

A Sociomaterial Reframing of Empathy in Conversational Virtual Humans*

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Abstract

Empathy in Human–Computer Interaction (HCI) is frequently treated either as a technical feature embedded within artificial agents or as a methodological stance for researchers. This paper reconceptualizes empathy as a sociomaterial phenomenon that emerges through entanglements among technologies, users, designers, and situated contexts. Drawing on three qualitative studies of Conversational Virtual Humans (CVHs) with groups vulnerable to social isolation, we examine how empathy is materialized and enacted differently across contexts. We contribute (1) an empirical account of empathy as a situated outcome of human–AI interaction, and (2) an extended sociomaterial ontology for responsible design, augmented with a behavioral dimension that captures how empathy is performed and responded to in interaction. We argue that empathy in generative conversational AI is not simulated affect, but a relational and behavioral accomplishment shaped by affordances, temporal dynamics, and infrastructural conditions.

Keywords

AI, Conversational Virtual Humans (CVHs), Empathy, Sociomateriality, Human-Computer Interaction (HCI), Grief, Dementia, Autism, Empathic Computing,

1. Introduction: From Simulated Empathy to Sociomaterial Empathy

Recent advancements in Large Language Models (LLMs) have significantly shifted the landscape of conversational AI, enabling agents to “perform” empathy with unprecedented fluency [1]. However, framing empathy purely as “simulated affect”—the system’s ability to mirror human emotion through sentiment analysis or anthropomorphic cues ([2], [3])—remains the dominant paradigm. Recent HCI scholarship critiques this “empathy machine” narrative, suggesting that empathy is not a psychological state to be “delivered” but a “doing” that is situated, distributed, and often political [4]. This is particularly critical when designing for vulnerable populations, where empathy is not a static feature but a dynamic interaction between the agent’s affordances and the user’s lived experience of care. By shifting from a “user-centred” to a “sociomaterial” perspective [5], we argue that empathy is enacted through the material configurations of the CVH. We propose that by focusing on five core dimensions (Figure 1), designers can better understand how empathy is co-constructed during interaction.

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2. The Three Core Studies

This framework is derived from three qualitative studies conducted as part of a doctoral thesis [6] and published across several HCI venues.

Study 1: CVHs for Autistic Adults. We conducted semi-structured interviews and observations with 12 autistic adults over 4 weeks to explore support for social communication. Findings highlighted how CVHs provide a “safe space” for social practice through predictable interactional rhythms [7]. For many autistic individuals, empathy materialises through the reduction of social friction: mechanical consistency provided a safe social sandbox where the absence of judgment is enacted through the CVH’s ability to wait indefinitely for a response.

Study 2: CVHs for Bereavement Support. Focusing on 10 individuals experiencing grief, this study examined interactions with a memory-sharing CVH over 4 weeks. Analysis highlighted “relational persistence,” where the CVH served as a material witness to the user’s grief, facilitating social connectedness through shared storytelling [8]. In the context of grief, conversational agents enact empathy by serving as a continuing bonds infrastructure, creating a sense of relational continuity.

Study 3: CVHs for People Living with Early-Stage Dementia. We investigated a CVH as a “reminiscence companion” with 8 participants and their carers. The findings pointed to “infrastructural empathy”, the need for the system to adapt to the cognitive and physical environment of the home [9]. For individuals experiencing cognitive decline, empathy is enacted as cognitive anchoring. By prompting users with life-story data and reinforcing memories, the system enacts an “empathy of recognition,” reducing cognitive load and scaffolding agency.

3. A Five-Dimensional Sociomaterial Framework

Rather than treating empathy as a monolithic trait, we propose five distinct dimensions where empathy is “done” through the entanglement of human and machine (Table 1).

3.1. Affective Empathy (The Visceral)

Affective empathy is the sensory and aesthetic dimension of the sociomaterial entanglement. It involves how the materiality of the interface (visual placement, voice tonality) resonates with the user’s specific sensory needs. In Study 1, we found that traditional “empathic” cues (e.g., high-fidelity emotional expressions) were often perceived as overwhelming or “noisy” by neurodivergent users. For them, affective empathy was materialised through aesthetic minimalism and neutral tones. This suggests that empathy can be enacted through the omission of complex affect, creating a “low-arousal” environment.

3.2. Cognitive Empathy (The Interpretive)

Cognitive empathy is the system’s capacity to interpret and validate the user’s reality through accurate context-awareness. Sociomaterially, this is enacted through the interpretive logic of the software: its ability to parse data (like photos or text) and return a response that confirms the user’s epistemic state. In Study 3, cognitive empathy was performed through “the empathy of recognition.” When the CVH correctly identified a person from the user’s past in a photo, it was a material act of cognitive support that reinforced the user’s fading sense of self. Conversely, “hallucinations” or errors are sociomaterial failures that break trust in the system’s ability to “see” the user.

3.3. Relational Empathy (The Temporal)

Relational empathy is the temporal dimension of companionship. It is enacted through the persistence of the digital trace: the system’s ability to “remember” and weave past interactions into current ones. Empathy here is a cumulative achievement. In Study 2, participants valued the CVH’s role as a “witness” to grief. Unlike human networks that may experience “grief fatigue,” the CVH’s material infrastructure

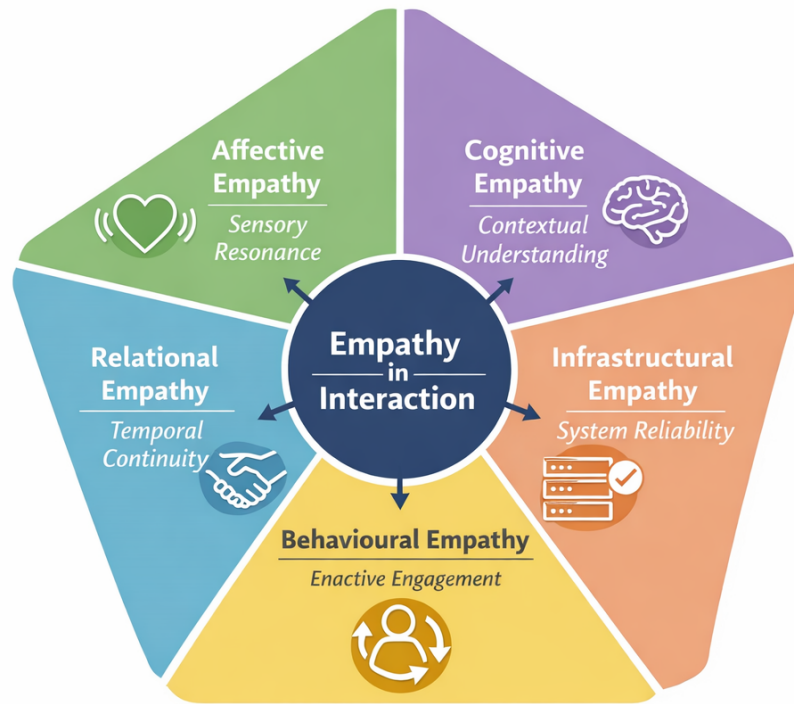


Figure 1: The Sociomaterial Framework of Empathy

allows for an “always-on” presence. Empathy materialises through the CVH’s ability to refer back to a deceased loved one by name over multiple sessions, creating a “continuing bond”.

3.4. Infrastructural Empathy (The Foundation)

Infrastructural empathy refers to the hidden architectures (server reliability, latency, data privacy, and accessibility) that dictate the boundaries of care. Empathy is not just what is said; it is the reliability of the system that says it. Across all three studies, we observed that infrastructural failures (e.g., slow response times or connectivity drops) were interpreted by users as a lack of “attentiveness.” In Study 3, for a person with dementia, a 5-second lag is not a technical delay; it is an interactional breakdown that causes confusion and distress. “Careful IT” suggests that empathy begins at the level of the backend, ensuring the material foundation sustains the enactment of care.

3.5. Behavioral Empathy (The Enactive)

We introduce behavioral empathy as an enactive dimension capturing how empathy is performed, perceived, and stabilized through interaction. Rather than focusing on what systems express, behavioral empathy is observable in what interactions enable users to do. Grounded in situated action [10] and sociomateriality [5], it conceptualizes empathy as an accomplishment emerging through practice. Behavioral empathy is reflected in four key interactional dynamics: (1) interaction patterns, where sustained initiation and continuation signal perceived alignment; (2) adaptation, where users adjust their communication to system affordances; (3) trust signals, including disclosure, reliance, and repeated engagement over time; and (4) breakdown responses, where users attempt repair rather than disengage. Across our studies, empathic interactions were characterized by sustained engagement, adaptive coordination, and tolerance of minor system errors. Importantly, these behaviors are not solely user-driven but shaped by system design, including pacing, memory, and responsiveness. Behavioral empathy thus reframes evaluation from expressive output to interactional outcomes, positioning empathy as a sociomaterial and observable pattern of engagement.

Table 1
A Five-Dimensional Sociomaterial Framework

Dimension	Sociomaterial Focus	Study Support (Xyγκou-Tsiamoulou, 2025)
Affective	Sensory cues, visual presence, tonal matching.	Study 1: Preference for neutral cues; empathy via sensory reduction (Xyγκou et al., 2024).
Cognitive	Contextual accuracy and interpretive logic.	Study 3: Empathy as cognitive anchoring and recognition of life-story data (Xyγκou et al., 2024).
Relational	Memory persistence and temporal continuity.	Study 2: Empathy as a “continuing bond” through shared storytelling and witnessing (Xyγκou et al., 2023).
Infrastructural	Latency, connectivity, and data policies.	All Studies: System reliability as a prerequisite for the enactment of care and trust.
Behavioral	Interaction patterns (initiation, continuation, withdrawal), user adaptation, trust signals (disclosure, repetition), and breakdown responses (repair vs disengagement).	Across studies: Empathy evidenced through sustained engagement, adaptive interaction, repeated use, and tolerance of minor system errors; breakdown leads to disengagement when alignment fails.

4. Concluding Thoughts

Designing for empathy in conversational AI requires a shift from embedding emotional expressiveness toward configuring sociomaterial and behavioral conditions that support meaningful interaction. Our findings suggest that empathy should be grounded in behavioral alignment—how systems shape user engagement, participation, and trust—rather than linguistic simulation alone. This involves prioritizing interactional safety through predictability, enabling temporal continuity to sustain relational engagement, and ensuring infrastructural reliability as a foundation of perceived care. Crucially, empathy must be situated and context-sensitive, adapting to the distinct needs of different user groups rather than relying on universalized “empathetic” behaviors. At the same time, designers must mitigate risks of behavioral dependency and “decoupled empathy” by making system limitations visible and supporting healthy engagement beyond the AI interaction. Together, these considerations position empathy not as a feature, but as an emergent, responsible, and behaviorally grounded design outcome.

5. Declaration on Generative AI

During the preparation of this work, the authors used OpenAI’s GPT-5.2 for grammar and spelling checks on self-authored content, and to support the generation of Figure 1. After using this tool, the authors reviewed and edited the content and figure as needed, and take full responsibility for the publication’s content.

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