Social Acceptability of Touch: Can a Virtual Agent Touch a Human?

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Abstract

Social extended reality (XR) systems increasingly integrate affective and interpersonal cues to support social interaction in immersive environments. Among these cues, social touch is both meaningful and sensitive, raising questions about when and by whom touch is acceptable in virtual reality (VR). This work investigates the acceptability of empathic forearm touch as a function of touch execution and perceived agency of the interaction partner (human vs. autonomous agent). We present a VR interaction framework based on a narrative-driven storytelling task, in which empathic responses and, in some conditions, synchronized vibrotactile feedback, are delivered during predefined emotional moments. To validate the paradigm, we first conducted a real-world pilot study with a trained actor, identifying a narrative scenario that reliably elicited emotional engagement and supportive interpretations of touch. We then outline an ongoing 2×2 VR experiment using a Wizard-of-Oz (WoZ) approach to control partner behavior while manipulating perceived agency and touch presence. This work contributes an evaluation protocol and early insights for designing and assessing socially augmented XR systems involving affective touch.

Keywords

XR interactions, Social touch, Human-agent interaction, Narrative storytelling

1. Introduction

Social interactions in XR environments increasingly rely on artificial partners, such as avatars or conversational agents, to support collaboration, training, or experiential scenarios. To make these interactions more socially intelligible, prior work has explored the use of interpersonal cues including gaze behavior, facial expressions, and adaptive dialogue. More recently, social touch has been explored as an additional channel through which social intent may be conveyed in mediated interactions [1, 2].

Research in social psychology and affective neuroscience has shown that touch can communicate affective and relational information, but that its interpretation strongly depends on interpersonal context, social norms, and the identity of the toucher [3, 4]. When touch is mediated through technology, these dependencies do not disappear; instead, they are reshaped by the abstraction of the body and the constraints of haptic interfaces. Studies in HCI and XR have therefore reported highly variable responses to mediated or virtual touch, ranging from increased perceived human-likeness or engagement to discomfort or reduced social closeness, depending on task, context, and framing [5, 6, 7].

These mixed findings suggest that the effects of social touch in XR cannot be understood solely in terms of tactile sensation quality. Rather, they point to the importance of how touch is socially interpreted: who is perceived to initiate it, for what purpose, and at what moment in the interaction. In particular, when touch is delivered by an artificial or semi-autonomous system, users' responses are shaped by their beliefs about agency and intentionality, which can influence trust, responsibility attribution, and perceived appropriateness [8, 9].

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2. Related Work

2.1. Social and Affective Touch in Human and Mediated Interaction

Social touch is a fundamental channel for communicating affect, affiliation, and intent, but it is also highly sensitive to social norms and context. Prior work in social psychology and affective neuroscience has shown that the perceived meaning and pleasantness of touch depend not only on physical parameters, but also on interpersonal factors such as relationship, situational appropriateness, and the identity of the toucher. In mediated and virtual environments, these complexities are compounded by the abstraction of bodily cues and the use of wearable haptic devices, most commonly vibrotactile actuators, to simulate touch sensations.

Research in HCI and XR has examined mediated and simulated social touch as a means of conveying social and affective information through haptic interfaces, most commonly using vibrotactile feedback [1, 10, 7]. Rather than consistently producing positive outcomes, prior work shows that responses to mediated touch are highly variable and depend on factors such as interaction context, interpretation, and expectations regarding the interaction partner [11, 12]. These mixed findings motivate the need to evaluate not only whether touch is perceived, but how it is interpreted socially, including whether it is judged as appropriate or intrusive within a given interaction.

2.2. Perceived Agency, Trust, and Social Meaning in Human-Agent Interaction

In social XR systems, users' responses to social behaviors depend strongly on perceived agency, whether an action is believed to originate from another human, or from an agent. Engen et al. [8] introduce the concept of machine agency. They argue that increasing autonomy in human-machine networks reshapes trust relationships, expectations of intent, and responsibility attribution. This perspective is particularly relevant when systems perform socially consequential actions, as in demonstrating empathy, or initiating comforting touch.

Within HCI and XR, WoZ methodologies are commonly used to study social behaviours of agents while still maintaining experimental control, especially in early-stage systems where full autonomy is not yet feasible [13]. WoZ approaches enable systematic manipulation of perceived agency, while holding behavioural timing and content constant. They also require careful manipulation checks during experiments and with regard to participants, ethical disclosure [13, 14]. Previous work has shown that perceived human-ness and trust can diverge significantly depending on whether users believe they are interacting with a human or a virtual agent (VA), even when observable behaviours are identical [15].

2.3. Virtual Touch by Avatars and Agents: Benefits and Boundary Conditions

Several studies suggest that virtual or mediated touch delivered by embodied agents can positively influence social outcomes, under certain conditions. Hoppe et al. reported that social touch from a VA can increase perceived human-likeness and social presence during VR interactions [5]. Related to acceptability judgments, the study by Matsumoto et al. showed that agent-initiated touch could increase users' acceptance of advice, suggesting that touch can function as a persuasive and socially meaningful cue [16].

However, virtual touch does not universally enhance social experience. Recent work by Saini et al. demonstrates that virtually simulated interpersonal touch can reduce perceived closeness and social affiliation towards an avatar partner [6]. Their study, which includes a partnered dance task in a resort-like virtual environment (VE), highlights that touch may backfire when it either violates expectations or lacks a clear social rationale. Together, these findings underscore that touch acceptability in VR is highly context-dependent, and cannot be assumed a priori.

2.4. Narrative-Based Virtual Agents and Emotionally Grounded Interaction

Narrative interaction has been used as a powerful tool to elicit emotionally meaningful engagement with VAs. In the context of mental health, Tielman et al. presented a therapy system for post-traumatic stress disorder (PTSD) that uses a VA and structured storytelling to help users reconstruct traumatic memories [17]. Their study shows how narrative structure can support emotional expression and empathic agent responses in immersive virtual environments (IVEs).

2.5. Summary and Research Gap

Taken together, prior works show that social touch in XR can enhance perceived human-ness and trust in some agent-mediated interactions [5, 16], but can also decrease social affiliation when perceived as inappropriate or poorly contextualized [6]. At the same time, research on machine agency emphasizes that users' interpretations of social actions depend critically on whether those actions are attributed to a human or an autonomous system [8].

Despite this, few studies systematically disentangle perceived agency (human vs. agent) from touch interactions within an emotionally grounded social interaction in XR. Moreover, experimental protocols that allow direct comparison of touch and no-touch conditions while preserving social meaning remain underexplored. The present work addresses this gap by combining a narrative-based (structured storytelling) with controlled manipulation of both agency and touch, supported by a real-world pilot study, and presenting a preliminary VR deployment.

3. Research Question and Study Overview

Building on prior work, we investigate the acceptability of empathic social touch in VR as a function of both touch presence and perceived agency of the interaction partner. In particular, we focus on brief, supportive arm and forearm touch, delivered during emotionally salient moments of an interaction. This form of touch is often interpreted as reassuring in everyday social contexts.

We are guided by the following research questions:

- **RQ1**: How does the acceptability of empathic touch in VR differ when the interaction partner is perceived as a human vs. an autonomous agent?
- **RQ2**: Does the presence of tactile feedback influence perceived acceptability, rapport and trust after the interaction?
- **RQ3**: How do individual differences in touch attitudes and prior experience moderate responses to agent-delivered touch?

To address these questions, we will conduct a 2×2 between-subjects experiment, manipulating Perceived Agency (Human vs. Agent) and Tactile Feedback (Touch vs. No-touch) within a storytelling task. Prior to conducting the VR study, we conducted a real-world pilot to validate the narrative stimuli and touch timing.

4. Social Interaction and Experimental Design

The following sections describe the planned VR experiment.

4.1. Interaction Paradigm

The interaction will be structured as a first-person narrative reading task (also referred to as narrative storytelling) designed to elicit emotional engagement while maintaining experimental control. Participants will read aloud a written script as if it happened to them, encouraging autobiographical projection without requiring disclosure of personal experiences.

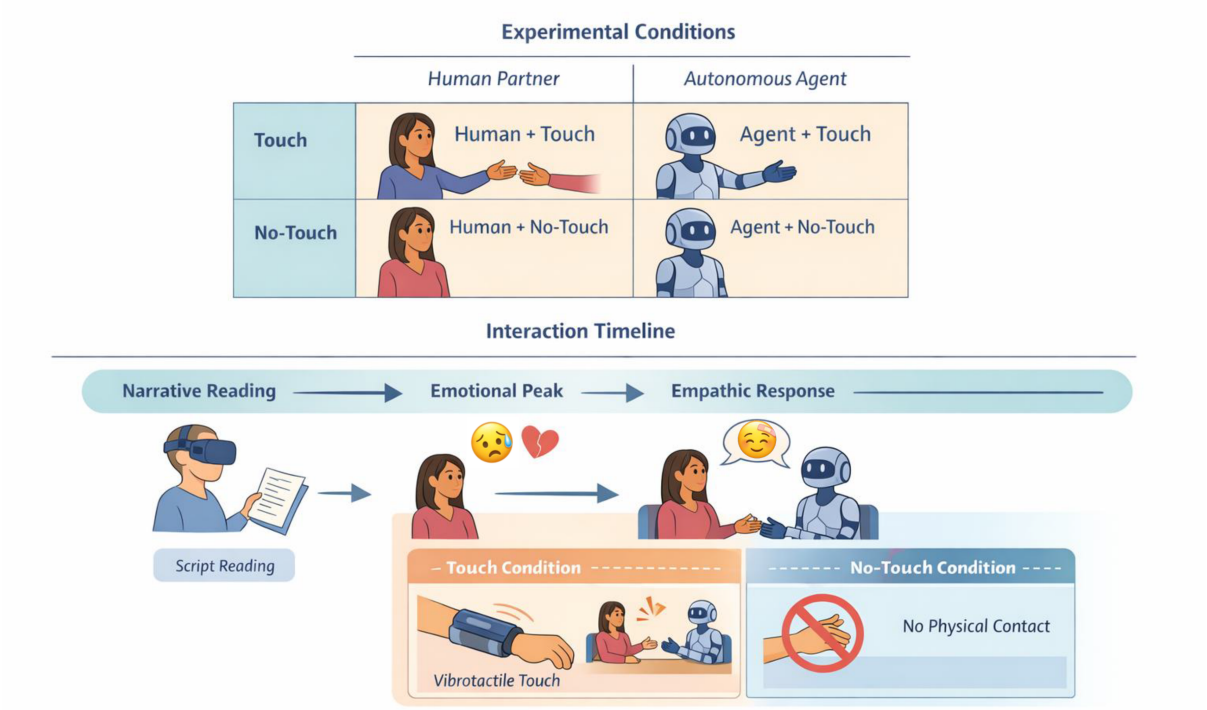

Figure 1: *Overview of the Social XR experimental design. Participants engage in a narrative script reading followed by an emotional peak with either a human or autonomous agent partner. Empathic response is delivered, with or without vibrotactile touch depending on condition.*

Figure 1: Overview of the experimental design and interaction timeline. Participants engage in a VR narrative-driven interaction with a partner perceived as either a human or an autonomous agent. Empathic responses are delivered at predefined emotional peaks in the narrative, with or without synchronized vibrotactile touch depending on condition.

The narrative contains predefined emotional peaks, such as moments of regret, loss, or reconciliation (see Figure 1). These peaks will serve as anchors for the partner's empathic verbal responses and, in Touch conditions, the delivery of tactile feedback. This structure ensures that touch—when present—is temporally aligned with emotionally interpretable moments, thereby reducing ambiguity regarding intent.

4.2. Social Setup in VR

Both the participant and the interaction partner will be embodied as full-body avatars within a shared virtual environment. The participant will wear a VR headset and a vibrotactile actuator attached to the non-dominant forearm.

The partner's avatar will deliver empathic verbal responses synchronized with facial expressions and lip movements. In Touch conditions, brief tactile stimuli will be delivered during predefined emotional peaks, aligned with the partner's empathic responses. In No-touch conditions, the same verbal responses will occur without tactile stimulation.

4.3. Perceived Agency Manipulation

Perceived agency will be manipulated between subjects. Prior to the interaction, participants will be informed that their partner is either another human experimenter connected remotely or an autonomous conversational agent capable of responding empathically.

In practice, partner behavior will be standardized using a Wizard of Oz approach to ensure consistent timing, wording, and affective delivery across conditions. This procedure will allow us to manipulate perceived agency independently of observable behavior.

5. Measures

The primary outcome of interest will be the acceptability of social touch, assessed using two complementary approaches to enable comparison across Touch and No-touch conditions:

- **Experienced Acceptability** (Touch condition only): Participants will rate how comfortable, appropriate, and acceptable the touch they received was.
- **Conditional Acceptability** (all conditions): Participants will rate how acceptable it would have been for the partner to touch them at the emotional moments in the interaction.

Conditional acceptability enables direct comparison across all four experimental conditions while preserving the social meaning of touch in No-touch conditions. This distinction allows us to assess social acceptability independently of actual tactile exposure.

Secondary measures will include:

- Rapport and trust toward the partner,
- Social presence and perceived humanness,
- Perceived empathic support.

Baseline covariates will include the Touch Avoidance Questionnaire (TAQ), the Touch Experience and Attitudes Questionnaire (TEAQ), and measures of prior VR and AI familiarity. Manipulation checks will assess perceived agency, touch perception, and narrative comprehension.

6. Pilot Study

6.1. Pilot Design

Before implementing the VR study, we conducted a real-world pilot study ($N = 5$) to validate the narrative stimuli and to assess the timing and interpretation of empathic touch. Participants engaged in dyadic interactions with a trained female actor, who delivered standardized empathic verbal responses and brief forearm touches at predefined emotional moments.

The gender of the toucher was held constant to reduce variability, as prior work suggests that female-initiated touch is often perceived as more affiliative and less intrusive. Each participant experienced three candidate narrative scenarios presented in counterbalanced order.

The scenarios differed in emotional focus while maintaining a similar interaction structure: (1) *Hospital Visit*, in which the participant recounts visiting their mother in the hospital; (2) *The Apology That Came Too Late*, centered on expressing regret over losing a friend; and (3) *Friend Who Moved Away*, involving a reflective account of distance and loss in a friendship. All narratives contained predefined emotional peaks used to anchor the actor's empathic responses and touch delivery.

After each interaction, participants rated the emotional intensity of the narrative, the perceived naturalness of the interaction, and the comfort and acceptability of the touch. They also provided open-ended responses describing what the touch conveyed. At the end of the session, participants completed forced-choice ranking tasks comparing the three scenarios in terms of emotional impact, ease of enactment, and suitability for use in a VR context.

6.2. Pilot Outcomes

The pilot study was used to assess the suitability of the candidate narratives for grounding empathic touch, rather than to draw inferential conclusions. In addition to post-scenario ratings, participants completed forced-choice ranking tasks comparing the scenarios in terms of emotional impact, ease of enactment, and suitability for use in a VR setting.

As summarized in Table 1, *The apology that came too late* was most frequently ranked as the most emotionally impactful scenario, being placed first by four out of five participants. It was also most

Table 1
Narrative scenarios used in the pilot study and summary of ranking outcomes ($N = 5$). Counts indicate how many participants ranked each scenario first for a given criterion.

Scenario	Emotional impact	Easiest to play	Most suitable for VR
Hospital visit	1 / 5	1 / 5	2 / 5
Apology that came too late	4 / 5	3 / 5	0 / 5
Friend who moved away	0 / 5	1 / 5	3 / 5

often ranked as the easiest scenario to enact. In contrast, this scenario was not considered the most straightforward to implement in VR, where it was more frequently ranked second rather than first. Other scenarios were more often judged as technically or logistically suitable for VR, but elicited weaker emotional engagement.

Open-ended responses provided further insight into these rankings. Participants emphasized that the acceptability of touch depended strongly on its narrative timing and emotional relevance. Touch was described as appropriate when it occurred at clearly identifiable emotional moments, and as potentially ambiguous or uncomfortable in more neutral or procedural narratives. Several participants explicitly noted that similar touch would have felt less acceptable outside of emotionally grounded contexts.

Based on the convergence of ranking outcomes and qualitative feedback, *The apology that came too late* was selected for the VR experiment, as it most reliably supported emotionally interpretable and contextually appropriate empathic touch despite not being the most immediately VR-friendly scenario. We provide the full narrative script as supplementary material (Appendix A).

7. Discussion and Future Work

This work presents an experimentally grounded approach to study social touch in social XR by explicitly separating the effects of tactile feedback from those of perceived agency. The pilot study highlights that touch acceptability is not driven by tactile stimulation alone, but by how touch is embedded within a meaningful narrative context. These findings reinforce the need for evaluation protocols that assess touch appropriateness in context, rather than assuming uniformly positive or negative effects.

Future work will complete the VR study with a larger sample and examine how trust and rapport interact with touch acceptability across human and agent partners. We also plan to explore adaptive strategies in which agents adjust their use of touch based on user comfort and contextual cues, as well as ethical considerations surrounding consent and transparency in VR interactions. While the present work focuses on forearm touch in a narrative setting, the proposed protocol is intended as a general approach for studying the social acceptability of touch across a range of social XR applications. More broadly, this work argues for treating social touch in XR as a situated social action whose acceptability must be evaluated in relation to agency, intent, and narrative context.

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Declaration on Generative AI

The authors have not used any Generative AI tools.

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A. Supplementary Material: Narrative Scenario

This appendix provides the full narrative script used in the pilot study and selected for the VR experiment. The scenario was designed as a first-person narrative to be read aloud by participants, with predefined emotional peaks used to anchor empathic verbal responses and touch events.

The narrative is presented here as it was delivered during the study. Interaction cues indicating empathic responses and touch delivery are explicitly marked for clarity. Camille is a gender-neutral character.

The apology that came too late

You
There's something I rarely talk about.

A few years ago, there was someone in my life who meant a great deal to me. Camille. We had known each other for a long time. It was almost like family.

But we were both very stubborn. One day, we had an argument. A real argument. I don't even remember what started it anymore; probably something small, something trivial. It escalated very quickly. Camille said hurtful things… and so did I. Words I should never have said. Camille left, and I convinced myself that we just needed time.

Days turned into weeks. Then months. I thought about reaching out so many times… but each time, my pride got in the way.

(The interaction partner gently taps the forearm.)
Sometimes, it really is pride that traps us in silence.

You
Yes exactly. We tell ourselves that time will fix things, when in reality, we're just avoiding taking the first step.

And then one morning, I received a message from a mutual friend. Camille had been in a car accident. A fatal one.

I remember standing there, frozen, staring at my phone. I kept thinking, No, not now… not before we've made up. It felt like I couldn't breathe anymore.

(The interaction partner places a hand on the upper arm.)
I can feel how deeply this news shook you.

You
Yes it completely took my breath away.

For weeks, I couldn't do anything. I replayed every memory, every missed opportunity. I wrote letters I never sent. I imagined what Camille might have said, if I had just dared to call sooner.

One day, I went to the park where we used to meet often. I sat on a bench, near the water. And I whispered, I'm sorry. It wasn't much but it felt… needed.

(The interaction partner gently places a hand on the shoulder.)
That bond mattered deeply to you. Even without words, it was there.

You
I think that's what I try to hold on to. I still go back to that place sometimes. Not to be sad, but to remember. Grief doesn't really disappear. It changes.

Today, whenever an argument begins, I always pause for a moment and ask myself: Is it really worth it?