Slide 1: Cognitive MRI of AI Conversations

"Good morning. This talk is about a simple question: what if you treat your AI chat history as data?"

"Most of us have hundreds of conversations with ChatGPT by now. Maybe thousands. And they just sit there, buried in a scroll. We wanted to know: is there structure hiding in there?"

"We call this a 'Cognitive MRI.' That's a metaphor—we're trying to extract a kind of knowledge map from chat logs."

Slide 2: Why Now? The Scale of the Opportunity

"ChatGPT has 1.7 billion users. That's a lot of conversations."

"And here's what's interesting. These logs capture something different. Citation networks show you papers—outputs. Social networks show you who knows whom—connections."

"But chat logs might show you the *process*. How ideas develop. The back-and-forth."

"Is that actually true? That's what we wanted to test. Today I'll show you one case study."

Slide 3: The Big Picture: Externalized Cognition

"We're using a framework called Distributed Cognition. The idea is simple: thinking doesn't just happen in your head. It happens between you and your tools."

"When you talk to an LLM, you're thinking out loud. Offloading work. And ideas get built through that conversation—not just looked up."

"Now, what gets saved? Usually just the product. The final draft. Clean and polished."

"But the messy part—the exploring, the dead ends—that usually disappears."

"Think about fixing a bug. Twenty rounds of trying things. False starts. Then finally it clicks. The commit message? One line."

"Or a mathematician. Notebooks full of wrong turns. We only see the final proof."

"That's what I call cognitive dark matter. And chat logs might capture it."

"So here's what we did."

Slide 4: From Log to a "Cognitive MRI"

"Start with a chat history. It's just a timeline. January: Python bug. February: banana bread. March: more debugging. April: ethics."

"We turn each conversation into a vector. 768 dimensions. Similar topics land near each other in that space."

"Then we connect by similarity, not by time."

"What happens? Those two coding chats—months apart—snap together. Banana bread floats off on its own. Philosophy clusters somewhere else."

"The key insight: close in time doesn't mean close in thought. The network reconnects what the timeline splits apart."

Slide 5: Method: Capturing Intent

"There's a problem though. AI responses are wordy. Lots of filler. If you treat everything the same, the AI's voice drowns out yours."

"So we split them. User messages separate from AI messages. Then we weight them."

"Why? Your prompts carry the intent. What you actually care about. The AI just adds context."

"We take the average of your messages, the average of the AI's, then blend them 2-to-1 in your favor. One vector per conversation."

"That gives us two knobs to turn. Alpha: how much to weight user versus AI. And theta—that's our similarity cutoff. How close do two conversations need to be before we draw an edge?"

"Both need testing. That's the ablation study."

Slide 6: Rigorous Parameter Tuning: 2D Ablation Study

"We tested 63 combinations. Swept through different values of theta and alpha together. Optimized for modularity—how clean the community boundaries are."

"For theta—the similarity cutoff—there's a tipping point around 0.875. Below that, everything connects. It's a mess. Above that, things fall apart."

"0.9 worked well. Clear structure, not too sparse."

"For the weighting: 2-to-1 user-to-AI gave the best modularity. That backs up the intuition—your voice matters more."

"So: theta 0.9, alpha 2-to-1, modularity 0.750."

"This isn't arbitrary. We tested it. Though it's still just one person's data."

Slide 7: The Cognitive MRI: 15 Knowledge Domains

[Pause—let them look]

"Here's the result. 449 conversations. Two years of chats."

"1,615 edges. 15 communities. Modularity 0.750—that's pretty good. Real structure, not noise."

"The clusters match what I'd expect. AI and machine learning up here—dense, lots of overlap. Probability, neural nets, embeddings, all tangled together."

"Coding projects down here. More spread out. Different projects, different clusters."

"Philosophy off to the side. Math. Writing."

"It's not uniform. About a quarter is this dense core—general stuff that connects everywhere. The outer parts are more specialized. And the average path? About 6 hops between any two chats."

"I labeled these myself. The algorithm finds patterns; I interpret them. Though I tested having an LLM do the labeling—it worked okay. You could automate the whole thing."

"Point is: the algorithm found something. Whether it means anything beyond my own head? Hard to say with N of 1."

Slide 8: Insight 1: Structural Heterogeneity

"Different topics have different shapes."

"Theory—math, ML concepts, philosophy—clusters tightly. Clustering coefficient around 0.58. That's high. Small-world structure."

"That makes sense. Theory means revisiting core ideas. Refining definitions. Everything links back."

"Coding is looser. Around 0.39. More like a tree."

"You fix one bug, move on. Less backtracking. Projects stay in their own lanes. Metaprogramming here, physics simulation there. Not much crossover."

"This is suggestive. We'd need more users to know if it holds up."

Slide 9: Insight 2: A Taxonomy of Bridges

"We also looked at the connectors. High-betweenness nodes—chats that link different clusters."

"Three patterns showed up."

"Evolutionary bridges. Conversations that drift. You start talking about one thing, end up somewhere else. Like a math chat that wanders into neural network loss functions."

"Integrative bridges. Deliberate. You're explicitly combining two fields. AI ethics, for example."

"Pure bridges. Rare. A single chat that links distant clusters. Maybe a Linux question that happens to connect gaming and work."

"We're proposing this as a taxonomy. Based on what we saw."

Slide 10: The Vision: Personal Knowledge Cartography

"Why does this matter?"

"Right now, your chat history is a scroll. Finding something from six months ago? Good luck."

"What if you could search by topic instead of date?"

"Query: 'Show me everything about entropy.' The network lights up. Biology connects to AI connects to coding connects to ethics."

"This paper is about structure—communities, bridges, topology. But that structure enables other things. Semantic search. Recommendations. Finding gaps. We haven't built those yet."

"The problem: insights buried in the scroll. The solution: a map."

"That's the direction."

Slide 11: Cognitive MRI: A Proof of Concept

"Key findings: user weighting works. The topology varies—hubs for theory, trees for practice. Three kinds of bridges."

"But this is exploratory. One user. One platform. One snapshot. No ground truth."

"Next steps: more users. Track changes over time. Proper validation—permutation tests, benchmarks, user studies."

"We'd love collaborators with bigger datasets."

"Thanks. Happy to take questions."