Whodunnit? Inferring what happened from multimodal evidence

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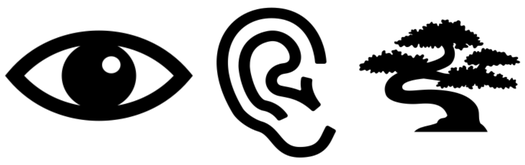
BACKGROUND

People combine information from multiple senses to understand the environment.



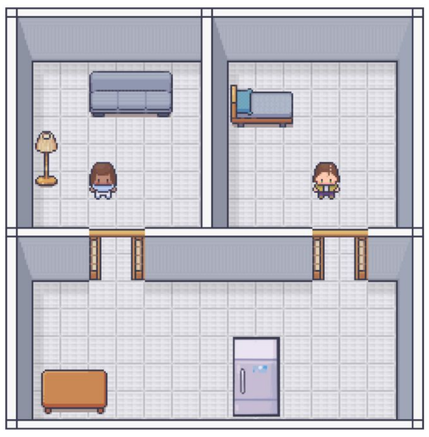
Mental models of how agents plan actions allow us reconstruct others' past behavior.

How do people combine evidence from multiple senses to understand past behavior? *And can AI systems (LLMs, MLMs)?*

EXPERIMENT

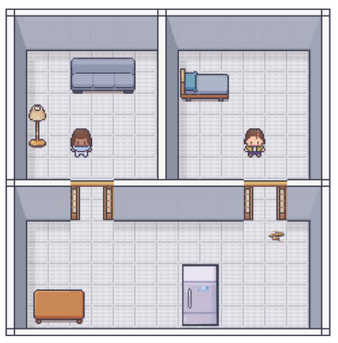
Agents get a snack from the kitchen or watch TV in the living room, leaving audio and/or visual traces.

Initial scene



Evidence

Visual



Audio

"step, step, …, fridge opened, fridge closed, step, …"

Who got a snack from the fridge?

definitely   definitely 

MODELS

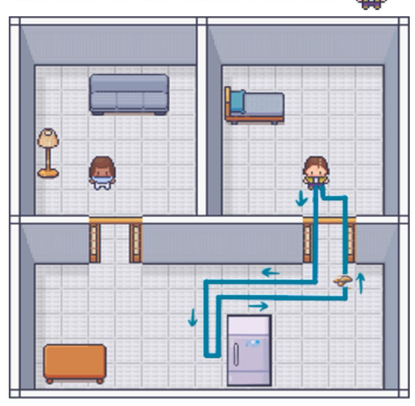
1. **`GPT-4V`** - images & audio transcript
2. **`GPT-4V`** - scene graphs & audio transcript
3. Multimodal event simulation model

Event Reconstruction for 

Expected Audio for 

[step x 11, fridge opens, food picked up, fridge closes, **step x 22**]

Event Reconstruction for 



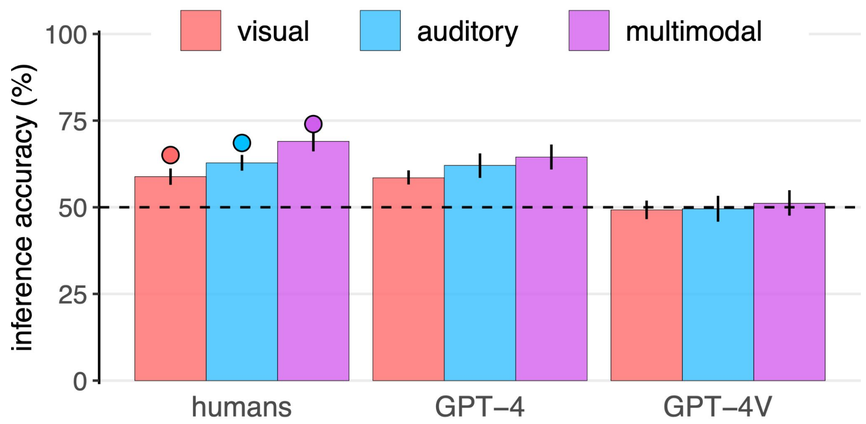
Expected Audio for 

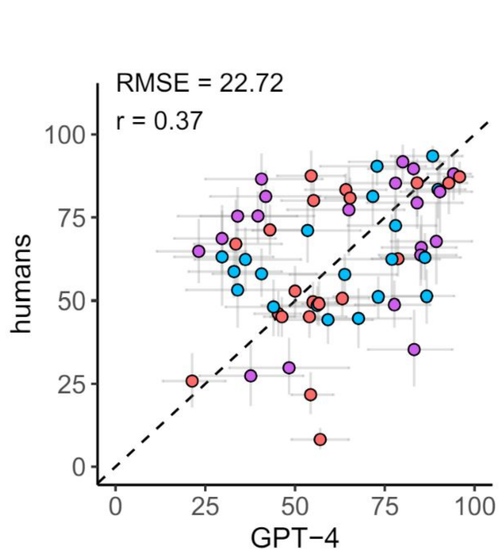
[step x 11, fridge opens, food picked up, fridge closes, **step x 13**]

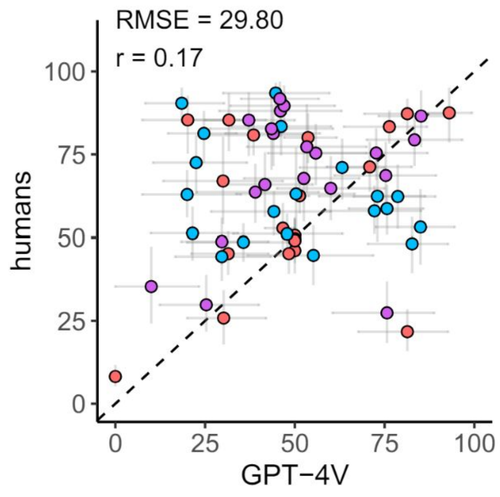
RESULTS

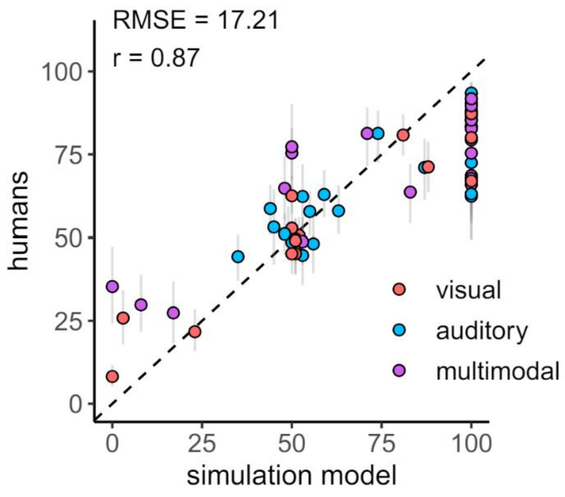
★ Humans and **`GPT-4`** more accurate with multimodal evidence, but not **`GPT-4V`**

★ Participants' visual and auditory accuracy can both predict multimodal accuracy





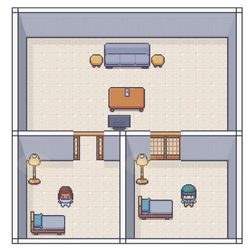




Example trial

Initial scene

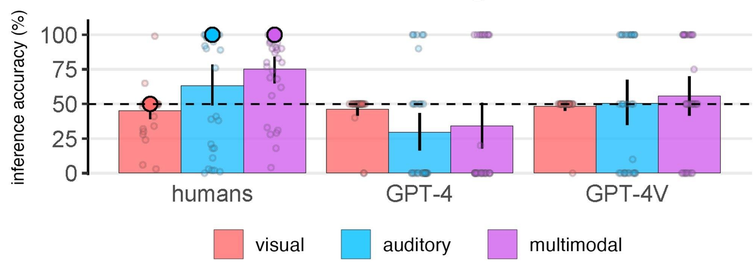
Visual evidence



Auditory evidence

step x **4**, door opened, step x **8**, TV played, step x **8**, door closed, step x **4**

Who was watching TV?



★ *Simulation model* captures indiv. human responses

★ **`GPT-4`** and **`GPT-4V`** do not match human responses

TAKEAWAYS

★ People use evidence from multiple senses to reconstruct others' behavior

★ This remains a challenge for **`GPT-4`** and **`GPT-4V`**. Our simulation model captures humans