Designing Minds in Dialogue: Conversational AI as a Scaffold for Children's Cognitive Agency

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RESEARCH QUESTION

How can LLM-powered conversational AI (CAI) support young children's nascent capacities to reflect, exercise voice, and make decisions, rather than narrowing their capacity to think independently?

Type of Paper: Conceptual. Translates the theory of Sustained Shared Thinking (SST) into a child-CAI interaction design framework. SST is an Early Childhood Education approach (Brodie, 2014). It uses dialogic questioning ("Why do you think that?"/What do you think would happen if…") to help young children make sense of the world and their own emerging identity.

WHY EARLY CHILDHOOD MATTERS

Young children (0-8) encounter CAI in a fundamentally different cognitive context from adults.

- Executive functions, causal reasoning, and metacognition are still developing (Conkbayir, 2021; Levitt & Eagleson, 2018).
- It is the quality of dialogue, scaffolding, and sustained exploration that strengthens emerging reasoning pathways (rather than simply accessing information quickly) (Hildebrandt & Musholt; Goswami, 2019).
- LLM design that prioritises rapid answer delivery risks encouraging passivity.

→ **Early childhood is a sensitive developmental phase for CAI-mediated cognition.**

THE "3C" FRAMEWORK FOR CHILD-CENTRED CAI DESIGN TO SUPPORT COGNITIVE AGENCY

1. CO-CONSTRUCTION

Young children build their understanding through repetitive (and often slow) questioning and exploration. Immediate, polished AI answers risk narrowing this process. Instead, nurturing children's cognitive agency as co-constructors of knowledge may include:

- Reciprocal questioning rather than rushing to correct the child's understanding ("Hmm. I wonder when you noticed this?")
- Reflective pauses ("Let's take a minute to think")
- Hypothesis prompts before synthesis ("What do you think will happen?")
- Collective deliberation before closure ("What do you think is the best explanation?")

Design implication: AI models agency-centred inquiry rather than final conclusions.

2. CHALLENGE

Learning occurs when children are stretched just beyond current competence (Vygotsky, 1978). SST-based challenges may include:

- Counterfactual prompts ("If we hadn't done this, what do you think would happen?")
- Requests for justification ("Why did you do that?")
- Perspective-taking questions ("How do you think this character felt?")
- Gentle contradictions ("You say X happened. I wonder why Y didn't happen then?")

Design implication: Adaptive scaffolding calibrated to developmental stages.

3. CURIOSITY

AI as a dialogic mediator, not an answer engine.

- Builds on children's prior ideas ("Just like you were saying before…")
- Surfaces multiple viewpoints ("Do you think another person might see this differently?")
- Invites peers, teachers, caregivers into dialogue ("What does your friend think?")
- Sustains multi-turn reasoning

Design implication: Interfaces must track and weave contributions across participants and turns.

DESIGN PRINCIPLES FOR LLM SYSTEMS

To support collaborative agency, CAI should:

- Redistribute epistemic authority toward children
- Delay premature solution delivery
- Encourage peer-to-peer reasoning
- Make meaning-making processes visible

CONTRIBUTION

- Reframes young children as participants in AI-mediated collaborative systems, not isolated users passively consuming information.
- Provides a concise, theory-grounded framework translating developmental psychology into actionable HCI design principles.
- If AI can support cognitive agency in early childhood, it establishes a benchmark for responsible agency-supportive, developmentally appropriate design more broadly.

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