- defined structurally by anatomical automatic labeling
- % signal change extracted by MarsBaR ROI toolbox

Hierarchical Diffusion Model
- 5-parameter Wiener model was was estimated using a version of Hamiltonian-Monte-Carlo using Stan.
- 750 post warm-up samples were estimated in 6 separate chains.
- Model convergence is assessed by r-hat and visual assessments of the chains.
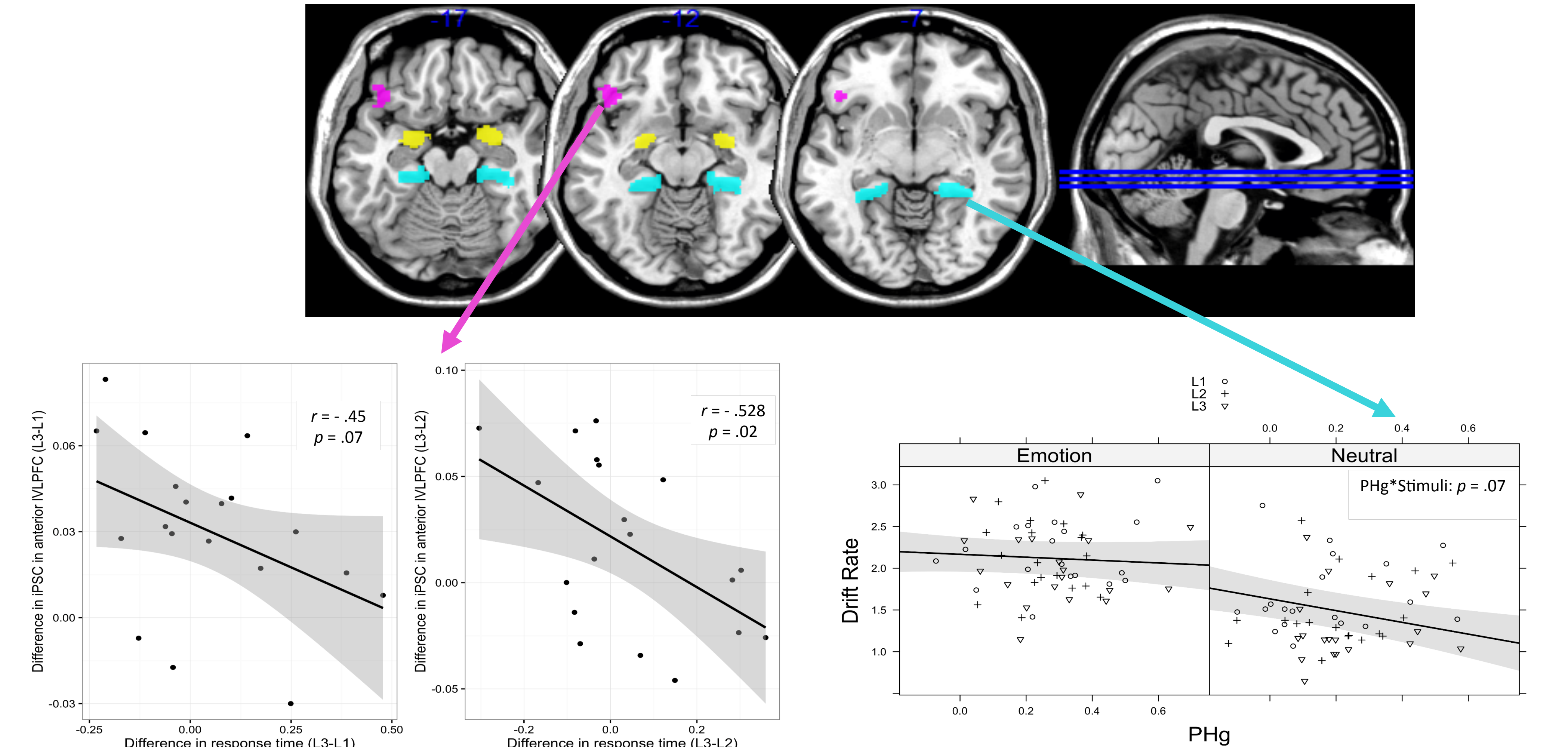
ROI ANALYSIS
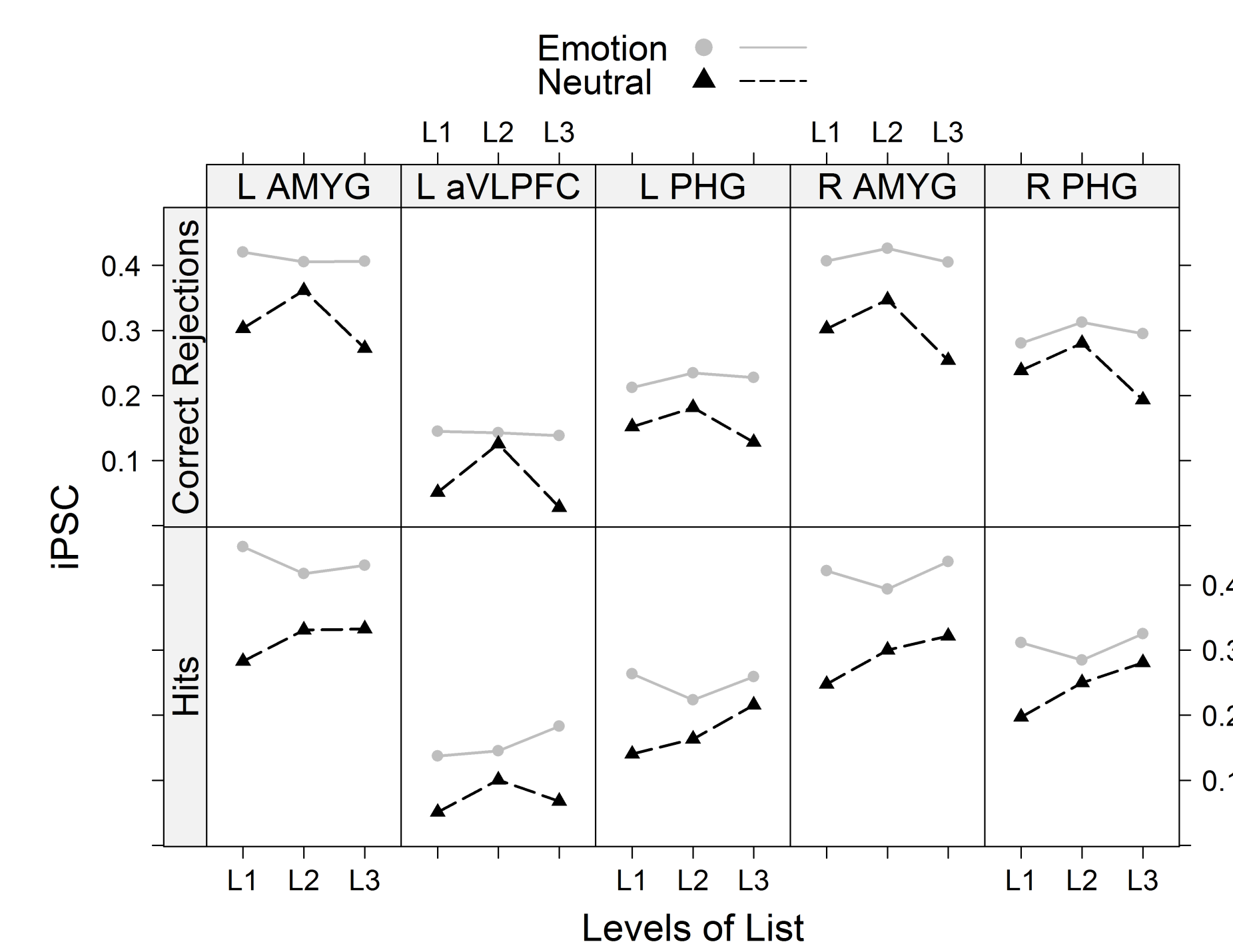
Emotion
- Higher amygdala response during retrieval of emotion trials at all levels of PI and for both probe types.
- Anterior VLPFC increase when PI is highest.

Neutral
- Enhanced parahippocampal gyrus activation during correct recognition of targets in high PI trials.

BRAIN AND BEHAVIOR RELATIONSHIP

Emotion
- Impact of PI on response times to hits were mediated by anterior lVLPFC activation.

Neutral
- Parahippocampal regions responded to the decline in evidence accumulation as a function of PI.

SUMMARY

- **PI has different effects on recognition performance of emotion trials compared to neutral trials:**
  Evidence accumulates slowly when PI is higher for both stimuli type: linear decrease for neutral items from List 1 to List 3, decline only in List 3 for emotion trials.
- **Different neural responses involved in the recovery from emotional and neutral PI:**
  Slower response times to hits due to high PI were mediated by aVLPFC activation for emotion trials.
  Parahippocampal region activation increases with decreasing drift rate for neutral trials. There was no MTL response to PI for emotion trials.
- **PI leads to opposite shifts in response level bias and memory level bias:**
  Response level bias towards "old" responses while memory level bias is adjusted such that upcoming evidence was evaluated as "new" more than "old" to overcome PI effects.

References

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