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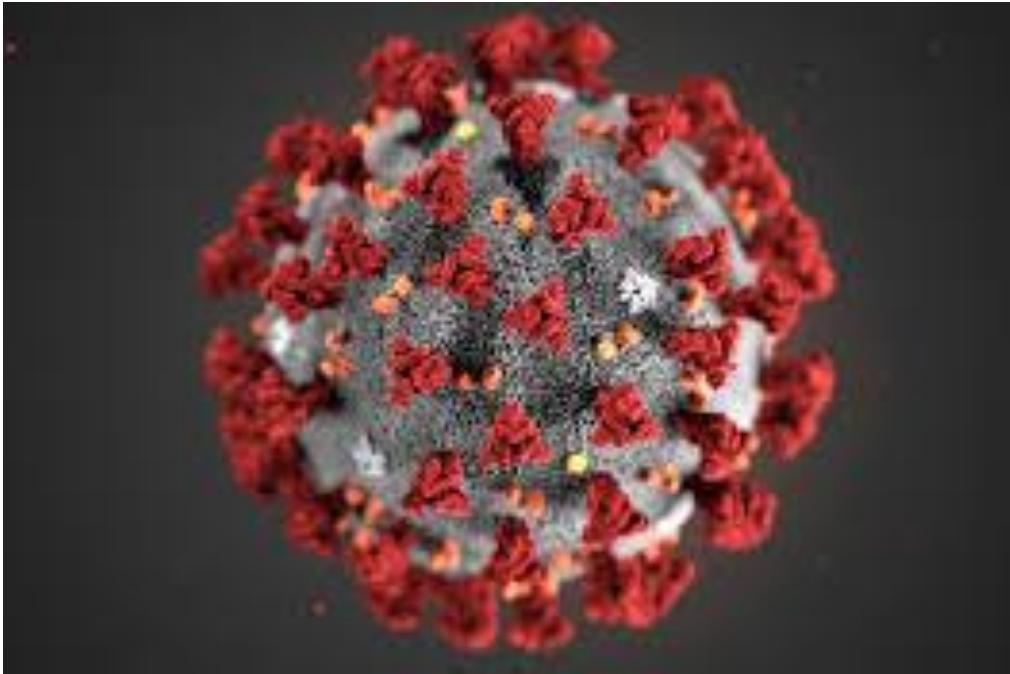
**Computational Affective and
Social Neuroscience Laboratory**

LLM-based scoring of narrative memories reveals that emotional arousal enhances central information at the expense of peripheral information

Xinyue (Yolanda) Pan, Jadyn Park, Yuan Chang Leong
University of Chicago



Can you recall what you were doing when you hear...



The outbreak of COVID-19



January 6 United States Capitol Attack

Flashbulb Memory

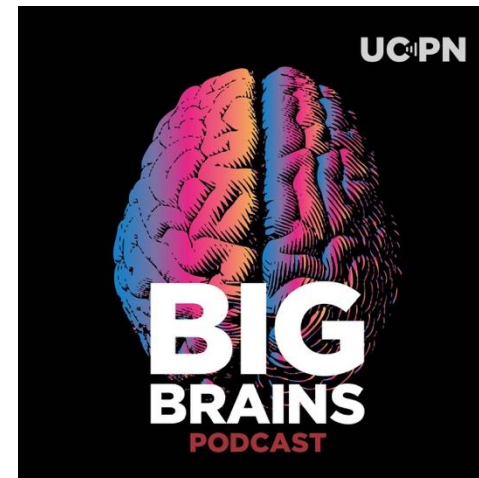
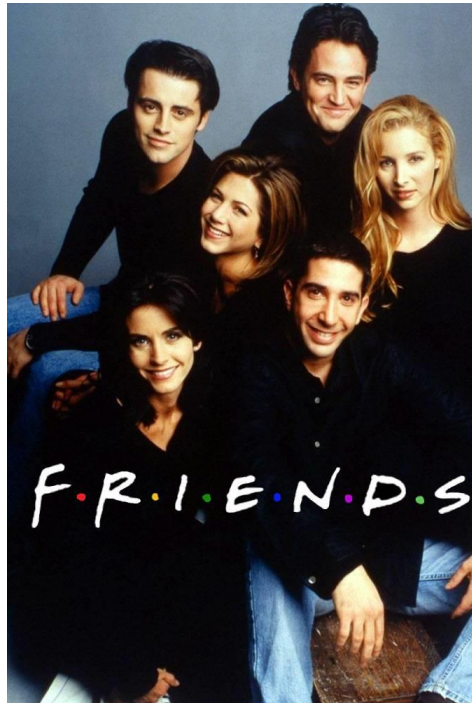
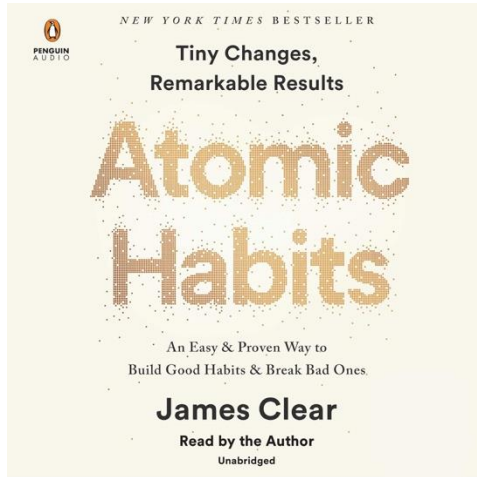
What about personal memories?



- Not standardized across individuals
- Hard to measure without ground truth



Study personal experience through narratives



Emotional arousal enhances narrative memories through functional integration of large-scale brain networks

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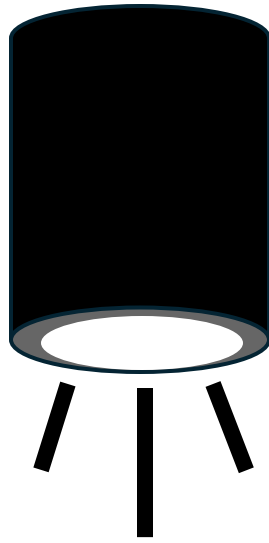
Jadyn S. Park^{1,6}✉, Kruthi Gollapudi¹, Jin Ke², Matthias Nau³, Ioannis Pappas⁴ & Yuan Chang Leong^{1,5,6}✉

- Emotional arousal is a **subjective state of heightened alertness and activation**, often accompanied by physiological changes such as increased pupil dilation and electrodermal activity.
- This paper revealed the neural aspects of the positive relationship between emotional arousal and memory integrity.

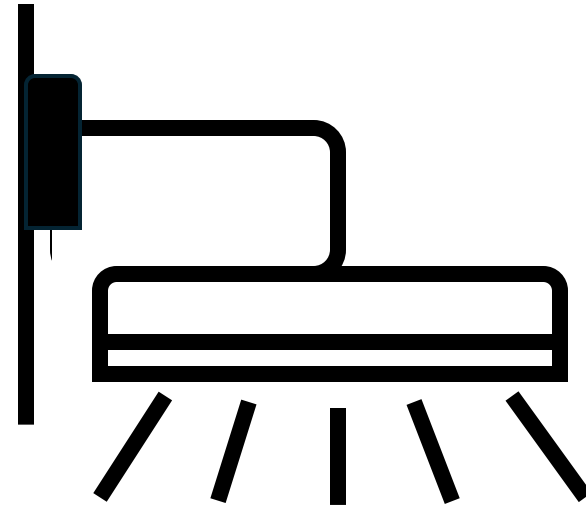
Which aspects of an event are better remembered
under emotional arousal?



Spotlight

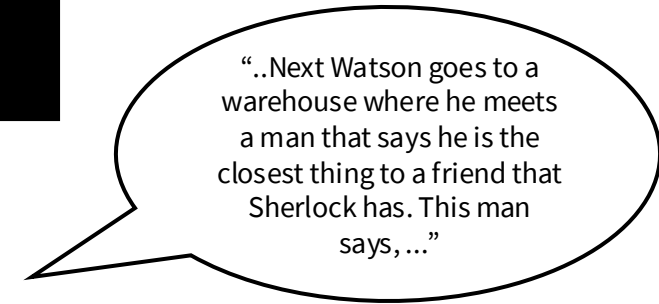


Floodlight



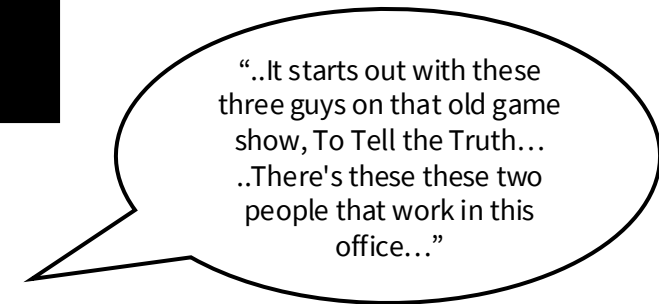
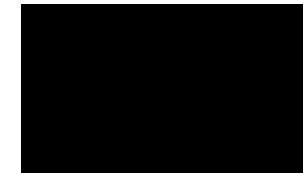
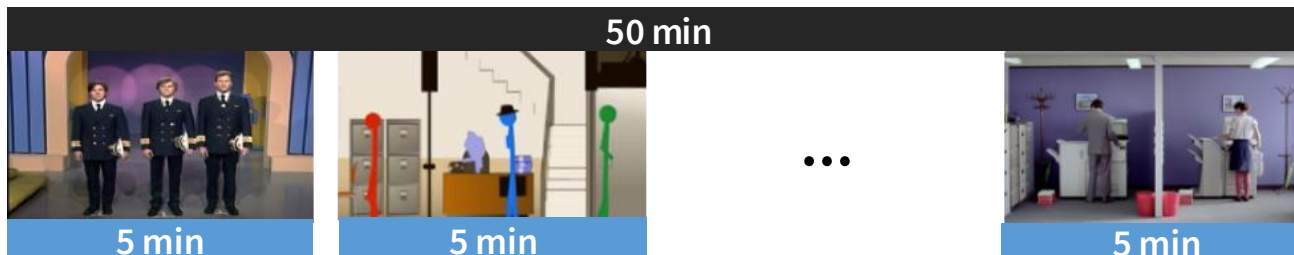
Does emotional arousal enhance memory for **central details**, or does it also shape how the **broader story context** is remembered?

Sherlock (50-min episode)

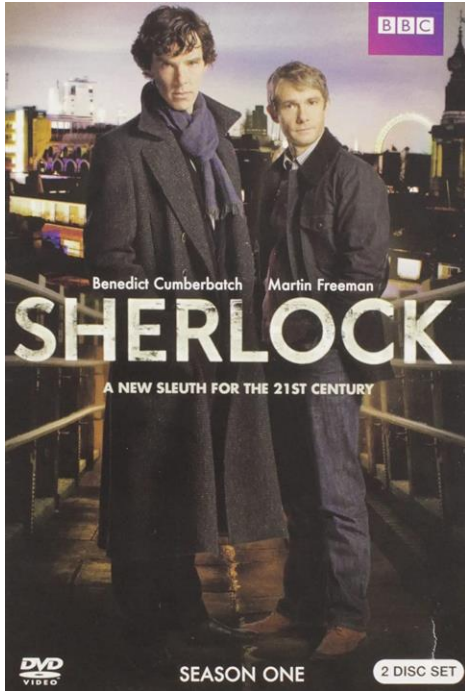


Chen, Leong et al., *Nat Neuro*, 2017

FilmFest (10 movie clips, ~5 minutes each)



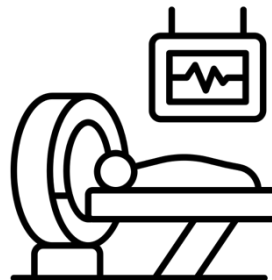
Lee & Chen, *Nat Commun*, 2022



(around 20min into the 50min episode)



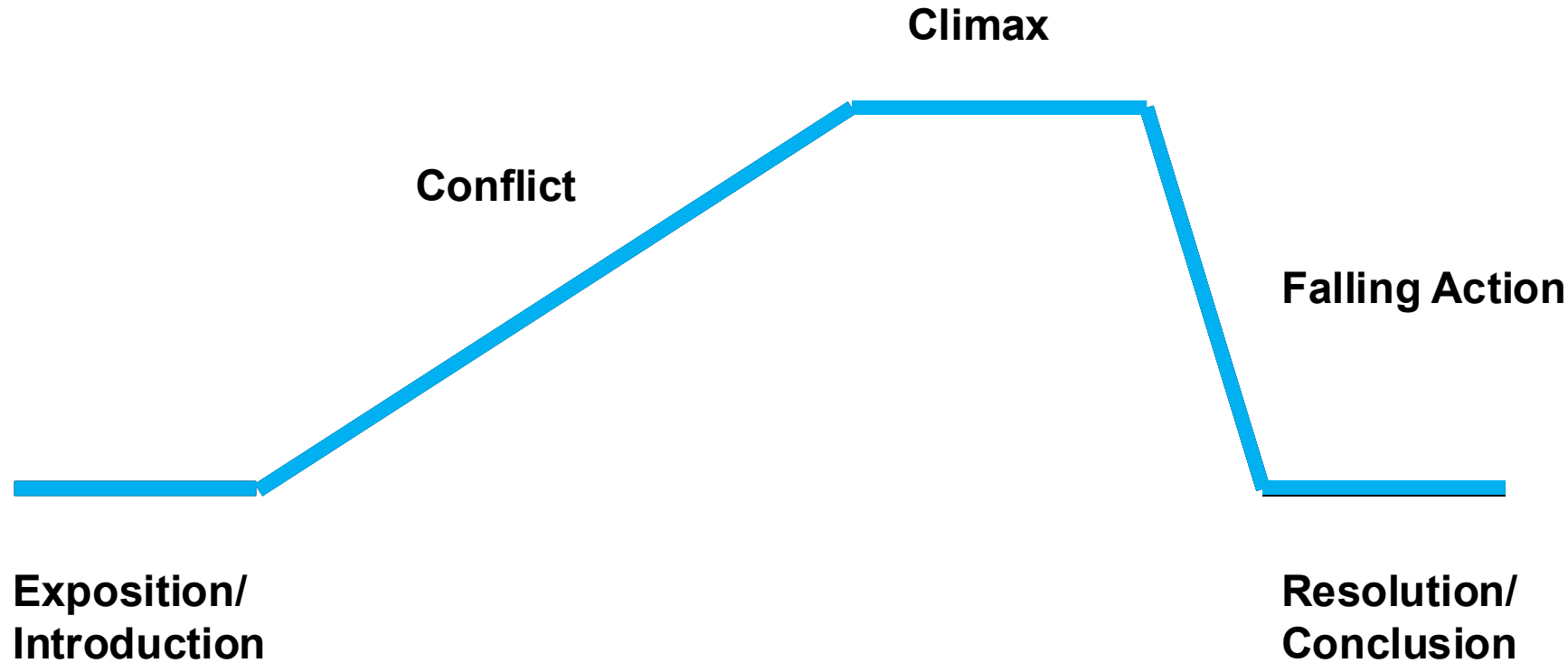
after watching 30 more min, and
recalling the first 20min of content



".. So they have an exchange
where Ms. Hudson comes in, asks
if everything looks okay, and she
picks up the newspaper and



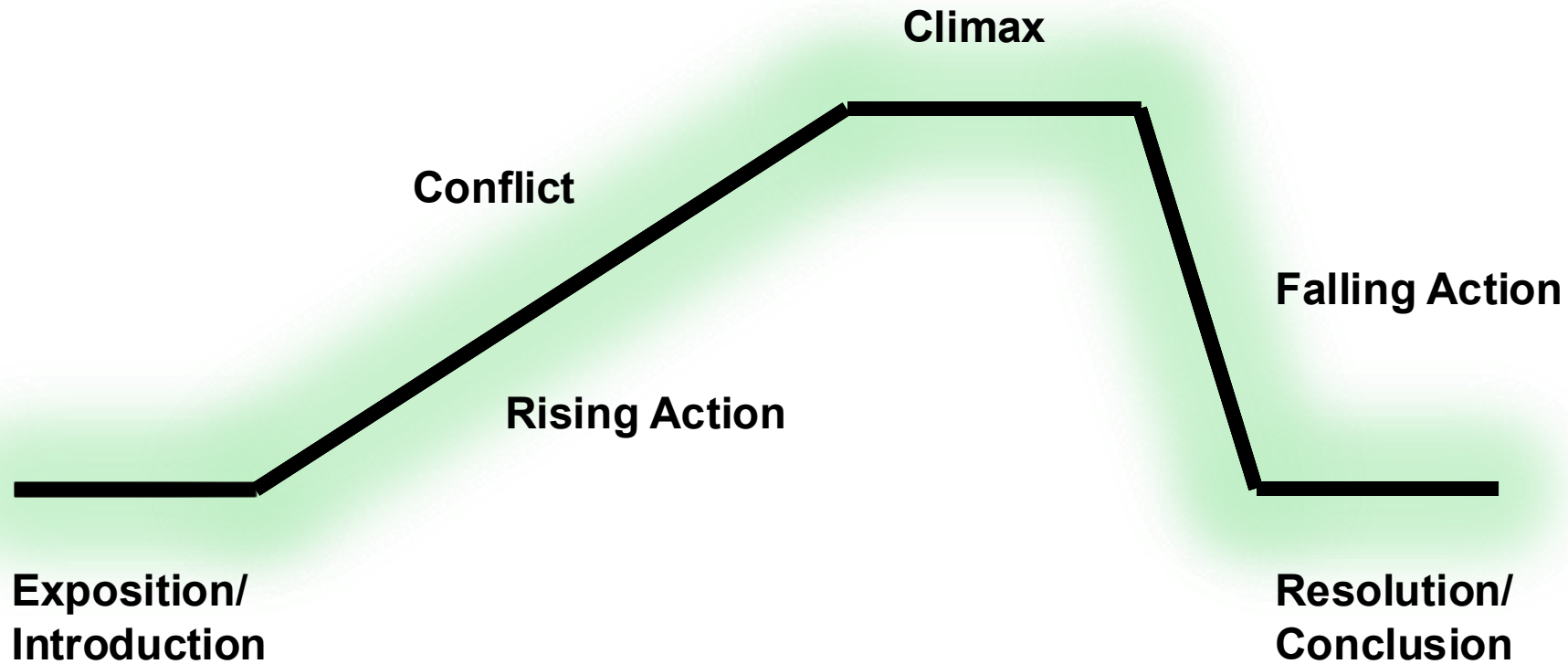
Central details are causally essential elements of a narrative that sustain the story line



C1: Sherlock learns the fourth suicide.

C2: Fourth suicide is different.

Peripheral details are descriptive elements to enrich the context



P1: Ms. Hudson asks about suicide.

P2: Police car parked outside.

Why LLM?



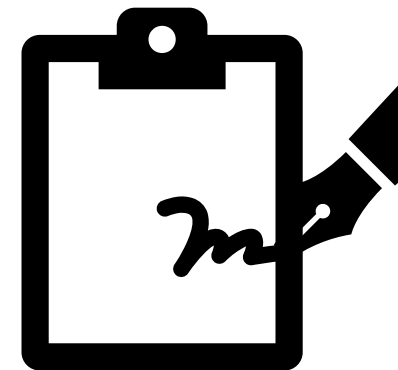
Event annotations



Free recall transcripts



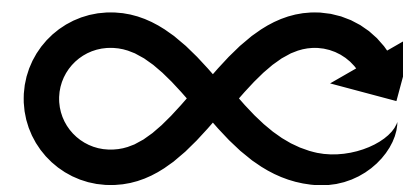
Efficiency



Consistency



Scalability



Generalizability

Automated Scoring for Memory Fidelity



Annotations

Detail Elements

Scores

A few moments later, John is sitting in the back seat of the car as it pulls away and drives off. John is in the right seat, right behind the driver. An attractive young woman is sitting beside John, her eyes fixed on her BlackBerry while she types on it. She is ignoring him. John turns toward her and says, "Hello." The woman smiles brightly at him for a moment and says: "Hi", before returning her gaze to her phone. John awkwardly stays seated. John turns to the woman and asks: "What's your name, then?" The woman, without looking up from her phone, replies: "Er...Anthea." John asks Anthea: "Is that your real name?" Anthea smiles, turns toward John, and says: "No." John nods, then twists to look out of the rear window briefly before turning back again. John says, "I'm John," while looking straight ahead. Anthea, still with eyes locked on her phone, replies: "Yes. I know." John, surprised, looks at Anthea for a moment, then turns back. John looks straight at the road and asks, "Any point in asking where I am going?" Anthea turns and smiles briefly at him and says: "None at all..." then looks back at her phone again. She continues: "John." John turns to look out his window on the right and says, "Okay." Some time later, the car pulls into an almost-empty warehouse.

Central

C1	John is taken to a warehouse.	0
C2	Anthea knows John's name.	0
C3	John is unaware of his destination.	2

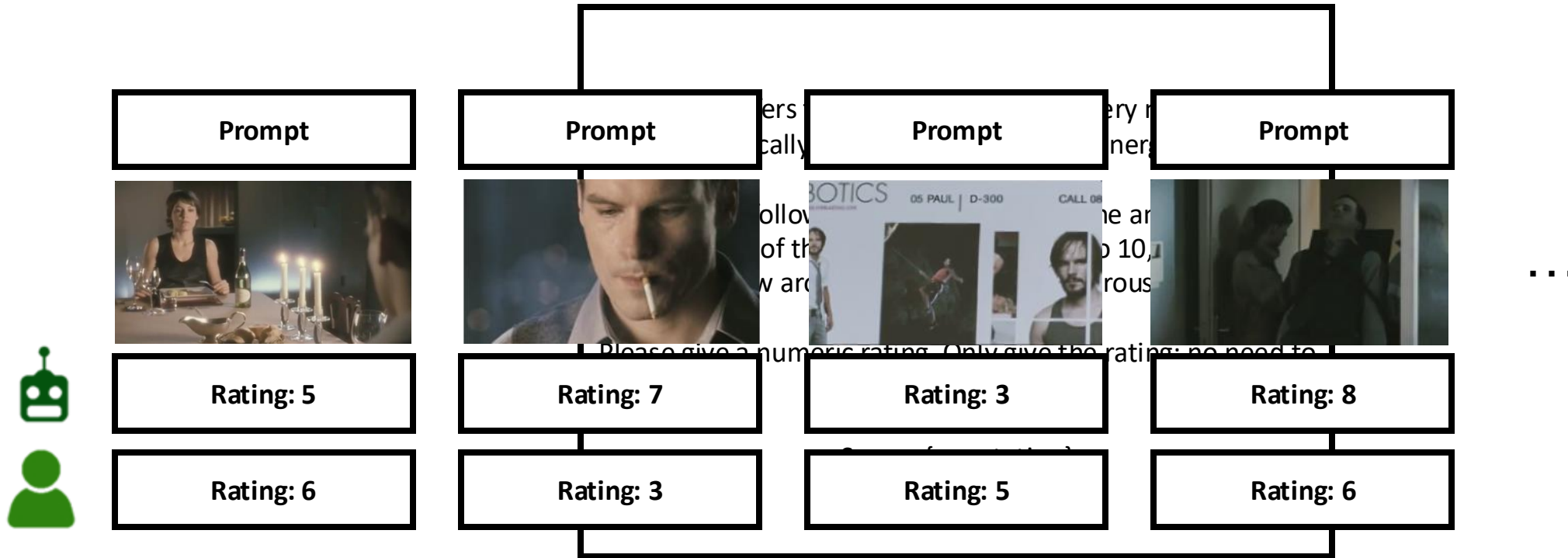
0.50

Peripheral

P1	John sits behind the driver	0
P2	Woman types on her BlackBerry	1
P3	Car enters an empty warehouse	0

0.25

Event-by-Event Measure of Arousal



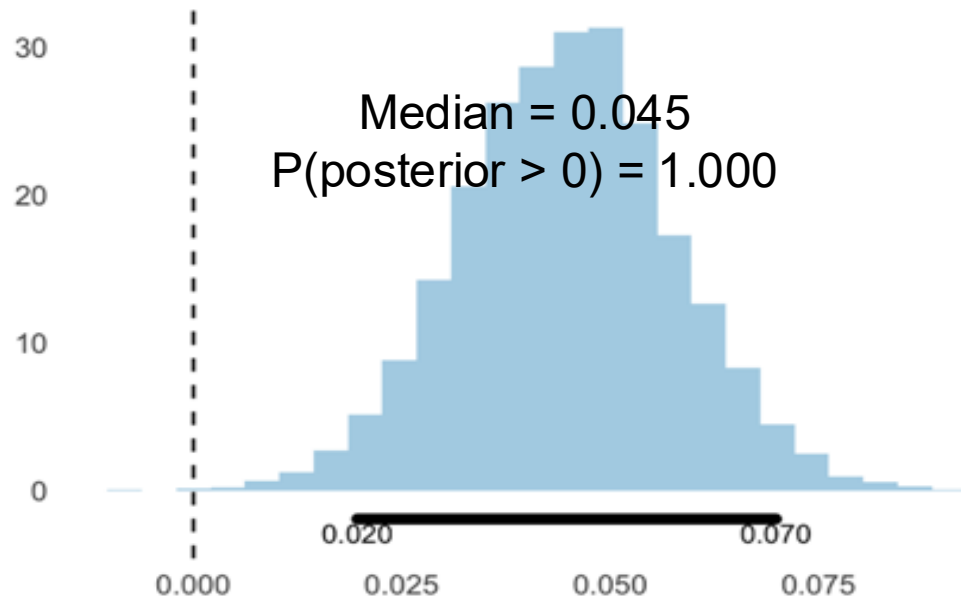
Film Festival

+

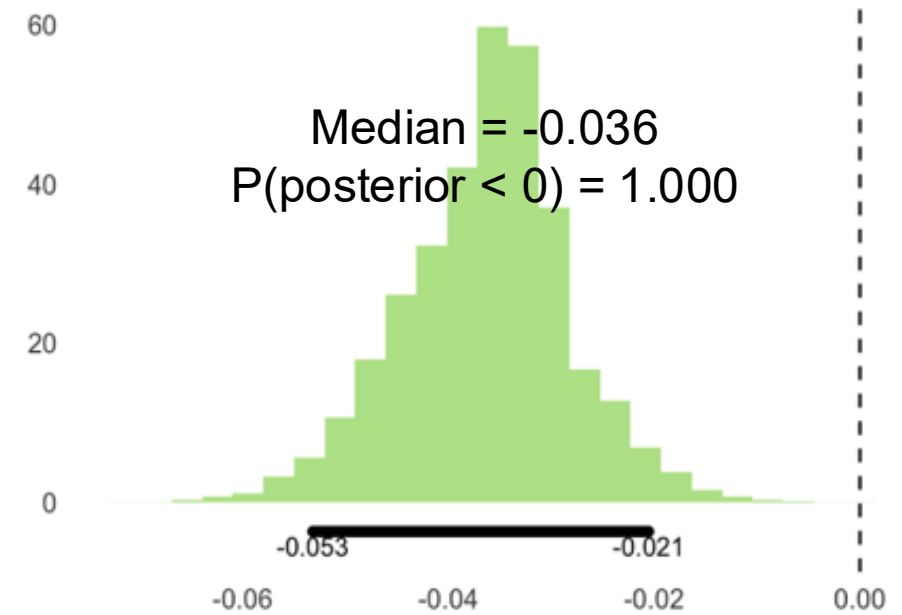
Sherlock

Spearman's rho = 0.73, $p < 0.001$

Effect on central information

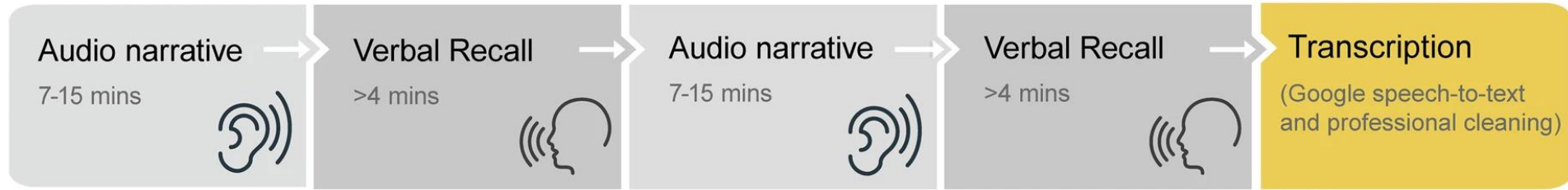


Effect on peripheral information



Emotional arousal enhances **central** information at the expense of **peripheral** information

Fu^a



• Hu^b



Pieman

● Example story event

"... there's a blur in the corner of my eye which becomes this figure holding a cream pie which becomes the guy standing next to me mashing a cream pie into Dean McGowan's face. And then runs away."



Eyespy

● Example story event

"Now all of this meant that no one was paying any attention to me and my cousins in the water."



Oregontrail

● Example story event

"... and I think they're gonna be really annoyed that they got slowed down but they are psyched. They got to throw up in social studies. ..."



Baseball

● Example story event

"We can't tell much about them in this storm," the station master said. "All our trains are more or less late. Stop in this afternoon, and I may have some definite information for you."

• Ex

• Au

● Example recall - P14

"... the guy sees a blur in the corner of his eye that gets bigger, and all of a sudden, this person throws a cream pie at the dean's face and then runs away."

● Example recall - P24

"... they're obsessed with them but that means that they weren't watching the three kids. So, it was the narrator and her two cousins who are kids and they were playing in the water."

● Example recall - P155

"but instead of being mad about it after they drank the fake oil and start puking in the game, they were all really excited about that."

● Example recall - P133

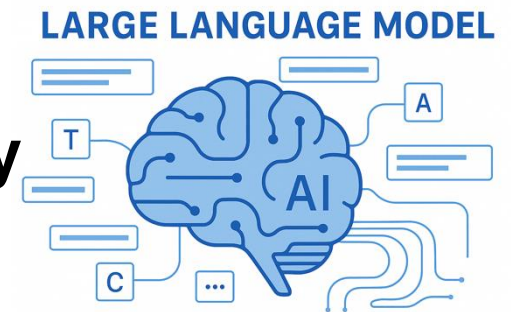
"The stationmaster or the guy at the train depot says he's not sure because the weather is so horrible."

Conclusion



- This trade-off **supports the attentional narrowing hypothesis**, which posits that arousal focuses cognitive resources on information most relevant to the event's core meaning.

- Importantly, our automated LLM-based pipeline demonstrates the potential to **scale memory fidelity analyses** with minimal human labor.



Emotion may not expand what we remember; but it refines it, narrowing attention to the core.

