

# Emotional modulation in the default mode network during narrative imagery

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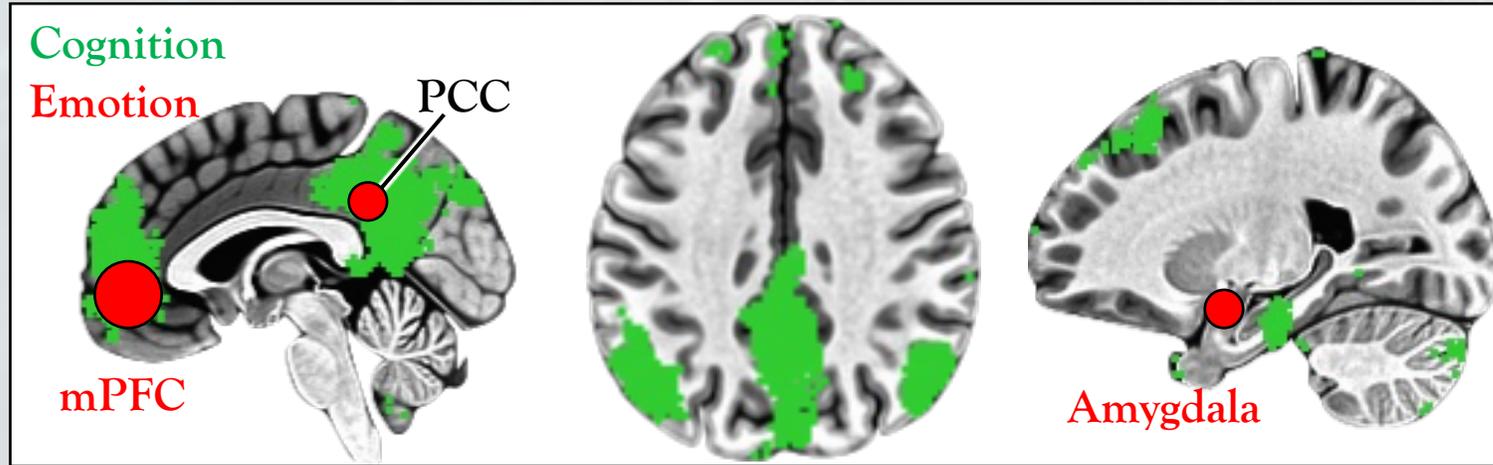
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# Unique abilities in humans are supported by the Default Mode Network (DMN)

- Ability to ‘relive’ past events in the ‘here-and-now’, accompanied by emotional responses during encoding
- Ability to imagine future events without temporal limitations, facilitating flexible goal-directed behavior
- Ability to imagine and simulate emotional fictitious events

→ A primary function attributed to DMN activation is to facilitate motivated and goal-directed behavior through mental simulation that accesses existing memories and knowledge (D’Argembeau et al., 2011; Pine et al., 2021 )

# Emotion effect in the DMN



DMN (green) generated from Neurosynth: Automated meta-analysis of 777 studies using 'default mode' term

Only one node of the DMN is consistently reported to be involved in pleasure processing, the medial prefrontal cortex (mPFC), while the amygdala is proposed to provide emotional information in episodic representations.

HOWEVER, two sets of evidence suggest the possibility that more regions would be activated during emotional processing:

- Studies on narrative imagery found either an increase in BOLD activity in the posterior cingulate cortex (PCC) when imagining pleasant (vs. unpleasant) events (D'Argembeau et al., 2008; Murphy et al., 2017) or an increase when imagining unpleasant (vs. neutral) events (Thome et al., 2020).
- Enhanced reactivity during emotional (either pleasant or unpleasant), compared to neutral, processing is a more frequent finding than valence-modulation in physiological (Bradley et al., 2001, 2017), neural (Cuthbert et al., 2000; De Cesarei and Codispoti, 2011), and behavioral measures (Ferrari et al., 2016; Padmala et al., 2018)

# The current study

Research question: Is functional activity in the DMN modulated by the emotional contents of episodic representations during narrative imagery?

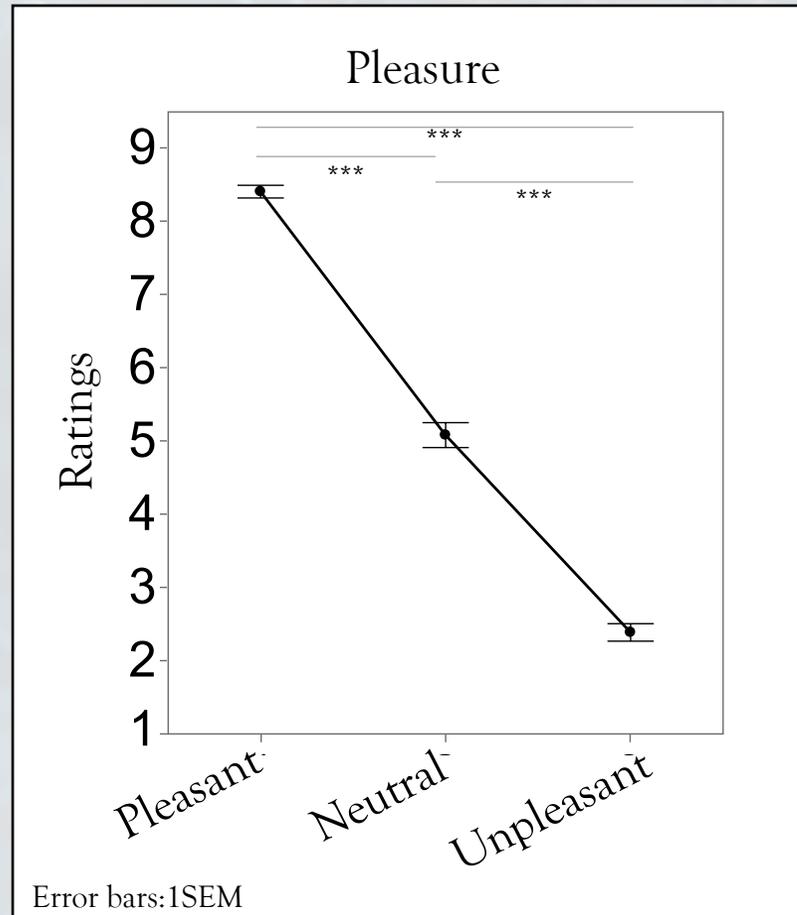
Sample: 27 students (17F) in Introductory Psychology courses at the University of Florida participated for course credits

fMRI:

- 1) 5 minutes resting-state scan
- 2) Imagery, fictitious narratives: 6 pleasant, 6 neutral events, 6 unpleasant. Each script is 15-20 words long. Each narrative script was presented for 6-s and, following script offset, a visual cue (a circle) signaled that the participant should continue to vividly imagine themselves in the described event (for another 6-s).

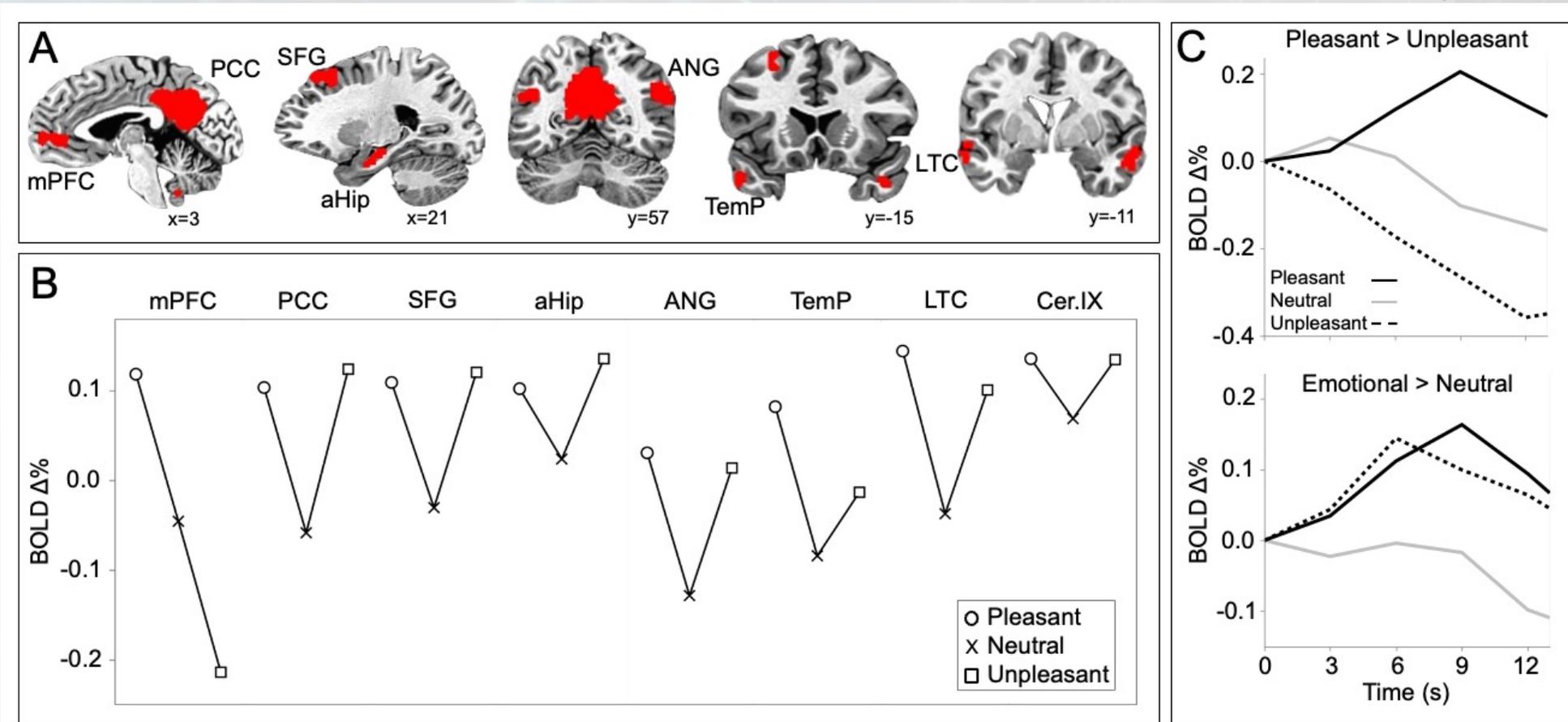
Analyses: DMN identified with a seed-based connectivity analysis centered in PCC with resting-state data, and then emotional effects tested by extracting BOLD activity (3-s to 12-s post script onset) in the identified nodes of the DMN when imagining pleasant, neutral, and unpleasant scenes

# Results: Pleasure ratings



Pleasant narratives were rated more pleasant than neutral and unpleasant narratives, with unpleasant narratives rated more unpleasant (low pleasantness) than neutral narratives

# Results: fMRI



mPFC = medial prefrontal cortex;  
 PCC: posterior cingulate cortex;  
 SFG: superior frontal gyrus;  
 aHip: anterior hippocampus;  
 ANG: angular gyr.; TempP: temporal pole;  
 LTC: lateral temporal cortex;  
 Cer.IX: cerebellum lobule IX;

A. Functional clusters resulting from the seed-based functional connectivity analysis (centered in the PCC), illustrate regions in the Default Mode Network (DMN). B. Mean BOLD activity following script onset in each of the DMN regions. C. BOLD time course in the mPFC (top) and BOLD time course averaged across regions modulated by emotion (bottom).

# Summary & Conclusions

- Replicating previous findings, enhanced BOLD activity was found in mPFC when imagining pleasant, compared to unpleasant, events
- Enhanced BOLD activity when imagining emotional (pleasant or unpleasant), compared to neutral, events was found across the other nodes of the DMN
- No emotional effect found in the amygdala (ROI analysis)

→ No distinction between cognition & emotion: From an evolutionary perspective, one hypothesis is that the cognitive processes mediated by DMN activation, such as recollection of past episodes and imagining future events have evolved from primitive motivational systems that function to support and protect the life of the individual and species (Bradley, 2009; Lang and Bradley, 2010; Pessoa, 2013).

→ Pervasive emotional modulation in the DMN is consistent with the view that a primary function of event retrieval and construction is to remember, recreate, and imagine motivationally relevant events important for planning adaptive behavior

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