

# An Expectation-Based Memory Deficit in Aging

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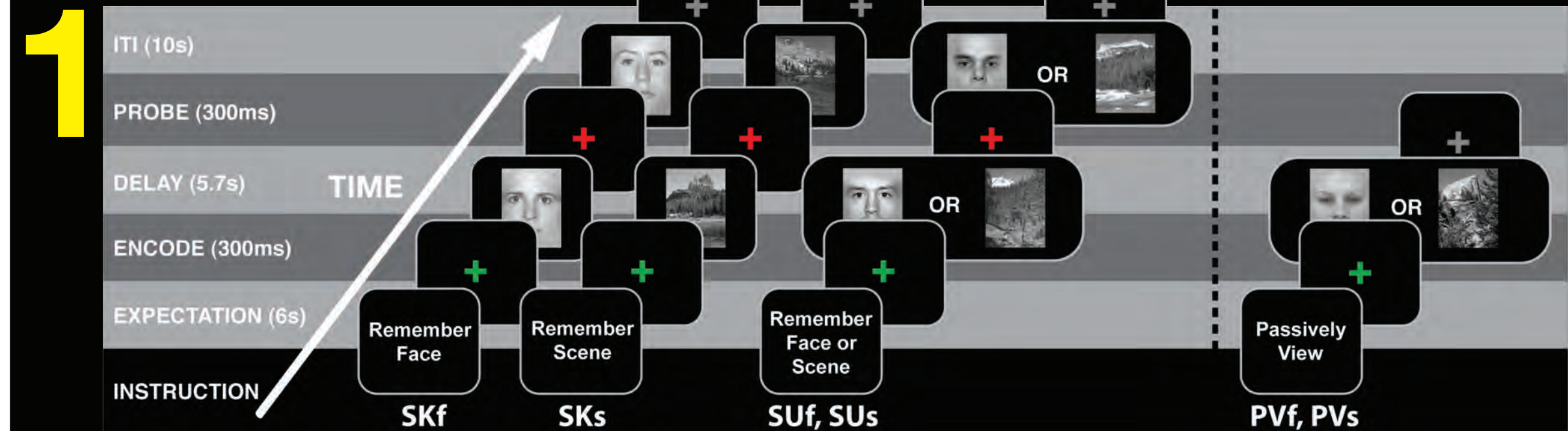
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## Background

- Expectation induced by valid cueing results in:
  - Enhanced speed and accuracy by which stimuli are detected and discriminated (Puri and Wojciulik, 2008; Puri et al., 2009; Esterman & Yantis, 2009)
  - Enhanced memory performance (Bollinger et al., 2010).
  - Sensory cortical activity modulation or biasing (Kastner et al., 1999; Desimone & Duncan, 1995; Bollinger et al., 2010).
  - Increased functional connectivity between sensory target regions and fronto-parietal network regions thought to mediate this biasing (Bollinger et al., 2010).
- Studies exploring the underlying basis of cognitive aging have revealed deficits in top-down modulation of visuo-cortical activity, shown to contribute to memory impairment (Gazzaley et al., 2005, 2008), and alterations in the fronto-parietal network (O'Sullivan et al., 2001).

**HYPOTHESIS: An age-related loss in the benefits that expectation has on subsequent memory may result from an inability of older adults to modulate pre-stimulus activity in response to predictive cues as a consequence of a disruption in top-down control networks.**

## Methods



	Younger (SD)	Older (SD)
N	18	17
Mean Age (year)	22.1 (3.4)	72.2 (1.8)
Age Range	18-28	60-86
Percent Male	44.4	41.2
Education (years)	12+	29.5 (0.2)
MMSE	n/a	29.5 (0.2)
GDS	n/a	2.5 (0.4)
Executive Composite		
WAIS-R Digit Span (backward)	5.5 (0.3)	34.5 (11.4)
Trailmaking Test A (s)	22.6 (1.7)	15.7 (1.6)
Semantic Fluency Test	4.6 (0.1)	13.0 (0.6)
Phonemic Fluency Test	12.9 (0.6)	11.1 (0.7)
Calculation Ability (out of 5)	13.2 (0.4)	12.3 (0.7)
Stroop: color naming	12.8 (0.6)	13.0 (0.6)
Memory Composite		
CVLT: Trial 5 Recall	68.4 (19.1)	55.1 (3.1)
CVLT: short delay free recall	55.1 (3.1)	87.1 (3.6)
CVLT: short delay cued recall	55.1 (3.1)	87.1 (3.6)
CVLT: long delay free recall	55.1 (3.1)	87.1 (3.6)
CVLT: long delay cued recall	55.1 (3.1)	87.1 (3.6)
Memory for Modified Rey	55.1 (3.1)	87.1 (3.6)
Processing Speed Component		
Trail Making Test B (s)	68.4 (19.1)	55.1 (3.1)
WAIS Digit Symbol Test	55.1 (3.1)	87.1 (3.6)
Stroop: color naming	55.1 (3.1)	87.1 (3.6)
MMSE = Mini-Mental State Examination (Folstein et al., 1975)		
CDR = Clinical Dementia Rating (Morris, 1993)		
GDS = Geriatric Depression Scale		
WAIS = Wechsler Adult Intelligence Scale		
*Information from 16 participants		

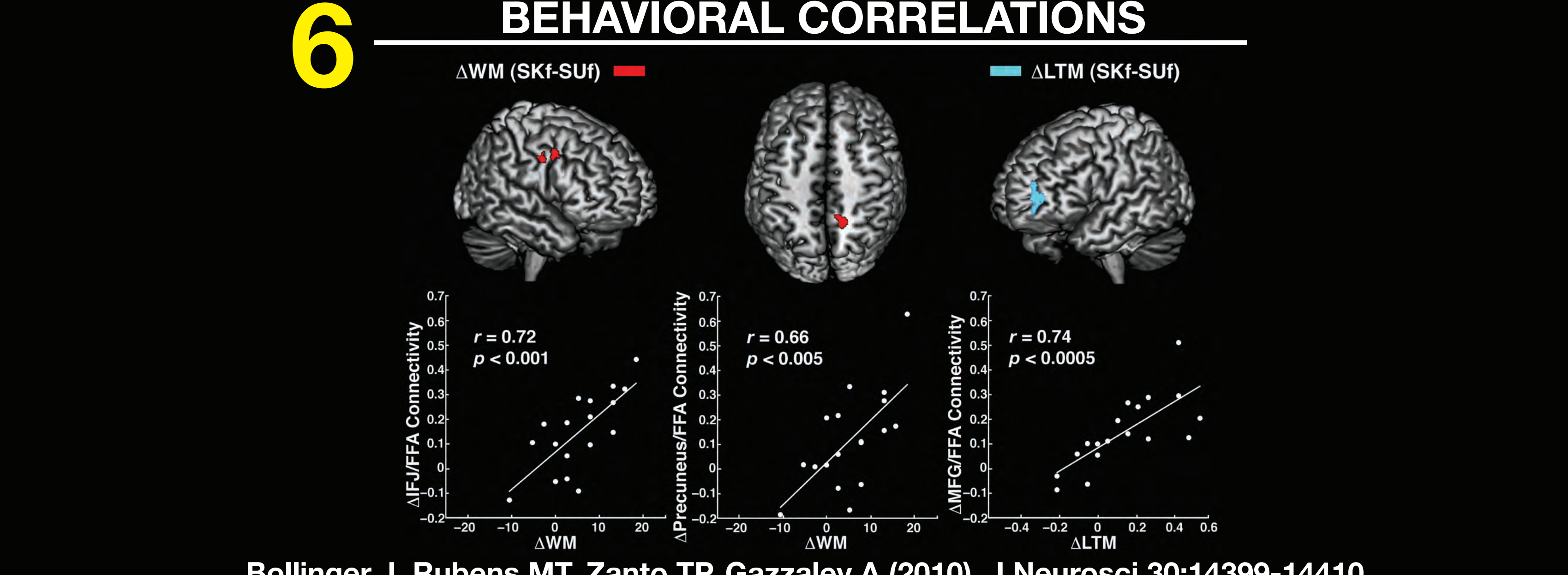
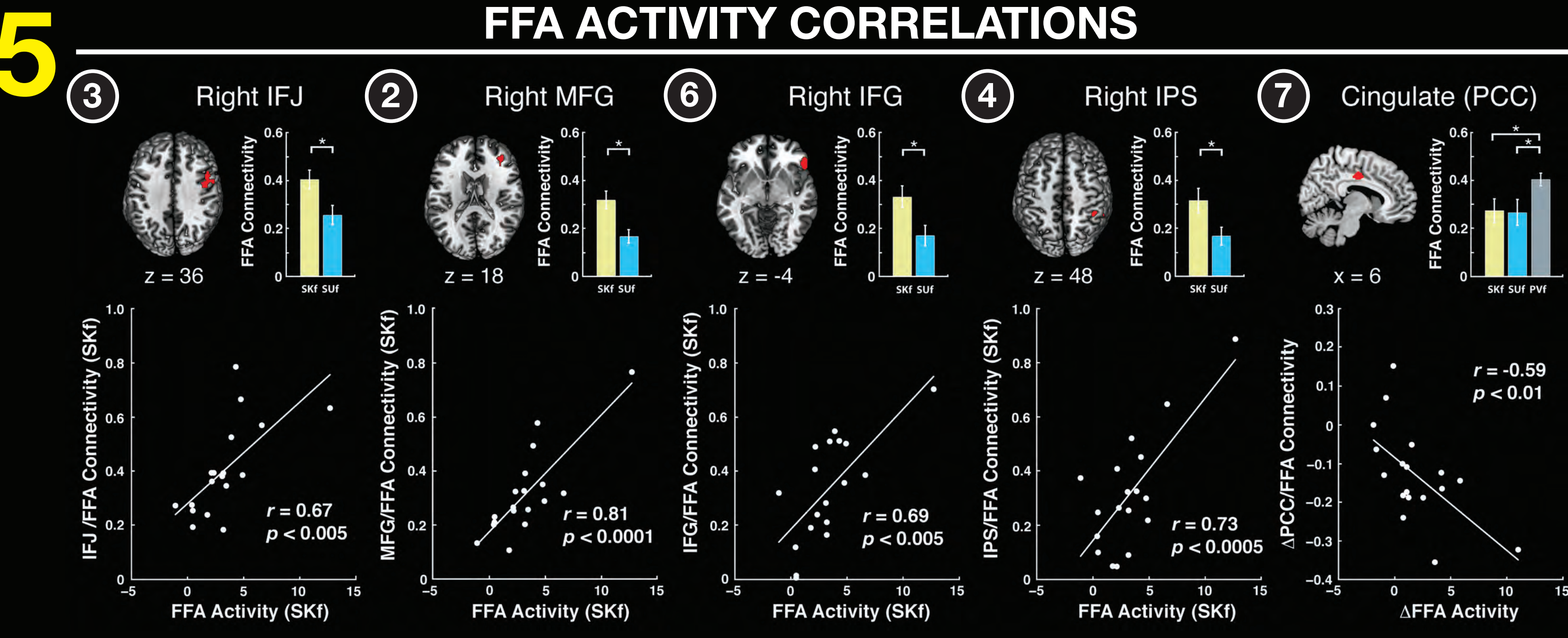
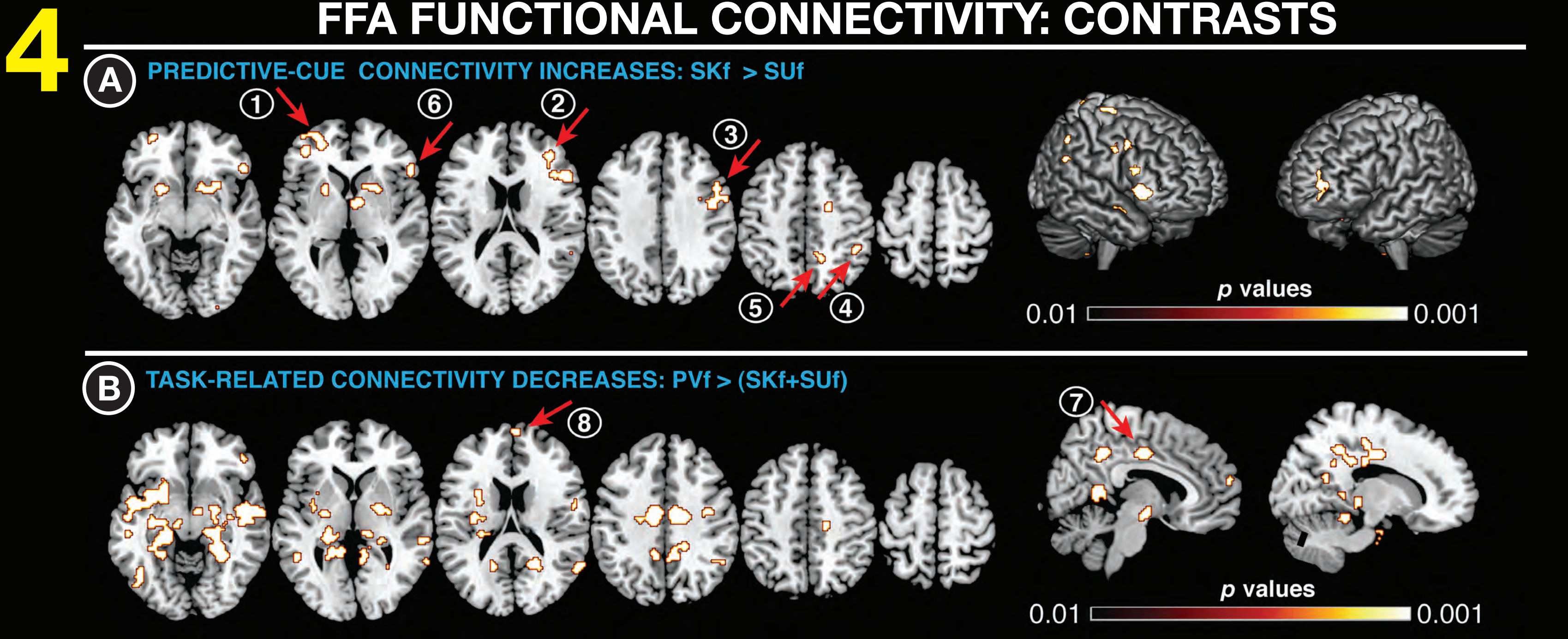
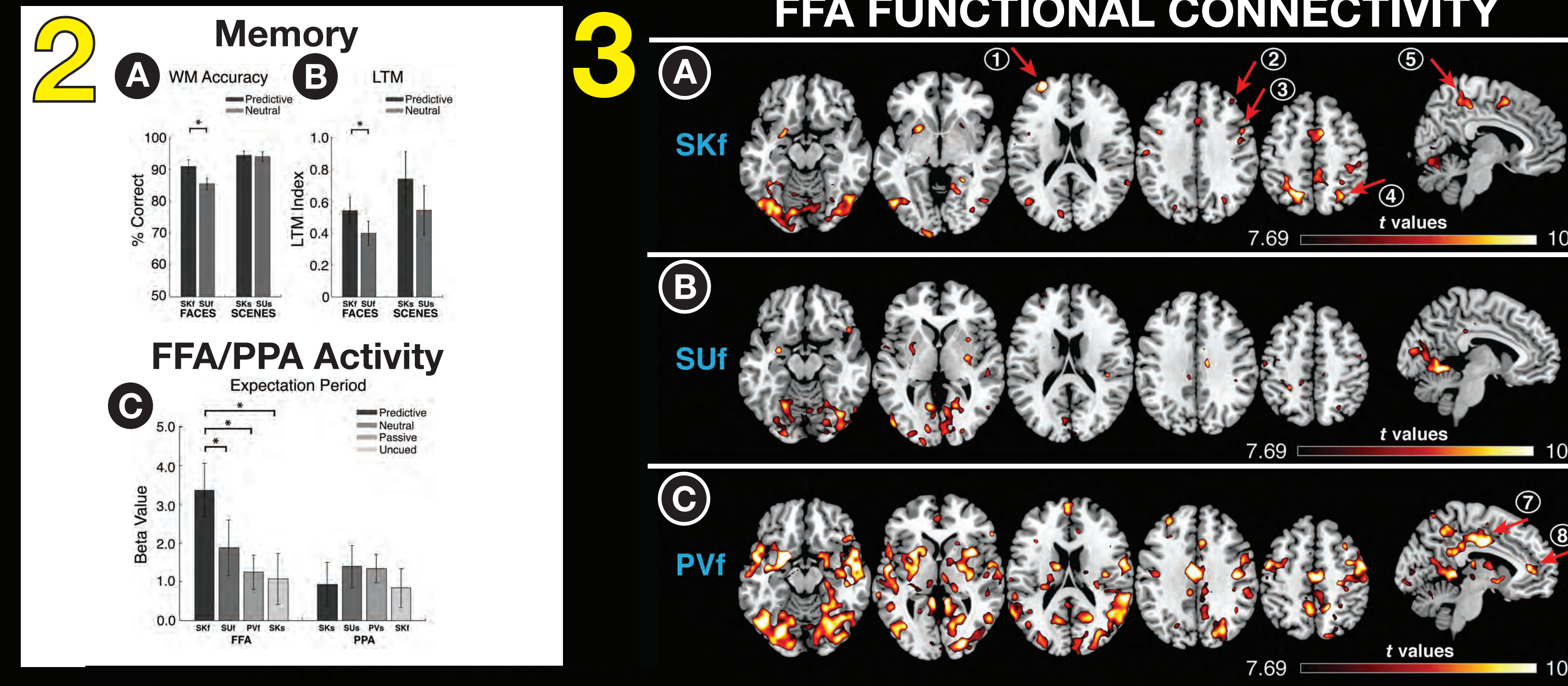
**3 Delayed-Recognition tasks: Stimulus-Known Faces (SKf), Stimulus Known Scenes (SKs), and Stimulus Unknown (SUf, SUs) and a passive baseline condition (PVf, PVs).**  
 Participants were instructed to respond with a button press as quickly as possible without sacrificing accuracy (match/nonmatch).  
**Blocked, event-related design (10 blocks total (2SKf, 2SKs, 4SU, 2PV)).**  
**Behavior: WM accuracy, LTM (surprise post-experiment test (4 point Likert)).**  
**Localizer: Participants performed a 1-Back task with faces and scenes to identify FFA and PPA in each participant.**  
**Functional Connectivity: Beta Series Correlation method (Gazzaley et al., 2004; Rissman et al., 2004).**

**fMRI - Siemens 3T Magnetom Trio; 29 interleaved 3.0 mm axial T2\*-weighted slices; 1.8 x 1.8 x 3.0 mm voxels (EPI); 1 x 1 x 1 mm voxels (T1 anatomical)**  
 Age-group contrasts utilized a hybrid template derived from 43 younger and 43 older participants from our laboratory (Buckner et al., 2004).

## References

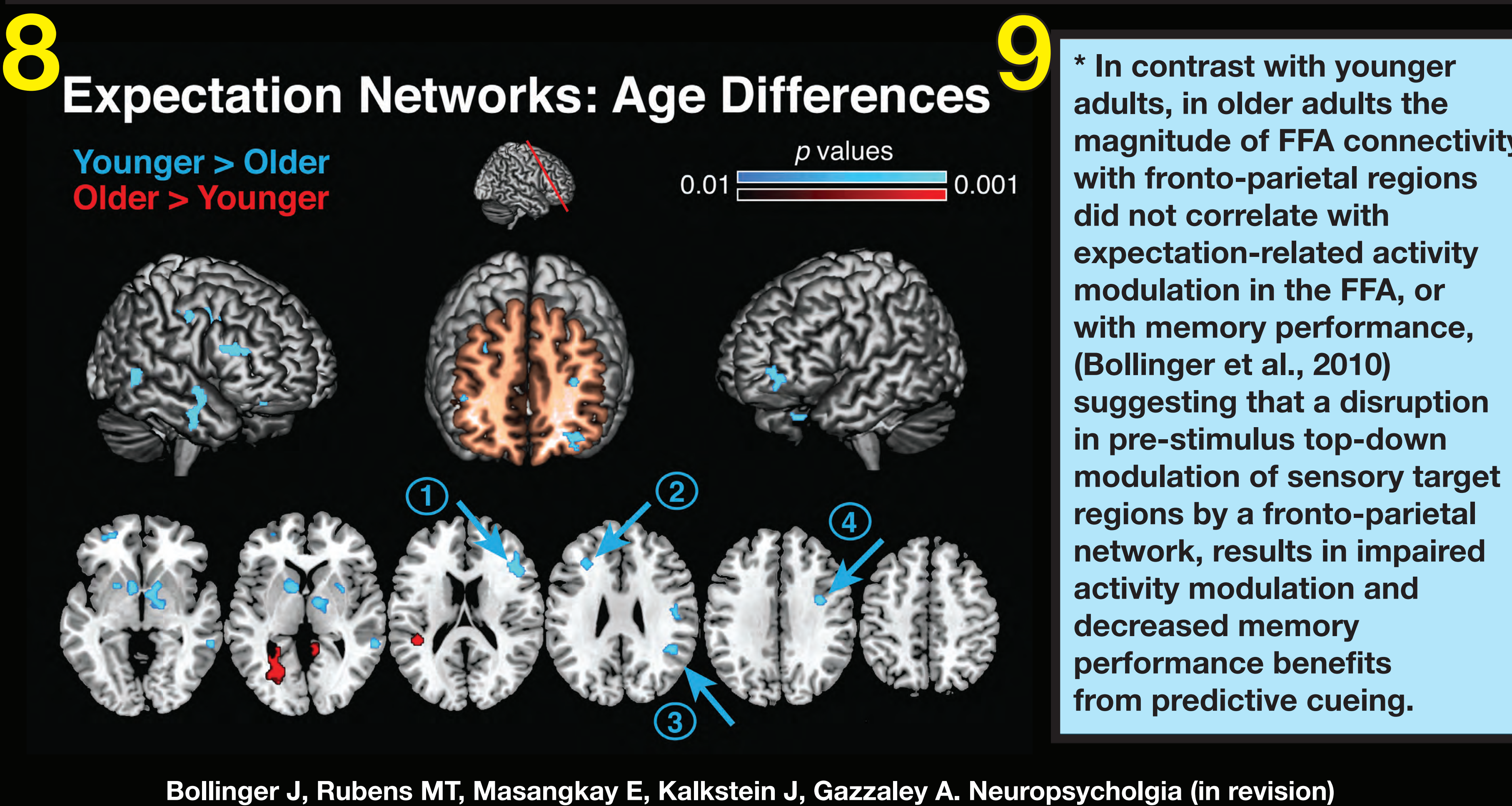
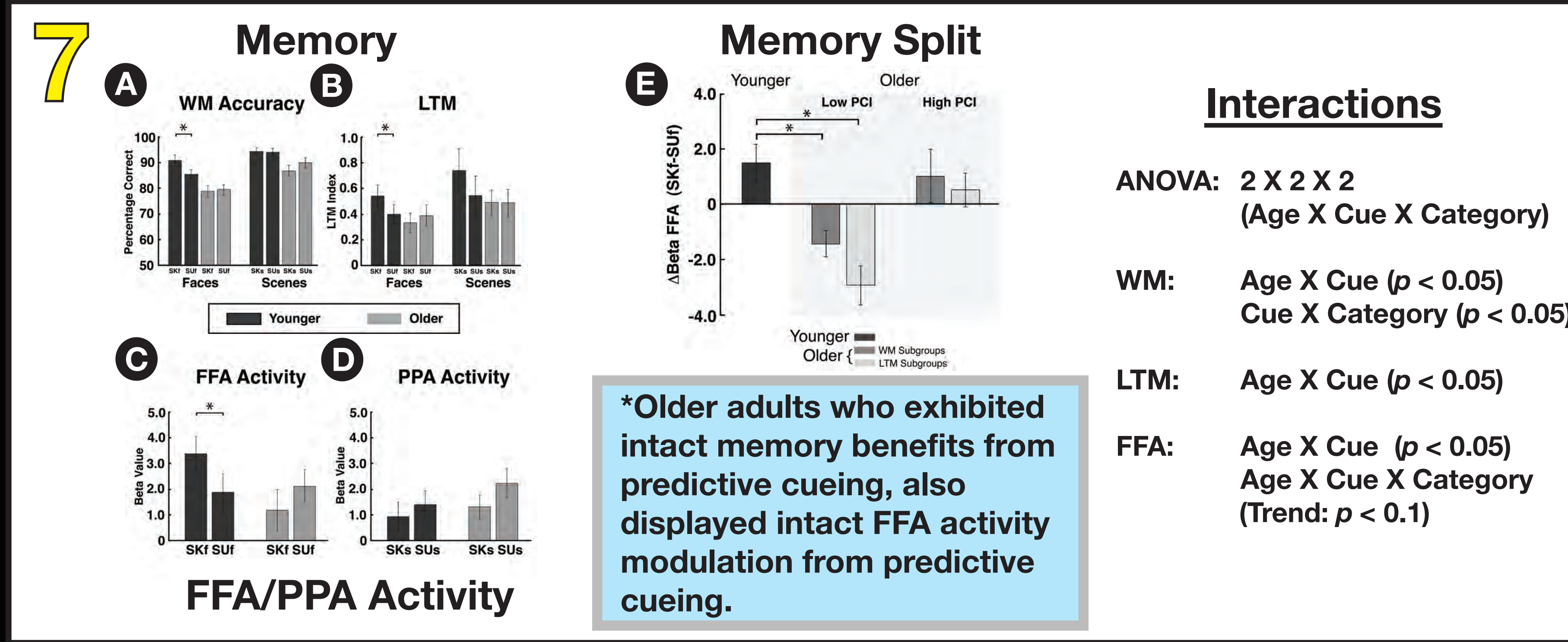
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## Younger Adults



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## Older Adults



## 10 Conclusions

- While younger adults displayed improved WM and LTM for predictively cued face stimuli (Bollinger et al., 2010), older adults did not display these benefits.
- While younger adults displayed FFA-activity modulation during predictive expectation of face stimuli (Bollinger et al., 2010), older adults did not display this modulation.
- A subgroup analysis of the older group revealed that older adults who exhibited intact memory benefits by predictive cueing, also displayed intact FFA activity modulation.
- Relative to younger adults, older adults displayed decreased pre-stimulus functional connectivity between the FFA and a fronto-parietal network of regions thought to mediate sensory cortical neural biasing.
- While in younger adults the magnitude of FFA connectivity with a subset of these fronto-parietal regions (IFJ, MFG, IFG, and IPS) correlated with pre-stimulus activity modulation in the FFA (Bollinger et al., 2010), as well as WM (IFJ, precuneus) and LTM performance benefits (MFG), older adults did not display these relationships.

**The Expectation Deficit Hypothesis of Cognitive Aging: Age-related impairments in engaging attentional networks during periods of valid-cue associated expectation, result in widespread costs in cognitive performance in older individuals.**