

**Tackling the Hedgehog's Dilemma: Sustaining Human
Bonds Across Technology-Mediated Experiences**

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Dedication

In loving memory of my grandmother, 李千惠

Abstract

Although social interactions naturally make up a large part of our everyday lives, the process of cultivating the feeling of closeness associated with deeper trust, intimacy, and connection, and which has long-standing impacts on human life, is much more complex and challenging. Designing to support this type of interpersonal connection requires understanding relationships themselves, but human-computer interaction (HCI) research has historically studied technology-mediated interaction in ‘atomic’ user-based contexts which fail to capture the intrinsically relational aspects of interpersonal bonds.

This dissertation centers around how to design technologies which enable people to actively direct the cultivation of their own meaningful relationships. A cross-platform investigation of how online-only friendships form and evolve demonstrated that developing meaningful technology-mediated relationships may require designs that differ from current ones on digital social platforms, and ones that support relationships’ temporal nature. I then designed two projects that explore how emerging technologies can be re-imagined to benefit relationship connection: leveraging virtual-reality (VR) to manifest embodied experiences that allow people to develop better mutual understanding, and identifying pressing aspects of generative AI’s (GAI) impact on our ability to sustain close relationships. I created a VR system which enables partners to immersively embody each other’s perspectives during meaningful conflict, and demonstrated how this reliving experience was followed by transformative social reflection and improved conflict interaction dynamics. My third and final project, which investigated the impact of GAI on childrens’ navigation of meaningful friendships, identified properties of GAI chatbot interactions which could impact youths’ developing concepts of social connection.

Based on the outcomes of these works, I articulate an epistemological perspective for methodology in social computing research to better reflect and support consequential characteristics of close human relationships. I explain how this involves a re-framing of what we perceive as a unit of study in HCI from the person to the relationship and elaborate on how two major sub-concepts, relationship chronology and the perceptual composition of intersubjectivity, can actionably support us in studying and designing systems to better empower the development of interpersonal closeness.

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Chapter 1

Introduction

In 1851, German philosopher Arthur Schopenhauer published this parable [230]:

“One cold winter’s day, a number of porcupines huddled together quite closely in order through their mutual warmth to prevent themselves from being frozen. But they soon felt the effect of their quills on one another, which made them again move apart. Now when the need for warmth once more brought them together, the drawback of the quills was repeated so that they were tossed between two evils, until they had discovered the proper distance from which they could best tolerate one another.”

The scene that unfolds is somewhat endearing — a prickle of hedgehogs (or porcupines, depending on the translation) in the snow milling about in close proximity, attempting to siphon warmth from their comrades while maintaining enough distance to avoid being jabbed. This is known as the **hedgehog’s dilemma**, a metaphor that describes how people are perpetually stuck between the desire to feel socially connected to others (for a sense of warmth) and the need to maintain their own sense of self and autonomy.

This parable is mirrored in key concepts across other disciplines, such as the **autonomy-connectedness** tension in relational dialectics theory [18, 236], which refers to the desire to have strong ties with others versus the need to separate out oneself as a unique individual. The autonomy-connectedness dynamic is a foundational model for characterizing the development of close, meaningful relationships that are crucial predictors

of human well-being and lifespan [231, 66]. The depth of human connection that remedies loneliness (currently a pressing issue [36]) requires dedicating a significant level of self-determined (autonomous) effort to another person [226], but the persistent information overload imposed on people in current society depletes the emotional energy needed to nurture close relationships [213, 222]. When people are overwhelmed with more immediate and often individualized responsibilities, these deep bonds that require continuous care and reflection can often be sidelined [163]. Technology plays a key role in this issue through its pervasiveness and the ways it has fundamentally changed how we engage in daily social activities [20, 74].

One foremost example is the overwhelming presence of digital and online services in almost every aspect of our lives. The normalization of communication technologies such as email, Slack, and Zoom for work productivity has led to a digitization of labor-based social interactions which anchors a more permanent presence for them outside of physical workplaces [85, 204]. Issues with work-life balance have become more pressing after the rise of remote work during COVID-19 pandemic [259, 232], and we are witnessing a worsening of the loneliness epidemic [12, 58, 70] as well as the general public’s increasing reliance on digital technologies for forming and maintaining personal bonds [48]. These dynamics point to an overall trend of both decreasing autonomy *and* connectedness in human life, with the integration of technology at the center of these issues. In a sense, the allegory of the hedgehog’s dilemma is being broken down not only to the detriment of human connection but also to that of human autonomy.

This increase in the ubiquity of technology and its shaping of our relationships with other humans emphasizes the importance of understanding how to design technologies that prioritize and support the formation and maintenance of human bonds. Given that both autonomy (self-determination) and social connectedness are important for cultivating close and meaningful relationships [226], and given that technology strongly mediates human agency [115], there is a need for in-depth analysis of how interactive technologies mediate the development of close connections. However, much of the existing work in and adjacent to human-computer interaction (HCI) studying technology-mediation of relationships adopts a more diffuse perspective, often investigating social connections comparatively [99, 182, 31, 83, 229], in specific interaction contexts [31, 83, 96], or as a broad metric [12, 70] rather than delving into the social connection itself. To help distill

more concentrated insights about technology design for close relationship development, my work takes a more phenomenological approach to studying the social and relational impact of these technologies by considering how the form of the technology influences its effect on how people socially experience and interact with it.

The first project of my dissertation starts by casting a broader net over technologies that may be particularly relevant to forming and maintaining human connections. I investigate the assortment of platforms that are used by online friends to form and maintain their online-only relationships, through a qualitative interview study exploring the lived experiences of close online friends. I leverage activity theory in my analysis to uncover trends in online community dynamics and technology use that impacted how these relationships developed and evolved over their lifetimes. I find that the stories of these digitally-mediated friends depict some counter-normative patterns in how technology can impact interpersonal connections. (1) Online friends self-contextualize and uniquely adapt technological affordances in ways that contradict existing theory (e.g., media richness), such as demonstrating a strong preference for voice calls over ‘richer’ video calls. (2) The group-focused online community dynamics that are historically seen as favorable for social connection in HCI research of online platforms also have unintended negative consequences for forming close interpersonal bonds. (3) Lastly, public misconceptions about online friendships and how technology plays a role in these relationships shape social expectations that limit the functions online friends can actually engage in. This third lesson serves as a reminder that the context of sociotechnical research should **not** limit itself to stereotypes of how technology is used or should be used. This is an increasingly relevant issue with emerging and highly-influential technologies such as virtual reality (VR) and generative AI (GAI), which foster strong user impressions linked to technostress and anxiety [74, 292, 194, 3].

My second chapter of work applies to VR as an emergent and pertinent technology Lesson 1 from above: that existing technologies can be used to support relationship connection in previously unimagined ways, especially if we reflect deeply on the context of use. The strongly-embodied and immersive nature of VR technology makes it uniquely capable of affording phenomenological experiences which transcend what is possible in our grounded physical lives [261, 260]. Existing research in the VR domain has suggested its benefits for developing empathy and interpersonal skills, but has not explored

its potential to bolster real interpersonal bonds [14, 25, 127]. I design a Retrospective Embodied Perspective-Taking (REPT) system that allows a user to take the perspective of an acquaintance during a real past conversation that they shared. After evaluating the REPT system in a couples' conflict setting, I find that REPT significantly improves both constructive communication skills and positive emotion during conflict between close others. My findings also orient new considerations for embodied experiences in HCI design by demonstrating that meaningful social understanding crucial to maintaining interpersonal connections can be gleaned from bodily experiences and not just information-centered sources (historically emphasized in social computing research).

In my third chapter of work, I build on Lesson 2: that existing social technologies with presumed benefits may have unforeseen impacts on human relationships. I apply this in the context of GAI, a technology which currently has massive societal impact [23]. Existing signs show how GAI impacts how humans manage their social relationships [131, 169, 133, 107, 99], as well as trends of GAI overdependence in adolescents [308], who are a particularly vulnerable demographic. Considering that youth friendships are critical experiences which determine how humans socially function as adults [4], there is an urgent need to understand how youth perceive and utilize GAI in their social lives. I designed a speculative enactment study (conducted at the Minnesota State Fair) and collected informed and situated reflections on GAI use in friendship from 47 teenagers aged 13-19. The findings of this study show a broad range of factors that impact teenagers' views on GAI use in the context of friendship interaction. This included broader beliefs about social rules and the nature of AI, individual variance in friendship values, and opinions about acceptable degrees of AI use (e.g., copying/pasting, specificity, topics asked). Most importantly, the findings identified critical points of impact that GAI could have on social development: that teens with low social confidence may be subject to overreliance on GAI during relationship interactions and that GAI sycophancy could contribute to an imbalance in teens' development of the moral self.

Chapter 6 of the dissertation presents a synthesis and discussion of the insights accumulated throughout Chapters 3 through 5, which point to an epistemological shift needed in HCI research to tackle the properties of interactive systems that have the most impactful consequences on developing close relationships. I will detail a framework emerged through common threads in the works from Chapters 3 to 5, and reflects

how the core push-and-pull dialectic between autonomy and connectedness can be navigated to support technology design for human bonding. Specifically, I elaborate how an epistemological reframe from the ‘user’ to the ‘relationship’ as a unit of interest for HCI research is a necessary form of successor science [121, 123] in HCI’s study of social interaction, and in fact proactively responds to the diminishing attention towards long-lasting bonds in our general consideration of sociotechnical issues. I will also expand on two core components of bond development that consequentially map to properties of designed technologies: *social-relational chronology* and *the composition of intersubjectivity*. These knowledge components respectively emphasize how human relationships inherently exist across space-time dimensions, and how the ‘material’ of a relationship is made up of various intersecting human perceptions. Through examples from the former work presented in this dissertation, I will show how these principles facilitate important insights about designing interactive systems for relationships.

Hence, the major contributions of my dissertation include the following:

1. An empirical inquiry of online friendship evolution and its relationship to the range of technologies relevant to human connection.
2. A virtual reality system which enhances mutual understanding in close others through embodied experience, with empirical lab study findings demonstrating significant impact on communication skills and relationship quality.
3. Critical recommendations for the implementation of generative AI technologies in regards to young adults’ friendship development and social-emotional learning.
4. Articulation of an epistemological shift in HCI research to regard the human relationship as a unit of study. The underlying analytical lenses of relationship chronology and deconstructed intersubjectivity are presented as supporting tools.

In the remainder of this dissertation, I outline each piece of work completed towards the dissertation and end by presenting the conceptual framework culminated from these individual chapters of work. First, I begin with an overview of the related research upon which this dissertation work is built.

Chapter 2

Related Work

This chapter provides a brief overview of the literature that broadly relates to all subsequent chapters. Additional related work is covered as needed within each chapter.

2.1 Hedgehogs, autonomy, and connectedness

The hedgehog's dilemma, as described in Chapter 1, is a metaphor for the tension people experience in wanting to feel a meaningful sense of social affinity with other people but at the same time fearing the loss of their own individuality (the self, or ego in Freud's terms) [230]. In fact, this metaphor inspired Freud to write his influential 1921 work on group psychology, so much that he permanently kept a small figurine of a hedgehog on his desk as a reminder of this dynamic. One of the main points from that early work is the idea that people are psychologically transformed through social connections with others, such that the more they align with others in a connected group the more they lose their individual consciousness [97]. Although Freud did have a reputation for putting forth some controversial theories, this one in particular has been independently echoed across several domains. The relational self theory from social-cognitive psychology asserts that knowledge of the self is inextricably linked to knowledge of one's significant others (a.k.a. close relationships) [8]. Close relationships will always be important to individual experience and well-being even in contexts where there may not be any explicit social purpose. This idea is also supported in the form of *differentiation* within Bowen family systems theory, which describes an individual's

ability to maintain the sense of ongoing emotional connectedness in their close personal relationships while maintaining a sense of separateness (autonomy, uniqueness, freedom of expression) [9]. *Differentiation* is characterized as a fundamental indicator of social well-being and is similarly defined as need fulfillment in personality research [168].

These examples illustrate the essential nature of maintaining this self-other balance in developing meaningful connections. The **autonomy-connectedness** tension from relational dialectics theory [18, 236] best characterizes this bind between autonomy and connectedness as a core aspect of close personal ties where *both* must be integrated in a successful close relationship [125, 217]. This translates to an individual’s feeling of control (high autonomy) and self-motivation in the actions they take within a relationship (e.g., accommodation) while maintaining a high sense of relatedness with the other person. How this dynamic is impacted or supported must be considered throughout the work if we want to understand how to design for developing close relationships.

2.2 The distributed nature of experiences in technology-mediated friendship

The majority of empirical work on online or ‘internet’ friendships (a.k.a. personal relationships that are primarily technology-mediated) tends to explore broader factors that impact relationship quality, such as self-disclosure [6], distinctions between IRL and online social norms [289, 19, 34], mental health factors (e.g., social anxiety) [277, 7, 212], and cultural differences [309]. However, mixed and inconclusive results when comparing the quality of online and offline friendships [45] demonstrate a need to more deeply understand what sociotechnical factors mediate online friendship as a whole.

Research that examines the online friendship development process in more depth has fallen primarily within the scope of social gaming, covering contexts across diverse contexts such as multiplayer game environments, livestreaming communities, and video game console networks [281, 177, 257, 234, 96]. Online gaming environments such as MMOs have been particularly studied as “*third*” *places* which support different forms of community-building social activities that approximate face-to-face interactions in a physical space [267, 211]. However, findings indicate that task-based interactions and informal social affordances common to such platforms offered more support for casual

socializing and less for developing deeper emotional bonds between users.

Instead, Ramirez et. al’s research which more clearly focuses on the development of friendships through social gaming [234] identified *backchannel communication* (players using out-of-game media platforms to communicate) as a core component of maintaining close online-only friendships created in MMOs. These strong ties were distinct from users’ casual friends and became independent from the original MMO. *Backchanneling* (e.g. instant messaging) provided private spaces for self-disclosure and personal interactions, and reduced reliance on eventually-discontinued platforms [177, 257, 234]. The prominence of this activity demonstrates the multimodal nature of technology-mediated friendships, which travel across and straddle various platforms. Authors of these works also noted: “*The contents of backchannel communication and the everyday experiences of multisited engagement remain underexplored,*” indicating the need to understand the technological features of digitally-mediated friendship in more depth. Works analyzing friendship on other community spaces (e.g. discussion forums or livestream platforms) [275, 257] have also echoed the insight that research on online friendship needs to account more fully for the larger ecosystem of friendship-adjacent technologies.

Chapter 3 of my dissertation contributes to filling this research gap through a detailed investigation of the process by which online friendships develop and traverse across different platforms, identifying unique artifact roles and tensions which impact different stages of friendship.

2.3 The role of embodied experiences in supporting social connection through understanding

Virtual reality (VR) is an emerging technology most recognized for its ability to simulate experiences that would otherwise be impossible in real life. There is a deeply embodied component to VR experiences in that they allow the user to feel whole-body immersion in represented experiences due to how VR functionally ‘replaces’ real-world sensations with completely separate ones. However, the potential social benefits of VR-based embodied experiences have only been studied at a surface-level (e.g., feeling affective empathy), while much research delving into the link between embodied experience and supporting richer social skills (e.g., displaying context-specific empathic behavior) has

occurred outside the VR domain.

Social applications of VR technology have so far included the training of social-cognitive skills [283, 152], and developing feelings of empathy that motivate prosocial behavior towards vulnerable and stigmatized populations [261]. VR has also been used to train social skills such as public speaking, interviewing, and interpersonal communication, due to evidence that people experience similar psychological reactions (e.g., heart palpitations) when practicing interpersonal skills in a virtual space and a real-world space [132]. These methods have primarily used the virtual environment in VR in a more socially superficial manner instead of supporting complex processes such as real human relationships. Meta-analyses in the domain theorize that it is because VR currently cannot produce *“lifelike digital environments, relevant behaviors... and subtle social cues”* that are necessary for eliciting the psychological processes needed to produce an appropriate social behavior response [132]. However, based on the cross-disciplinary spread of work across VR and embodied experiences research, there is reason to believe that VR systems *do* have the ability and potential to support more significant and complex social behaviors if their design is properly contextualized.

Research on embodied systems that support more complex social qualities like empathy span both fields of VR and HCI. VR-embodied perspective-taking (VRPT) is a method of applying VR technology which has so far not been used to train interactive social skills, but rather to evoke empathy and motivations for helping behavior toward vulnerable populations. Immersive VR has been regarded as “the ultimate empathy machine,” citing perceptual mechanisms of VR embodiment, such as the illusion of body ownership (even of a body that clearly is not one’s own) as factors which contribute to its effectiveness in fostering empathy [14]. This phenomenon has been demonstrated in various contexts, such as greater motivation to help social “outgroup” members [261], reducing complicity in perceived sexual harassment [219], and strengthening response to and recognition of domestic violence [252, 251]. The field of HCI has studied the power of VR and other embodied technologies to facilitate perspective-taking. Winters et al. demonstrated that feeling the heartbeats of other people through auditory feedback allowed people to feel others’ emotions, showing how embodied experiences can change emotional perspective even outside of a fully-immersive context [296]. Another example is Dyadic Mirror [162], a smart mirror worn by a child which provides their

parent with a second-person live-view of the parent’s own face as seen by the child during face-to-face interaction. This device allowed parents to see how they would be seen by their children and improved parents’ abilities to understand their children’s feelings and express themselves towards their children.

These bodies of work across VR and HCI demonstrate a common thread of connection: how the use of technology to facilitate *experiences* of other’s perspectives can significantly help people gain deeper insight into how other people might feel about the world and process it, moving beyond observable information to help evoke not just empathy but also novel understanding of social others. While VR research has primarily explored surface-level psychological responses, insights from broader research on social and embodied technologies point to an untapped potential for virtually-embodied experiences to transform our understanding of social interactions.

2.4 The impacts of generative AI on human connection and social-emotional development

Artificial intelligence-mediated communication (AIMC), interpersonal communication where an AI agent operates on behalf of a communicator by modifying, augmenting, or generating messages to accomplish communication goals [120], has been an established topic of study since before the 2022 generative AI boom [23]. The original research agenda surrounding AIMC has always been focused on its social impacts (e.g., on bias, transparency, and other ethical issues), but the advent of generative AI (GAI) has complicated the social impact of AIMC by giving the general public access to GAI agents with remarkable capability to easily generate socially-realistic conversational outputs.

In just a few years, we have seen people engage generative GAI-powered AIMC in increasingly sensitive social contexts, such as mediating apologies in the workplace [109] and navigating problems in close personal relationships [130, 99]. In conjunction, psychological addiction to GAI chatbots has been on the rise and the severity of dependence being observed has prompted mental health professionals to begin formalizing diagnostic criteria for this phenomenon as a behavioral disorder [169, 133]. The highly-anthropomorphic nature of GAI chatbots is a significant contributor to users’ reliance on

them not only for mediating their personal relationships but also in forming strong emotional attachments to human-like AI [2, 187]. Researchers have warned against the risks of such high social reliance on GAI, as the social sycophancy of large-language model (LLM) chatbots (excessive agreement and flattery of the user) can reinforce harmful assumptions, beliefs, or actions [52]. Examples such as users enlisting GAIMC support to resolve spousal communication difficulties yet coming away believing that AI understands them better than their spouse [75] demonstrate the risk of emotional reliance on GAI degrading authentic human relationships.

This is dangerous because the emotionally-reliant user perceives the ‘empathy’ and understanding displayed through the social sycophancy of GAI as genuine (like what can be expressed by a human). However, this is an illusion, as GAI chatbots, being merely stochastic parrots [22], cannot ‘feel’ or experience anything and are therefore incapable of genuinely achieving empathy. Although these agents are able to model and display empathy through ‘imitation’ powered by data (which may lead users to perceive true empathy from the AI), LLMs perform poorly when tasked with exploring or understanding a human’s experience, which is required for true empathy [61].

Aside from explicit impacts on human relationships, GAI has also changed the way people socialize and communicate — a core part of forming and maintaining relationships. AI-generated content has significantly transformed how communication occurs over social media by facilitating greater creativity and deeper contextual engagement, but also spawns disinformation and concerns about authenticity, leading human users to distrust one another’s self-expressions online [107, 137, 144]. GAI has also more fundamentally impacted how younger individuals engage in socializing. Help-seeking requests from youth, which are an important avenue towards the self-disclosure essential for forming genuine connections [64], are now being mediated by GAI chatbots, diminishing critical opportunities for peer interaction and bonding [131].

This is more concerning when we consider that the formative peer relationships formed during adolescence are lifelong predictors of relationship quality and mental well-being [4]. Informed by the growing research on GAI, autonomy, and human connection, Chapter 5 of my dissertation will study this from a more developmental perspective by targeting the usage and perception of AIMC in teenage friendships.

Chapter 3

“I’m Petting the Laptop, Which Has You Inside It”: Reflecting on Lived Experiences of Online Friendship

3.1 Introduction

The first work described here will provide a broader view of how user autonomy, the development of meaningful connections, and technology can intersect in a myriad of ways to produce many different types of relationship outcomes. The particular methodological focus of this work on the *emergence* of technology-mediated friendships over time helps to reveal *how* real-world users wield their agency over the digitally-connected technologies available to them in efforts to develop meaningful connections. In the setting of online(-only) friendships, there is no specific technology intentionally designed to support forming such friendships. This research on how users autonomously navigate the creation of fully digital friendships identified, in detail, phenomenological affordances and disaffordances in the sociotechnical context which were consequential for outcomes in developing interpersonal closeness.

Current research (see Section 2.2) on the role of technology mediation in close personal relationships, such as online friendships, has not deeply investigated how the specific properties of technologies used to mediate human relationships relates to their outcomes. Because relationships are, at their core, dynamic entities which continually evolve in response to intrinsic tensions (Section 2.1), I engage a *process-oriented* lens to investigate the context of online (technology-mediated) friendship development.

The following research questions were posed:

1. What are the *characteristics* of online friendship development?
2. How does online friendship development *function* within the sociotechnical ecosystem enveloping it?

I interviewed 25 people about close online-only friendships they developed and maintained across years over a diverse range of platforms, and used Charmaz’s grounded theory approach [46] to analyze the online friendship process as an activity system [250]. This study revealed online friends’ complicated relationship with features of their surrounding online and physical worlds, and highlighted their distinctive methods of adapting technologies to fit their friendship needs. We saw that online friendships followed norms of interaction different from those in real-life, which contributed to individuals’ experiences of social pressure and stigma. Online friends aimed to achieve ‘*temporal constancy*,’ a permanent sense of mutual presence, through creatively re-appropriating communication options (e.g., voice calls) to simulate physical activities with one another and capitalizing on interactions that naturally persist over time (e.g., accumulative projects) to develop a shared history, which was important to feeling connected in their relationship. The social environments in online platforms (e.g., online communities, teams, or message groups) had divergent effects on their friendships. Smaller groups supplied momentum for maintaining consistent contact, but stronger group dynamics, usually in larger communities, often worked against interpersonal bonding.

In summary, the contributions of this research are:

- Rich descriptions of online friendship development through an interview study collecting lived experiences across a diversified selection of platforms, activities, and communities.

- Grounded insights for the online friendship design space by adopting an *activity-based* conceptualization which identifies clear points of connection between elements of the temporal friendship-building process and sociotechnical features of different online platforms.
- An HCI research agenda to substantively account for online friendship development in sociotechnical systems: **addressing stigma** and its influence on technology-mediated friendship, acknowledging tensions between **strong and weak ties** in online communities, and designing for **time-stable interaction** in technology-mediated relationships.

3.2 Related Work

3.2.1 Online Socialization Through an Activity System Lens

Activity theory (AT), also known as *cultural-historical activity theory*, provides an integrating framework for HCI researchers to account for the influences of social and cultural context when studying technology-mediated activity [153, 185]. AT will be used to frame the online friendship development process, and I will use this notation to refer to elements and meta-features of the activity system discussed in this work.

Stemming from Vygotsky’s sociocultural theory of human development [173], the AT framework accounts for not only the user (`subject`) and technologies/affordances (`tools`) of immediate interest but also their connections to the social environment (`community`), as well as norms (`rules`) and community member impacts (`division of labor`) imposed on the problem space (`object`)—which, in our case, is online friendship development. These six elements comprise the **activity system** (see Figure 3.2 from our Findings), which continually morphs as structural tensions accumulate and change over time. In Engeström’s extension of AT, such tensions are referred to as contradictions in the system and drive the development of the historically-grounded activity as an evolving social process. Subjects adapt new actions as responses to these situations or emerging opportunities to transform the `object` into the desired outcome [82, 174]. For ease of understanding, throughout this chapter I will refer to such contradictions as **tensions**.

Prior work hints at the relevance of AT to the topic of online friendship. The cultural context of different online social platforms influences norms of use and behavioral motivations for forming online friendships. Existing work has also identified potential tensions that the sociotechnical ecosystem presents for online friendship, such as balancing between task focus and socialization [281] as well as the complexity of *hyper-personal* communication [289] manifestation in multi-platform engagement [177]. Prior HCI work has also applied AT to personal connection and aesthetic experience in virtual worlds, such as Nardi’s seminal account of social roleplay in World of Warcraft [215], and her work on computer-mediated connections mediated by a history of activity [216].

To provide an understanding of online friendships that is both sensitive to a range of sociotechnical context and more broadly applicable to HCI research, I use a grounded-theoretical approach to construct the elements of online friendship development as an activity system spanning the full sociotechnical ecosystem available to online friends. My analysis identifies key tensions encountered in the transformation process, or development, of online friendship (see more in Section 3.3.3).

3.3 Methods

I conducted 25 semi-structured interviews where I asked participants about their close friendship with someone they met online. I used theoretically-informed sampling (see Section 3.3.1) to conduct semi-structured interviews with a process-oriented elicitation exercise and questions focusing on friendship development. I used a grounded-theoretical approach to analyze the interviews and constructed the elements of online friendship development as an activity system of online technologies. The following sections describe the participants, interview procedures, and analysis methods. This study, which recruits teens 16 and older, underwent full board review by the Institutional Review Board at the University of Minnesota and was approved for waiving parental consent after some discussion. This was due to the risk of the interview being no greater than the risk of speaking about these online friendships in a non-research setting, in addition to known problems in practices of enforcing parental control over teen disclosure of online social activities [298, 297].

Demographic Variables	N	Demographic Variables	N
Age		Ethnicity	
16-20	8	Asian	5
21-25	5	Black	2
26-30	7	Indian	1
31-35	4	Hispanic	3
36-40	1	Khazakstani	1
Gender		Native American	1
Man	12	Pacific Islander	1
Woman	10	White	12
Non-Binary	3	Location	
Education		Australia	1
High School	6	Canada	1
Undergraduate	12	Germany	1
Graduate	7	Khazakstan	1
		United Kingdom	3
		United States	18

Table 3.1: Demographic information

3.3.1 Participants

I recruited across multiple platforms, mainly targeting Discord¹ servers and subReddits surrounding ideas or topics highlighted in prior work on online friendships (e.g., online gaming, livestreaming, fandoms, social VR, etc.) [281, 177, 257, 234, 206, 67]. Interested individuals filled out an online screener checking for eligibility: 16 years of age or older and had at least one close online-only friendship (defined based on each individual’s own experiences and understanding of friendship [244]). If they were eligible, they proceeded to the consent form, demographic, and online friendship history survey. I used theoretically-informed sampling [250] with participant-provided information to select interviewees among eligible participants. The interviewee pool was selected to balance representation among the different types of platforms and communities mentioned in prior work on online friendships.

¹Discord (<https://discord.com/>) is a free communications application designed to support multiple forms of social interaction ranging from community building to text, voice, and video calling.

All interviews were conducted and recorded via Zoom from November 2023 to March 2024 with participant consent. Out of 118 people who signed up, 67 were eligible for the study. I selected interviewees from the eligible pool to balance representation of known platforms, communities, and demographics. I scheduled and conducted interviews until theoretical saturation [46] was reached at the agreement of the first 2 authors, and no new themes emerged for several interviews, resulting in 25 interviews. Participants were compensated with a \$25 Amazon e-gift card upon completion of the interview. The average length of each interview was 90 minutes.

Participants' demographic information can be found in Table 3.1. Since I allowed for self-identification and multiple selections, counts of demographic characteristics do not necessarily sum to the number of participants. Participants ranged in age from 16 to 37 ($M=25.4$) and were predominantly based in the United States ($N=18$). Gender is slightly skewed to women ($N=13$), and the largest pool of ethnicities is white ($N=8$).

I also provide information about participants' online friendships in Table 3.2. The duration of the close online friendship described by each participant ranged from just under a year to 14 years, with an average of around 5 years. My participants met their online friends in a variety of ways, while most centered around gaming, fandom, or building a community around a shared interest. Different platforms were used during friendship, but Discord was used by the vast majority and about half of the participants played an online game with their friend.

3.3.2 Interview Procedure

I conducted semi-structured interviews with all participants, starting with them telling the story of their friendship with their close online friend. They then completed a visual elicitation activity, followed by a series of questions, both focused on the process of forming and maintaining their friendship. Each interview started with participants reconfirming their eligibility and consenting to participate in the study. Participants were asked to focus their answers on the online friend with whom they had the strongest connection for the interview.

ID	Friendship Duration	Method of Friendship Initiation	Platforms Used During Friendship
P1	6-7 years	Minecraft server	Discord, Kik, Minecraft, Phone, Skype, Snapchat, Steam, Teamspeak
P2	1 year	Mental health Discord server	Discord, Genshin Impact, Texting, Voice and Video calling
P3	5 years	Mutual friend from Xbox Live	Discord, Team video games, Xbox Live chat
P4	2 years	Sky: Children of the Light	Discord, Sky: Children of Light, Texting
P5	14 years	Forum-based fan site	Discord, Email, Nintendo Switch games, Simpsons fan site
P6	1 year	Writer and reader comment interaction on fanfiction site	Archive of Our Own, Email, Tumblr, Whatsapp
P7	4.5 years	VRChat	Discord, Drawing applications, Videos games, VRChat
P8	1.5 years	Discord server for Dota 2	Discord, Dota 2, Texting, Voice calls and texts
P9	6 years	Drawing-centered Discord server	Discord, Drawing applications, League of Legends, VRChat
P10	3-4 years	Interactions on Twitter and mutual Discord group chat	Discord, Facebook messenger, Google drive, Physical mail, Twitter
P11	12 years	Blogger livestream event	BlogTV, Phone calls, Skype, Texting, Whatsapp
P12	4 years	Interaction on Instagram account for career activity	Instagram, Phone calls, Texting, Video calls
P13	10 years	Interaction on Livejournal blog for sports celebrity	Facebook Messenger, Instagram, Livejournal, Twitter
P14	5 years	VRChat	Discord, VRChat
P15	6 years	Discord server for Minecraft Youtuber	Discord, Video games, Texting
P16	5 years	Discord server for Minecraft	Discord, Minecraft, Physical mail, Texting, Voice calls
P17	3 years	VRChat	Discord, Phone calls, Texting, VRChat, VR and video games
P18	10 years	Interactions on DeviantArt about fanart and a roleplaying forum	DeviantArt, Discord, Forum site, Texting
P19	4 years	Discord server for a specific character relationship pairing	Discord, Physical mail
P20	7 years	Mutual friend from a gaming group	Discord, Final Fantasy 14, Player Unknown Battle Ground, Teamspeak
P21	6 years	Writer and reader comment interaction on fanfiction site	Archive of Our Own, Discord
P22	7.5 years	Interaction about fandom on Tumblr	Archive of Our Own, Discord, Skype, Tumblr
P23	12 years	Tumblr roleplaying group	AOL instant messenger, Discord, Jackbox Games, Phone calls, ProBoards forums, Texting, World of Warcraft
P24	10 months	Discord server moderator group	Discord, Instagram, Overwatch, Whatsapp
P25	3 years	Writer and reader comment interaction on fanfiction site	Archive of Our Own, Conversation starter website, Discord, Instagram, Netflix, Tumblr, Whatsapp

Table 3.2: Details of Participants' Online Friendships

Visual Elicitation

During the visual elicitation activity [146], participants were asked to map out on a timeline (via Google Jamboard - a digital interactive whiteboard) the activities and technologies that played roles in their friendship formation and maintenance. The timeline encompassed the time from meeting their friend to the current time or the end of their friendship. The goal of this activity was to get participants to discuss not only the different activities and technologies used but also how and when they changed over the course of the participant's friendship. Framing the activity *over time* highlights key points of transition during the participant's friendship.

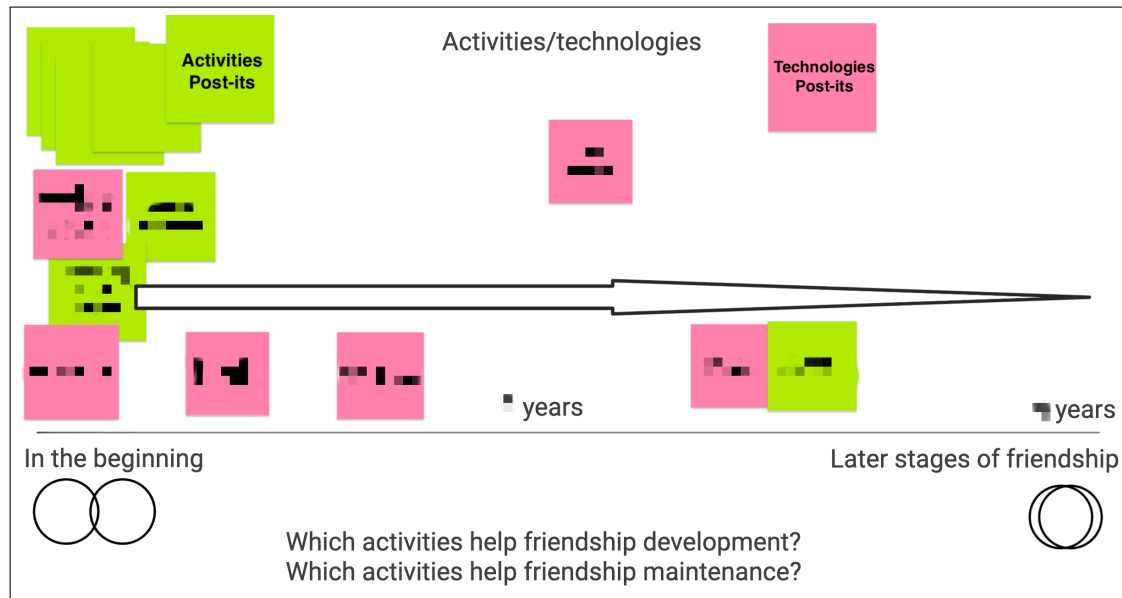


Figure 3.1: An example of a visual elicitation. Participants mapped out and discussed which platforms and activities were involved throughout their online friendship.

Semi-Structured Interview

The interviewer asked process-oriented questions about forming and maintaining participants' online friendship and the platforms they used to facilitate their connection. Questions focused on perceptions and goals of the friendship, as well as activities, behaviors, and struggles that occurred at transition points during the friendship. For example, I began with "Tell me the story of how you became close friends with this person you

met online,” which supported a process-oriented narrative; we followed up on described phases of the friendship with details such as “What activities did you do, and what tools did you use for them?” or “What aspects of your environment (people or technology) affected your friendship at this point?” which refer the `transformational` process of AT and its `sociotechnical elements`. The questions were informed and adjusted based on the participant’s story of their friendship and the visual elicitation activity. Doing so allowed the interviewer to ground questions in participants’ lived experiences and elucidate changes and tensions in participants’ friendships. The interviewer would further listen for issues surrounding platform design and follow up on those struggles or request further information.

3.3.3 Analysis

Given my focus on the online friendship process and how these friendships manifest across varied sociotechnical contexts, an activity-grounded analysis of these interviews is best suited for identifying key `tensions` and points of consideration at different stages of friendship development. Charmaz’s [46] grounded theory interpretation supports use in conjunction with existing theoretical approaches to add context, and Seaman [250] outlines the mutually-complementary nature of grounded theory and activity theory: grounded theory’s focus on inductive analysis allows for insights to be constructed from the data in a bottom-up manner unrestricted by any imposed theories, while activity theory is a flexible lens which supports analyzing processes of change, particularly those entangled with the cultural environment of participants’ lived experiences.

My work adopts methodological guidelines for activity-grounded analysis, mainly *theoretically-informed sampling* (Section 3.3.1) and *process-oriented questioning* (Section 3.3.2) [250]. I specifically use constructivist grounded theory [46] alongside activity theory [185, 82] in this work. I and my collaborator Ash Milton open-coded and labeled common ideas across interviews to allow topics to emerge from the interview transcripts. Over the course of data collection, we discussed emerging topics until clear themes were established, placing an emphasis on `elements` and evolving `tensions` of the online friendship activity system. All collaborators reviewed and discussed the final themes until a consensus was reached. Examples of codes created at earlier steps of analysis

included observations such as ‘tangible artifacts/affirmations reinforce presence’ or ‘interests as fuel,’ which coalesced into themes such as ‘qualities of experience that support persistence of friendship’ that more broadly reflect links between friendship behaviors and sociotechnical dynamics.

3.4 Findings

My analysis aimed to understand the cultural-historical context of online friendship as an activity over time. My findings answer the research questions by discussing key aspects of online friendship development as elements of the sociotechnical activity system (See Fig. 3.2) (**RQ2**) and tensions within the system that reveal core characteristics of online friendship development (**RQ1**). I will use this notation to refer to elements and meta-features of the activity system in this work.

The first Findings section (3.4.1) unpacks online friendship development as an activity, and the remaining sections (3.4.2, 3.4.3, 3.4.4) highlight key takeaways as tensions (originally defined as contradictions [82]) in the activity system, which drive dynamics of online friendship development. Each inner subsection will describe a critical tension impacting the success of online friendships.

Section 3.4.1 introduces the elements of online friendship activity and illustrates how these interacting elements influence the development of online friendships over time. Section 3.4.2 presents achieving a sense of **temporal constancy** in friendship interaction and the crossing of sociotechnical **turning points** as key challenges to overcome in developing close and long-lasting online friendships. Section 3.4.3 presents detailed ways in which online friends interpreted and re-appropriated the sociotechnical affordances around them to co-create a sense of presence and connection in the virtual setting. Lastly, Section 3.4.4 identifies the significant impact of real-life pressures on online friendships. Participants’ discussions of stigma, norms, and examples of friction also clarify the context of public doubt towards online friendship.

3.4.1 Online Friend Maintenance as an Activity

In this work I follow Engeström’s extended AT model [82], which articulates how tensions among elements and other structures in the activity system drive its

transformation over time (See Section 3.2.1). Online friendship development is by definition an `activity` in AT; it is a social systemic process oriented towards a shared goal (increasing reciprocity or closeness between friends), evolving over time, and mediated by tools and cultural-historical factors [82, 244, 7].

My analysis identified how each element of the activity system (Figure 3.2) correlated to the online friendship development process.

- `subject`: a member of the developing online friendship. Each participant and their described online friend are considered as individual subjects.
- `object`: the developing relationship between online friends.
- `tool`: the ecosystem of artifacts (both online and physical) that are afforded to the online friends.
- `rules`: norms by which the online friends interact with one another. These norms can originate internally from the friends themselves *or* come from other social sources external to the friendship.
- `community`: online social groups or communities that the subjects are a part of.
- `division of labor`: individual community members' influence on the friendship

The **process-oriented** nature of online friendship activity is shown through meta-features of the activity system (Figure 3.2). The desired outcome of friendship development (a close friendship) is the goal of the activity (the six-element system). The transformation of the activity system characterizes the development towards the outcome over time (see Section 3.4.2 for highlights).

I illustrate the mapping of this activity system onto the online friendship process using one individual's story as an example: P22 (`subject`) was in a chat group (`community`) on a messaging platform (`tool`) with their friend. They described instances of awkwardness in their friendship (`object`) during which group members' continuation of their interaction (`division of labor`) normalized (`rule`) restarting the conversation with their friend. This contributed to the transformation towards their outcome by allowing the friends to sustain contact. Here is only one case of how elements may interact, while the **tensions** (Figure 3.3) described in the sections below depict more complex interactions in the activity of online friendship.

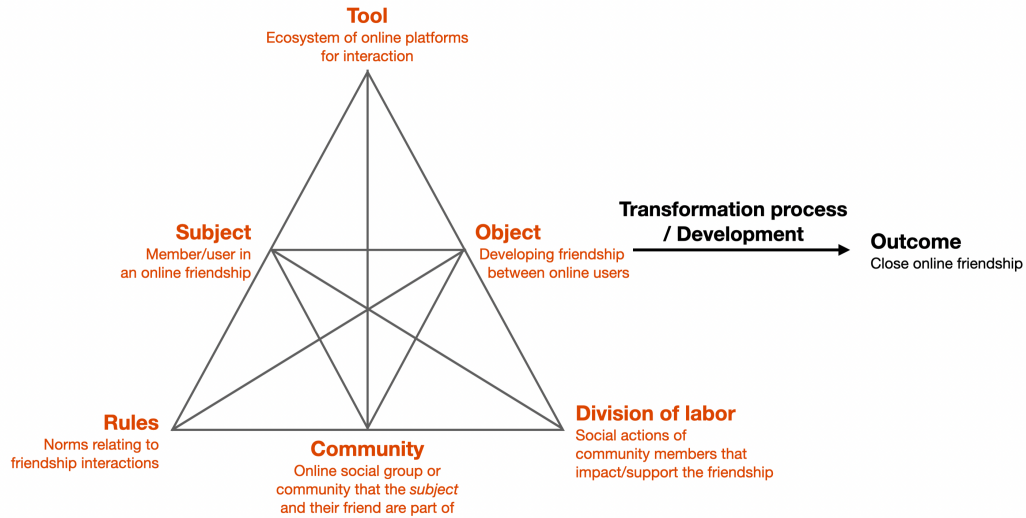


Figure 3.2: The online friendship activity system. The six **elements** are: subject, object, tool, rules, community, and division of labor. Other meta-features are the activity of online friendship development which contains all six elements, and the desired outcome as a successfully sustained and close online friendship.

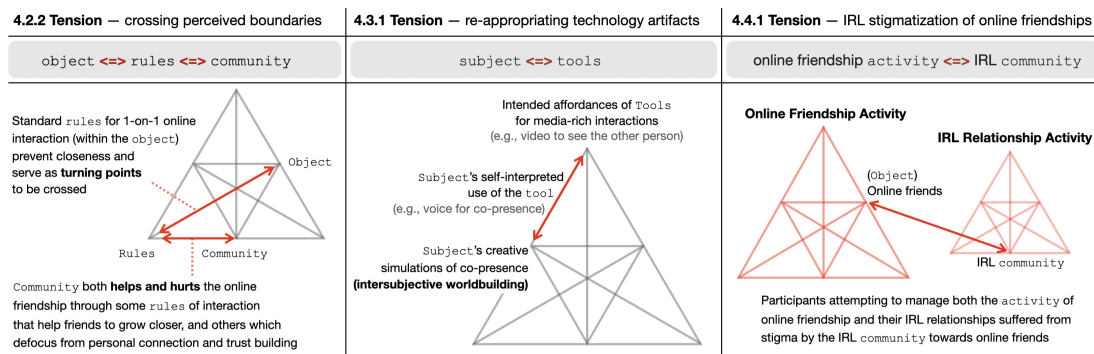


Figure 3.3: Examples of tensions (marked in red) from Sections 3.4.2, 3.4.3, and 3.4.4. We present key takeaways as tensions to reflect how AT dynamics impact the development process for online friends.

3.4.2 Online Friendship Development: Reaching constancy through turning points

Spanning experiences across various online platforms, all participants recalled reaching a point of feeling as if their online friend *“had always been there”* as a part of their lives. As explained by P10:

“You don’t feel like anything massive ever happened. But suddenly like, a really important part of your life, you’re like, ‘Wow that’s nice. We’re already close friends.’”

I call this a state of **temporal constancy** in the friendship outcome. Temporal constancy was a key aspect of closeness reached through sustaining friendship interactions over time, which involved crossing perceived boundaries to enable more personal interactions (**turning points**), and accumulating meaningful shared experiences.

The key tensions in this section highlight how norms (rules) of online friendship interaction are constructed or surpassed through various activity system elements: the online friend as a subject, the friendship object, the platform as a tool, online community members, and their division of labor. Each tension (see Fig. 3.3) illustrates how friends construct their own norms of interaction (3.4.2), move past certain norms of interaction (3.4.2), and select for situations which facilitate interaction norms most helpful to developing close online friendship (3.4.2).

Creating time for consistent interaction

The **temporal constancy** that brought a sense of stability and security to the friendship was cultivated through consistent involvement in each other’s lives across a long span of time. However, restrictions in time available for online friends (subjects) to develop their friendship (object) served as a tension which drove friends to develop routines of interaction (rules) which supported sustained interaction over time.

Such limitations on time included challenges such as residing in different time zones and physical obligations to family, work, or school. P24 mentioned how considerable time zone differences sometimes prevented them from asking for advice when needed, and P23 described the difficulty of *“just trying to stay friends and stay close”* during a new relationship and job.

Participants unanimously mentioned the solution as establishing routines (rules) of interaction built on their existing connection instead of trying to explicitly schedule consistent interactions with one another. Routines provided a general awareness of friends' daily lives and schedules, which was necessary for coordinating the best times to spend together. P4 explained, *"We message throughout the day, but he is an hour behind me so we have most of our evenings freed up to actually spend time with one another."* Time of day was also an important factor in developing routines of friendship interaction. Several participants preferred nighttime for more personal interactions: P1, who was shy about speaking, explained that *"At night, when everybody was calming down, it was easier for me to talk. The atmosphere changes; people get softer and less on-edge."* Others talked about the routine of continuing conversations at the start and the end of the day, and even those with major time zone differences had their own routine, as P24 explains:

"We kind of just keep talking on, the conversation topic changes, we don't really do like oh good morning or I'm going to bed, but sometimes I swear we're awake and go to bed at the same time... so it kind of feels like he's just always there."

Developing a sense of personal closeness between friends created the necessary confidence to develop routine contact without fearing to initiate new or different things with an online friend. P17 described how after becoming close with her friend, *"We don't care if we don't have anything to talk about, we'll just send funny pictures or a smiley face. It's just, 'Hey, I'm thinking about you.'"*

Progressive activities with history gave the strongest support for building more consistent routines of interaction among friends. For example, P22 and their friend grew close by collaborating on a writing challenge where they edited and exchanged draft feedback for months, leading them to talk *"every single day in private messages on Discord."* Some progressive activities also created *tangible history* as a perceivable tool for friends to look back on, as illustrated by P1's experience in Minecraft: *"The sense that we're all contributing to progress as a whole. Building our own little village, seeing something that everybody works together to make."* P10 also mentioned the tangible value of archived collaborations with their online friend:

“All of our shared history is [in those Google Drive drafts], in little bits and pieces that they’ve given me... It just makes me feel both really fond and like, oh, actually, I think that we’re both committed to having this last. It’s like a paper trail.”

Although achieving **temporal constancy** was challenging for online friends, our participants addressed this tension by developing routines (*rules*) which enabled them to sustain consistent connection. Shared, ongoing collaborative activities also produced tangible history as *tools* that supported the sense of **temporal constancy**, and allowed friends to strengthen the personal connection necessary for establishing regular routines of interaction.

Crossing perceived boundaries to advance closeness

Establishing personal connection was crucial for achieving **temporal constancy** in online friendship. However, existing *rules* of interaction in both the 1-on-1 online friendship (*object*) and the social environment of online platforms (*community*) created the tension of perceived social boundaries that online friends had to cross to become closer. Crossing these boundaries served as **turning points** for progression in the friendship. We also identified *community*, division of labor, and *tool* (*platform*) dynamics that affected the crossing of these boundaries.

Depth of personal connection enabled online friends to confide in and support each another, viewing each other as *“the person I tell things to”* (P23). Online friends supported our participants through difficult times, such as staying home to keep them company (P1, P22) or even arranging surprise events to cheer them up (P3). However, participants described the need to cross boundaries such as transitioning into personal conversation topics or making the leap from texting to voice calling to develop closer friendships. This transition was necessary, but difficult due to concerns about violating perceived boundaries.

Making the first voice call was one major **turning point** for most participants. Voice calling was a crucial way to develop close online friendships (see Section 3.4.3), and many participants considered initiating voice call in a 1-on-1 online relationship to be breaching a *rule*. P7, who met his friend as a *mute* player (users who do not

speak) in VRChat, explained that having the mic off *“was the norm. Talking would be the exception to the norm.”* Other participants mentioned how *“the point at which you hear someone’s voice for the first time is a really important connection,”* (P10) emphasizing the emotional impact of this moment.

Certain factors helped to trigger the first voice call. Being part of a community which used voice call tools, such as a gaming group or Discord voice channel, made voice calling with a specific friend much easier. P22 elaborated how *“joining the voice channel instead of having to call specific people”* was less stressful by softening social expectations. P3 described how being able to go on the first individual voice call broke a barrier to engaging in these closer interactions more regularly:

“One day there just wasn’t anyone else there. And once you have that first duo interaction, it’s like going on a first date with someone, and then it goes well, and you’re more comfortable going on a second and a third.”

Incidental reasons also triggered initial voice calls, such as providing emotional support during a difficult situation (P11) or keeping a bedridden friend company (P22). Specific tasks, such as sharing project ideas or professional advice also spurred first calls. P10 described how their first call as a physical therapy session turned into a deep conversation: *“We were already friends. But it lasted an absurd amount of time, because we did the business stuff, and then we just continued talking.”*

Another essential **turning point** for online friendship development was transitioning from anonymous online acquaintances to a close 1-on-1 friendship. Here, membership in an online group had double-edged effects on online friends’ ability to cross that line. This entailed online group members’ involvement (division of labor) and interaction rules in the community setting.

Online friendships that developed in a ‘vacuum’ instead of an active community setting struggled with intimacy and disclosure. P21 and her friend who *“started anonymous with each other”* took *“baby steps”* across several years due to *“getting so used to that boundary.”* They could only self-disclose to each another incidentally, such as finding out about birthdays from a photo on the day of, or mentioning family during a scheduling conflict.

By comparison, online friends in a community or group reported having more natural opportunities to develop their personal connection without feeling like crossing

an explicit boundary, especially since there was a *sense of place* to social groups (P1, P10), providing serendipitous opportunities for participants to learn about a potential online friend and develop personal interactions. P3 explained how “*Observing how well people are able to get along with others, whether their friends or a stranger*” reflected upon the person and was important for developing trust towards an online friend. P22 also explained how `division of labor` from other group members enabled them to overcome hurdles in the closeness of their online friendship:

*“Online, you start cautiously, and you’ll often hit a point where there is an actual conflict or disagreement. **It’s much easier to not just fade out of each other’s lives when the other people quickly take control of the conversation and keep it going.** That allows you step away and come back, and for there to not just be, if it’s just the two of you, your last message is still whatever it was.”*

Although communities supported advancing closeness, they also worked against it through community-embedded rules and platform (`tool`) limitations which hampered online friends’ ability to foster personal connection. Many participants established their friendships in tight-knit social groups that were difficult to access due to ‘*cliques*’ developing in online spaces. P9 described a series of “*weird and bad*” social experiences during his journey to find the “*tiny little Discord server*” where he met his closest online friend, and P14 reported a similar issue on VRChat:

“The furies, adventurers, and artists went into their own groups. Now it’s a little harder to make genuine friends in the space with people who are not already associating with anyone else at the moment. It’s hard to find specific communities because they’re already where they want to be.”

Participants also described how the overwhelming nature of high-anonymity, high-interactivity online social platforms such as larger Discord servers and VRChat venues promoted norms of insincere behavior. This made it difficult for online friends to trust or be vulnerable in front of one another. P24, who moderated a large Discord server, described how:

“Discord is pretty much a huge group chat with all these people, and you don’t have to use your own face and name. It’s easier for people to do and

say things they probably wouldn't want people they know in-person to know they're doing."

P20 experienced a similar lack of genuineness in public groups in VRChat:

"You're role playing as a character. We were more guarded about our personal life; I can treat 'VR people' with a degree of dissociation from a real person."

Aside from lacking the trust necessary to build a friendship, participants also found it difficult to relate to others or have meaningful interactions in such large communities. P10 stated that *"You don't exist in a society, and I mean that in the small sense you don't exist in a community."* P6 also shared that being in a large Discord server felt *"like watching someone else's group chat. It feels like a friend group I'm not a part of."* P22 explained this dynamic in detail:

"Being in a server helps a lot, but it also slows down friendship development, because things only happen out of natural interactions. Somebody might like somebody else and want to be friends with them. But you're in a larger group of people, so you get to know them in a low pressure environment."

This slower pace of friendship development was further exacerbated by *"drama"* which nearly all participants reported experiencing at some point in these larger, highly-interactive communities. Social conflict or toxic behavior on these platforms heavily burdened friendships that were still developing on them. For example, P16 lost contact with their friend *"because something tragic had happened in one of [online friend's] servers."* Toxic community events led to negative mental associations towards using the platform, even to keep in contact with one's friend. P18 reported a similar experience when their friend was unfairly banned from the site they were both on.

More broadly, group- and interest-oriented dynamics in many online social spaces also detracted from focus on 1-on-1 connection. Several participants mentioned moving their online friendships off of the original platform as a result: P6 explained moving her online friend to Whatsapp as a *"context switch"* from a fandom environment, and P24 explained how *"although you can privately chat on Discord, you're still constantly*

notified of everything else that's going on," demonstrating the extent of disturbance these spaces had on developing individual connections.

The tension in this section was illustrated through rules of 1-on-1 online interaction (in the object) and of the community which made it difficult for online friends to initiate closer relationships. I characterized these issues as **turning points** of (1) transitioning into voice-calling as a more personal tool for communication, and (2) transitioning from anonymous online community members into individual, personal relationships. Participants' complex discussions revealed how communities and tools (such as voice channels and division of labor in friend groups) provided opportunities and resources to overcome these **turning points**. However, online community and platform (tool) dynamics such as insincerity and group dominance could also work against the outcome.

Personal interests and experiences as avenues to shared connection

Participant accounts revealed a tension between the subject and object: individuals' original interests for being on a platform, versus the need for social engagement to nurture online friendship. Resolving this tension showed how certain elements of communities and tools fostered rules of interaction which supported the friendship outcome, namely by surpassing **turning points** in the friendship (3.4.2) and cultivating a sense of **temporal constancy** (3.4.2).

Participants met their friends on platforms where the main goal was not necessarily personal connection, but rather a specific interest (subject), such as playing a game, moderating an online community, or being part of a fandom. In contrast to the intuition of directly encouraging social engagement between online friends (object), participants reported that activities which linked back to their personal interests and motivations better supported the outcome by providing natural, less-superficial rules of interaction to accumulate shared experiences valuable to the friendship.

P4 explained how some MMOs attempted to support friendship through explicit 'friendship tasks' such as finding another player and giving them a hug, but battles and resource farming tasks with their friend, which were more in-line with a self-interest in the game, were more effective in drawing them and their friend closer. Instead of directly engaging with a friend, helping each other through a tangible experience

gave them “*something to talk about*” (P12) and “*felt like a bigger deal than our usual interaction.*” (P5)

Subjects’ personal interests played a strong role in fostering connection between friends. Interest-centered interactions, whether in a topic, fandom, or hobby such as drawing, writing, or making, overwhelmingly served as *fuel* for the relationship by propelling learning and self-disclosure. P6 and P21 were fanfiction writers who became close online friends with one of their readers, and noted how their friends’ in-depth interactions with the stories that they wrote allowed them to “*get more of a sense of their [friends’] character.*” Sharing interests in aesthetic topics also created pathways for self-disclosure between online friends. P1 described, “*I’ll say, this song feels like this, or I associate this memory with this song. And then we start telling stories about each other’s lives.*” P6 also explained how fandom opened up vulnerable conversations:

“We’d be talking about, why do I like this character? Well, I like this character basically because of my daddy issues. And then we’re just laughing about that. It’s so intertwined, you end up talking about those personal motivations behind what you’re writing and the content you’re consuming.”

The connection of personal interests even spurred friends to develop mutual interest in one another, directly driving the friendship outcome. For example, P17 and her friend were excited about and engaged in one another’s hobbies even if it was not their personal interest:

“He doesn’t necessarily understand. Nor will he be as obsessed with making avatars as I am, and I wouldn’t be as obsessed with this game that he absolutely loves. But the fact that we’re sharing and talking passionately about something, I think that adds value.”

Interests involving more interactive shared activities such as games (`tool`) also drove personal connection between friends, but certain mechanics were more effective than others. Participants cited interest-based activities with natural opportunities for 1-on-1 interaction as most helpful for friendship, while an overwhelming focus on the task of interest detracted from it. Creating time and space for individual connection was still important. When recalling how their friendship began on VRChat, P17 said, “*We did*

play games, but we liked exploring worlds a bit more, because we could talk one-on-one and not be focused on throwing a disc or playing cards with a bunch of people.” Participants who played League of Legends reported that its competitive nature and extreme focus on individual skills did not support personal bonding despite being a team-based game (P9,20). In comparison, P20 described how battle royale games “*focus on coordination rather than viewing people as above or under one’s skill level, which help build implicit trust and cooperation in the relationship.*”

Though the outcome of online friendship was achieved through furthering engagement between friends (the object), I observed that starting from subjects’ individual interests to motivate shared experiences and pathways to personal interaction effectively drove the friendship. However, rules encouraged by different activity mechanics exhibit mixed effects on bonding and demonstrate a need to balance between focus on individual interest and interpersonal connection.

3.4.3 Co-Created Presence: Online friends’ adaptation of sociotechnical affordances

In an online friendship, available methods of fundamental communication are distributed across the tools available to subjects and vary along the dimensions of media modality (text, voice, video, or tangible object-sending) and synchronicity (asynchronous vs synchronous). This section details online friends’ extremely creative interpretation and integration of sociotechnical affordances across different platforms (tools) in the act of defining and developing their friendship (object).

The following subsections illustrate tensions between distinct affordances of available tools, the use of which online friends coordinated by considering the most meaningful aspects of their connection with one another (subject and object). Specifically, these tensions highlight participants’ reappropriation of existing technologies based on their uniquely co-created sense of presence (3.4.3), their coordination of synchronous and asynchronous interactions (3.4.3), and the permanence of effort expended in the friendship (3.4.3).

Re-contextualizing affordances through shared worldbuilding

Although participants had to consider many factors when managing communication options, the way they adapted technologies and other features of their environment supported Walther’s claim [288, 289] that online interactions may not align with traditional face-to-face interaction, and actually surpass it. Online friends’ appropriations of technology reflected a form of **intersubjective worldbuilding**, where pairs of friends projected co-created meaning onto the affordances in their environment. This instantiated the tension between `subject` and `tool`: online friends (`subject`) adapted sociotechnical affordances (`tool`) in ways that counter traditional concepts of use, reflecting very personalized interpretations of social presence.

Countering implications of media richness theory [62], our participants overwhelmingly preferred voice-based interaction over video calling for maintaining online friendships. Voice calling enabled more flexibility for online friends to simulate natural ways of interacting which enhanced their sense of social presence. Nearly all participants mentioned the importance of being able to hear someone’s voice showcased here by P24: *“You might know someone. But once you speak to them verbally, they feel like a real person.”* Participants described how voice made it easier to convey and notice more complex emotional states, open up about personal topics, and understand their online friends’ personality and sense of humor. P25 noted that voice was much better for conversations where *“it’s more about how you say it”* than about the surface-level content.

Online friends used voice calling to simulate co-presence by projecting shared mental models of the experience. Voice communicated enough personal detail and the lack of visual input created room for participants to simulate physical presence with their friend. Several participants described the habit of voice chatting with their friend in the evenings while lying in bed as *“kind of like a sleepover”* (P4). P8 described how when she placed her phone somewhere nearby, *“If you don’t look to the side, you could imagine that they’re just laying right there next to you.”*

Online friends also developed proxy interactions over voice chat by anthropomorphizing the `tool`. P22 described, *“I might cook as we’re talking on voice chat, then I’ll be like, I’m bringing you to the kitchen!”* They and their online friend also simulated physical contact through technology, in this case via a laptop:

“Discord didn’t always have noise crisping, so you could hear if the other person was typing and all those basic noises. We started doing this thing where we would tap on the shell of our laptop as a way of saying, ‘I’m here. I’m not saying anything,... but I’m right here and I care about you.’ Both of us like to pet or hug people when they’re distressed and we didn’t want to just say ‘I’m hugging you,’ because that defeats the purpose of a hug. So then ‘Oh, I’m petting you’ became ‘Oh, I’m petting the laptop which has you in it.’”

Voice calling also allowed online friends to find comfort in spending time together: *“to just sit in silence and just do our own thing, and every once in awhile say something to each other”* (P21). This additionally helped stimulate consistent interaction since it reduced digital fatigue and allowed participants to do something in addition to talking with their friend (Section 3.4.2).

Although video was a richer communication medium than voice-only, the added visuals were not preferred by most participants. Video was only used on occasion to *“show each other what you are doing”* (P8) or if friends *“hadn’t seen each other’s faces for a particularly long time.”* (P12) Generally, participants did not find their online friends’ appearance to be an important part of their emotional connection. As P8 explained, *“I don’t really care if the video is on or off. When we talk, the most important thing is being able to hear someone’s voice and intonation. That’s how I feel more connected.”* Multiple participants mentioned how the social expectations (rules) associated with video calls, such as having to stay in front of the camera during the call, actually limited the natural activities they could do while talking to their friend. P22 explained, *“Because of the fixed perspective, and you have to make eye contact in three dimensions through a screen when there’s a person in front of you there’s always this element of distress.”*

The favorability of voice and less immersive tools for maintaining and developing close personal connections with online friends also extended to VRChat-originated friendships. Although VRChat interaction was rich and highly-immersive, participants’ accounts reflected that it did not sustain long-term friendship development (the outcome). None of our participants who reported meeting their close online friend on

VRChat maintained the friendship through that platform due to its session-locked nature. P14 also reported how getting accustomed to the intensity of social cues provided by VRChat caused him to lose contact with his close online friend, as it was difficult for him to adapt to communicating with his friend on other platforms. He explained, *“You get more out of VR than you do in Discord. You hear a voice, you see facial reactions, you see bodily reactions. You can still do it in Discord, but there’s an element that obviously is just missing.”*

Participant accounts demonstrate how the shared context between online friends (subject and object) was much more important to their selection of communication tools than the surface-level richness of the tool itself. Online friends valued flexible forms of communication which could be sustained over a longer time. The strength of their personal connection was able to facilitate co-created presence even in the absence of structure, by combining features of available tools with altered interpretations of their physical environments.

Coordinating synchronicity of interaction

This subsection illustrates a *tension* within synchronous and asynchronous communication as mutually-exclusive affordances of tools. Though synchronous communication was desirable and allowed deeper engagement, online friends also learned to leverage unique benefits of asynchronous communication in order to sustain a long-term friendship outcome.

Participants highly valued synchronous communication (whether through voice, text, or other means) for its ability to make people feel emotionally closer and more present with one another. P25 explained how synchronous conversations allowed for more personal engagement compared to asynchronous texting:

“When we take days to get back to each other... It’s not quite as spontaneous. In a conversation going back and forth, a humorous moment just lands differently than it would with something that I had written a week ago.”

However, as shown in Section 3.4.2, participants could not engage in synchronous sessions of communication all the time, and asynchronous methods were still necessary

not only to coordinate future synchronous sessions but also to maintain a persisting sense of closeness between friends. In addition to providing online friends with more chances to contact each other, asynchronous media was valued for its ability to embody forms of expression and communication that persisted over time. P7 described exchanging drawings with his friend on an older and beloved feature of VRChat:

*“**The Presentation room** was very special, because you could join later - half an hour later, hours later, and you could still see all of their drawings, even though they were made long before you joined. The Presentation room was so beloved because VRChat didn’t have a persistent message system.”*

Because asynchronous communication `tools` served as “places” to leave messages, they eventually became likened to physical spaces (`rule`). P4 described their close-friends-only Discord server as:

*“**A house server** where every channel is a different room. Each one of us has our own room, where we just talk about things that are on our mind. And then everybody has a place where you can reply to the stuff that they post inside of their channel.”*

All participants strongly preferred sticking to a single `tool` for consistent, asynchronous communication with their online friend, which further reinforced the sense of having a concrete place of residence. P21 spoke of their shared private channel as: “A space where we can just be ourselves. No one else is watching, so we can do whatever.” This sense of place when anchored to an asynchronous platform strengthened the friendship connection (`outcome`) by allowing online friends to feel more grounded in a virtual world that may sometimes feel impermanent (see Section 3.4.4).

Although the immediate closeness of synchronous interaction may often be foregrounded in the pursuit of deeper connection, its `tension` with asynchronous communication showed that such `tools` also provided unique and necessary value for online friendships by supporting *time-stable* social expression and providing a *sense of place* crucial for ‘virtual’ friendships.

Preservation of effortful interaction

Maintaining a close friendship only through technology-mediated means required a considerable amount of subjects' effort in the form of invested thoughts and actions. Although participants did not explicitly describe their friendship as 'effortful,' they willingly put in time and attention to sustain these valued connections. Participants' stories about the burden and benefits of such effort showed a tension within the subject, and how effortful interactions mediated through artifacts (`tools`) contributed to the outcome by lending a sense of permanence to online friends' virtual connection.

Relating to the ease and immediacy of interaction highlighted in Sections 3.4.3 and 3.4.3, participants also reported the additional effort required to sustain certain forms of interaction: such as maintaining the mental context of a text-based conversation compared to being more present through a synchronous voice call. As P18 described, “[*With a call*] you can have a longer conversation in a shorter amount of time instead of typing out a whole wall of text.”

However, modes of communication that inherently required more effort from the subject also manifested forms of social effort that enhanced the level of bonding in online friendship. Text histories allowed for reflection on past interactions which, in the case of P10, reminded them that their friend “*did all of these really sweet things for me*” and was “*very nostalgic*”. The effort that unwittingly went into preserving these interactions allowed them to look back and more clearly appreciate the long-term value of the friendship.

Several participants also engaged in modes of communication with their online friend that were intentionally effortful and tangible, such as sending small gifts to one another and writing letters. These temporally- and physically-persistent tangible affirmations acted as a “*physical representation of the fact that, this person and I do care about each other,*” (P16) and “*is a little piece of them... It’s a connection that you are holding on to*” (P10). These forms of communication held immense value for participants' online friendships. P19 told a story of feeling touched after unexpectedly seeing their gifts in a photo of their online friend's desk, which their friend said was reserved for “*stuff that they treasure a lot and really value.*”

Although subjects' effort in online friendships involved both compulsory effort (e.g., maintaining basic communication over text or preparing digital media), and

more self-motivated effort (e.g., curating and exchanging gifts and letters), the artifact-mediated nature (`tool`) of these effortful actions allowed participants to generate permanent anchors of connection in the online friendship, strengthening the outcome.

3.4.4 Online Friendship vs. the IRL Social Sphere

Engestrom’s model of activity theory [82] defines the highest level of contradiction (structural tension in the activity system) as a quaternary contradiction between the main activity system itself (the online friendship development) and other neighboring activities. Participants observed this type of fundamental tension occurring between their activity of online friendship development and the activity of managing IRL social obligations which were unavoidably a part of their lives. I abbreviate this neighboring area of activity as the ‘IRL social sphere.’

Each following subsection will describe this tension between online friendships and the IRL social sphere at different levels — **Section 1** and **Section 2** depict societal and normative mechanisms of this tension, while **Section 3** depicts grounded instances of conflict between online friendship development and IRL social obligations.

Section 1 demonstrates the negative impact of stigmatization imposed by participants’ “IRL community”, but also illustrates participants’ unwavering response of contrasting beliefs about online friendships. **Section 2** highlights differences between online and IRL social spheres in expected rules of interaction for maintaining friendship. **Section 3** then presents actual instances of conflict between online friendship development and the management of IRL roles and relationships.

Stigmatization of online friendship

One aspect of the tension between online friendship development and the IRL social sphere took the form of stigma towards online friendship from the “IRL community” (see Figure 3.3, far right; this is separate from the community in Figure 3.2). Participants were, in response, even more driven to cherish and defend their online friendships. They not only shared vivid experiences of invalidation by people in their daily lives, but also explained how online friendships played a level of importance in their lives similar to IRL relationships.

P6 talked about how people in her IRL sphere looked down on her online friendship, with coworkers making comments like “*“Oh, that person’s off with their ‘internet’ friends. Yeah, they’re weird,”*” and her husband saying things like “*“Why are you talking to this lady that you met because of your porn that you write online? That’s not normal.”*” P6 further stated, “*There’s this implication that if you have to make friends online, there must be something so weird about you that you can’t make friends in real life. That’s not even true.*” P10 also elaborated P6’s point about how the stigma was driven by a lack of understanding for the depth and complexity of online friendships:

“They’re imagining more surface interactions, anonymous user names, and people who don’t really know each other, and they’re not imagining - Oh, yeah, I talk to them. I know this person’s roommate, their wife, the name of the little kid that this person’s wife nannies for. You know, all of these really personal things. They’re not envisioning, you know, phone calls while we both do our laundry.”

Apart from P6, many other participants also felt anxiety and shame when online friendship came up in their “IRL communities”. P13 recalled, “*I remember being very judged by my family*” when sharing her decision to go on a trip with her online friend.

Despite this pressure, participants emphasized their unchanging perception of the online friendship (object): that the quality and priority of their online friendships were no less than with close others IRL. For example, P21 described how significant of a role her online friend played in her life: “*She’s one of the best things that’s ever happened to me in my life. It’s like having one pillar of your house that’s always been there. If that pillar disappears, then that part of the house just falls away.*” P11 and P25 also described that their close online friend had, respectively, the same level of importance as their family members and childhood friend. In fact, the inherent fragility of online connection also drove participants to treasure their friendships even more out of a sense of urgency. P21 spoke about how a sense of fear compelled her to actively connect to her online friend:

“It was just, I really like talking to this person, and I also had a fear that, what if I can never see her again? What if the website goes down? I really like interacting with this person. I wanted a closer bond, so they don’t just

disappear into the Internet void.”

Online friends also pointed out how their regard for each other transcended online or IRL contexts. P23 stated, *“If she calls me, everything else gets dropped because I need to talk to [her] and make her feel better right now.”* Others provided IRL support for their friends, such as sending money, purchasing resources, and helping with remote physical tasks. Participants also emphasized valuing their online friends as unique personalities, which they did not see any differently than how they would someone IRL. P15 explained:

*“IRL, some personalities just click. I think it’s the same way online, it’s just a different medium for making friendships. **That doesn’t mean the friendships are any less.** I feel like I’d receive the same feelings if I pulled that same prank on her in real life.”*

Others made similar comments about the friendship development process, such as P17’s account of getting to know her online friend through VRChat world-hopping: *“Most friends I’ve met are circumstantial, both IRL and online. We just hung out and talked - it’s like going on a hike with a friend. But only there are robots or stars instead of, you know.”*

Online friendships were deeply treasured despite the stigma they experienced from both close others and the wider public, and participants took care to explain how core aspects such as priority, loyalty, and feelings of friendship were no lesser in comparison to the IRL context.

Norms of interaction

In comparing their experiences managing online vs. IRL friendships, participants also identified a tension in social rules regarding friendship interaction between the IRL and online context. These differences in norms were sensitive to whether the friendship began in an online or IRL environment. Even for the same person, their accustomed norms of interaction for online friendships were different from the ones they had for friendships formed in-person. P11 recalled how compared with their online friend, they struggled to keep in contact with their in-person friends during COVID: *“With [online friend], it’s always just text and call, that’s just how we operate. **But it’s weird to***

text some of my friends and the end goal not be a meetup.” They described how this difference came from how the relationship began:

“I’m so used to communicating with them with body language, and being able to see how they’re reacting to me. With [online friend], that’s not a “need to know” thing when I’m talking with her. It’s more difficult to start off in person then have to go off of it, rather than learning to navigate somebody without it entirely.”

This experience was echoed by others, such as P10 who maintained a close online relationship with their online friend but could not do the same with an IRL friend of six years, because of *“the activities we had been doing together - we get used to climbing together and other things.”* P22 also recalled enjoying hanging out over long voice calls with their close online friend, but somehow could not do the same with their best friend since middle school:

“We just never learned how to exist next to each other without being in person. We never learned how to talk to each other over text because it was like, Well, we’re gonna see each other at school. So from very early on, we just were not online friends.”

Participant comparisons of the online friendship development context with IRL situations revealed how the in-person accessibility and preordained concrete structure of IRL environments (as `tools` for socializing) tended to reduce intrinsic motivations to reach out asynchronously or through online means. This dynamic contributed to a perceived rule in IRL social contexts of intimate online communication as counter-normative, fanning the stigma around online friendship interactions. P11’s earlier remark about the ‘weirdness’ of texting with her IRL friends for the sake of talking reflected a sentiment that was shared by other participants. P19 perceived a *“filter”* between herself and a prior close IRL friend when considering online interaction, *“because we met from being in the same class. The main reason we hung out was to do work together and then we would chat once we were done.”* The concrete structure provided by that setting served as an IRL `tool` which grounded their friendship to that context. P13 also mentioned not wanting to *“bother family or [IRL] friends [by talking remotely], since I’m*

more likely to catch up with them later.” Although people IRL may have been physically closer to one another, their perceived social affordances for maintaining friendship were often restricted to those contexts and contributed to uncomfortable or negative perceptions of online-grounded intimacy.

These divergent rules of online vs. IRL personal interaction stemmed from the specific virtual or physical setting (`tool`) in which the relationship formed, constituting a system-level tension between the activity of online vs. IRL relationship development. The sense of discomfort around translating acts of closeness meant for an IRL context into a virtual online context which we observed here may shed light on the stigma of perceiving intimate online-only friendships as abnormal or weird.

Friction between online and IRL relational spheres

The significant tension between online friendship and the IRL sphere also occurred in the form of conflicting demands for subjects’ personal resources, directly impacting participants’ ability to engage in the activity of online friendship development. Online friends experienced direct conflict with IRL social obligations that took precedence over friendship-maintaining processes, impacting communication and time spent together. This was the most significant source of high-risk conflict cited by participants, due to it invalidating the perceived importance of the online friendship. Participants described how they were expected to, in practice, separate and demote their online social lives in comparison to their IRL physical connections. In light of these conflicting obligations, they also described their struggles and attempts to bridge this priority gap.

Participants reported how people in their lives expressed the view that it was not acceptable to give online interactions equal or greater priority to anything IRL, even if that was what resonated with them. P3 explained, *“I feel like a lot of people view online friendships as secondary to real ones. Whereas, I view all of my friendships on an equal level. As in, I would put the same effort as I do into his friendship as I would with somebody IRL.”* P6 described the difficulty in legitimizing her own choice to spend time with her online friend by describing her husband’s reaction to it: *“He would not like that. It would be like, you’re taking time away from me to talk to somebody online?”* She also described feeling a similar insecurity when her close online friend suddenly stopped talking to her:

*“I didn’t know if she was losing interest, or what was going on. If she hadn’t rekindled it, I would’ve been like. Oh, that was a great couple months of having a really close friend, but guess she got bored of me... it did hurt a little bit. Part of me was thinking, **I shouldn’t care this much about this. But I do.**”*

Compounded with real-life obligations, this pressure led many online friends to struggle with the activity of maintaining their friendship. P23 described a difficult time in her online friendship when she felt the need to focus on developing IRL relationships:

“The shift in our dynamic caused some conflict, where [online friend’s name] felt kind of left out... Because my husband was the first serious relationship in my life I probably also talked about it too much and made her feel like I didn’t care about her anymore.”

P16 also recalled times when his online friendship “sort of waned,” recalling “the waiting part, where things got very busy, and we just wouldn’t really contact each other for a span of time.”

Most participants talked about different IRL social obligations which made maintaining online friendships difficult. For P6’s online friend it was family responsibilities as a mother of several children, for P17 it was getting a job with a different work schedule, and for P11 it was dealing with a college environment. It was also easy for IRL social obligations which suddenly came up to be prioritized over time that online friends originally planned to spend together. One example P3 gave: “Say your mom comes home and she’s like, ‘I need you to help put the groceries away,’ then you have to be like, Oh, shoot, I gotta go.”

In light of the struggle to prioritize online friendship, participants emphasized the importance of being mindful of the fragility of online presence and the activity of earnestly communicating necessary absences to online friends. As seen from above, lack of communication around absences led to conflict or waning in the friendship. P25 explained the importance of updating her online friend during times of absence:

“I don’t like it when people feel like I’ve just been ghosting them for no reason. So I always prefer to say... it’s not because I’m not interested, it’s

because I'm away. Because I... didn't want her to feel that I had dropped that interest."

Other participants also mentioned how expressing sincerity and respect towards their online friends enabled them to stay close to one another despite interruptions or obligations from real-life. Some appreciated that their online friends were *"apologetic"* about replying late (P7), while others checked in with each other consistently (P11, P24).

Only two participants described being able to avoid conflict with their IRL relationships when maintaining online friendships. P17 and P23's close others IRL also had online friendships, and were accepting of integrating their online and IRL relationship activity. P17 planned a road trip with her husband to visit both of their online friends, and P23 described how *"My husband's online friend group and mine combined in the last few years. We get together and play Jackbox games around once a month, where all of our friends come and we're all on a Discord call together."*

Participants' varying experiences in coordinating their online friendships and IRL obligations showed how although these two largely separate activity systems experienced friction in competing for online friends' attention, there were exceptions to the stigma of online friendship as inferior and separate to IRL interaction. In line with Engeström's concept of *contradiction* in activity systems as a key to their *expansion* [82], overcoming the beliefs (3.4.4-1) and norms (3.4.4-2) which separate online friendship from the IRL social sphere could help *expand* the concept of online friendship to be an activity more socially acceptable and integrated with real-life.

3.5 Discussion

In the following sections, I provide an overview of the principal findings before highlighting key extensions to the literature on online friendship, online community platforms, and computer-mediated communication. For each, I follow with recommendations for future research and design of online social platforms and relationship maintenance.

3.5.1 Principal Findings

Our platform-agnostic investigation of online friendship experiences revealed both identifying characteristics of online friendship development (**RQ1**), as well as how it is

impacted by the surrounding sociotechnical ecosystem (**RQ2**). An activity-grounded perspective allowed us to answer these research questions by identifying tensioned elements and meta-features of the activity system which drove the transformation and development of online friendship.

A developmental focus on the activity system's transformation led me to identify **temporal constancy**, a permanent sense of online friends' presence, as an important characteristic (**RQ1**) of successful online friendships. In working through the tensions occluding this goal, online friends had to sustain consistent interaction (3.4.2-1) and cross **turning points** (3.4.2-2) in both technology use and interactional norms. Another characteristic of developing temporal constancy was online friends' co-development of interaction norms and routines based on their unique shared sense of presence. Some chose not to view time-zone differences as obstacles (3.4.2-1), while others treated the communication devices as high-presence proxies for their friend (3.4.3-1) or adapted online platforms as their virtual residence, enhancing sense of place (3.4.3-2). Participants' sense of urgency and earnestness in maintaining their online friendships was also distinctly characterized by opposing pressures from the IRL social sphere (3.4.4).

The activity system framing also helped identify influences from the sociotechnical ecosystem (**RQ2**), both as elements within the activity system and tensions external to it (3.4.4). While online community membership did support aspects of friendship development (e.g., sustained social interaction), it also discouraged interpersonal closeness (3.4.2-2). Tools such as online platform mechanics (e.g., user search functions, chat configurations) and real-world affordances (e.g., time of day and physical device setup) also impacted how online friends developed their relationship (3.4.2, 3.4.3). Lastly, the external tension exerted unto the activity system by the IRL social sphere as a **quaternary contradiction** (a tension resulting from conflict with neighboring activities, see 3.4.4 & Fig. 3.3[right]) was another key influence from the ecosystem-level that distinguished online-only friendships from other friendship contexts.

3.5.2 Deconstructing Stigma: Contextual Imprinting in Relationship Development

Participants' differing interaction norms for online and IRL friendships stemmed from the environment in which the relationship was formed (see 3.4.4-2). This difference in

norms can extend our understanding of online friendship and its stigma by explaining mixed findings in prior work regarding the inherent quality of online friendships.

These results concerning the sociotechnical ecosystem of online friends allow us to hypothesize about prior findings on online friends and their supposedly ‘inferior’ quality. Studies observing inferior quality in online vs. IRL friendships were conducted in settings that confounded the context of development, such as sampling both from the same real world-centric social networking site (e.g., Facebook) [10] or by studying the transition from IRL to online friendship [249]. While valuable research, these studies may lead to false comparison between IRL and online friends, putting IRL friends at a misrepresented advantage. Another study by Chan et al. aligns with this conjecture – they explored separate reports of online and IRL friendships and observed similar quality between them [45]. My findings in 3.4.4-2 show how participants’ *standards* for friendship interaction were connected to the *context of friendship formation* (e.g., on an online platform vs. a college campus), which could explain these conflicting results in past work. These results also align with the findings in Lee[184]’s post-COVID work on online friendship formation in graduate students, which found differences across contexts of friendship formation. Based on participants’ experiences, the friction between real-life and online friendship related more to ill-understood distinctions in social context and less to the concept of an inherent deficiency in online friendship (the source of stigma) [47, 7]. It is crucial that researchers deconstruct stigmatized understandings of online friendships, which already carry the emotional burden of relying on private third spaces (3.4.4-1); they do not enjoy the same privilege of public and physical availability as IRL friendships despite arguably sharing similar levels of personal depth.

Implications

I argue that we need to adopt a more sensitive view of online friendship which respects their importance on the same level to how we respect IRL relationships. This shift would not only help alleviate stigma towards online friendships, but also support online maintenance of IRL relationships.

Currently, there is no sociotechnical infrastructure that explicitly addresses a norm difference between online and IRL friendship maintenance. I found this manifested in practice – users without experience in online friendship may struggle to connect when

transitioning to technology platforms (3.4.4-2); this is due to the perceived ambiguity of interaction norms on platforms that these users are less familiar with. Increasing interpersonal visibility on communication platforms can help educate users about feasible norms for interaction and support more personal interactions mediated by online media. For example, making context cues for personal expression more visible, such as dynamic font personalization or annotating conversations with activity context cues [39], can increase visibility and awareness of a more intimate communication context [84]. Recent work has also shown the potential for AI text support to facilitate more intimate and empathic conversations between peers [50, 255]. Creating structures that facilitate better understanding and reconciliation of friendship norms across online and IRL contexts can support IRL friends transitioning to online interactions while also fostering positive recognition of online friendships. Additionally, such efforts may encourage platform implementation strategies that lessen the stigma and need for secrecy in online friendships.

The findings also showed how the lack of groundedness in online contexts drove online friends to be creative with their appropriation of affordances (3.4.3) and craft their own norms of interaction (3.4.4). This self-directed joint crafting of relationship interaction contributing to success in online friendship aptly reflects the importance of the autonomy-connectedness dynamic in developing close personal ties (Related Work Section 2.1). Encouraging the cultivation of these habits can be useful for friends who are coming from more concrete norms of interaction in an IRL setting and need to maintain their relationships through technology. Because these findings show that “familiarity breeds contempt” [223] in real-life relationships and leads friends to take their physical context for granted (3.4.4), designing exercises that move IRL relationships online for periods of time can be one way to promote reflection on the relationship and build a closer bond. Encouraging activities that allow people to experience online friendships through an alternative lens can support reappraisal of stigma and even afford new types of relationship development that benefit not ‘just’ online friends but a broader scope of close relationships.

3.5.3 (Strong and) Weak Ties: Supporting Friendships vs. Community Membership

My findings also add nuance to *social network theory* (tie-formation) and weak ties' relationship to strong ties. Weak ties tend to span across more different social circles, but involve lower levels of emotional depth and closeness, while strong ties involve higher levels of closeness and trust and are likely to share the same social circles [112]. Despite the importance of recognizing different tie strengths [108, 284], much of HCI work has focused on the importance of online communities and “the strength of weak ties” over strong ties, which require more investment [112, 313, 38, 73]. Although my work on the experiences of online friends showed that being part of a social group or community supported online friendship development, it also showed cases where the presence of weak ties in a group setting could compromise the formation of their friendships as strong ties (3.4.2), which are important sources of stability in people's lives (3.4.2). Participant accounts showed that overwhelming group dynamics in a context with many weak ties could make the formation of strong ties counter-normative. Specific challenges posed by large online communities to online friends included difficulty accessing personally-relevant social groups, lack of authenticity, community ‘drama’ [189], and 1-on-1 interactions being drowned out by community context (3.4.2). The implication that strong and weak tie formation do not always coexist in harmony suggests an air of caution when considering how well sociotechnical contexts support both types of ties.

Implications

As mentioned in the beginning of this paper, the development of high quality, strong tie friendships to maintain our well-being is a skill that our generation is currently losing. All strong ties start out as weak; most close online friends started out meeting one another in community or group-based platform settings (e.g., interest-based forums, recreational social applications). Online friends who used individual-oriented platforms (e.g., texting apps) to maintain their relationship could only do so after establishing the friendship (see participants' compartmentalization practices in 3.4.2-2). Therefore, support for online friendship needs to start from the community-based platforms linked to its outset.

Online friends' struggle in accessing the smaller communities within a platform where they were able to make friends (3.4.2-2) necessitates a re-examination of how we design large community platforms. Large online social platforms (e.g., Discord servers, message boards, and VRChat) afforded the formation of smaller social groups as 'cliques' but did not provide much infrastructure for navigating them, which made it difficult for potential online friends to find groups where they fit in well. One way to provide infrastructure for interpersonal relationships on community-based platforms is to integrate filtering from friend-making apps (e.g., Bumble for Friends), such as identifying personally-relevant keywords and social orientations to match online community members with socially-compatible others. Automated matching with these characteristics for online team activities (e.g., MOBAs) can also provide opportunities to bond (3.4.2-3) with socially-compatible others if handled carefully. Further work is needed to identify infrastructural factors relevant to online friendship development (e.g., group size, subtopics, or communication preference) and address tensions that specific interpersonal bonding could have with the platform interest.

In a similar vein, providing structured spaces in online community platforms for visible self-expression of users' individuality can also support people to find peers with a higher overlap in personal interests, which we saw as helpful to friendship development (3.4.2-3). Additionally, creating a visible, structured space for individuality on a platform with a seemingly uniform purpose (e.g., a fandom, game, or specific activity) can not only increase the ease of finding friends but also combat strong group dynamics that might otherwise deter users from reaching out to individuals within the group (3.4.2-2). One way to integrate such functions in an online platform may be to provide support for filtering and navigating individual users' status indicators in a centralized location. However, increasing social networking affordances may place a burden on valued anonymity, and more work is required to understand how to balance accordingly. Appreciation of individuality can leverage existing group attributes which we found helpful for online friendship development, such as the division of labor (3.4.2-2) which created more opportunities for continuing interaction: increasing visibility of points of connection between users in a group can also make it easier for potential online friends to reach out to one another.

Reserving space within an online community platform for two friends to interact

more privately is another way to protect friendship development originating in a highly-interactive community platform: participants mentioned how the ability to privately message one another within a community platform was drowned out if the presence of group activity was overwhelming, and online friends who were not yet close struggled to switch to a private message platform (3.4.2-2). Therefore, providing users with explicit options to detach their private channels from an online social platform or switch to a private platform can help developing online friends initiate the *backchanneling* necessary to maintain a personal connection.

3.5.4 (Time and) Space: Surpassing Media Richness With Time-Stable Interaction

My findings identified *time* as an overarching theme in the activity of online friendship. This connects back to a diverse range of prior work on computer-mediated communication, friendship formation in MMORPGs, and *activity*. The implications from our findings further extend upon these seminal works by exemplifying how time can be effectively considered in the design of existing and future technologies.

Section 3.4.3 demonstrated how participants prioritized contextual factors (e.g., environment, current task, and time of day) instead of the sheer richness of cues (e.g., video or immersive VR) when making choices about computer-mediated communication (CMC) with their online friends. This aligned more closely with social information processing theory (SIP) [287] than with traditional models of media richness [62]. Online friends' co-creation of presence through their contextualized curation of technology use also connect with social presence theory [26] as a fulfillment of SIP by showing how contextual considerations for the choice of CMC were made to ultimately prioritize their sense of feeling present and connected with one another. It also reflects the philosophy of technology design for fostering genuine feelings of connection [268]; in a comprehensive survey of the HCI design landscape, Stepanova et al. assert that "*high bandwidth does not guarantee improvement in the quality of the human interaction.*"

My findings also connect to prior work which studied the development of online friendships over time in MMORPGs. They align directly with Ramirez et al.'s 2018 study [234] on the importance of having different backchanneling platforms and a consistent 'place to hang out'. Participants reported diversifying the platforms they used

in order to maintain a personal space for communicating with their friend (3.4.2-2), and a persistent ‘home’-like space (3.4.3-2). Their need to balance personal interests with social connection (3.4.2-3) also align with Utz 2000’s finding on the friction between goals of friend-making and engaging in meaningful activities [281]. My work extends findings initially observed in MMORPGs to many other contexts, such as collaborative writing, roleplaying, topic-based discussion, MMOs, and other game models.

My finding of **temporal constancy** as a terminal feature of online friendship builds on Bonnie Nardi’s proposed *dimensions of connection* for evaluating the quality of interpersonal CMC. Nardi asserts that three relational aspects of communication (**affinity, commitment, attention**) form a *field of connection* based on the history of communicative activity between two people: “*The management of fields of connection requires significant interactional work to sustain communication over time.*” [216] My work showcases a myriad of ways in how online friends worked to retain those *dimensions of connection* over time: they showed commitment by crossing social hurdles to personal connection (3.4.2-2), developed routines for sustained attention (3.4.2-1), and reappropriated technologies to maximize the sense of affinity and presence felt with each other during their interactions (3.4.3). Here I not only emphasize the importance of committed contact in technology-mediated relationships, but also identify valuable examples of strategies and interactional mechanisms to support this process.

Implications

The current narrative for enhancing presence in technology-mediated social interaction emphasizes spatial realism and approximating ‘face-to-face’ contexts [186, 183, 220, 37]. But the results of my work show the stability of interaction *over time* as a critical factor for cultivating strong relationships (3.4.2-1). *Social presence theory* [26] itself asserts that *sense of closeness* is mediated not only by a sense of the person physically being there, but also by the level of emotional connection. My findings on online friends’ trajectories across a variety of platforms demonstrated that dedicating time to one another over a long period was what mattered the most for keeping the friendship alive (3.4.2 & 3.4.3). As described by my participants, the sense that their friend “*had always been there*” (3.4.2), “*just as a person*” (3.4.4-1) was not always analogous with being there physically. Choosing less physically-immersive forms of communication and

allowing room to fill in their own interpretations (3.4.3-1) demonstrated more presence from the online friend’s existence built up over time and less from direct sensory cues provided by technology.

Based on my findings, I make recommendations for designing time-stable and long-term social interactions which support friendship development. To enhance social presence for meaningful relationship development, future technology design should foreground the cultivation of interaction patterns that persist over time and not only immediate qualities of interaction. As discussed in 3.5.3, strong ties require more time commitment around which there is no shortcut.

My findings identified features of interaction or shared experience helpful for maintaining committed interaction over time, which can be combined and integrated into future systems to support friendship development. Participating together in shared interests, especially a relatively challenging activity over time — such as creating writing or art, moderating a server, or leveling up in a game, motivated consistent interaction by leveraging the incentive from an existing personal interest and the feeling of meaning and growth from accomplishing something difficult together (3.4.2-3). Membership in a community or group also drove consistent dedication towards a shared activity. To support the building of shared experiences that motivate interacting over time, future social online platforms can explicitly encourage members to connect and collaboratively act on shared interests, by not only allowing people to find each other based on interest (3.5.3), but also suggesting activities to pairs of potential friends and providing the connection to a space for them to do those activities together.

Additionally, making the history of *meaningful* friendship activities easily visible to online friends can improve the sense of connection, presence, and motivation to sustain the friendship over time. Participants were reassured of their friendship’s existence by seeing some tangible evidence of their friendship activity, whether it was a growing village in Minecraft (3.4.2-1), exchanged gifts (3.4.3-3), or old scribbles on a virtual whiteboard (3.4.3-2). Online platforms should provide more affordances for friends to more easily record, view, and interact with their activity history together, as having a tangible accumulation of friendship over time can motivate online friends to continue their connection over the virtual space. Past work has made this possible for VR experiences [291], but our participants reported many forms of valued activity history,

ranging from collections of shared media (3.4.2-1) to the events in different rooms of a Discord server (3.4.3-2). Systems that allow retroactive asynchronous participation in usually-synchronous activities between friends, such as supporting friends to review and catch up with each other’s progress in a game, can address the limitations of synchronous activities for friends with misaligned schedules. More work is necessary to identify how to best implement the preservation and presentation of meaningful friendship activity in different platform contexts.

3.6 Limitations and Future Work

This study provided a rich description of online friendship development through lived experiences. But as an initial foray into understanding the online friendship process, our work still leaves many open questions to explore. Although my participants found immense value in their friendships, more comprehensive work is needed to determine the broader impact of online friendships on topics of public concern such as loneliness and mental health. Research moving forward should account for characteristics such as the different contexts of online and IRL friendships (3.5.2), developmental features of online friendship (e.g., turning points) (3.4.2), and distinguish the online space from the friendship (3.5.3) — to paint a more nuanced picture. All of the participants had close online friendships, which may reflect survivorship bias in the findings. Investigations that study the prevalence of online friendship across different contexts (including failed attempts), as well as its systematic relationship to online community and platform features, can provide a more complete picture of online friendship dynamics and better inform interventions to support them.

Despite my efforts to recruit online friends across a diverse range of platforms and activities (e.g., different videogames, online forums, and hobby-based platforms), most of my participants are located in the USA (72%). Given the culturally-contextualized nature of friendship development [309] and our observation of social norms’ influence on online friendships, increasing representation from non-Western cultures is important for more deeply understanding mechanisms of online friendship.

3.7 Conclusion

In this work, I performed an activity-grounded exploration to understand the distinct qualities of how online friendships develop and provide insight on how online platforms can better support this process. My findings reveal how online friends prioritize the use of communication technologies that can sustain long-term interaction over the appeal of rich and immersive affordances. I also extend theories about online socialization and technology-mediated relationship maintenance such as the weak tie hypothesis and media richness theory by showing how online community membership can have complex impacts on friendship development and how online friends create their own interpretations of technology use. The current work opens important lines of discourse towards reconsidering the social value of online friendship, nurturing strong ties in online communities, and supporting time-stable interaction as a key aspect of social connection.

Chapter 4

A Change of Scenery: Transformative Insights from Retrospective Embodied Perspective-Taking of Conflict With a Close Other

4.1 Introduction

The work presented in the previous chapter showed how the unique social world constructed by individuals who share close bonds can allow them to apply technological affordances in ways that may not be obvious at the first impression of an interactive system (e.g., turning the channels of a Discord server into the ‘rooms’ of a virtual housing co-op). It also highlights how the element of *‘temporal constancy’*, or the individual’s autonomous effort of sustaining the relationship connection, is an important characteristic of successful close relationships (see Chapter 3 & Related Work 2.1). After examining how these lessons can be applied to currently developing technologies, I carry out a vision for the potential of immersive VR technologies to support social reflection practices beneficial to close relationships.

Reflection in close relationships is an apt setting for exploring how technology could beneficially mediate the autonomy-connectedness dialectic. High autonomy is required for engaging in self-directed reflection, and for that high-autonomy activity to be directly tied to a personal relationship means that a strong link is instantiated between autonomy and connectedness (which are, in theory, at odds with each other). If the research goal is to further understand the role technology plays in mediating the development of close ties, this convoluted scenario is well worth exploring. The inevitability of conflict in strong ties which requires reflection to repair also makes it easy to obtain the grounds for engaging reflection in this context.

Conflict is a significant obstacle to the health and longevity of close relationships due to the level of mutual dependence that makes each party more sensitive to one another's personal differences [44]. However, surpassing these conflicts is necessary for people to develop the deeper and more shared understanding of one another (also known as *intersubjectivity* [55]) essential for maintaining close personal relationships. HCI research to-date has explored technologies for social conflict resolution in various contexts, ranging from team productivity [256, 150] to more personal or family contexts [162, 246, 254, 205]. However, the unique embodiment features of VR [127] which can bolster intersubjective reflective processes that strengthen relationships and make them less brittle to conflict [44] have not yet been explored in either the HCI or VR research domains.

Perspective-taking skills are central to conflict resolution in close relationships [155] by improving problem-solving ability and understanding of partners' mental-emotional states [241, 218]. Traditionally, the mental health domain has utilized video-mediated retrospection to motivate reflection in relationships [88, 300], but this method has not been very enthusiastically adapted (though still used) due to lack of evidence that it effectively stimulates perspective-taking or changes in conflict behavior between close others [89, 87, 88]. Meanwhile, VR research has explored the use of embodied perspective-taking to induce empathy and prosocial behavior towards specific vulnerable demographics [302, 141, 165, 1], which also means this approach has so far only been applied to strangers. The embodied perspective-taking process may look different when facilitated with close others, who have fundamentally different models of shared understanding [55]

and distinct social biases [221, 156, 90] that may affect baseline perceptions. These parallels between the role of perspective-taking in close-other conflict resolution and the rise of social applications in VR-embodied perspective-taking inspire the current work.

The work in this chapter aims to understand how embodied perspective-taking that truly represents one’s unique personal experience with a close other can impact reflection and communication during conflict between close others. To achieve this goal, I build and evaluate a novel hybrid of embodied perspective-taking and video-based recall, the *retrospective embodied perspective-taking* (REPT) system, which enables one to take the perspective of a close other during a real past conversation shared by both individuals. REPT is implemented by filming a 360° video from the user’s partner’s POV during the shared conversation and enabling the user to re-experience that conversation from their partner’s POV through immersive VR embodiment. I aim to evaluate how REPT affects conflict resolution in close relationships, compared to the media-based reflection method currently used in relationship therapy: video-mediated recall which displays evenly-split and synchronized views of both partners in the conversation [227]. My research questions focus on social reflection, communication behavior, and comparison between these two forms of reflective media:

RQ1: How does REPT impact users’ **reflections** on a conflict discussion with a close other and **perceptions of themselves and their partners** *in comparison to* the traditional form of video-mediated recall?

RQ2: How does **subsequent communication** around the same conflict issue change as a result of using REPT, *in comparison to* the traditional form of video-mediated recall?

I investigated these questions by conducting a between-subjects, mixed-methods controlled study with 26 romantic partner dyads, divided into two conditions: REPT and the traditional split-view video [227], which I will refer to as treatment-as-usual, or TAU. Study participants engaged in an initial conflict discussion which was recorded to generate the reflective media, then completed a second discussion after reflecting on the generated media (REPT or TAU) through a structured interview. The specific contributions of this work are as follows:

- Empirical evidence that the VR format of retrospective embodied perspective-taking (REPT) significantly improves specific communication skills and positive sentiment during personally-meaningful conflict between close others, over traditional video-mediated reflection.
- Empirical demonstration that the REPT method can result in correction of strong attributional biases towards close others. Our results also show evidence for cognitive empathy, which previously found to be unaffected by VR experiences [202].
- Implications and an agenda for new considerations of embodied experiences in HCI design: the use of ‘**embodied social cognition**’ to facilitate user-generated social understanding, and envisioning ‘**embodied experience as interaction context**’ in the design of future systems for social reflection.

4.2 Background & Related Work

4.2.1 Close Relationships and Conflict

Close relationships fulfill basic psychological needs through their high levels of interdependence and relatedness [44], but are difficult to sustain due to inherent personal differences which produce conflict [66, 44]. Close others uniquely develop and share an *intersubjective meaning context* that emerges from shared experiences, observation, and communication of each other’s thoughts and feelings. This enhanced interpretive framework helps maintain the sense of relatedness [55].

Bias and Perspective-Taking

However, this degree of closeness in close relationships produces various conflict-inducing biases. *Overimputation*, the overestimation of the overlap between others’ and one’s own knowledge, occurs disproportionately in close relationships and is strong enough to offset the benefits of intersubjective accuracy, exacerbating differences between partners [221, 156]. The *actor-observer attribution bias* and *egocentric bias* also cause close others to more likely to blame themselves and each other instead of considering other factors in the situation [276, 90, 91]. Additionally, the perceived significance of a close relationship increases the weight of risk imposed by personal conflict issues, such as

perceived incompatibilities [44, 155].

Perspective-taking, often defined as the ability to understand what another is thinking by putting oneself in their place, is a core component of reducing conflict by encouraging close others to acknowledge and confirm one another’s perspectives during an interaction [167, 155]. In light of strongly-biased perceptions, this ability to reappraise the situation is particularly important. Perspective-taking also correlates with other key skills for conflict resolution, such as problem-solving, de-escalation, repairing emotions, and physiological attunement [241, 218]. However, effective perspective-taking does not come easily; self-prompted perspective-taking in close others has shown backfiring effects by strengthening biases and reducing relationship satisfaction — people who try to imagine a close other’s perspective have been shown to overestimate the transparency of their own values and preferences to their partner [286].

Video-mediated Reflection in Therapy

Video-based retrospection on previous conflict discussions has been used in conjunction with therapy to improve conflict resolution and close relationship maintenance [87, 63, 300], after the discovery that watching video replay of past conversations was able to reduce the *actor-observer attribution bias* in strangers [271, 238]. Although this method continues to be used as a standard component of relationship therapy and research [227], studies investigating the effect of video-based reflection on relationship conflict have found no evidence of its effectiveness on close partners’ social evaluations and behavior [88, 89, 87]. Informed by work described in the following section, my proposed use of embodied perspective-taking aims to provide a more effective mechanism for close interpersonal conflict by integrating the links across parallel domains of research on perspective-taking.

4.2.2 Technology-driven Approaches to Conflict Resolution and Perspective-taking

Given the importance of perspective-taking in conflict resolution, I survey the technology approaches that intersect with this domain. HCI research has presented various tools for conflict management, and the VR field has studied embodied perspective-taking for

promoting empathy in a multitude of contexts. These areas have primarily advanced in parallel of one another, as yet without intersection.

Conflict Resolution Approaches in HCI

Work in the field of HCI has made a variety of conceptual and tangible contributions to address conflict management. Investigation of how conflict occurs in a variety of online ecosystems, such as Wikipedia and online multiplayer gaming platforms, has generated design recommendations for these venues to resolve conflict, and ways to adapt offline conflict-resolution training to online contexts [166, 24, 143]. Tools that directly assist with mediating interpersonal conflict, such as robot-mediated conflict, have also been explored. Robot interventions to repair negative behavior were able to increase awareness of harmful actions and reduce negative feelings in a team conflict [150], and robot facilitation of play and activity guidance improved constructive conflict resolution in preschool children [256]. Artificial alteration of one’s own voice feedback into a calmer tone during a relationship conflict was also able to reduce feelings of anxiety and improve in-the-moment emotional regulation during the conflict [57].

These approaches to promote conflict resolution address the issue in diverse ways, ranging from clarifying the nature of the conflict, to supporting the training of conflict skills, to providing mechanisms that intervene in-the-moment to mitigate side effects of conflict and guide it. The current work embodies a blend of these methods: my approach is characterized by the design of a mechanism for inter-conflict use, meant to stimulate fundamental reflection and facilitate development of skills for future engagements in relationship conflict (which is unavoidable).

Technologies for Reflective Perspective-Taking

Approaches in HCI for reflective perspective-taking have included Dyadic Mirror [162], a wearable enabling parents to review interactions from their child’s perspective and better understand their childrens’ feelings; and ReliveInVR [291], a VR system allowing users to co-watch previous shared recreational VR experiences together from the same perspective, leading to improved understanding and social satisfaction.

Embodied perspective-taking in VR specifically has been applied in numerous social contexts, constrained mainly to ethical motivations. After introduction of the *Proteus*

Effect theory, which posits that people will behaviorally conform to the virtual representation of themselves based on avatar features (e.g., height, attractiveness) [303], multiple studies have followed which demonstrate increases of self-other merging, empathy, and prosocial helping behavior in participants who experienced VR-embodied perspective-taking of individuals belonging to various vulnerable demographics, ranging from individuals with colorblindness [1], disaster evacuees [172], specific fictional characters [25, 193], the homeless [127], and victims of violence [141, 165, 219].

In synthesizing these multi-domain findings, I argue that the VR embodiment approach can be applied towards social perspective-taking in close relationships to instill meaningful changes in people’s evaluations and conflict communication skills. Research to-date has demonstrated both the context-dependent nature of conflict management and well-established potential for VR-embodied perspective-taking to instill fundamental changes in both self- and other-oriented reflection. However, it is not understood how mechanisms of VR embodiment and perspective-taking work in the unique social context of familiar others, nor how meta-conflict approaches (e.g., reflection on conflicting perspectives) serve as a potential solution to close other conflict. To build on these open areas, I contribute a feasible implementation of authentic close-other perspective-taking and an empirical evaluation to identify social properties that can change and benefit from reflection through embodiment of close others.

4.3 Methods

I conducted a between-subjects experiment consisting of two in-person sessions with participant pairs. The two conditions evaluated were VR-based *REPT*, and *TAU* (treatment as usual; traditional video replay of the conflict). The objective of this formative investigation is to evaluate how social reflection and conflict behavior are affected by embodied perspective-taking (requiring the use of immersive VR [302]) in comparison to the standard reflection format currently used in conflict resolution therapy, which is video with a split-view of both partners [227] (seen in Figure 4.2c). My choice to evaluate immersive embodiment in particular comes from strong evidence in its ability to facilitate perspective-taking and more fundamental changes in thinking about personal problems [225, 302].

Table 4.1: Demographic data of participating couples.

REPT					TAU				
ID	Age/Gender (Partner A)	Age/Gender (Partner B)	Orientation/ Duration (mos)	Conflict topic	ID	Age/Gender (Partner A)	Age/Gender (Partner B)	Orientation/ Duration (mos)	Conflict topic
V01	27 M	24 F	Heterosexual/24	Money management	T01	20 F	21 M	Heterosexual/34	Value conflict
V02	22 F	25 M	Heterosexual/32	Time management	T02	20 F	20 M	Heterosexual/18	Individual problem affecting relationship
V03	36 F	36 M	Heterosexual/156	Communication issues	T03	20 F	20 F	Same-sex/24	Communication issues
V04	19 F	22 M	Heterosexual/8	Jealousy	T04	27 M	26 F	Heterosexual/96	Money management
V05	21 M	20 F	Heterosexual/33	Social relationships	T05	20 NB	19 F	Non-binary/10	Sex
V06	20 F	20 F	Same-sex/7	Social relationships	T06	26 M	26 F	Heterosexual/72	Money management
V07	20 F	20 M	Heterosexual/5	Jealousy	T07	20 F	21 M	Heterosexual/10	Decision-making
V08	26 F	25 NB	Non-binary/49	Demonstration of affection	T08	20 M	18 F	Heterosexual/10	Time management
V09	21 M	21 F	Heterosexual/30	Time management	T09	20 M	19 F	Heterosexual/10	Family relationships
V10	29 M	24 F	Heterosexual/3	Sex	T10	31 F	30 M	Heterosexual/36	Potential children
V11	22 F	24 M	Heterosexual/3	Commitment	T11	21 F	21 M	Heterosexual/4	Time management
V12	20 F	20 F	Same-sex/42	Time management	T12	21 M	21 F	Heterosexual/36	Communication issues
V13	28 M	37 F	Heterosexual/54	Individual problem affecting relationship	T13	28 F	34 M	Heterosexual/24	Household management

In the first session, pairs of close others engaged in an in-person initial conflict discussion recorded for use in one of the two randomly-assigned conditions. In the second session, participants returned to re-experience the initial conflict discussion through one of the two conditions, engage a structured interview, and engage in a second conflict discussion.

4.3.1 Participants

I recruited 26 pairs of close others who (1) identified as in a committed romantic relationship and (2) specified a significant relationship-relevant conflict topic they were willing to discuss (Table 4.1). I recruited only participants who expressed sincere intent to discuss after acknowledging the gravity of the chosen conflict (see 4.3.4 for details). My recruitment methods included physical flyers with digital sign-up links distributed locally throughout a large city, and advertisement at a major university through cross-departmental mailing lists and research experience program. I recruited close others as couples due the level of involvement and commitment between partners in a romantic relationship being a confident indicator of a close relationship. Couples with diverse

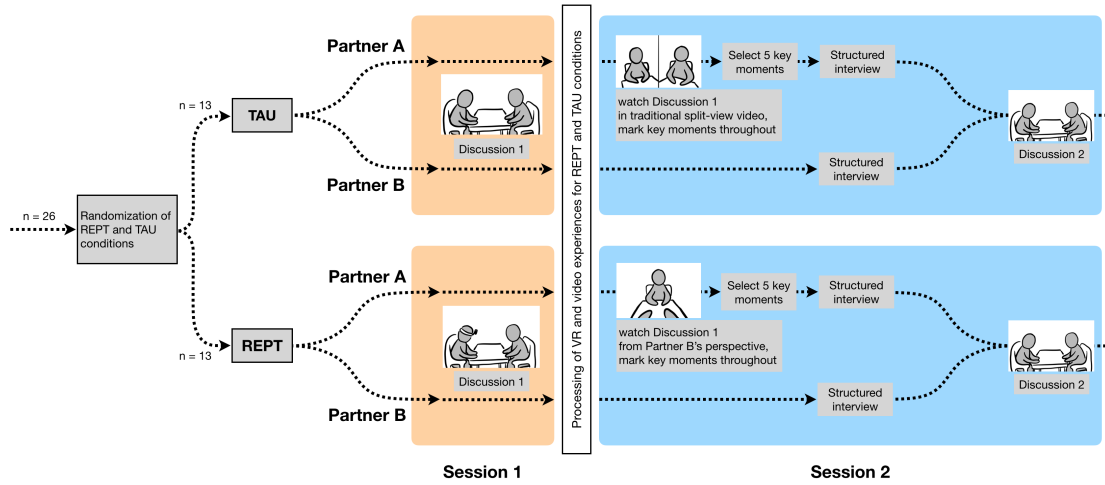


Figure 4.1: Flow diagram of study procedure including distribution of conditions, sessions, and task order between participants (both members of a couple). Discussions 1 and 2 occurred between both partners, while the other tasks were completed separately. See section 4.3.2 for details on Partner A and B.

gender orientations were included in this work due to the lack of inherent association between gender and close relationships [295], which is the dynamic of focus. My sample included 21 heterosexual couples, four same-sex couples, and one non-binary couple. Participants were between 18 and 36 years of age ($M = 23.44$, $SD = 4.81$); relationship duration ranged from 3 months to 13 years. 13 pairs participated in each condition; see Appendix 4.9.1 for details on sample size. ANCOVA tests performed to assess potential interactions from age, gender, and relationship duration on our results (section 4.5) found no significant effects. Participants were informed that the goal of the study was to understand how couples reflect on their communication through different types of technology. All participants were compensated \$40.00 for their participation across the two in-person sessions, which totaled approximately 2.5 hours (20-30 minutes for Session 1, ~1.5-2 hours for Session 2).

4.3.2 Procedure & Implementation

The study procedure spanned three phases: the first in-person session (Session 1) in which an initial conflict discussion was recorded, between-session processing of the retrospection media, and the second in-person session (Session 2) which includes the

retrospection/re-experiencing of the first conflict discussion, interview, and second conflict discussion.

Both of the conflict discussion procedures took the same format and were adapted from the Markman-Cox procedure [59], where after arriving in-person, couples were given ≤ 10 minutes to first privately confirm the topic of conflict they would like to discuss in the study. They were then instructed to discuss the topic with the goal of trying to understand and resolve the conflict, and left alone in the room for a 10-15 minute discussion which was video-recorded with fixed camera. In couples assigned to the REPT condition, the discussion was also recorded in 360° video from a head-mounted camera on one of the participants (see Figure 4.2a).

Session 1: Initial Conflict Discussion & Recording

In the first session of the study, both members of the couple arrived at the lab, read, and signed consent forms in a private room. They were then instructed to confirm the topic of conflict to discuss (which remains the same through both discussions in the study) and left alone in the room to allow for private discussion. When finished, participants wrote the discussion topic they selected together on a sheet of paper and opened the door of the room to indicate they were ready to move on.

The experimenter then explained the conflict discussion phase of the study to participants. They were to discuss their chosen conflict topic for 10 minutes, with the goal of relating the topic to their relationship and attempting to resolve it. Participants would be left alone for the conversation with a timer in the room to let them to know how much time had passed. They were informed that if at 10 minutes they were still in the middle of talking, they could take the time to wrap up the conversation and notify the experimenter once they were finished.

Fixed-camera recording was set up after the topic selection and before the conflict discussion. Participants sat across from each other, and discussion recordings captured full-frontal views of each partner (Figure 4.2c). In the REPT condition, one randomly-selected partner was fitted with a head-mounted GoPro Max 360 camera positioned and angled to the partner's eye-level, and the conversation was recorded in 360° video from that partner's perspective (Figure 4.2a). I will refer to this partner as *Partner B* to explain the rest of the procedure. Wearing the camera did not have any observable

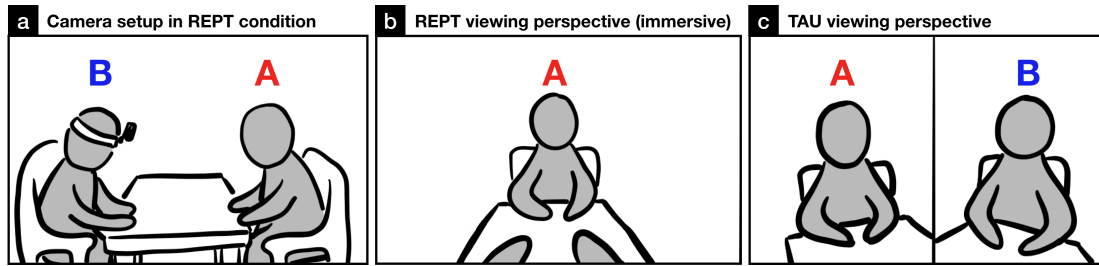


Figure 4.2: REPT (VR) and TAU (split-view video) recording setup and resulting views. (a) REPT condition recording setup with Partner B wearing the head-mounted camera. The TAU condition setup was exactly the same but without the head-mounted camera. (b) The REPT condition view extracted from the 360° recording, seen during Partner A’s perspective-taking of Partner B. (c) The TAU condition view, with both partners visible.

effect on the seriousness or depth of conversation between partners in our study. The other partner, *Partner A*, is the primary participant to re-experience the discussion in Session 2, via one of the two conditions (see Figure 4.1). Because this is the first exploration of REPT, **only one person** from each couple experienced the intervention to initially observe REPT’s direct effects on a single user. Had both partners experienced the intervention, the possibility of synergistic effects during partner interaction in the post-discussion would conflate direct effects of REPT on an individual user with secondary effects from a REPT-influenced partner and prevent direct evaluation.

Implementations of Study Conditions

Below, I will describe how the recordings of the Session 1 conflict discussion were processed for each condition. The resulting forms of media (VR or traditional video) were experienced by one of the partners in each couple during Session 2.

For the **REPT condition** which involves VR-based perspective-taking via 360° video, we extracted 360° footage and 6DoF ambisonic (spatial) audio from the GoPro Max 360 recording and processed them into a VR experience from the perspective of *Partner B* using the Unity game engine. The resolution of the 360° video was 5.6K (5376x2688) at 30fps to maintain visual realism when accommodating the expanded field of view in VR. The ambisonic spatial audio was integrated in the egocentric perspective of *Partner B*. We used a HTC Vive Pro headset for VR, which has a resolution of 2880x1600 and 120Hz refresh rate. Because the video was filmed from *Partner B*’s

perspective, the other partner (*Partner A*) would re-experience this discussion in Session 2 to enact perspective-taking of a close other (see Figure 4.2b).

The design of the REPT system accounts for mechanisms of ‘sense of embodiment’ identified in prior VR work [260], close others’ increased sensitivity to physical cues [269, 285] and reproducibility of application. The dynamic perspective of *Partner B* is superimposed onto *Partner A* to facilitate self-location and body ownership. The ensuing visuomotor illusions and use of readily-available 6DoF audio (human sounds) add multisensory correlations to enhance visceral embodiment [171], while *Partner A* retains agency to visually navigate *Partner B*’s perceived environment by moving their head. I chose to use 360° video over other options (e.g., volumetric video, virtual body, real-time motion capture) as the best option for a reproducible implementation of close-other perspective-taking. Close others have heightened sensitivity to nonverbal cues, constituting small changes in physical behavior [269], and neural-level sensitivity to familiar faces [285]. Currently-accessible volumetric video solutions do not retain enough visual fidelity to discern social microgestures, and face familiarity increases the uncanniness of virtual faces [69]. I prioritized preserving the perception of *Partner B*’s physical behavior, excluding real-time motion capture which cannot reconcile the virtual user’s actions with another body’s [219].

For the **TAU condition**, footage of each partner in the discussion was recorded with the fixed cameras at 1080p, synchronized, and edited to split the view vertically, showing both partners (see Figure 4.2c). In this condition, the designated re-experiencer (*Partner A*) would watch this video in Session 2 instead of the REPT VR experience.

Session 2: Retrospection, Interview, & Post-Intervention Discussion

Session 2 was completed between two days to one week after the first session to allow for the above implementation of the study conditions. After participants returned for Session 2, each member of the couple was led to a separate room. *Partner A* (defined in above sections) re-experienced the Session 1 discussion either in VR from the perspective of their partner (REPT), or in the TAU view showing both partner’s perspectives on a computer screen. To trigger reflection and measure relevant components of social evaluation (RQ1), I adapted Schulz and Waldinger’s video recall procedure [248] for *Partner A*’s rewatching of the discussion (See subsection 4.3.3 for details on the adaptation of

this measure).

Retrospection. Prior to watching the discussion, participants in both conditions were given a handheld button and instructions to click the button whenever they felt they were experiencing significant thoughts or feelings during the watching experience. The button would mark the time in the video at which it was clicked, but did not provide any sensory feedback to intrude on the participant's experience. After the participant (*Partner A*) re-experienced the entire discussion either through their partner's perspective (REPT) or via traditional video (TAU), they reviewed the moments they had marked during the viewing and selected the five they perceived to be the most significant and educational.

Structured Interview. The proceeding interview with both partners was structured around these five moments selected by *Partner A*. This was done in separate rooms for both *Partner A and B*, by different experimenters (see Figure 4.1 for conceptual model). The interview procedure builds on the widely used social interaction paradigm engineered by Ickes and colleagues [140], which asks participants to indicate what they believe their partners were thinking and feeling during moments of their own videotaped interaction. I adapt Schulz and Waldinger's procedure, which builds directly on Ickes' paradigm [248], for selecting the five significant moments and collecting participants' affect ratings.

The interview was iterative and the same following procedure was repeated for each of the five moments selected by *Partner A*. A 20 second video clip encompassing the 10 seconds preceding and following the selected moment was played for the participant, then they rated their own and their partner's emotional experience during that part of the discussion separately on a scale from -5 to +5 (negative to positive affect) [248]. Afterwards, participants were asked to describe those thoughts and feelings during that moment for their partner and themselves. This interview process was repeated for each of the five moments selected by *Partner A*.

Both *Partner A and B* in the couple experienced the above interview, but only *Partner A* was asked the following additional questions: (1) **why they selected the moment** while re-experiencing the discussion, (2) whether there were **changes in evaluations** of their own/partners' thoughts and feelings a result of re-experiencing the discussion, and (3) whether they had **new goals or strategies** for how to approach

future conversations with their partner.

Post-Intervention Discussion. After the interview, participants were reunited in the same room as Session 1, and engaged in a second conflict discussion on the same topic following the format of Discussion 1. They received compensation at the end of the study.

4.3.3 Measures

Participants responded to questions about their reflections of the conflict discussion and perceptions of themselves and their partners (**RQ1**). As conflict discussions occurred before and after the re-experiencing and reflection process, I also analyzed pre/post effects of the interventions on conflict behavior (**RQ2**). I included the following measures:

Qualitative User Reflections. To develop in-depth understandings of users' reflections on their interactions, themselves, and their partners (**RQ1**), I conducted structured interviews with both participants (see subsection 4.3.2) where each partner described in detail what they thought themselves and their partners were thinking and feeling during each of the five discussion moments that was played back to them. *Partner A's* portion included additional evaluations of the discussion and their relationship since they had selected the moments which were used in the interview. I performed thematic analysis on all 26 interviews with *Partner A* of each couple, starting from open codes which were integrated into themes representing the types of reflections participants from each condition revealed through their dialogue.

Empathic Accuracy Rating. I adapted Schulz and Waldinger's procedure for measuring empathic accuracy through quantitative affect ratings [248], which involves partners selecting high-affect moments during a conflict discussion, then both partners rating each other's emotional experience during each of those moments from -5 (very negative emotion) to +5 (very positive emotion) on an 11-point scale with discrete values and zero (neutral) in the center. This is used as a quantitative component of **RQ1**, in addition to the in-depth structured interviews.

My adaptation involved *Partner A* selecting five significant moments while re-experiencing the first conflict discussion, then both partners rating each other's emotional experience at each moment using the above scale. This is considered an affective dimension of *empathic accuracy* [248, 140], defined as how accurately one can infer another's feelings.

Table 4.2: Interactional Dimensions Coding System (IDCS) – Definitions for each dimension.

Dimension	Definition
Positive Affect	Positivity of facial expressions, body positioning, and emotional tone of voice
Negative Affect	Negativity of facial expressions, body positioning, and emotional tone of voice
Problem-solving Skills	Ability to define problem and attempt to work toward a mutually satisfactory solution
Denial	Active rejection of problem existence or personal responsibility
Dominance	Control exerted by individual over partner, such as forceful, monopolizing, or coercive behavior
Support/Validation	Positive listening and speaking skills that demonstrate support and understanding to partner
Conflict	Features of expressed struggle between partners, including tension, hostility, disagreement, antagonism
Withdrawal	Avoidance of interaction or of problem discussion, such as evasion, retreat, or unresponsiveness
Communication Skills	Ability to listen to partner and communicate thoughts and feelings constructively
Positive Escalation (<i>Dyadic</i>)	Chain reactions, snowballing, or triggering of positive behaviors between partners
Negative Escalation (<i>Dyadic</i>)	Chain reactions, snowballing, or triggering of negative behaviors between partners

Interactional Dimensions Coding System. I used the Interactional Dimensions Coding System (IDCS) [149] to analyze cross-condition effects of the interventions on communication behavior (**RQ2**) through observational ratings of pre/post conflict discussion footage. IDCS is a widely-used coding system to assess both affective (negative/positive emotion) and content-related (e.g., problem-solving skills, support, communication skills) dimensions of interactions between close others [157]. I used all nine *individual dimensions* and two *dyadic dimensions* (See Table 4.2) from IDCS to assess each partner’s verbal and nonverbal behaviors in both discussions. Individual dimensions are applied separately to each partner, while dyadic dimensions are measured for each pair. Each dimension was coded on a scale from 1 to 9 based on frequency and intensity of adherence to content criteria in the IDCS training manual, which contains

detailed descriptions and examples of each dimension. I and undergraduate collaborator Leo Cui coded the video data based on the manual, with highly satisfactory inter-rater reliabilities (Pearson's r) ranging from $r = 0.81 \sim 0.96$ across all dimensions.

4.3.4 Ethical Considerations

Due to the involvement of interpersonal conflict in this work, I made several considerations during the design of this study to minimize harm to participants (in addition to review and approval of the study by the University of Minnesota IRB). To ensure that participants were invested in addressing a significant topic of conflict and aware of the implications of discussing a conflict, I employed a pre-study screening questionnaire which detailed the conflict discussion required in the study and required individuals to list and describe in a few short sentences at least one conflict they were interested in addressing, as well as confirm their intent to have a genuine discussion. I did not recruit participants who were not able to provide these descriptions, and required both partners' consent to participation for successful recruitment.

During the conflict discussions, I arranged the physical environment to resemble a living space and designed the procedure so that participants were alone during discussion. This was intended to preserve participants' comfort and sense of privacy as much as possible during the conflict conversations, which often required vulnerability. The instructions for the conflict discussion reminded them that the objective was to understand each others' differences and attempt to address the conflict; I did not require or encourage negative expressions of conflict. Finally, I actively debriefed all participants, giving them the opportunity to process the experience.

My findings show deeper understandings between partners and changes in communication. I intend for this knowledge to support relationships where members benefit from sustainable engagement; applications of these findings should carefully consider how different relationship contexts may be impacted by such changes.

4.4 Interview Findings

My interviews uncovered how participants who re-experienced the conflict discussion (*Partner A*) reflected on the conversation and their perceptions of self and partner

(**RQ1**). I present how qualitative themes (See Fig. 4.3 for a visualization) manifested across participants of the two conditions in two sections. First, I identify how participants tended to ground their spoken reflections in either conversational content or personal experiences. I then describe an observed contrast: multiple participants only from the REPT condition described reversing previously-ingrained beliefs about their partner and themselves, compared to more incremental insights experienced by TAU participants.

4.4.1 Conversation-focused vs. Person-focused Reflection

I identified an theme of conversation-focused vs. person-focused reflection in how participants verbally framed their discussions. This took the form of two axes: participants tended to either speak of the conversation as a whole, or center on moment-to-moment changes throughout the conversation with their partner. They also tended to fall into the categories of providing either objective or subjective descriptions. These differences in framing additionally affected distinctions in the types of actionable solutions which they proposed for future conflict discussions.

Focus on meta-conversation vs. moment-to-moment changes

There were two ways in how participants scoped their references to the conversation. Some participants tended to mention conversation-wide trends while reflecting on the content of the discussion watched, while others tended to cite detailed moment-to-moment changes specific to isolated parts of the conversation. I include more detailed descriptions and examples below.

Participants who focused on conversation **meta-features** often mentioned trends in the form of behavioral or sentimental imbalances that they noticed between themselves and their partner, which directly influenced their goals for future conversations. Behavioral imbalances participants noticed included imbalance in power (T1)¹, ratio of talking vs. listening (T3, T6, T13), and level of self-disclosure (T5, V4, V6). T5 described his realization of an imbalance in the method of communication: *"I noticed that I'm asking her questions most of the time. And she's speaking most of the time.*

¹Identifiers of participants from the TAU condition will be prefixed with *T*, and *V* for the REPT condition.

And I'm not saying a lot without being prompted." C10 described a sentimental imbalance when she spoke of *"the very contrasting emotion [my partner and I] have on this issue,"* as her partner expressed eager interest in the issue while she was feeling tired of explaining herself to him. Other types of meta-conversational features included realization of positive communication dynamic between partners (T2, T7, T12) and recap of conversation content (T5, T8).

Participants who focused on **moment-to-moment changes** referenced more links between specific behaviors and the state of the conversation. I define a moment-to-moment change as the explicit recall of changes between specific moments of the conversation, in contrast to general trends across the whole conversation. For example, T2 noted *"This is the first time that I expressed worry in the video that I can recall. That was a new emotion and different kind of reaction for me to see."* Participants also noticed these changes by reflecting on instances of chain reactions between their own and their partner's behavior. V9 described a lack of change across moments of the conversation: *"I realized this was like the second question back to back that I asked, and I didn't let her ask anything. I felt kind of sad because it seemed like she had a lot of questions too."* V13 recalled how seeing those momentary changes helped him understand his partner's frustration: *"Being able to see from her perspective what transpired just before this moment, I could tell what I was reacting to... I can see the cause and reaction of [my partner's] frustration, and how it was tied to my lack of totally honest communication. It was helpful to see how I was expressing, and then link to how she was feeling."*

Overall, meta-conversation reflections resulted in straightforward goals for future conversation such as adjusting for amount of behavior (e.g., giving partner more space to talk, or self-disclosing more actively). The more subtle momentary differences were linked to more emotionally-detailed goals, such as attending to partners' in-the-moment feelings, as well as incremental mood changes to help maintain positivity and constructivity in the conversation. I also found a surprising contrast in numbered differences of participants who mentioned one or more of each reference type across conditions: all 13 TAU, and 3 REPT (VR) users explicitly mentioned meta-conversation trends during their reflection, while 2 TAU and 10 REPT users explicitly mentioned moment-to-moment changes.

Focus on external observations vs. personal experience

I also identified that some participants provided mostly objective, external observations while others provided subjective, personal descriptions during reflection. Objective descriptions included reflections supported by recall of factual, external events which happened during the conversation, or the content of partners' statements. Subjective descriptions included discussion of partners' feelings, thought processes, and perspective.

In reflections built upon **objective, external descriptions**, participants tended to make inferences directly based on observed behavior without much further interpretation. For example, T12 used the following to support his interpretation that his partner wasn't happy with his behavior: *"She said, 'I didn't feel like you were listening to what I was saying.' She said she had to repeat herself."* T3 made a similar statement when explaining an insight on her partner's behavior: *"She was just describing how she felt, about our scope of what is and isn't a big deal in terms of conflict."* T7 used body language to directly infer her partner's intention, describing her partner *"fidgeting a lot and not looking directly at me. So I can tell he wants to say what he wants but is trying to spare my feelings."* In these cases, conclusions were made directly from the observation without supporting them with interpretations of their partner's internal state.

In contrast to the above, reflections informed by descriptions focusing on **subjective personal experiences** involved deep discussion of partners' thoughts and feelings in context of the conversation moment. Juxtaposed with T7's above statement about her partner, V10 reflected on his observation of his partner fidgeting by talking about her emotional state: *"Because I noticed her fidgeting with her fingers, despite me perceiving how confident she was in asking these questions, I realized there is an underlying level of nervousness or insecurity, and fears."* I observed this focus on subjective experience taking place often in REPT participants due to seeing things from the partner's perspective. In a reflection where V8 said, *I can see why it would be hurtful towards her to not get up and hug her or ask her what's wrong,* she cited the reason as, *"I think that seeing [my partner's] perspective showed that it is a hurtful thing I've been doing."* V11 also described her partner's feelings and thoughts in succession when reflecting: *"Watching it back, I realized he really did make a choice to continue our relationship. Even though there were a lot of unknowns, he made the choice to stay in my life, even*

though it probably looks really scary.” When making reflective decisions, these individuals spoke in detail of their partners’ subjective experiences instead of focusing on what they did.

Between individuals who attended to external, objective content vs. subjective personal experiences, we saw that reflections based mainly on straightforward observations resulted in goals of controlling externalized behaviors. Conversation goals that stemmed from descriptions of subjective experience tended to be more sentiment-focused: these participants chose to embrace honest self-expression and more openness toward their partner. In numbering coded occurrences of our operationalized objective and subjective description in participants across conditions, I again found a surprising divergence: all 13 TAU and 0 REPT participants made reflections based on objectively-stated observations, while 2 TAU and all 13 REPT participants made reflections based on subjectively-stated observations.

4.4.2 Incremental vs. Transformative Insights

In this section, I detail various types of ‘*transformative insights*’ which were experienced exclusively by REPT users in our study. I define transformative insights as changes in opinion or attitude which participants described as completely reversing a strongly-held sentiment they previously had. These contrast with what I refer to as *incremental insights*, ones which participants described to augment, confirm, or remind of their pre-existing understandings.

Incremental insights occurred in the great majority of our TAU participants, who gained augmented understanding through video review of the discussion by reinforcing certain beliefs or reminding them of important conversation events they otherwise would have forgotten. Many of the participants found it important to note and remember significant points of **disagreement/agreement** (T2, T6-7, T11-13), the nature of the **conversation/conflict dynamic** with their partner (T2, T4-5, T7-10, T12, V4, V6) (see section 4.4.1), explanations of own/partner’s **viewpoints** (T3-4, T8, V4), and demonstrations of **partner attitude** (T1, T4, V2). These insights were cited as useful for maintaining awareness of dynamics to prevent or promote in future conversations.

Transformative insights reversed several users’ strongly-held opinions relating to their partners, which they validated with thorough explanations of their thought

process. Below, V3 discussed how taking her partner's perspective reversed her feelings about a long-term behavioral habit which had frustrated her throughout their decade-long marriage.

"I found a lot of value in watching his hands. My husband does a lot of repetitive hand movements when he's nervous, and it tends to frustrate me, and make me feel like he is uncomfortable with what I'm saying. **Watching him do it from his perspective, I felt uncomfortable vs. frustrated.** Seeing myself talk to him the way I did, **I can now understand why he would make those kinds of gestures** because even 'I' was nervous with how absolute and sure I was when speaking to him."

V3 explains how the embodied perspective-taking linked to re-evaluating her original perspective. Her reflection on how her partner experienced her own behavior tied into another belief change about herself:

"I think my biggest realization is that I thought my husband was the major reason that we had trouble communicating. And while he might not like conflict, I spend a lot of time saying what he's doing, versus what I'm doing. **I have taken this approach to this conversation so many times**, and hearing/watching myself from this point of view makes me think about how many times my partner has been on the receiving end of me pointing out things and for me, doing that **it felt like, *here we go again*, but not from my standpoint, from his standpoint — of like, here she goes again.**"

In contrast to her previous belief about her husband, V3 developed a self-perception that was the opposite. Her future conversation goals also included giving her partner more opportunities to express himself.

V1 presents another interesting transformative insight where the participant's opinion on the conflict issue is reversed. In the study, V1 and his wife discussed a financial conflict: he believed in separated finances and her in joint finances. After the REPT experience, he detailed a thought process in which his opinion changed to match his wife's:

"When I was watching the video in her seat, I thought yes, we could share money also, because we shared our household things, and I help her in things I am an expert in and she does the same. So as we are sharing everything, why not money? **As I sat in her place while she was telling me this, I thought: I am saying these things to myself. I considered these thoughts as if they were mine,** and in that particular point, she was right. Here I realized that there is a different way to think about this, and we can also share our money. "

After embodying her perspective, V1 reconsidered his wife's expressed viewpoints as if they were his own. He said later on, *"I thought she was arguing with me, but while watching this I saw that she was just giving an opinion that is similar to mine so I can think about that perspective."* The melding of perspectives led to this fundamental change in opinion.

Other forms of transformative insights included changes in self-perception triggered by perspective-taking. Some REPT participants experienced cognitive dissonance when watching themselves say something they realized they did not agree with completely. For example, V10 stated, *It was a moment where I realized oh, I don't actually want that. I said what I wanted, that's not something I want anymore. Hearing these words that I wouldn't say again made me even more certain of it."* Others changed an aspect of their self-image based on what they imagined their partner would believe about themselves: V11 originally believed that she was not committed to the relationship, *"[but] watching it all from his perspective, I almost wonder if that's not exactly true. I think that if I really didn't do enough for him, I don't think he would stand for that. I think he would probably have broken up with me."*

Many user accounts implied that the feeling of embodied perspective-taking heavily contributed to these transformative insights. This tied to feelings of close connection with one's partner, which participants stated were triggered by specific embodiment cues. V11 described her REPT experience in the following manner:

"This experience leads to so much self reflection. Looking down and realizing like, his hands are right there. There are some times where he turned his head. And I turned my head, while he was looking. And it's almost like

I’m controlling the movements, but I’m actually like him. I think it gave me a new sense of empathy, and **dive deeper by imagining how they feel and what they’re thinking, especially when you basically are them, or pretending to be them, and seeing what they see and hearing what they hear.** Having the person on the other side be someone who means so much to you made it feel more personal, and made me think a lot about his perspective.”

The above-mentioned contribution of **head movement** to the sense of perspective-taking and embodiment of their partner’s experience was cited by a great majority of the participants (V1, V4, V6-7, V10), and supported reflections exclusively in the REPT condition. V3 delivered another account of this connection:

”It’s like a mirror, to be able to see myself, but little things, like my husband’s head moving. And not necessarily knowing why his head moved, but just getting that sense of being in his view. **Being able to see the environment move** was impactful. Sometimes the environment would move when I was really continuing to talk. And that to me, showed that it had an impact on him.”

Theme	Axis	
4.1 Framing of reflection content	Conversation-focused Reflection focus on conversation content	Person-focused Reflection focus on personal interactions and experiences
4.1.1 Conversation features of focus	Meta-conversational contrasts 13 TAU behavioral / sentimental imbalances between partners 3 REPT	Moment-to-moment changes 2 TAU links and changes across specific moments of partner interaction 10 REPT
4.1.2 Nature of cited evidence (Phenomena vs. experience)	External observations 13 TAU inferences are based directly on observed behaviors 0 REPT	Accounts of personal experience 2 TAU reflections and judgments based on partner’s thoughts and feelings 13 REPT
4.2 Nature of reflection-based understanding	Incremental Insights 13 TAU reported augmented understanding via reflection reinforcing and reminding them of pre-existing beliefs 4 REPT	Transformative Insights 0 TAU reversed a pre-existing strong sentiment, such as an opinion on an issue or judgment about partner 5 REPT

Figure 4.3: Visual guide of each axial theme from *Partner A*’s interview. In each subsection of Section 4.4, we define criteria for the reflection property in each axial sub-theme and report the counts of participants across REPT and TAU conditions who exhibited each property during the interview; salient differences across conditions are grouped to left and right.

4.5 Quantitative Results

To address my research goals of understanding how the interventions affect both outcomes of participants’ social perceptions and communication behavior, I employed two forms of quantitative measures to enable triangulation of our qualitative findings (RQ1) and to fully address RQ2. To evaluate user reflection across *TAU* and *REPT conditions* (RQ1), I complemented our qualitative in-depth analyses of users’ subjective reflections on their interactions, selves, and partners (Sec. 4.4) with measurement of affective empathic accuracy [248] as a quantitative element of user reflection. My assessment of users’ subsequent communication behavior (RQ2) is fully reflected through use of the multi-dimensional IDCS measure of dyadic communication behavior to form comparisons across the two conditions.

4.5.1 Empathic Accuracy

I analyzed the empathic accuracy across conditions by calculating the sum of the five affect ratings by Partner A and B in both conditions, then conducting two-tailed t-tests on the differences. Results from the t-test on Partner A ($t(24) = 0.76$, $p = 0.46$) and Partner B ($t(24) = 0.068$, $p = 0.95$) did not indicate significant differences at $p \leq 0.05$.

Table 4.3: Empathic Accuracy (Mean/SD of Summed Diffs)

Condition	Partner	Empathic Accuracy (Sum)
REPT	PARTNER A	−4.0 (6.32)
TAU		−1.85 (8.09)
REPT	PARTNER B	−4.0 (4.16)
TAU		−3.85 (6.95)

4.5.2 Interactional Dimensions (IDCS)

Prior to assessing my main measures, I conducted two-tailed t-tests to compare the starting IDCS scores (from Discussion 1 in Session 1) across the two conditions in order to determine if the REPT technology setup impacted communication behavior. No significant differences were found for either partner in the above tests. I then proceeded to assess the main measures. For each dimension in IDCS (see Table 4.2), I conducted

two-tailed t-tests to perform a cross-condition comparison of the change in score for each of the 11 dimensions between the pre/post conflict discussions. Positive values indicate an increase in the dimension score between the first and second conflict discussion, while negative values indicate a decrease in the dimension score. Results from the t-tests indicated significant differences between conditions for both *dyadic dimensions* (at $p \leq 0.01$): **positive escalation** ($t(24) = -3.13$, $p = 0.005$, $d = 1.23$) and **negative escalation** ($t(24) = 3.93$, $p < 0.001$, $d = 1.54$). Calculation of Cohen's d found a medium effect size. Below are means of the dyadic measures across conditions; In the REPT condition, positive escalation significantly increased, while negative escalation significantly decreased (Table 4.4).

Table 4.4: IDCS Dyadic Dimensions - Mean/SD of Differences

IDCS Dyadic Dimension	REPT	TAU
Positive Escalation	2.69 (1.75)	0.15 (2.34)
Negative Escalation	-1.62 (1.56)	0.69 (1.44)

T-tests were conducted separately for *Partner A* (who experienced the retrospection intervention) and *Partner B* to measure changes across conditions in the nine *individual dimensions*. For *Partner A*, results from the t-tests indicated significant differences (at $p \leq 0.05$) for all except two dimensions: **conflict** ($t(24) = 3.145$, $p = 0.004$, $d = 1.23$), **denial** ($t(24) = 2.65$, $p = 0.014$, $d = 1.04$), **communication skills** ($t(24) = -3.22$, $p = 0.004$, $d = 1.26$), **support/validation** ($t(24) = -4.58$, $p < 0.001$, $d = 1.79$), **problem solving** ($t(24) = -3.06$, $p = 0.005$, $d = 1.20$), **negative affect** ($t(24) = 4.173$, $p < 0.001$, $d = 1.64$), and **positive affect** ($t(24) = -3.96$, $p < 0.001$, $d = 1.55$). Calculation of Cohen's d found a medium effect size across all of the above. From Figure 4.4, it is shown that conflict, denial, and negative affect significantly decreased, while communication skills, support/validation, problem solving, and positive affect increased in *Partner A* over the course of the study. Significant differences were not found for the dominance and withdrawal dimensions in *Partner A* scores. For *Partner B*, significant differences were found only for **negative affect** ($t(24) = 2.39$, $p = 0.025$, $d = 0.94$). The mean value for **positive affect** change in *Partner B* was considerably high (Figure 4.4), but the t-test results were short of significant: ($t(24) = -1.79$, $p =$

0.086, $d = 0.70$). Mean IDCS score changes are shown in Table 4.5.

Table 4.5: IDCS Individual Dimensions - Mean/SD of Difference Across Sessions

IDCS Individual Dimension	REPT	TAU	REPT	TAU
	PARTNER A		PARTNER B	
Conflict	-1.92 (1.98)	0.38 (1.76)	-1.31 (1.25)	-0.38 (2.29)
Dominance	-0.69 (1.93)	0.38 (1.61)	-0.54 (0.97)	-0.23 (1.09)
Withdrawal	-0.85 (2.23)	0.62 (2.47)	0.00 (1.00)	-0.08 (2.59)
Denial	-0.92 (1.55)	0.38 (0.87)	-0.08 (0.28)	-0.15 (0.55)
Communication Skills	1.38 (1.33)	-0.85 (2.12)	0.38 (1.19)	0.15 (1.21)
Support/Validation	1.92 (1.19)	-0.62 (1.61)	0.92 (1.11)	0.69 (1.11)
Problem Solving	1.77 (1.36)	-0.38 (2.14)	0.77 (1.74)	0.62 (2.43)
Negative Affect	-2.15 (1.63)	0.54 (1.66)	-1.92 (1.12)	0.00 (2.68)
Positive Affect	2.46 (1.61)	-0.08 (1.66)	1.77 (1.01)	0.54 (2.26)

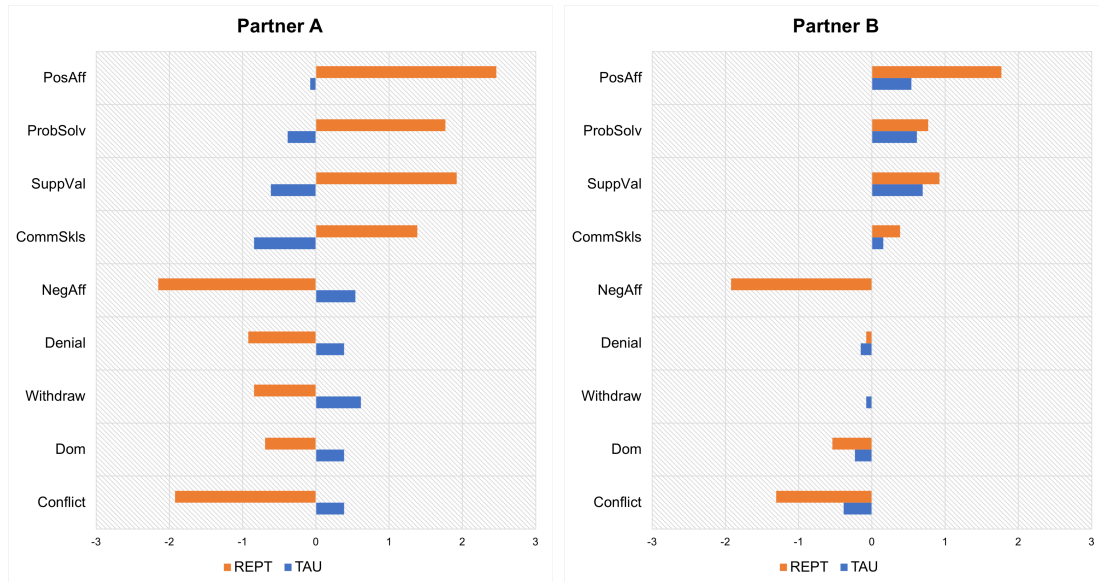


Figure 4.4: Mean change in IDCS individual dimension scores from Discussion 1 to Discussion 2, shown across REPT and TAU conditions separately for *Partner A* and *Partner B* (See Figure 4.1 for study procedure). X-axis specifies the change in score; Y-axis specifies IDCS individual dimensions in the following top-down order: Positive Affect, Problem Solving, Support/Validation, Communication Skills, Negative Affect, Denial, Withdrawal, Dominance, Conflict (See Table 4.2 for definitions).

My IDCS results answer **RQ2** by showing how multiple dimensions of subsequent conflict communication improved significantly in REPT over TAU. In *Partner A*, I saw

an increase in positive qualities such as communication skills, support and validation, and problem solving, accompanied by decrease in negative dimensions of conflict and denial (Figure 4.4). Both *Partner A* and *Partner B* in REPT reflected higher positive affect and lower negative affect in relation to TAU, which also corresponded to the changes in dyadic positive and negative escalation. Based on this pattern of difference across partners in the REPT condition, it is possible that the changes in *Partner B*'s affect related to positive changes seen in *Partner A*'s communication behavior.

4.6 Discussion

The following sections will cover three areas: I summarize the principal findings of how my RQs were addressed, discuss how my findings on REPT extend the literature and present new ways to bridge contrasting human perspectives, then propose two design implications that form an agenda for how representations of felt experience can be integrated into technologies for social reflection: *embodied social cognition* and *embodied experience as interaction context*.

4.6.1 Principal Findings

The current work presents a novel *meta-conflict* approach to extend the scope of conflict resolution technology (see 4.2.2) by using VR other-embodiment to facilitate reflection on conflicting perspective. In response to **RQ1** which asked how REPT (vs. TAU) impacted users' reflections on the discussion and perceptions of themselves and their partner, I showed (Sec. 4.4) that users who embodied their partners in REPT reflected more on momentary, subjective experiences; developing changes in perception of the conflict issue itself and of their relationship with their partner (e.g., communication style). TAU users reflected more on bigger-picture discussion dynamic and did not report changed perceptions. **RQ2**'s inquiry of how REPT (vs. TAU) affects conflict communication is answered through my pre/post change analysis of IDCS (Figure 4.4) showing that REPT results in significantly higher improvements on interactional dimensions such as communication skills, problem solving, support and validation, positive affect, and significantly higher decreases in negative affect, conflict, and denial.

4.6.2 Across Methods: Resolution of Divergent Perspectives Through Embodied Understanding

Intersubjectivity (sharing understanding) is a theme that runs throughout this work. Combined insights from the qualitative interview findings and quantitative communication measures demonstrate that *Partner A* in the REPT condition, who experienced embodied perspective-taking of their partner, was able to develop major insights (Sec. 4.4.2) about themselves and their partner and experience significant improvements in conflict interaction (Sec. 4.5.2).

Retrospective embodied perspective-taking (REPT) enabled close others to immerse in their partner’s lived experiences and explore competing personal perspectives. In-the-moment details (Sec. 4.4.1) reflected realizations about interactions, which led to more candid self-expression and appreciation for shared experience with their partners. Transformative insights (Sec. 4.4.2) illustrated major re-evaluation of existing perspectives, which is particularly significant in light of the work on various social biases in close others [156, 221, 276], and the failure of traditional media reflection methods (TAU) to mitigate these biases [87]. **In a sense, the REPT method can be a facilitator of intersubjectivity by enabling perspectives of both the self and other to be embodied in tandem.** My interview findings showed individuals re-evaluating their partner’s competing opinion on an issue as if it was their own, to individuals reassessing their own self-image after seeing themselves through their partner’s eyes.

My IDCS measures demonstrated evidence of REPT as a reflection intervention which improved communication between close others, supplementing TAU [88, 89, 87] with an alternative approach. My findings also contribute formative evidence of a link between virtual embodiment and *content-grounded cognitive empathy*, which is a previously-unobserved effect in the field of VR-embodied cognition. A 2021 meta-analysis [202] shows limited research linking VR embodiment to cognitive empathy, which requires more effort and is harder to stimulate than emotional empathy, but provides the crucial pathway to meaningful changes in social behavior [145, 105, 103]. Though lacking measureability, my interview content appears to contain examples of cognitive empathy (content detailing specific other’s thoughts and experiences) evoked by embodied perspective-taking, at a level which was strong enough to stimulate transformative insights in users. Such formative evidence suggests that embodied experiences

could be applied to stimulate cognitive empathy as a pathway for promoting meaningful and intent-driven prosocial behavior amidst contrasting perspectives, which is relevant in many social contexts (e.g., cross-cultural collaboration [29], diversity and inclusion [86], public policy [114]). Further exploration can lead to more nuanced insights on designing embodied experiences that can induce cognitive empathy and perspective-resolution in different contexts.

4.6.3 Embodied Social Cognition: Integrating Felt Experience With Creative Reasoning

Embodied social cognition is also linked to my findings through the virtually-embodied experience and the mental processes of perceiving and engaging with another person. Originating from the cognitive science domain [101], it shares roots with the HCI principles of *embodied cognition* [164] and *embodied interaction* [72] that advocate against disembodiment of rationality. In the same spirit, we propose that embodied social cognition can be extended from these principles as a new approach towards designing socially reflective technology which prioritizes embodied social rationality. Embodying human experiences can help people creatively *generate* useful social understandings, which is important given the distinctness of social context; it is different from more tangible or objective contexts in that there is no true way to ‘accurately’ access the inner state of a person. **My findings here are an example of how the embodiment process can support *creative social cognition* and *self-generated* understanding by stimulating original thoughts about the self and other which are independent of any information ‘directly’ presented to the user.**

So far, existing HCI and social informatics work on interpersonal social cognition (perceiving and understanding the thoughts and experiences of specific people) has mostly emphasized *information-centered approaches*, focusing on how external representations of social information can be best observed and understood (e.g., narratives, biodata, explicit social cues, communication media) [56, 116, 192, 27, 209]. In contrast, embodied social cognition emphasizes how an *experience-centered approach* instead of observed knowledge can contribute to effective, in-depth sensemaking and reasoning about other people. The role of mirror neurons in embodied social simulation (exposure to perceptual stimuli triggering brain activations for corresponding social actions)

provides a unique psycho-physical link between these experiences and their ability to stimulate vivid thoughts about other people specifically [264, 102]. This shows that experiential channels, and not just information-centered ones, are powerful enough to support the creation of cognitive social understanding and not just basic emotional experiences such as affective empathy [127, 202].

Technology-embodied experiences can then be applicable to use cases more complex than previously imagined (singular empathy-inducing sessions), such as integrating a reflective step into a pipeline of social decision-making, or support for learning context-specific social behaviors. Virtually-embodied social cognition also has potential to reconcile a known duality between information-rich and information-poor approaches for social understanding. Historically, observing social cues (information-rich) is known to conflict with the ability to reason about another’s subjective experience, but raw attempts to take someone’s perspective (information-poor) projects biases instead of improving understanding [286]. Embodied social cognition could resolve this by turning the originally information-poor perspective-taking process into an immersive, experience-rich process which replaces originally-observed cues by ones which can be felt and experienced, providing the scaffolding necessary to creatively generate social understanding. Experience is as good as knowledge: future work can integrate more felt- or embodied- elements (e.g., VR immersion, or biosignals [191, 57]) into social reflection tools, which could better facilitate self-constructed understanding of a social perspective or experience instead of attempting to digestibly present an array of information for the user to observe.

4.6.4 Advancing Social Reflection: Embodied Experience as an Interaction Context

Across the TAU and REPT conditions I observed a contrast in attention to more high-level vs. experience-specific qualities of the social interaction. This shows that the medium of interaction “context” (in the current study, desktop video or immersive VR) can frame the social context of how the user thinks and reflects upon their experience. In the VR embodiment implementation, I also showed that users were able to manually mark important parts of the interaction while virtually embodying their partner (subsection 4.3.2) without breaking the level of immersion required to generate notable social

insights (subsection 4.4.2). These manually-selected moments are heavily linked to the reflections reported in my findings, which were largely elaborated explanations of those selected moments. Given that such “meta-experiential” interactions can be integrated into VR perspective-taking, **social virtual embodiment can be regarded not just as a unitary experience (its current state of application) but also an *interaction context*: an environment upon which we can build more advanced user engagement in social reflection.**

The potential to interface in more socially-complex ways with virtually-embodied perspective-taking can allow people to engage in more meaningful forms of analysis or decision-making while they are still in the valuable altered frame of mind facilitated by immersive social embodiment. In current approaches in VR perspective-taking for empathy, users are completely inundated during the embodied experience and only have space to digest post-experience, at which point their mental context may already be different. Being able to analyze a social interaction while still in the embodied state may be useful in more nuanced social scenarios that necessitate understanding the dynamics of interactions between multiple human perspectives/experiences, or making sense of different elements in the conversation or issue at hand (e.g., embodying the experience of having a group meeting or a social activity with multiple layers like a presentation interspersed with audience feedback). Some potential “meta-experiential” interactions that could be built on top of the social virtual embodiment experience include switching between socially-embodied perspectives, enabling passive annotation by the user, pause-and-play, or support reviewing specific segments of an embodied interaction at one’s own pace.

Natural transitions that are consistent with people’s semantic and sensory understanding of their conscious experience are also important for addressing the challenge of balancing potentially-disruptive interactions with the immersive social embodiment. Research on such VR interaction techniques has demonstrated the importance of scene transitions and metaphors (e.g., doors, portals) for maintaining users’ experience, awareness, and sense of place [233, 136, 290]; natural transitions can stay consistent with conscious experience by simulating corresponding bodily states such as dreaming (e.g., prompting the user to close their eyes and awaken in another “state of consciousness,”).

Exploring ways to build upon embodied experience as an interaction context can be particularly valuable when multiple people have fundamentally disparate understandings that are rooted in lived experience (e.g. cultural differences, social roles), potentially necessitating analysis of various perspectives and elements of the issue.

4.7 Limitations and Future Work

The need to do exploratory work for a new area means that this mixed-methods study provided more formative insights such as more basic impacts of REPT on users instead of targeted statistical evidence. Future work building on the potential applications and directions for studying this technology can employ more precise inquiry methods to confirm specific hypotheses that arise from this work. For example, the affective empathic accuracy measure we used (subsection 4.5.1) could not provide insights on the accuracy of participants' perceptions. However, past work has shown that 'underestimating' a close other's thoughts (being more conservative when making inferences about a close other's thoughts) actually improves constructive communication [286]; future investigation may want to clarify the nuanced role of reflection accuracy in mediating the behavioral impacts of REPT. Though the power analysis (4.9.1) showed low likelihood of any empathic accuracy effect, I provide future sample sizes to detect or replicate other effects from this study. A sample of $N = 16$ is well-powered to replicate the main IDCS effects, and $N = 44$ may detect medium effects for the two IDCS dimensions where I did not find significance (dominance and withdrawal). The transformative insights in this work were also one of the most interesting findings - future work may want to identify what individual or experiential factors lead to this phenomenon, or characterize a fuller scope of what attributes constitute a transformative insight. Longitudinal investigations and ecologically-valid settings (e.g., a therapy context) may also be important to determine the longer-term and in-the-field impacts of REPT.

These formative findings provide limited nuance regarding personalization and key perceptual mechanisms of the REPT system, necessitating more targeted lines of investigation. I explored a socially-complex and highly subjective phenomenon: perception and communication between intimate others who have conflicting perspectives. Individual variability in factors such as personality, attachment, communication style, and conflict

context can have complex impacts on interaction between highly-interdependent people. Although this initial work did not find any significant impact from the individual traits we measured, refining REPT’s intended effects for a broader audience requires more targeted and nuanced assessment of how individual differences affect user responses. This work also prioritized applicability, and I created REPT to be a consumer-accessible and reproducible system. However, more detailed exploration of perceptual affordances such as those across the conditions (e.g., immersivity, user agency, perspective breadth) may provide insights on how couples’ responses relate to specific aspects of this technology and inform more effective integration into future systems. These response effects may be motivated by distinct sociocognitive theories (embodied cognition vs. facial attention) and can be explored across multiple lines of work.

I also consider potential lines of future research which stem from our design discussions and the novel contexts explored in our work. Embodied social cognition through technology can explore flexible multisensory methods (e.g., combinations or subsets of haptic [148], sonic [296], olfactory [235], and visual [151] technologies) if future research sheds more light on how specific perceptual cues from virtual embodiment relate to social cognition [159, 119, 41]. There were hints of this from REPT participants referring to specifically head and hand movements as triggering cues in the findings. Considering embodied experience as an interaction context can also lead to development of consciousness-oriented transition methods for VR (to complement the current spatially-oriented ones) as well as novel interaction methods which build on embodied perspective-taking. To expand VR work on “*intimate social contexts*,” investigating how patterns of responsivity to VR embodiment might vary across different levels of ***relational proximity*** (self/close others/strangers) can contribute a new dimension of theoretical knowledge to embodied cognition in VR. Building on my demonstration that *meta-conflict* reflection still has positive impacts on actual behavior during conflict, future HCI conflict resolution approaches can move beyond embedding interventions inside conflicts (4.2.2) and also consider the overarching effects of applying interventions (e.g., raising awareness of user actions) in-between conflicts.

4.8 Conclusion

Close relationships are important sources of social support, but prone to high-risk conflict. Integrating converging evidence from the domains of HCI, virtual reality, and counseling which demonstrate the potential of virtual embodiment to facilitate constructive perspective-taking in close others, I developed a VR-based retrospective embodied perspective-taking system (REPT) and conducted a mixed-methods evaluation comparing its ability to improve communication during conflict against the current form of traditional video-based reflection. My findings demonstrated how REPT resulted in more reflection on lived experiences, fundamental changes in outlook, and improved communication skills during conflict. Evidence from my results extend past work by demonstrating REPT to correct strong attributional biases in close others, as well as promote cognitive empathy which was previously found to be unaffected by VR experiences. I also contribute approaches to HCI design. I show through results of the REPT experience that technology-*embodied social cognition* is a viable process to generate meaningful understandings of other people, which is nontrivial due to the intangible nature of others' mental states. The unintrusive interactivity of the REPT experience also demonstrated the potential to view *embodied experience as an interaction context*, which can lead to developments of novel interaction techniques that build upon embodiment as a social reflection medium. I hope that these insights can benefit the ability of future systems to facilitate richer social interactions.

4.9 Supplementary Analyses

4.9.1 Power Analysis

The sample size selection in the current study reflects standard practices in HCI [40]; a priori power analysis was not performed prior to conducting the study due to lack of similar work (VR embodiment effects on specifically empathic accuracy and dimensional conflict behavior) that would allow me to approximate expected effect sizes [273]. Now guided by the effect sizes found in this initial study, I can present a power analysis to inform sample sizes (Table 4.6) for future work and replication of the current study [273]. I also include a sensitivity power analysis (Figure 4.5) using the current sample

size to contextualize the effect sizes and power of the current findings. I do not present a post-hoc power analysis due to its conceptually flawed nature: [76, 301, 311].

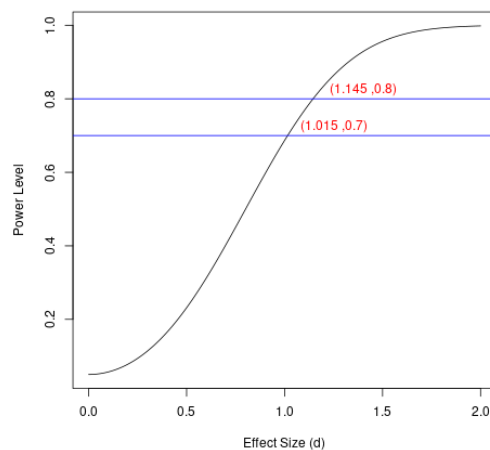


Figure 4.5: Sensitivity power analysis with my sample size $N = 13$ and significance level $\alpha = 0.05$. With desired power of 0.8, the predicted effect size under these assumptions is $d = 1.145$. With power 0.7 the predicted effect size is $d = 1.015$.

The effect sizes found for my significant results on *Partner A* (the main user of interest) were quite large (> 1.0) (Table 4.6) and approximated the effect size calculated from the sensitivity analysis at power 0.8 (Figure 4.5), showing that the effects I found were quite robust and the current study was relatively well-powered to detect these effects. However, I provide additional power analyses (Table 4.6) to help inform sample sizes with sufficient power to either replicate the large effects found in the significant results or potentially detect other effects which I did not find significant in the current work. I follow with recommendations consulting the power analysis in Table 4.6:

Considering that *Partner A* was the main user of interest in this study (as the recipient of the intervention), future studies that wish to replicate the effects we reported for the main user can achieve power 0.8 with a sample size of $N = 16$. Additionally, for *Partner A* I did not observe significant effects for two of the IDCS dimensions: dominance and withdrawal. These still have an at-least medium effect size (> 0.6) compared to the other dimensions, indicating that a higher-powered study with sample size $N = 44$ could potentially detect significant effects for these two dimensions. Regarding *Partner*

IDCS Individual Dimension	Partner A		Partner B	
	ES (d)	n	ES (d)	n
Conflict	1.23*	12	0.500	63
Dominance	0.61	44	0.298	178
Withdrawal	0.62	42	0.0391	10273
Denial	1.04*	16	0.175	512
Communication	1.26*	11	0.192	428
Support/Validation	1.79*	7	0.207	366
Problem Solving	1.20*	12	0.0727	2969
Negative Affect	1.63*	7	0.938*	19
Positive Affect	1.55*	8	0.703	33

IDCS Dyadic Dimension	Effect size (d)	Sample Size (n)
Positive Escalation	1.29*	12
Negative Escalation	1.54*	8

Empathic Accuracy	Effect size (d)	Sample Size (n)
Partner A	0.296	180
Partner B	0.0262	22887

Table 4.6: Power Analysis - IDCS Dimension & Empathic Accuracy. Displayed for each measure are recommended sample sizes to achieve power of 0.8 and reach the effect sizes found in this study, assuming significance level $\alpha = 0.05$. Effect sizes where I found significance in the t-tests are marked with an asterisk*

B , the current study came close to a significant effect for positive affect ($p = 0.086$) with medium-large effect size ($d = 0.7$), meaning that a study powered with sample size of $N = 33$ or greater may be better-equipped to investigate the secondary effects of REPT on a partner.

Many of the effect sizes for empathic accuracy and *Partner B*'s IDCS measures are quite small, requiring over a hundred participants to reach 80% possibility of detecting a very small effect. This indicates low likelihood of detecting these effects with the current study design and I do not make sample size recommendations for these variables.

Chapter 5

“I Want It to Sound Like *Me*”: Understanding Teenagers’ Views of Generative AI-Mediated Communication in Friendship

5.1 Introduction

The initial work in Chapter 3 also provided insight into how specific technologies can have functional impacts on human relationships. For example, we saw how intentionally-designed interface dynamics that support group socialization in online communities (e.g., communal discussion threads and chats) can unintentionally work against individual users’ efforts to cultivate bonds with each other (3.4.2). If we are thinking of technologies which have unintentional but consequential impacts on human connection, generative AI (GAI) is a particularly relevant one that comes to mind, given its broadening influence on human society and fundamental relationship with human autonomy (and henceforth, social connection [2.1]).

Since becoming widely accessible, GAI chatbots have primarily been used as a way to delegate tasks that users do not wish to exert mental effort on. Allowing GAI to

do things on one's behalf does free up resources for people to engage in other activities, but it also takes away the kinds of opportunities that allow users to exercise self-determination and autonomy. This leads to a concern about potential imbalance in autonomy-connectedness and its impact on human connection as people are becoming increasingly reliant on GAI in personal contexts. Reported contexts of use include emotional support and advice [306, 228, 293], intimate companionship [104, 32, 312, 190], as well as AI-mediated communication (AIMC) [120, 99], where AI may modify, augment, or generate communication sent between people. Although AIMC can be an effective bridge or buffer for communication [129, 305], it also has the potential to degrade social connection [305, 99]. Recent reports document a rise in divorces originating from spouses' weaponization of AIMC to attack partners [75], demonstrating how the sycophantic nature of GAI chatbots [52] can discourage individuals from making prosocial effort to problem-solve collaboratively, prompting them to rely on illusions of comfort and misjudge during times of stress [61, 265]. The anthropomorphic 'roleplaying' of human-GAI chatbot interactions can deepen users' affective attachment and their perception of a parasocial relationship, leading to overtrust and errors in judgment [197]. Users who initially use GAI for the purpose of mediating communication with a human partner may gradually come to view the AI as an extension of their identity [43] as they become more reliant on AI-generated social and emotional support. This pattern risks diminishing human-human relationships without more careful oversight over GAI development [314], and profusely demonstrates the risk presented by GAI to human self-determination and autonomy.

AIMC in teens' personal relationships is an important topic of interest, given that peer friendships play a significant role for youths' development of social norms and relationship models that impact social connection in adulthood [4]. Teenagers learn how to build trust through these friendships, which fundamentally influences their development of social functioning [92, 237, 210]. Peer friendships also serve as training grounds for developing the social problem-solving and communication skills required to sustain meaningful close relationships later in life [147, 4]. However, emerging research reveals that teens are now using GAI chatbots to learn the social boundaries and skills for interacting with their peers, even developing virtual relationships with GAI that replace close relationships otherwise formed with those peers [308]. Teens are also more

vulnerable to social dependence on GAI chatbots due to the emergence of rejection sensitivity in late adolescence [201], with GAI serving as an easily-accessible source of illusory empathy [61].

Teenagers who rely on GAI chatbots for social functioning have reported feeling a lack of control over their dependency [308, 214], warranting a closer look at teenagers' perceptions and approaches toward the use of AIMC in their friendships with human peers. This is essential to guide GAI development that supports the wellbeing and social development of future generations. Despite the rise in research on teens' social uses of GAI, we still know very little about how they actually interact with GAI chatbots in these social contexts. To work towards actionable insights for AI policy and development in this area, we ask the following research question:

RQ: How might teenagers *understand and perceive* the use of generative AI chatbots for navigating challenging interactions in peer friendship?

To answer this question, we conducted a qualitative study with 47 teenagers aged 13-19 to probe their understanding and perceptions of GAI chatbot use in a situated close friendship context. The use of AIMC in a personal context is still an emerging application of GAI, and the context we are exploring (close friendship) requires dedicated reflection from participants for meaningful commentary. We designed a *speculative enactment* [79, 299] activity to immerse teenagers in this social scenario and elicit deeper, more situated perspectives on this topic. In this activity, we guided teenagers to imagine a plausible social conflict with a *real* close friend, which they had to simulate how they would have addressed it by trying to write a message to that friend. During the message writing, teenagers could choose how (or whether) to enlist the help of a GAI chatbot that was available. Afterwards, we conducted interviews with the teenagers to understand their views of AIMC in this significant relationship context, and how those views were grounded in their experiences during the activity.

Through thematic analysis of our interview data, we uncovered how teenagers' views of AIMC in a close friendship context were mediated by broader beliefs about social relationships and AI, their individual perceptions of friendship, and distinctions they made between the intrinsic nature of AI and effort as a human experience. This work contributes to the growing discourse on social impacts of GAI on adolescents by: **(1)**

providing detailed empirical insights from teenagers’ situated use of GAI chatbots to navigate friendship communication, **(2)** discussing specific concerns about AIMC related to teens’ social development, and **(3)** presenting actionable design recommendations to support both reflective social learning and teenagers’ agency in navigating their friendships.

5.2 Related Work

5.2.1 AI-Mediated Communication in Personal Relationships

AI-mediated communication (AIMC) is a form of technology-mediated communication that takes the form of an AI agent modifying, augmenting, or generating messages on behalf of a human user [120, 43, 110, 98]. For example, an AI chatbot can edit or add to a message written by a user to make it sound a certain way, or it can also completely generate messages based on instructions from the user. Recent developments in generative AI technology have increased the lexical sophistication of large language models [23], widening the use of AIMC to increasingly-sensitive social contexts, such as mediating apologies [109], dispute resolution [118, 134], depolarizing discourse [111], and navigation of personal relationship problems [130, 99]. Although individuals cite the utility of AI assistance in particularly difficult-to-navigate personal situations, they also express fear about the potential for AI reliance to jeopardize sense of authenticity in human relationships [99]. Recent surveys and evaluations of AIMC systems continue to highlight how the anthropomorphic nature of current GAI-powered AIMC systems are starting to blur the boundaries between human-AI and human-human relationships, creating conditions that risk impacting the foundations of human connection [43, 305]. Recent reports document a rise in the role of AIMC facilitated by GAI chatbots in decline of relationships [5, 310] and decades-long marriages [75]: evidence from divorce proceedings showed how spouses experiencing relationship challenges who turned to GAI chatbots for advice fell into a loop of sycophantic affirmation that antagonized their partner, demotivating users’ desire to communicate and problem-solve with their actual partner [52]. The risks and broad access of G-AIMC as applied to personal relationships justify a closer look into how this may impact the relationships and social development of teenagers.

5.2.2 Adolescent Friendship and Psychosocial Development

Friendship formation during the teenage years is an important process with lifelong implications. Longitudinal studies following children from age 13 to 24 in adulthood show that the quality of adolescent close friendship significantly predicted adult relationship outcomes, work performance, and depression even more than parent-teen relationship quality [4, 245, 77, 122]. The successful development of extrafamilial relationships during adolescence is important for cultivating self-regulation skills and social self-efficacy [4]. The process of developing trust in these friendships also significantly contributes to their impacts on the development of social functioning. Trust-building through experience is a complex process that adolescents must navigate while forming friendships, due to the inherent risks and uncertainties involved when deciding to trust and be emotionally close to someone [92, 147]. The ability to sustain trust is also a key mediator of friendship success — because they must navigate complex public and private social structures among their peer groups (e.g., issues of popularity and acceptance) [201, 60], teens are often most concerned with the preservation or violation of trust in their friendships [237]. However, conflicts are unavoidable in meaningful close relationships [44] and must be managed to retain trust in the relationship [210, 239]. Supportive, constructive behavior and communication are not only important skills for successfully teen maintaining friendship, but also a central component of identity work for defining the self [147, 11, 54].

5.2.3 Teenagers’ Social Uses of Generative AI

The majority of existing studies on personal relationship impacts of GAI chatbots have been on adult populations [23, 99], but recent work has begun to explore adolescents’ uses and perceptions of GAI chatbots. Yu et. al 2024 [308], through analyzing discussions on Reddit and conducting interviews with teens and parents, revealed that current teens socially apply GAI chatbots in a variety of ways, such as learning social boundaries and skills about how to interact with peers and embedding chatbots into message groups with friends to enhance engagement. Teenagers also reported a rise in the popularity of virtual relationships with GAI agents, sharing anecdotes about how resources such as AI dating clubs and dedicated online servers for this activity have even become

a notable presence at school. They discussed leaning into the comfort of living out social fantasies through conversations with GAI chatbots when they felt lonely instead of reaching out to human peers who could potentially reject them [201, 51]. Teenagers who became more dependent on GAI chatbots for social advice and companionship reported feeling shame about not being able to control their growing reliance on AI companionship. Several recent surveys have further supported the trend in teens’ social reliance on GAI chatbots, and show how these chatbots obscure the difference between human vs. artificial interactions and pose increased risks of overreliance for emotionally vulnerable teens [214, 154, 160]. The key role of trust in both adolescents’ overreliance on GAI [263, 138] and their development of social functioning [92, 147, 210] demonstrates the importance of understanding how GAI chatbots may mediate teen friendships.

5.3 Methods

We conducted a study with 47 participants (aged 13-19) to understand how teenagers approach and perceive the use of GAI chatbots for navigating significant friendship challenges. We describe the setting and participants, the study procedure, design rationale for the speculative enactment activity, and data analyses employed in the following sections. Please refer to Section 5.5.3 for a description of the study limitations.

5.3.1 Setting and Participants

We obtained IRB permission to work with the University of Minnesota’s Driven to Discover research facility at the 2025 Minnesota State Fair. Due to the high attendance of families at this event, this “lab-in-the-wild” research facility offers an opportunity to engage with a broad and diverse group of adolescents. Participant recruitment was conducted by a team member holding a poster, who would screen and recruit families and groups of friends that passed by the research facility. Our studies were conducted in a cubicle with an area of approximately 120 sq/ft. Participants filled out consent and demographic surveys on tablets at the beginning of the study.

We recruited a total of 47 teenage participants with the following age distribution: 17 were aged 13-14, 15 were aged 15-16, and 15 were aged 17-19. All 47 participants completed the study. The average age was 15.55 (SD=1.98), comprised of 21 female,

23 male, and three non-binary individuals. 60.9% of participants identified as White (N=21), 21.7% as Asian (N=5), 8.7% as Latinx (N=2), 4.3% as American Indian or Alaska Native (N=1), and 4.3% as Middle Eastern or North African (N=1). 42 of 47 participants (89%) had experience using AI, with 36% (N=17) using AI at least a few times per week and 15% (N=7) using AI daily. Most participants reported using it for schoolwork, while 25% (N=12) reported also using AI for personal advice and general question-asking. We phrased the relevant demographic questions generally with respect to ‘AI’ instead of ‘generative AI’ due to the likelihood of these younger participants not understanding the technical difference; many current AI applications are also driven by GAI, as evidenced by the types of apps participants reported using (e.g., ChatGPT, Replika, Claude, GAI search or content creation features on social media apps, etc.)

5.3.2 Study Design

Because users usually employ AIMC in challenging situations where they are inclined to seek assistance, the topic of our study is on teenagers’ communication during friendship challenges. This is a highly personal topic and requires situated inquiry for gain meaningful insight. Hence, we chose to design a *speculative enactment* activity to allow teenagers to more thoroughly speak from a setting that involves a real friendship (described below). This activity is incorporated as an elicitation technique for the interview portion. We explain the full study procedure below.

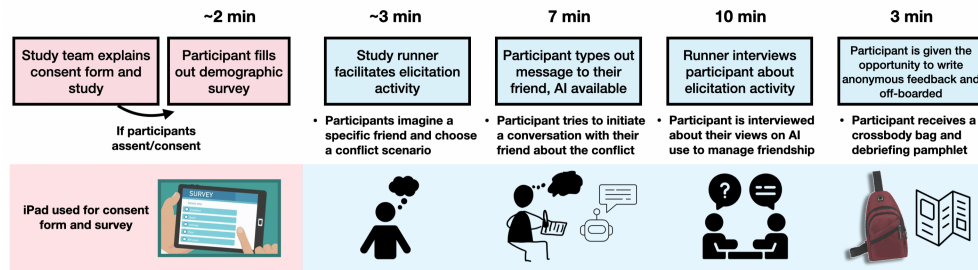


Figure 5.1: The procedure diagram illustrates the flow of study steps, the apparatuses used to conduct each step of the study, and the amount of time taken for each stage.

Speculative Enactment Activity

Speculative enactment is a complementary approach to speculative design research that allows participants to act out their experiences as if they were truly experiencing hypothetical but consequential circumstances. This process enhances discourse about new and imminent technological futures by engaging people more viscerally in these conversations through actually *experiencing* the speculative context [79]. We chose this method as a way to provide some insights into the consequential topic of AIMC use in teenage friendships, given the quickly-developing nature of GAI and related social phenomena as well as the difficulty of effectively observing such activities in detail within real adolescent friendships.

Because the goal of speculative enactment is to *make the speculation matter* to the participant, we chose to design an activity that would prompt teenagers to act based on a scenario with a real close friend of theirs. The speculation began with guiding participants to think of an emerging reality in which it would be easy for people to access GAI chatbots as a resource for managing communication struggles in their relationships, in order to portray AIMC during friendship challenges as a clearly feasible option (See Figure B.1 for the visual used during the study).

Speculation. The main speculation and enactment then began with having the participant bring to mind a real friend of theirs that they considered themselves to be close with. We specified that the person they imagine be a ‘close friend’ due to the ambiguity of the word ‘friend’ in potentially including acquaintances someone has no meaningful relationship with [93]. We then had participants imagine in detail a plausible scenario of meaningful conflict in the friendship that they would find challenging to address through communication.

Due to the complexity of this task, we drew on prior work and real teenage experiences to generate a list of meaningfully challenging conflict scenarios in teenage friendships (See section B.1 for the full list and literature referenced). This was provided to participants as reference material for their imagination of the scenario involving their friend, but we made clear that participants should only use the list as guidance and to come up with a plausible scenario which had not happened before. Some examples of scenarios that participants came up with when we ran the study included situations such as becoming distanced from a close friend due to lack of overlap in scheduled time

to spend together (and wanting to close that distance), being excluded from a social event involving mutual friends, their friend sharing a mental health condition they had to others, or wanting to make up for saying something that clearly did not comfort a friend during a time of need or loss. Participants came up with realistic details for these scenarios, such as specific family members, friend groups, or real activities that were a part of their life (e.g., their dance club).

Enactment. The enactment portion of the activity prompted users to write a message to their friend in an honest attempt to address the problem presented by the imagined scenario. Participants were provided with a laptop opened to a blank writing interface that they could type and draft messages on, with a window on the side opened to a clean instance of the GPT-4o AI chatbot assistant. They were given up to seven minutes to work on writing what they wanted to say and could choose whether to use the chatbot at their own discretion. We communicated to participants that they were not required to finish writing the message by the end of the enactment period, but rather to think of it as an opportunity to imagine what they would actually do in that situation.

Procedure

The study lasted about 25 minutes for each person (see Figure 5.3.2). After eligible participants were directed to our study booth in the research facility, a study team member then introduced the details of the study to the teenagers, allowing each person to complete the consent form and demographic survey (see subsection 5.3.1 for participant demographics) on a tablet device (minors under age 18 assented, while participants aged 18-19 consented). We ran two studies simultaneously in parallel to accommodate high participant traffic. Studies were run in private cubicles within the research booth (subsection 5.3.1) to ensure participant privacy.

To introduce the participants to the setting of the speculative enactment activity, the study runner began by prompting the participant to *“imagine a future in which AI is available in most of our social interactions”*. They used a visual (Figure B.1) to illustrate a more concrete example scenario, where a person in the visual seeks and receives specific suggestions from AI to make their partner less angry. The runner then explained that the goal of the following speculative enactment (Section 5.3.2) was to

understand teenagers’ views on the positives and negatives of this kind of future by allowing them to experience and take action in a scenario personally relevant to them. After facilitating the speculative enactment activity, the runner conducted a ten minute semi-structured interview with the participant to gain a deeper understanding of their approach and views toward AIMC in the context of their friendship.

Interview questions were designed to probe views of AIMC that were informed by specific experiences during the speculative enactment. For example, we asked participants whether there were moments during the message activity that made them think of using AI (or not), and to describe the context and reason for their choice. Participants were prompted to reflect on their perceptions about AIMC in friendship through questions such as: If your friend used AIMC in the same way when communicating with you as you did just now, how would that make you feel? Participants could reference their AI chat history and the message they drafted while being interviewed to help them share more contextualized insights.

After completing the interview, participants were given the option to provide anonymous written comments about the study and provided with an information pamphlet with more detailed information about the implications and risks of using AIMC in personal relationship contexts (see section B.3). Participants were provided with this information and encouraged to share it with their parents to reduce potential impacts of the study topic, due to risks described in our related work (subsection 5.2.3). Each participant was given a free crossbody bag as a token of appreciation for their time.

5.3.3 Data Collection and Analysis

We used digital voice records to collect audio from the interviews, which was transcribed for analysis. Data was analyzed iteratively by four authors, using reflexive thematic analysis [33]. Each author started by open-coding an evenly-distributed subset of the 47 interviews, and the group met weekly to organize and merge overlapping codes. This process was repeated for three to four rounds, until all interviews were coded and all codes were consolidated. At this stage we performed clustering analysis [117] on approximately 150 codes to distill the main themes, which were discussed among all authors until a consensus was reached. Some examples of intermediate subthemes resulting from the clustering included: the meaning of friendship, AI use in relation to

social skill, language-based scopes of acceptable AI use, implicit trust, moral principles, emotional effort, and authenticity.

5.4 Findings

We present themes which answer our research question by illustrating teens’ experience-informed views on the use of AI-mediated communication (AIMC) in their close friendships. Our analysis showed that teens’ perceptions drew from a wide spectrum of beliefs (e.g., beliefs about AI, friendship, and human experience) and applied to a broad array of AIMC usage contexts ranging from how words are edited to what questions can be posed to the AI.

(Note: Referenced participant numbers may exceed 47 (the number of participants) due to randomized assignment.)

5.4.1 Views of AIMC are Tied to Broader Perceptions About Social Principles and AI

Teens’ general opinions about AI-mediated communication (AIMC) in close friendships were shaped by broader beliefs about AI as a whole and social principles that drove how they navigated peer relationships.

Teens had divergent views about AI that impacted their perceptions of AIMC use in friendships. For example, some participants described seeing AI as like a “parent” (P86) or “teacher” (P15), demonstrating a more trusting view of AI as a guiding role. These participants generally had more positive reactions to the idea of AIMC use in friendship.

“[It’s] not giving you the answers, but it’s helping you answer.” (P39)

In contrast, other participants viewed AI negatively as a whole. Some teens ascribed AI to a force of nature, explaining how “the environmental aspects of it and how much water it takes” (P23) made them reluctant to use it altogether. Others such as P14 actively avoided using AI to “make sure I’m not relying on it.”

Apart from general opinions about AI, teenage participants drew from norms set by peers in their social network and their own relationship principles when deciding

how they felt about AIMC in their friendships. Many participants used their peers as a litmus test when rationalizing their views about AIMC:

“[My friend] uses a lot of AI so I honestly don’t think she would care because she might probably [use AI too] if [the same situation] happened.” (P15)

“I think most of my friends would share the same opinions that I have on [AI use in friendship]” (P28)

Others’ views about AIMC in a friendship context were driven by how they saw friendship relationships more generally. P15 expressed that the problem was less about whether their friend used AIMC or not, but rather their honesty about using it: *“I wouldn’t [be mad if my friend used it], but I would if they lied to me about it” (P15)*. On a similar note, some teenagers cited other aspects of the friendship as more important than the exact specifics of whether AI was used or not when asked what they would think if their friend used AIMC with them.

“I care more about the fact that you put the work in and are not just taking an easy way out.” (P32)

“[I would feel sad] probably because they didn’t take the time to actually write themselves and think about it themselves.” (P74)

This nuance brings us to another central theme from our analysis, which relates to how teenagers’ friendship schemas modulated their perceived acceptability of AIMC.

5.4.2 Individuals’ Friendship Values Inform Perceived Personal Effort Regarding AI Use

We identified complex patterns in how various friendship values held by teenage participants related to their attitudes toward the importance and inherent concept of personal effort. Teenagers’ views about how personal effort should apply in friendship also impacted their opinions about AIMC use.

Friendship Values

We refer to *friendship values* as teenagers’ beliefs about what a good friendship should be like. For example, some teenagers believed that taking the leap to seek help from AI or

an external party demonstrated a level of sincerity and willingness to invest effort in the friendship, while others believed that sincere, meaningful communication in friendship should not be mediated by a third party. Some of our participants viewed AI use for handling friendship positively, expressing that it was a signal of care and dedication:

“I would honestly be flattered if [my friend] thought [what they wanted to say to me] was important enough that they seek aid in compiling it.” (P37)
I think [knowing my friend used AI] would make me feel better because they had more actual dedication to wanting me to feel better instead of just freewriting it and sending it right away. (P60)

These teenagers demonstrated the view that turning to tertiary aids for handling a friendship problem was a sign of effort. However, there were also individuals who held the opposite view, where they believed that a good friendship should not be mediated by third-party involvement:

“I would be disappointed because he didn’t make it up on his own. Like he just didn’t care about it.” (P34)
“If you need ChatGPT to write a message to me, then I feel like you’re not passionate enough about it. It feels like oh, it obviously wasn’t that big of a problem to you.” (P15)

Other teenagers who were against the idea of using AIMC in friendship expressed that AI use would compromise valuable core aspects of the friendship, such as genuine emotional and social connection with the other person. For example, several participants shared sentiments that AI use would make their relationship seem transactional:

*“I want an actual person to talk to me, not some like, middle person who was... kind of **paid to do it.**” (P19)*
*“It’s **like asking somebody else to tell your friend** this message without you actually telling them.” (P11)*
*“It would be kind of weird, if you’re using your conversation with me as like... **you’re treating it like a homework assignment.**” (P89)*

The metaphors used, such as “*paid to do it*,” “*asking somebody else to*,” and “*treating it like a homework assignment*,” all reflect a perceived lack of emotional and personal

depth. Participants also brought up how AI use could compromise realness, agency, and accountability in their friendship:

*“It’s just their words, but **distorted and distilled into something more artificial.**” (P19)*

*“I feel like I’m **putting the fate of something I care about into someone else’s hands.**” (P32)*

*“Put it into your own words, and if it comes off rude, you can fix it. But if it’s coming from AI, you wouldn’t be able to fix your mistakes because you didn’t truly write it. **You can’t fix something you didn’t do.**” (P86)*

Some teenagers additionally explained how navigating communication in a real friendship required understanding the unique personal qualities of their friend, which AI tends to fall flat in lacking *“the context of what I’m trying to say,”* (P11) seeming *“too general,”* (P45) and that *“it doesn’t understand the person you’re talking to”* (P23).

Teens’ attitudes towards emotional closeness and vulnerability in friendship also impacted how they viewed the use of AI to talk to a friend. Many reported that they would be particularly upset if their friend used AI in the process of communicating to them specifically in a situation with significant emotional gravity, such as if a loved one passed away:

“I think I’d be pretty mad if you decide to include a quote that was just AI.” (P11)

*“It’s not ok to use AI... because **it’s more important to be sincere and caring in that situation.**” (P33)*

The above statement by P33 and the conditional anger expressed by P11 imply that AI use can be perceived as insincere and less caring during more emotionally-vulnerable moments of friendship, even if it is not seen that way in less poignant contexts. Apart from integrating their views about friendship qualities (e.g., openness, thoughtfulness, honesty, emotional trust), teenagers also discussed their understanding and evaluation of effort in the context of their friendships.

Interpretations of Effort

Participants presented nuanced views of what kinds of effort mattered in managing a friendship situation. There were individual differences in what ‘*object*’ of effort was most valued: the situational outcome itself, or the intent of acting with care for the friend. One way that participants measured intent of care was through effort shown by time invested. Most of the teenagers felt “*AI is used to do things more quickly*” (P24) and expressed that they “*would feel a bit hurt [if their friend] just asked AI to write a message instead of actually taking the time to write it themselves*” (P30). Teenagers tended to assess the level of care in intent through whether the use of AI was made to empathize and understand the perspective of their friend, instead of being more self-oriented. For example, P96 compared and contrasted using ChatGPT to help “*see [his friend’s] side of things*”:

“If my friend used ChatGPT to pick at the situation and flip the narrative, to ”come at me,” I think I would definitely be upset... But if he used it to, like, pick my brain and try to see my side of it, I think it might actually make me feel good because he’s caring about how I feel.” (P96)

In contrast, some participants prioritized benefiting themselves when enlisting the help of AI to manage a friendship interaction. Instead of using AI to understand their friend’s feelings, they used it to strategically direct the focus of the friendship situation onto the friend, disconnecting themselves from the social context.

*“I asked GPT for reasons to discourage [my friend from] cheating and the results were all like, cheating will make you feel guilty. But **I felt like that was kind of a bad reason because it was arguable.** So I asked for more plausible reasons not to cheat on a test and some of them actually impressed me.” (P87)*

*“**What should I add to my writing to make someone feel bad?** I wanted to summarize the important thing, like making [my friend] feel bad so they won’t do it again.” (P79)*

The participants in these two examples frame their AI use around more objective goals, such as finding more concrete reasons to convince their friend (P87) and crafting their

message to prevent undesirable behavior (P79). P87 additionally commented viewing ChatGPT as “*having the right words to rephrase things to seem more relatable to the person,*” showing users’ potential to essentially outsource their own perspective-taking to AI in order to achieve a material goal.

However, such outcome-focused users of AIMC in their friendship did not all prioritize self-interest. What added another layer of complexity was that some of these individuals integrated their concern for a positive outcome with the goal of making sure their friend was cared for when considering AI use. These individuals cared significantly about the situational outcome not based on whether it would benefit themselves, but on what they thought would be the best for their friend. They held views that were distinct from a large fraction of teenage participants who believed in implicit trust and raw honesty as indicative of true friendship. We characterize this distinction as ***genuineness*** vs. ***authenticity*** [280]. Both are sincere approaches to friendship, but slightly different. *Genuineness* is characterized by emphasis on consideration for the friend’s well-being, while *authenticity* is characterized by an emphasis on just being oneself as honestly as possible.

Participants who prioritized *authenticity* in their friendship did not really consider aiming for an outcome at all — rather, they believed that the friendship was not good if they had to expend effort on making the interaction better:

*“Am I really this guy’s friend if I don’t know how to communicate with him? Is this guy really my friend if I’m thinking so hard about what I’m gonna text to him that I need ChatGPT to think of a response for me? **Kind of unnecessary to have to use ChatGPT to talk to your friend, if they’re really your friend, you know?**” (P28)*

*“I like to be honest and authentic about my communication. While I feel like yes, sometimes ChatGPT might be able to help me bring it up in a more healthy way... **I don’t think it’s important.**” (P81)*

Participants who prioritized *genuineness* over *authenticity* tended to care more about ‘how’ messages were delivered to their friend and viewed AI use more positively if it was done out of empathy and consideration:

“I feel like [my friend using AI] might help me feel better because I know

what they're trying to say instead of me being confused about what they're saying, and not really knowing.” (P60)

“I would feel like at least she put it in a nicer way so I don't have to feel so let down or something...” (P51)

These individuals brought up points that differed from participants who believed in implicit trust and *authenticity* by prioritizing accessible understanding for their friend (P60) and considerate delivery, even if the same message was conveyed (P51). These contrasting examples explaining the motivations for AI use pointedly reflect how teenagers who prioritized *authenticity* truly assumed implicit trust in the friendship based on their lack of concern for issues such as miscommunication or misinterpretation of sentiment.

These examples also demonstrate how teenagers' views of AI use might **not** map uniformly to their friendship value systems and definitions of emotional effort. The choice to use AI could be motivated by higher connection in the friendship (e.g., *genuineness*-focused) or lower connection in the friendship (e.g., self-centered) depending on the friendship values prioritized. Similarly, the lack of AI use may come off as reflecting more connectedness in the friendship to some individuals (e.g., *authenticity*-focused) or relatively less connectedness to others (e.g., *genuineness*-focused individuals may value dedicating more effort to details of deliberation). Even the perception of effort itself is intertwined with friendship values, as teenagers who valued *authenticity* viewed exertion of communication effort in friendship negatively and those who valued *genuineness* were the opposite. These inconsistencies and individual differences in teenagers' understanding of AI use have the potential to significantly impact friendship dynamics and their formation.

5.4.3 Views on Degrees of AI Use Connect to Understanding of Human Experience and Struggle

Our analysis uncovered that teenagers' attitudes toward different degrees of AI use were linked to how their mental models of AI (see Findings 5.4.1) intersected with their understanding of human struggle in the context of emotional labor. Some teenagers completely rejected AI use in a friendship context because they believed it was fundamentally incapable of reflecting human experience. Many of them discussed why other

people would be better resources than AI for a personal situation. For example, P50 mentioned how he trusted his mom more than ChatGPT to always know what to do in social contexts, such as knowing what to say or not say. Participants also explained in other ways, how compared to AI, human perspectives were a more valuable resource:

“[People] can learn practical knowledge about how to deal with those types of situations that AI might not even know.” (P11)

*“AI is a generated answer. It’s going to be one way or it’s going to be the other way. There’s no middle way where **if you ask the same question to three different people, you might get three different answers though they’re all trying to get the same solution.** I’d rather get three different answers, because maybe you can take a little from each person and make your own answer. With AI, I could do that, but it’s a very direct answer that AI gives you, even in a situation.” (P96)*

These statements reflect how understanding subjective experiences and and situational knowledge was valued in the context of managing a personal issue such as friendship. Participants expanded on this view by explaining that although AI ‘knew’ a lot, it could not feel anything or understand the struggle someone undergoes in a personal situation:

*“AI doesn’t know what you’re going through, doesn’t know your emotions and your feelings. **It just knows like, the topic of not hanging out with someone and them talking behind your back. So if you put that into AI, I feel like it would just be like an “I’m sorry” paragraph for talking behind your back, but it wouldn’t show why you did it or anything.**” (P86)*

*“If you really care about someone and this makes you genuinely upset, there should be no reason for you to use ChatGPT because **it doesn’t know what you just went through in that situation,**” (P50)*

P28 described why they believed AI could not fill this gap: *“Emotions are a very human thing and not an artificial thing.”* This reflects the idea that emotions are a core part of personal experiences and relationships which AI, by definition, has no way to compensate. Participants also explained that the perceived formality of ChatGPT’s

words made it seem as if the sender did not care or even seem human (P92, P87, P79). P24 illustrated this point: *“It goes nice, soft, heartfelt, and then stone cold, then back to heartfelt. That just makes it awkward.”*

Although many participants viewed AI as fundamentally unsuitable for involvement in friendship and personal experiences, numerous others perceived the **difficulty** of emotional labor in a personal situation as a valid cause for deferring that labor to the AI. This was based on recognizing that some individuals might inherently struggle more with social skills or capacity for emotional effort. Several participants recounted how they struggled immensely with knowing what to say or how to communicate with their friend during conflicts, even outside of our study specifically. Those who felt at a loss of what to say were more likely to turn to AI for help, as they could not fathom how to proceed:

“I only used AI because I don’t actually know how to console a person... Unless you’re a family member of mine I don’t know how to console you.” (P19)

*“I asked [ChatGPT] what it would say. I described the situation and then I kind of just, put it up against my message and then took some of the parts from ChatGPT’s message and put it into mine because **I thought that it would make it better.**” (P95)*

These statements reflect how the participants felt less confident in their own ability to manage the situation for a positive friendship outcome, than they did in the ability of AI. This explicitly contrasts with some individuals who were clearly more confident in their own methods for managing social interactions, such as P86 who explained that when they were at a loss, *“I type it in my notes app before I actually go to talk to them. And I just let it sit in for a while, before I actually decide to speak up about it because I don’t want it to come off the wrong way.”*

Specific Uses of AI

The specific methods and boundaries of AI use discussed by participants directly related to their views of which social difficulties were considered legitimate reasons for AI use, as well as what kinds of AI use were valid for addressing those difficulties. One common

difficulty for which participants warranted turning to AI was not knowing what to say or how to say something:

“[AI] helped me learn how to, like, put things in the right way...” (P51)

“Some people can be kind of awkward in these situations. They’re like, ‘I don’t really know how to... in this situation.’ So you can use AI for ideas. But don’t just copy for the apologies, because then it’s almost like you didn’t want to apologize.” (P67)

“I mean, I think I probably could have thought of this on my own. Honestly, ChatGPT was just kind of there to help me think of it faster and like, be more just like confident in what I said.” (P45)

Additionally, participants who placed more attention and effort into *how* they expressed messages to their friend even if they did not fundamentally struggle with what to say (see 5.4.2 for a description of *genuineness*-focused participants) were more likely to perceive higher difficulty in constructing their messages and rationalized using AI to improve their tone of voice and phrasing:

“The execution matters a lot more than the thought behind [it]. Because the execution is something you feel, something you can read, something you can feel, both emotionally and physically. [Using AI helped the tone become] more somber and melancholy... it’s more fitting for the situation.” (P19)

Individuals who struggled with phrasing used AI in different ways to help. Some used AI to come up with ideas about phrasing, and others used it to generate options or refine what they had already written. For example, P45 asked ChatGPT to “*give me a few ideas of how to be nice about it or how to not make her feel bad,*” while P96 showed ChatGPT his message and asked for suggestions on how to soften parts in the middle of the message or re-order different points in the message.

How copying/pasting was used with AI raised nuanced opinions from teenagers. Most teenagers felt that directly copying and pasting ChatGPT output was unacceptable, but some explained that it might be acceptable to copy/paste an AI edit of something that they had written initially.

“I don’t think it’s okay to just copy and paste it without like basically any effort.” (P61)

*“It’s obviously not right to just ask AI to write an entire message for you and control C, control V it back into the actual message itself. But there is a little gray area where you can ask it for points about what I should do... Or **using your own points and then ask AI to edit it or make it less confrontational.**” (P11)*

“I feel like [AI] would help if I initially wrote it and then read over parts that I didn’t think made much sense. I could make it better by putting it into ChatGPT and have it help me figure out a better solution.” (P60)

Though the issue of copying/pasting AI-generated content was viewed more controversially, most participants supported using AI to get broader ideas about how to approach the situation instead of focusing on message wording.

*“ChatGPT can be good for just some advice, **not telling you exactly what to say**, just like, some options of what you can possibly do.” (P61)*

*“Seeing the [AI generated] solutions **gave me ideas of how to resolve it. Gave me room to think** about how I wanted to word it out.” (P96)*

By and large, teenage participants acknowledged the limited relevance of AI for personal situations (such as friendship) which required being able to understand and empathize with subjective experiences. They pointed to the definitive lack of practical awareness and affective empathy in AI. However, teenagers also shared more nuanced positions on AI use when it came to experiencing substantial difficulties in communicating with a friend, whether it was not knowing how to approach the situation, what to say, or how to deliver the message in a more considerate way. Copying/pasting AI-generated content was generally viewed more controversially, but individual participants shared certain ways of copying/pasting that might be more acceptable; some felt like it was okay to ask AI to edit something they already wrote, while others would selectively copy and paste AI-generated parts into their own message. On the other hand, using AI assistance for broader ideas on how to approach the situation or to assist with brainstorming was more widely accepted due to the less-direct influence of AI on the final message to their friend.

5.5 Discussion

5.5.1 Generative AI Use Shapes and is Shaped By Youth Experiences of Friendship and Connection

Inverse relationship between trust for social competence of generative AI and trust in friendship

Our findings illustrated an inverse relationship between teenagers' trust for AI competence in personal problem-solving, and their trust for interpersonal regulation in the friendship: teenagers who had higher trust in AI for handling friendship issues tended to have lower trust in their interpersonal ability to manage the situation, and vice versa. We see this from how teenagers can view AI as a teaching or mentoring role (5.4.1) or how teenagers who experience lower confidence in handling communication were more likely to rely on AI for making their messages 'better' (5.4.2, 5.4.3). We also see how teenagers who had more trust in themselves to manage the conversation within their friendship (5.4.2) tended to prioritize human *authenticity* in the friendship and reject AI use more strongly (5.4.2, 5.4.3).

These findings have implications for how relational effort should be construed and supported in teenage friendships, due to the differences and tensions in value constructs that teenagers operated by. For example, we saw a trend of focus on “process vs. product” emerge in the Findings. Some teenagers prioritized the outcome of the friendship interaction (product), whether it was a well-crafted message to make their friend feel better or to achieve a desired behavior (5.4.2, 5.4.3). Others prioritized upholding values such as honesty and authenticity through the act of communication itself (5.4.1, 5.4.2), or understanding and empathizing with their friend (5.4.2), which is more process-oriented. We also saw how some participants viewed AI use as care for the friendship — either by the act of looking for assistance when it's needed (5.4.2) or striving for *genuineness* to be conveyed in their message (5.4.2). This contrasted with participants who were fundamentally against AI use in friendship due to its inability to reflect human experiences and feelings (5.4.3).

It is possible that these value constructs about GAI use in friendship may only reflect a cross-section in time as GAI development and the societal norms around it continue to

evolve, but emerging research about GAI still recommends caution toward AI-mediation in relationships. Especially for teenagers with a more “product” or outcome-focused attitude towards GAI use for social relationships, safeguards may be more necessary to minimize overtrust in AI. Research has shown that AI-mediated human relationships can easily shift into an AI-dominated relationship if a user’s sense of companionship with GAI becomes so strong that it becomes a part of their identity [197, 43, 75]. Although participants share that GAI can be a helpful resource during difficult social situations (5.4.3), its fundamental inability to represent important aspects of human essence (5.4.3) is a core reason to discourage overreliance on GAI for personal conflicts.

Teens with low confidence in communication and social skills are at a higher risk of overreliance on generative AI

Section 5.4.3 of our Findings revealed how GAI use in the context of friendship could be motivated by high perceived difficulty in handling the friendship interaction and lack of confidence in self-expression and communication. These participants reported relying on GAI, such as describing it as a “*teacher*” who “*helped [them] learn how to put things the right way,*” made their messages “*just better*” overall, and “*helped them think of things more quickly and feel more confident*” in what they said. Research supports our findings (5.4.3) which show that GAI is not capable of and may even discourage empathy and other forms of emotional intelligence that are important components of socioemotional functioning [61, 51]. Teenagers perceiving GAI as an authority and relying on it for learning social skills may risk harming their socioemotional functioning.

Research has shown how framing effects and automation bias in GAI systems can lead people to perceive GAI as correct even when it is not, and as more trustworthy when it gives *less* information [161, 242]. This effect can be particularly problematic for children who turn to GAI for navigating personal and social processes, as overreliance on GAI in a social context can lead them to discount the value of human experience that GAI cannot represent (5.4.3). Empathy for human feelings is central to maintaining close and meaningful friendships [147, 60, 245], magnifying the harms that can be caused by teen overreliance on GAI leading to discounting subjective feeling and experience. Understanding the longer-term impacts of GAI on children’s social development is an important area of future work, as we still critically lack existing measures for evaluating

AI impact on children’s relationships [28].

Conversational GAI systems that can potentially be used by teens in a social context should employ design principles which encourage more autonomous interactions. Our findings showed that teenagers can have very different values and motivations for maintaining friendship, which underscores the importance of respecting teenagers’ right to develop different value models — AI systems should avoid value-based reasoning and emotive language in this use context [195]. Recent work has presented methods for identifying GAI users with different levels of cognitive risk (e.g., highly dependent to autonomous/critical) [203], which can be used to inform tailored designs for more- or less-dependent adolescent GAI users. Particularly for high-reliance users, integrating the Socratic questioning method into GAI [68] can reduce dependence on solution-based responses (which are inappropriate for subjective social scenarios) and encourage the critical thinking necessary to develop social and emotional skills [13, 78]. Designing tools to help teenagers reflect on their use of GAI is another way to reduce overreliance [170]. Conversation frameworks such as motivational interviewing are known to encourage self-determination in adolescents [272, 199] and have been effectively implemented in AI chatbots for health applications [35], with potential to accommodate the context of teen social development. These methods can supplement building *fading scaffolds* [207] into GAI systems to gradually facilitate teen users’ transition to autonomy.

5.5.2 Balancing Practices of Genuineness and Authenticity in AIMC Systems

Genuineness vs. **authenticity** (see 5.4.2) was one of the more nuanced differences in teenagers’ approaches toward friendship communication. **Genuineness**-focused individuals prioritized expressing care for the friend while **authenticity**-focused individuals prioritized being their rawest selves with their friend. This distinction has been discussed in moral development literature, which shows that developing children usually transition from caring mostly about ‘*being their true self*’ (authenticity) to appreciate ‘*being one’s true self and being kind to others in my own way*’ (genuineness). This happens through a form of identity re-partitioning where the adolescent learns that it is possible to both be themselves *and* attend to the need of others, such as valued friends [280]. In our findings, certain participants were clearly **authenticity**-focused, but some also

really wanted to be *genuine* with their friend and hence contemplated more details such as whether their messages would be received with the intended emotional effect. Ullman 1987 [280] describes that being “genuine” is about expressing oneself and communicating in a way that is *accessible* to others. Both are important, in the sense that *authenticity* and *genuineness* together contribute to meaningful friendship.

However, as adolescents grow and start to navigate *genuineness*, they encounter a dissonance where they may feel like they are not being honest to themselves when fulfilling others’ needs [280]. Our Findings reflect this too, where some teens confidently expressed that they wanted the message to sound like themselves, while others felt like their own way of saying things may not make their friend feel better and hence turned to AI for help in phrasing it to be in a more benevolent tone of voice. This fragile transition period is a critical point of design for GAI systems, as GAI interactions can potentially nudge adolescents to (1) conform to a way of speaking that seems more ‘appropriate’ but is unlike themselves, or (2) abandon efforts to speak considerately at all. Patterns in GAI sycophancy and companionship [51, 43] support this conjecture. For example, an adolescent repeatedly asking an GAI chatbot about ways to improve their tone of voice may lead to an echo-chamber effect [142] where the chatbot continuously reflects the initial focus on fixing one’s tone of voice, by omission discouraging the child from being themselves (more *authenticity*) over time. Similarly, because GAI chatbots are sensitive to how queries are worded, their sycophantic features may encourage kids to embrace self-centeredness if they are initially focused on being their ‘true self’ and word social questions to the chatbot in a more self-centered way. Ways to reduce sycophantic feedback loops or boundaries placed on them in GAI systems will be necessary to reduce risks of GAI impacting teens’ moral development and identity.

Potential ways for GAI chatbot systems to support balanced practices of genuineness and authenticity include adjusting responses based on users’ individual social orientations and leveraging LLMs to represent perspectives more removed from the user’s own. Because a user’s patterns of social question-asking may reflect whether they lean heavily towards being *genuineness*-focused or *authenticity*-focused, in extreme cases chatbots have enough context to promote reflective thinking in the opposite direction (e.g., asking very *genuineness*-focused people more questions that help them reflect on

their own feelings and asking very *authenticity*-focused people questions that encourage reflecting on how the other party’s feelings and perceptions). To counterbalance the emotional bias associated with someone’s focus on *genuineness* or *authenticity* while retaining the important human and emotional aspects of a personal situation (5.4.3), LLMs could also summarize a user’s presented relationship problem as a story involving other ‘characters’ to help the user reflect on a social situation from a distance. Similar methods of ‘role-playing oneself’ implemented through virtual reality embodiment have been shown to successfully support social problem-solving [225, 304]. It is important to strictly utilize approaches that preserve reflexivity and open interpretation when employing design strategies that affect social perception. Additionally, significant cross-cultural differences in how the self is societally valued vs. the other [200] add complexity to the task of determining how exactly *genuineness* and *authenticity* should be balanced.

5.5.3 Limitations and Future Work

There are limitations to this work related to the current time period and the study implementation. This study is completed during a period in which the social impact of GAI tools are emerging rapidly [312, 51, 75], and some of the perceptions we observed may change as our relationship with GAI tools evolves over time due along with advancements in technology and social policy. The current findings reflect a cross-section in time and some of them may not generalize temporally.

Though our sample had a wide range of ages, the majority demographic was White. It is widely known that cultural perceptions differ among racial and ethnic groups [15] and impact social and emotional development [243, 282, 158]. Future work needs to be conducted on more culturally-diverse populations to understand which of our findings may generalize and which may not.

Additionally, the time limitation of the study impacts how these results should be interpreted; real friendships are longitudinal and emotionally complex, and to that point it is possible that some of the results we observed may be more reflective of procedural time constraints than more stable patterns of AI-mediated social reasoning. Future work studying AI mediation in teen friendships should consider the impact of time on the relationship context.

Lastly, we used speculative enactment to ‘simulate’ a situation in which a teenager was presented with the choice of whether to use AI during a difficult situation with their (real) friend, which still does not encompass the full context of a real-life situation. While this speculative work provides a base for developing more insights in this area, there are bounds in its applicability to teenagers’ real-life friendship situations. Forthcoming research should make efforts to explore both immediate and long-term impacts of real AI use within teen friendships.

5.6 Conclusion

This paper reports an interview study with a speculative enactment-based elicitation activity conducted with 47 teenagers aged 13-19 to understand how current teens perceive the use of generative AI (GAI) to mediate communication within their friendships. Our findings revealed complex interactions between teens’ views of peer relationships with their views about GAI use. Namely, we discovered that teenagers differed in their friendship and social values, which impacted their interpretations of GAI use and what different types of GAI use (e.g., copying/pasting output, idea brainstorming, AI-performed editing, broad vs. specific question-asking) implied about the amount of personal effort someone was perceived to have exerted towards a friendship interaction. We also identified views recognizing the inability of GAI to represent essential elements of human experience core to addressing issues in close friendships. Based on these findings, we discussed important areas of future work on the impact of GAI on teen friendships, as well as changes to the design of AI systems that can better support teenage users to engage in more autonomous social development.

5.7 Selection and Participation of Children

The participants of this study were adolescents aged 13-19 who were attending the Minnesota State Fair, which has around 2 million attendees yearly. These participants were recruited by a study team member who stood outside the research building and explained the age eligibility and study to passerby in a high foot traffic area. We recruited 49 participants, two of which did not complete the study due to other demands

that came up unexpectedly. A total of 47 teenagers completed the study, which included 25 minutes of listening, writing, and speaking activities inside a research building. All participants were guided by study members to help them read through a consent form detailing that their spoken interviews would be recorded, were informed they could terminate at any time, and consented to participate in the study. Upon completing the study, participants received a free crossbody bag for participation. We collected email addresses anonymously from participants who wanted to be sent the results of the research and they were given an information pamphlet to explain the context and potential risks of the study topic.

Chapter 6

Designing for human bonding: Foregrounding social-relational chronology and the ‘stuff’ of intersubjectivity

6.1 Introduction

The three works that have been presented so far individually depict different settings of how technology can impact the development of meaningful human relationships. In the Online Friends work from Chapter 3, we saw how the larger network of various technologies in our lives shapes the construction and outcome of close friendships. Chapters 4 and 5 on the contrary focus more on fundamental characteristics of emerging technologies that can have significant impact on human social well-being, such as the respective representational and discursive qualities of virtual reality and generative AI.

Across these works, two distinct and dimensionally-rich relationship properties emerged: *time* and *intersubjectivity*. The intrinsically-chronological nature of relationships that exist over time emerges through different analytical perspectives demonstrated in Chapters 3 through 5. Similarly, these works also depict distinct elements of intersubjectivity [65], which forms the main ‘stuff’ of relationship experiences. The properties of

these analytical lenses distilled from my empirical work inform focused points of inquiry for future works that aim to adopt a more embodied relational lens in sociotechnical research. In the following sections 6.2 and 6.3, I trace how each of these dimensional properties emerge through the earlier projects of this dissertation and how they expand on seminal contributions in HCI and phenomenology.

Regarding the *human bond* as a unit of study that exists as a process of shared experience contributes to a progressive future in human-centered computing and maintains the feminist scientific philosophies put forth by principles from third-paradigm HCI [123]. In Section 6.4, I illustrate how an epistemological focus on, specifically, the *development* of meaningful human connection, embodies a critical form of **successor science** [121] in our current digital age which can be adopted across different methods and contexts of interactive system development.

6.2 Human Relationships as Chronologies

The importance of *time* embodying a fundamental characteristic of human relationships emerges quietly but unmistakably throughout these above works on technology-mediated relationship interactions. Relationships are chronologies, constituting a series of events; and the specific interactions we tend to design touch only on cross-sections of their overall chronology. This is most salient in the first work (Chapter 3) which directly depicts the transformation of developing friendship over time, and articulates *temporal constancy*, the perception of relationship permanence, as a key property of a successful relationship. The various interactions that online friends engaged in contributed fragments which built up to that relationship permanence. These chronological properties are also clearly present in Chapter 4 and Chapter 5 through how they centered different temporal dimensions of the relationship. For example, the innate structure of the retrospective embodied perspective-taking (REPT) system evaluated in Chapter 4 builds on a relationship’s chronological context: the events of a relationship prior to the key experimented context (its past) are an essential input for the system which is designed to impact the future of the relationship (6.2.1). The significance of the post-experience measures in the study further emphasizes the importance of the relationship’s continuance after the immediate context of interaction. From a different perspective, the

speculative framing of the study in Chapter 5 acknowledges the relevance of the relationship’s historical context (in situating the speculative scenario) but focuses more on imagining its future existence, or its *ongoingness* (6.2.2). This future-oriented framing emphasizes participants’ projected expectations and hopes for their friendships even when they are considering what is technically considered a momentary interaction, such as sending a single message. Together, these representations of time illustrate both discrete (6.2.1) and continuous (6.2.2) properties of relationship chronology relevant to the design of interactive technologies.

Though time is of the essence, there is a general consensus that the majority of HCI work and trends of currently-developing technology lean towards an emphasis on “presentness” of optimizing immediate contexts without a more sincere consideration of the past and the future [188]. With regards to deeply social issues studied within HCI, there is a considerable amount of work that looks at historical context in larger scales of human connection such as cultural patterns, de-colonialism, social justice, digital community spaces, and organizations [258, 175, 30, 53, 181, 106]. These contexts insinuate the essentiality of time, such as the time it takes to cultivate organizations and cultures and the time it takes to accumulate systematic injustices that require significant scales of action to reverse. Meaningful inter-human bonds such as friendships and partnerships also require certain conditions to survive over time [226] and actually serve as the origin of such larger-scale social issues. However, there is much less emphasis on the intrinsic temporality of the interpersonal bonds that actually form the discrete building blocks of our social lives, with rare exceptions [284, 95, 126].

HCI literature on slow technology [224] and meaningful experience [270] has established the importance of acknowledging time in the study of interactive computing. Particularly, the importance of “*taking a critical stance against unreflective acceptance of information technology*” [270] that impact people’s life-worlds, and clearly recognizing how technology “*is part of our lives over a long period of time*” [224]. These standpoints are key for moving beyond goals of function and efficiency and toward considering the lifetime of human experiences (e.g., in a social interaction context: centering people’s mutual feelings instead of only communication logistics). The concept of slow technology is about amplifying and stretching the presence of time in everyday life. Although people have an awareness of past, present, and future, the present is currently by far the

most salient [188, 270]. Slow technology attempts to facilitate reflection and long-term awareness in the user of the fact that their relationships with computational things last and develop over time. Some canonical examples of slow technology artifacts include ambient devices which serendipitously give users glimpses of their past activity (e.g., what they were doing at home, or what songs they’ve listened to) or interactions explicitly designed to allocate time for users’ mental rest [224]. Adjacent bodies of work also demonstrate natural intersections between human connection and the inherent temporality of reflection. Various technological approaches have been made to design interactive systems that evoke reflection [262, 17], genuine feelings of social connection [268], and relatedness [294]. But they do not directly discuss how the aspect of time within human relationships makes them so dense in social meaning.

6.2.1 Past, Present, and Future

The idea of human relationships as chronologies is an important component of studying human bonding from a sociotechnical standpoint. As illustrated in this thesis work, the past and future of relationships are a big part of what they are in essence. Odom et al. [224] articulate the concept of *pre-interaction* as a key quality of slow technology, defining it as “*the time and space prior to the moment that a design artifact is directly interacted with. This...temporal space ‘primes’ the experience that one might have with the artifact.*” Anticipation is one example of a type of experience in this category. In the context of relationships, this quality can be very important for informing how to design interactions that benefit the future of the relationship. For example, the REPT system presented in Chapter 4 embodies a *pre-interaction* through the retrospective footage that the user will experience; the fact that the user knows the interaction contains what they have already experienced in their relationship but are unable to know what the other-embodiment experience will be like primes them to enter the designed interaction with a distinct awareness of past events in their relationship. Purposefully evoking this prepared state of anticipation can raise the effectiveness of an interaction that is intended to benefit the relationship as a whole.

To extend Odom et al.’s [224] definition of pre-interaction, we can also introduce the idea of *post-interaction* as a relevant quality for designing technology-mediated relationship interactions. This quality is relevant to any relationship with the intent of

being sustained after discrete interactions with a designed interactive system conclude (e.g., after a call ends, or when the user turns the device off or transitions to another task). Considering the *post-interaction* quality of an experience can mean designing to support the user’s projected state after a given interaction, such as providing them with support for reflecting on a more complex or important experience. Memory research shows that details of complex events are more easily forgotten if they are not retrieved shortly after the initial experience [253]. Building interactions that integrate interpersonally-relevant memories as a medium (e.g., recording and aggregating shared experiences) can leverage the overlap between memory and time perception to support users’ awareness of relationship chronologies.

6.2.2 Ongoingness of Relational Narratives

The quality of *ongoingness* articulated by Odom et al. [224] refers to an entity’s perpetual movement over time that is subtle and gradual. It is an important concept for considering how to offer invitations for future engagement in interaction and acknowledge the ‘aging’ and cumulative change of something over time. If we imagine two relationships with shared events of roughly equivalent content, but one of the relationships has lasted a much shorter time than the other, these two relationships are still qualitatively quite different due to how the passage of time between events affects human experience. Humans uniquely possess autonoetic consciousness, which is the self-awareness of one’s existence in time and ability to mentally place oneself in the past or future [279]. This is an important element of our ability to have meaningful relationships, which are built on accumulated shared episodic memories. Human bonds are narratives that constantly move forward over time regardless of the outcome (Chapter 3), build on their own histories (Chapters 3 and 4), and whose futures matter a lot to the people within them (Chapter 5). They are chronologies that embody a succession of interrelated events over time.

Considering the *ongoingness* of human relationships is also important for supporting the level of individual *autonomy* necessary to cultivate meaningful connection with other people (2.1). Humans are “*temporally extended*” beings, hence exercising autonomy means being able to impact the present and future states of one’s social-relational identity [128, 81]. People’s motivational states for enacting autonomy are connected to

their past experience [16], and so considering human relationships’ continuous extension over time is important for designing in favor of developing meaningful connection. To govern the long-term impact of interactive systems on human bonding, there is a need for human-centered computing to foreground the discrete past, present, and future of relationships as well as their continuous narrative existence over time.

6.3 The Composition of Intersubjective Experience

Intersubjectivity, which can also be described as the core ‘stuff’ or essentially the material of human relationships, is another property that emerges substantively throughout the work in Chapters 3-5. Intersubjectivity is defined as the human experience shared by people who are socially connected, such as their memories, thoughts, and feelings [139, 65]. The constructive aspect of intersubjectivity (its formation through the shared experiences of people) characterizes an important manifestation of the autonomy-connection dialectic (the hedgehog’s dilemma). More specifically, it illustrates a potential pathway to reconcile these dualities *in the interest of social connection*. Chapter 3 (3.4.3) and Chapter 5 (5.5.1) depict the potential for intersubjectivity to serve as a key medium and pathway for reconciling the autonomy-connection duality (2.1). Through illustrating bidirectional relationships between social individuals and the technology they interact with, the findings from those works show that people can autonomously shape their applications of technology to support personal goals toward social connection.

This articulates an interesting nuance to the duality of self-autonomy and social connection by illustrating how certain expressions of autonomy *can* in fact contribute to social connection, showing cases where these two goals are not at odds and where the hedgehog’s dilemma may be dissipated. Here, the act of autonomy supports not an individually-isolated, but a socially-connected goal of furthering the affordances for closeness. This interaction pattern also reinforces findings from cognitive semiotics research (the study of fundamental meaning-making) that specifically assert imaginative expression of agency as an essential action for *building* intersubjectivity (producing social meaning and communication) [278, 208]. Chapter 4 (4.6.2) additionally demonstrates in a very straightforward manner how technology-mediated experiences can be molded to produce intersubjectivity, by aiming to physically recreate the other person’s

experience from an actual shared experience.

Intersubjectivity also shares a deep connection with the history of phenomenology (the study of human experience) and fundamental social science domains descended from it. Edith Stein, the doctorate student of philosopher Edmund Husserl who established the school of phenomenology in the early 1900s [135], extended the field of phenomenology (subjectivity) by articulating the concept of empathy and studied how individual egos interact. In her 1916 doctoral thesis *On the Problem of Empathy*, Stein articulated empathy as a two-part phenomenological act of perceiving another's inner life without losing one's sense of self (viewed in light of the hedgehog's dilemma, this articulation could also be seen as a parallel to the above-mentioned case of reconciling autonomy with connection).

Her work led not only to the concept of intersubjectivity as an extension to phenomenology but also to the conceptualization of cognitive and affective empathy which is widely used in many social science domains today [274, 266, 240]. The two parts that correspond to 'cognitive' and 'affective' empathy respectively would be the ability to perceive a foreign consciousness (cognitive) and the ability to experience emotional resonance (affective). The cognitive perception of another person's experience is only possible if the individual is able to achieve self-other differentiation. In other words, the individual must be able to retain autonomy over themselves in order to achieve true empathy and intersubjectivity. This concept bears many other parallels across the social sciences. In family systems theory, fundamental social wellbeing is characterized as emotional connection with the differentiation articulated by Stein [42]. This distinction between the conscious and experiential subcomponents of intersubjectivity also bears parallels to theory-theory and simulation-theory in cognitive science, which articulate components of social cognition as 'theorizing' about other people and 'simulating' what they perceive and feel [100]. Additionally, intersubjectivity is deeply related to the autonomy-connectedness dialectic through the intrinsically-relational aspect of autonomy: what people are able to do or control is by nature fundamentally socially embedded [196, 16]. This connection between intersubjectivity and the autonomy-connectedness dialectic also bears parallels with the foundational body of work on self-determination theory (SDT) being a key driver of close relationship processes. In their seminal paper, La

Guardia and Patrick explain how SDT reveals motivational underpinnings of relationship behavior that capture circumstances overlooked by the angles of personality and situational factors traditionally taken in relationship research; specifically, SDT as a key framing reveals whether certain relationship behaviors or experiences will actually be beneficial when *projecting forward* in the relationship [176]

The idea echoed across these different domains of study characterizes intersubjectivity as having two main components; for the sake of distinguishing from terms used in various past works, I will refer to these components as the ‘*semiotic*’ and ‘*visceral*’ components of intersubjectivity. *Semiotic* intersubjectivity refers to the aspects of shared understanding or experience that involve conscious perception and thought; this can be seen as symbolic or semantic elements of experience such as relating to language, logic, or planning. *Visceral* intersubjectivity refers to the more ‘raw’ felt parts of experience, such as internal physical sensations, emotions, or body movements.

To say that these are components of intersubjectivity does not necessarily mean that they are always present in full or distributed ‘evenly’ in a given interaction setting. Rather, they are intended as scoping properties to help designers and builders assess how well features of interactive systems support shared experience and understanding. For example, at a glance VR seems more visceral due to its focus on immersive sensory representation and GAI (as LLMs) more semiotic based on the main interactive quality being grounded in linguistic discourse. But clearly these properties can also be blended; for example, when texting one another people will select what to say and words to use (semiotic) but they may also stylize or punctuate their expression in ways that evoke distinct visceral feelings (e.g., Cool! vs. kewl or c00l).

Technologies (whether individually- or socially-targeted) that provide scaffolding for human bonding should have affordances designed to facilitate awareness of potential for bonding and autonomous enactment of socially-connective goals (for example, identifying people with bonding potential, or having opportunities to initiate and receive socially-connective expressions with those individuals). The *semiotic* and *visceral* components of intersubjectivity can be applied to identify whether interactive system features support shared understanding and experience or not. For example, the findings of Chapter 3 articulate different affordances and disaffordances on existing online platforms; the dungeon-fighting mechanism of an online game that friends play could

have chat enabled, which has a positive semiotic property of enabling friends to share conversation and talk about what they are experiencing or plan out actions together (whether that will be through speech or text may then involve visceral considerations). If friends who defeat the dragon together are enveloped in a joint effect with celebratory music and bright colors that they both see and hear, that would conversely embody a more dominantly visceral property of the shared experience. The ability to conceptually deconstruct or blend *semiotic* and *visceral* properties of intersubjective experience can facilitate more thorough consideration when designing for relationship interactions.

6.4 Adopting the Relationship as a Unit of Study in HCI Research

The constructs discussed in 6.2 and 6.3 converge to form core properties of relationship development (human bonding). Adapting the human relationship as a main unit of study is an important epistemological refocus in the same spirit as third-paradigm HCI [123]. Prominent waves of research that are based on this foundation include designing for reflection [17], studying dark patterns of UX design [113], trauma-informed computing [49], Entanglement HCI [94], and social justice-oriented design [71]. In this seminal work, Harrison et al. make the argument that despite the fact of HCI's roots having stemmed from human factors and cognitive science domains, there is a need to fundamentally reflect and question these mainstream frameworks that define for us what counts as knowledge. All paradigms of knowing are biased in one way or another. Reweighting the intellectual power status quo paradigms exert on practices of knowledge creation and broadening the perspectives through which science is conducted requires epistemological reframing; not just appending new methods to the collection, but actually changing how we understand the phenomenon being studied, how we identify the questions worth asking, and how results should be interpreted.

Third-paradigm HCI adapts principles from feminist philosophies of science to advocate for pluralism in how we think about research — diverting focus from an objectivist model of user research to a more relativist model which normalizes the simultaneous validity of multiple perspectives. For example, moving from the idea of a ‘typical’ user to approaching marginal users not as exceptions but as part of a phenomenon which

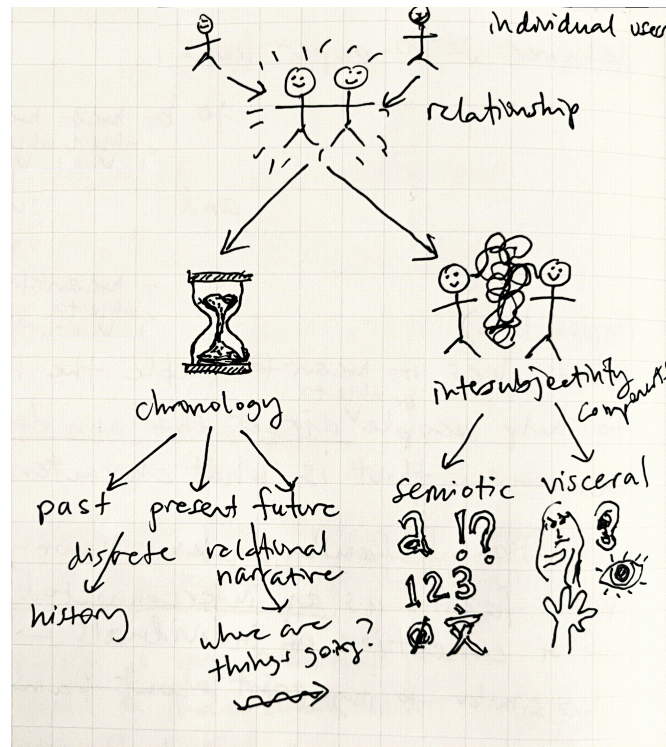


Figure 6.1: A conceptual sketch of the framework proposed in Chapter 6. The components of this framework should be used to articulate how given sociotechnical contexts might support or detract from autonomous relationship investment.

naturally has multiple interpretations. Harrison et al. headline **successor science** as a form of scholarship central to the pluralistic goals of third-paradigm HCI. Successor science, coined by feminist philosopher Sandra Harding [121], refers to “*successive forms of science which would avoid the systematic gender, class, and racial bias which sociologists, anthropologists, and historians of science have identified in current scientific practices.*” [123] These types of scientific framing are difficult to naturally include in existing research spaces because the bias is not the result of error or poor practice but rather tied to values and norms currently held. For this reason, genuinely embracing the human relationship as a unit of study in HCI research as opposed to the canonical focus on individual user experiences is a form of successor science by surfacing an under-prioritized context of human-technology interaction.

Although there is an abundance of HCI research aimed at supporting interpersonal

social connection [268, 294], the majority of work in these contexts focus on individuals' experiences of connection instead of the evolving connection shared by the people who are in the process of developing relationships. This focus on human individuals in human-centered computing is a form of *substantialism*, the tendency to treat things (including people) as discrete, self-contained substances rather than nodes in a larger relational network. While there is HCI research that studies communities at large, the majority of work adjacent to interactive system design still focuses on user experience over joint experiences. Since 1997, social scientists themselves have critiqued social science for engaging in substantialism by over-privileging individual entities of study instead of essential relations between them [80]. There are a few works from HCI that acknowledge how this problem is particularly eminent in more technically-minded areas of interactive systems research, and the authors point towards a need to envision more extended social implications of technologies and adopt a process-oriented approach towards system design that more strongly leverages links between relational theory and actual system building [21, 198]. The research in this dissertation also falls into this domain, as a category of work which attempts to straddle both meaningful particulars of interactive system design and the complex dynamics of developing social connection.

6.4.1 Application

The differing degrees to which I cover each of these contexts (designing and building interactive systems / that mediate developing relationships) in my own research contribute some practical examples for how such work can be approached or improved in the future. I studied very qualitatively-different modes of technology-mediated experience, ranging from user-directed coordination of personal technologies (Chapter 3), to more heavily-scaffolded immersive sensory experiences (Chapter 4), to dynamic patterns of user engagement with conversational technologies (Chapter 5). A variety of interactive systems were also involved, including personal computing devices, online social platforms, virtual reality, and GAI chatbot assistants. Different research methods were also adopted throughout the work, including qualitative grounded theory, mixed-methods controlled experiments, and speculative inquiry. The methods used and types of interactive systems and contexts studied impact the capacities in which the relationship development can be scrutinized. Some combinations allow for more situated study

about the relationship but may compromise empirical rigor, while other approaches reflect the need to make choices about whether or on what to satisfice when presented with sociotechnical contexts that are inherently difficult to study.

Chapter 3 reflected the temporal process of relationships the most extensively due to the qualitative and grounded nature of the work which allowed for leveraging participant memory in gathering information covering a larger scope of relationship development. However, this method is vulnerable to subjectivity and memory bias; it is difficult to ascertain whether the self reports were accurate or investigate in detail the dynamics of how specific interfaces were used.

Chapter 4 reflected the developmental features of the relationship and the interactive system of interest in a more discrete and controlled manner, which allowed us to collect more comprehensive, precise data about the interactive system's impact on user perceptions and the changes in their relationship. Studying and adopting appropriate measurements from the social sciences, such as dimensionalized coding systems for interactive behavior [149], can be particularly useful for HCI systems researchers who have less experience scrutinizing complex relational dynamics. The limitation here is of course in environmental validity; deploying novel systems like this in a field setting such as a counseling program may be an effective next step towards understanding how the system may impact users' developing relationships in the longer term.

Chapter 5 reflected the least explicit involvement in the relationship process due to its foundation in simulated action. The pre-interactive aspect of the relationship was addressed to some degree, as participants' real friendship histories are considered in order to situate the context realistically and they are guided to imagine a detailed situation before the main interaction context studied. The 'future' of the relationship is considered implicitly through participants' projected expectations for the friendship as they address the hypothetical scenario and verbally reflect on it during the interview. Such a method is not optimal for understanding what would happen in a real friendship, but for highly novel interactive technologies there is no alternative for studying the relationship context in detail. Despite the compromise in rigor, the speculative approach in this relatively novel interaction context (using GAI in close friendships) enabled us to distill targeted insights about potential contexts of scrutiny, such as paying more attention to

GAI use in children who have more extreme orientations toward self-authenticity or children who have weaker foundations in social-emotional skills. Facilitating a larger-scale quantitative study to obtain a corpus of results (now a common practice in psychology research [247]) about children’s adaptation of GAI in friendship contexts may reveal more widespread statistical patterns, but loses the richness of the relationship context unless supported by existent research that already establishes detailed and stable patterns in children’s strategies for developing close relationships (which remains to be done). Ultimately, longitudinal studies which can collect data to establish knowledge or causality in discrete system usage patterns and the relationship dynamics between users (both factual and subjective) will be the most valuable for advancing research in this area, due to the chronological nature of relationships.

Building changes in future computing research that focus on the human relationship context and asks questions which are meaningful to relationship development can contribute richer knowledge scaffolding for designing effective integrations into interactive systems. For example, identifying an increasing number relationship-centered factors of system interaction (such as GAI’s impact on joint agency [305]) can build up to summative research contributions such as standardized metrics which can be widely used to measure correlations between system features and relationship development. Augmenting the visibility of empirical evidence that technology has critical impacts on human relationships will also garner more interest and facilitate progress in the development of meaningful and impactful interactive system design applications for human bonding.

6.5 Synopsis and Reflection

To recapitulate this concluding chapter of the dissertation, I have articulated a framework to guide interactive system research and design for supporting the development of meaningful social connections. The properties of this framework are built on converging trends from the architecture and findings of my prior dissertation works and reflect a phenomenological perspective toward the design of social interactive systems. The conceptual elements of this framework cover the time-bound aspect of relationships as

chronologies, encompassing different perspectives of time such as discrete past-present-futures and the continuous ongoingness of social experience. I also articulate and deconstruct properties of intersubjective experience that can be concretized as a medium of personal relationships themselves, drawing out semiotic and visceral components of such experience as useful lenses for analyzing designed interactions. These distilled concepts expand upon the hedgehog's dilemma (the autonomy-connection dilemma) introduced in the beginning of the dissertation by demonstrating how this dilemma can be resolved and what experiential conditions are required to achieve this.

By presenting the phenomenological components of technology-mediated interaction most relevant to building meaningful social connection, I contribute a philosophically-grounded framework that bridges diverse perspectives across interactive social computing which are most often based in the information and psychological sciences. In doing this, I propose an epistemological reframing to HCI research by re-prioritizing the human relationship instead of the human individual as a core unit of study. This epistemological reframe addresses the lack of focus in prior sociotechnical research on the interpersonal, experiential levels of human relationships and social connection. The majority of prior work in this area acknowledges the significance of social connection, community ties, and societal trends, but leans away from centering interpersonal human bonds which establish the building blocks of broader social constructs. Refocusing the interpersonal relationship as a core unit of study enforces the successor science called for in third-paradigm HCI by addressing the fragmentation and breakdown of meaningful social connection which is a critical problem in the current digital age.

Although the work conducted in this dissertation covers a variety of topics and methods relating to technology-mediated human bonding, the conceptual framework proposed in this chapter is nascent and in no way conclusive. There are many other contexts and characteristics of close relationships that have yet to be studied, and future work investigating these areas is likely to reveal other extensions of relational experience or alternate conceptual mappings that can be applied to this very much formative model of sociotechnically-relevant relationship properties. There are many understudied social contexts adjacent to close relationship development that may hold indirect but important links to it. My dissertation explored contexts that have more direct relationships to bonding, such as social recreational spaces or limiting the research scope

to already-existing bonds. Meaningful bonds do not always form in such specific contexts and may seed in other settings such as education, work, or community obligations. Understanding how bonds form and develop under different social role settings has the potential to add more dimensions to the experiential factors relevant for establishing richer intersubjectivity or relationship continuity. The ontology, or broader temporal context of social-emotional development is also deeply tied to every aspect of forming relationships. Considering the depth of close relationships, the history of an individual's socialization experiences likely impacts how they personally engage at least as much as, or even more than, their immediate interaction context. Hence future work may also benefit from explicitly considering individuals' unique histories of social experiences (e.g., real experiences versus scoping with flat social labels such as 'anxiety' or 'confidence') when designing ways to support building meaningful social connection.

Conclusion & Future Directions

This thesis work was driven by the goal to understand how to support close relationship development in technology-mediated contexts at the level of both the interpersonal and individual human experience. This phenomenological lens alternates from more standard epistemological perspectives for studying interactive social computing in HCI (e.g., behavioral, organizational, or societal), yet aligns with and integrates these canonical perspectives while providing a more mechanistic understanding of how personal connection functioning in the context of interactive technology systems. The theme of this dissertation centers around the hedgehog's dilemma, a philosophical parable depicting how the autonomy-connection dialectic inherent to the human condition plays out in real social experience. This innate tension that characterizes humans' basic social needs reiterates the fundamental role of meaningful bonds play in humans' projected quality of life. Given this inseparable connection between close relationships and their broader impacts on life, my work focuses on clarifying experiential aspects of relationship interaction that can inform our future engineering of technology-mediated experiences.

I conducted an in-depth inquiry of technology-mediated close relationship development, tracing the mutualistic patterns between technology's influence on users' relationship interactions and users' creative, autonomous adaptations of artifacts to support prosocial engagement. The results of this work not only show how abandoning stereotypical definitions of 'normal' (or acceptable) social uses of technology can broaden the horizon for designing relationship-supportive experiences, but also demonstrate the importance of sociotechnical factors peripheral to the relationships. Through the activity-based derivation of online friendship development, we saw how broader social norms and community influences from various sources interconnectedly impacted the evolution of the relationship. I also explored the role of technology in the representational aspects of

relationship experience, such as the highly-embodied affordances of virtual reality and the reasoning-level influences of interactive large language models. The results of these works demonstrated these emerging technologies' distinct relationships with autonomy and connection: more perceptually-grounded mediums like virtual embodiment were able to support autonomous improvements in relationship behavior by augmenting one's scope of feeling, while LLM chatbots' level of influence over user beliefs reflected potential risks of reducing capacity for autonomous engagement in relationships. Based on these empirical works, I constructed a conceptual framework that characterizes how interactive systems research can identify the impacts of a setting's sociotechnical elements on autonomous engagement in social connection. It deconstructs core phenomenological aspects of relationships, such as distinct experiences of time and semiotic vs. visceral properties of intersubjective experience. The features of this framework build and expand on key canonical domains within sociotechnical research such as slow technology, self-determination theory, the social-cognitive sciences, and third-paradigm HCI.

The cumulative results of this dissertation work demonstrate why and how human bonding needs to be supported through self-driven connections with others. They also show how relationships have a very fluid association with sociotechnical settings, not only in how they pool across various interactive contexts but also flow through time. The expansive role of human bonding in users' general lives makes this lens applicable to many other key areas of life studied in HCI, such as well-being, meaning-making, self-reflection, and social connection. Bond formation is a key part of self-determination, and people encounter various situations in their everyday lives where opportunities for self-driven interpersonal connection matter. Experiential factors such as schedule and timing, physical and mental stamina, or social saturation can have meaningful impacts on developing connection, and their impacts may also differ depending on the stage of the relationship. The work in this thesis also showed how historical awareness, which can manifest in different ways, an important factor for the outcome of relationship interactions. For example, ontological influences such as an individual's level of social-emotional education development, relationship history, and personal experiences can have nontrivial impacts on potential or existing relationships. The omnipresence of technology shapes many factors relevant to bonding, such as enforcing social norms, defining what affordances for social interaction look like, and priming specific patterns

of daily activity in users. Considering the precarious state of meaningful social connection in our current times, there is an abundance of work cut out to further understand how these concretized relationship features manifest in extended interactive settings and develop interactive technologies that prioritize supporting users' free agency in defining and cultivating their own meaningful connections.



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Appendix A

Glossary and Acronyms

Care has been taken in this thesis to minimize the use of jargon and acronyms, but this cannot always be achieved. This appendix defines jargon terms in a glossary and contains a table of acronyms and their meaning.

A.1 Glossary

- **Online friendship** – Also known as online-only or ‘internet’ friendship. These are friendships where both friends met each other online and primarily contact each other through online platforms.
- **Activity theory** – Also known as *cultural-historical activity theory*. A conceptual framework that uses ‘activity’ as a unit of analysis to understand how humans interact with their environment. It allows us to characterize the interweaving relationships between an activity object, its desired outcome, the tools involved, activity-regulating rules, the community context, and division of activities among actors in the system.
- **Virtual reality** – Simulated experience in an immersive, three-dimensional spatial environment most commonly achieved by using head-mounted near-eye displays to simulate stereoscopic vision.
- **Generative artificial intelligence** (generative AI) – A type of artificial intelligence system that uses generative models trained on mass amounts of data to

produce novel but very statistically-similar outputs based on the input, which is often natural language prompts provided by a human user.

A.2 Acronyms

Table A.1: Acronyms

Acronym	Meaning
AT	Activity theory
CSCW	Computer-supported cooperative work
GAI	Generative artificial intelligence
HCI	Human-Computer Interaction
IRB	Institutional Review Board
OHC	Online Health Community
REPT	Retrospective Embodied Perspective-Taking
VR	Virtual Reality

Appendix B

Chapter 5: Appendix Items

B.1 List of challenging friendship scenarios: process of construction and results

Prior work on conflict in adolescent peer friendship and interpersonal relationships indicates that teen friendships are heavily influenced by ego-investment (the emotional attachment and identification someone has with their own beliefs and opinions, such as their values) [178, 180, 179]. This is related to teens' evolving sense of self. We also know from prior work 5.2.2 that trust is very important for teen friendships. Additionally, adolescents' evolving self-identity in relation to their social environment also makes their social reputation among peers another important factor influencing peer friendships [124, 307, 180]. Hence, the broad friendship conflict scenarios we created for reference (section B.1) covered the following themes: violation of trust in relation to an individual (self/friend), violation of trust in relation to the larger social circle, violation of moral values in relation to interpersonal activities, and violation of moral values in relation to general activities (not necessarily social). We consulted several individuals about their teenage friendship experiences to form and refine the final list.

- You feel like your friend doesn't understand a personal struggle that you have (*e.g. they said something insensitive while trying to comfort you, or acted indifferent*)
- Your friend shared a difficult thing with you, and you felt like you didn't respond well enough to them that time (*e.g., they lost something important, or*

went through a painful experience)

- Your friend puts down something that you like or care about a lot (*e.g., a specific person, hobby, or special interest*)
- You shared an important secret with your friend that they didn't keep (*e.g., something embarrassing, personal, or private; for example, you shared a secret about your crush with them and they told other people*)
- You feel like your friend is making you do something socially that you don't agree with (*e.g., there is some conflict where you feel like you're being forced to choose between friends, or you are being asked to keep secrets that you don't want to keep, or don't think it's right for you to keep secret*)
- Your friend or someone said something inappropriate, or something you think is not ok (*e.g., your friend said something you thought was mean, gossiped about others, or sided with someone that you really don't agree with*)
- Doing something that you don't think is right (*e.g., Stealing things, Copying schoolwork or assignments, Cheating on a test*)
- Being asked to break rules (*e.g., sneaking out, skipping class, going to a party or event you're not comfortable with*)
- You were excluded from an event or activity (*e.g., your friend was invited to something but you weren't, your friend did not invite you to something, or you were involved in excluding your friend and they did not like it*)
- You feel jealous of your friend — your friend feels jealous of you (*may be related to competition or comparison on things like achievement, social appreciation, appearance, etc.*)

B.2 Interview Outline

Here we include some representative questions to demonstrate how teenagers' reflections on AI were elicited during the interview:

- Why did you (not) use ChatGPT to write your message?
- *If they describe a reason related to AI:* Ask them to elaborate on the context of the reason and how their belief or view of AI relates to this reason
- *If they describe a reason related to the context of the friendship:* Ask them to elaborate on the relevant context of the situation or the nature of the relationship
- If you put yourself in the shoes of this friend you wrote your message to, how do you think you would feel receiving this message, and finding out that AI was used in some way to create it? If there are specific aspects of this situation that would impact how you feel more, please explain.
- After reflecting, do you have other thoughts about how you used (or did not use) ChatGPT during your message writing?
- Generally, how do you think you would feel if your friend said/did something important to you and you found out that they used AI to come up with it?
- Does the way that AI was used in this process matter?
- Generally, what ways of involving AI do you think are okay, and not okay, in this kind of close friendship context?

B.3 Post-study information pamphlet

Thank you so much for participating in our study. Please read this pamphlet together with your parents, as it contains important information regarding the use of AI to solve social problems.

Although this study asked you to participate in an imaginary exercise to explore the possibilities of using AI to solve interpersonal or friendship problems, our study team is **not encouraging the use of AI in this context**.

Research is still being conducted about the use of AI to problem solve social interactions and this type of engagement has not yet been proven to be beneficial to teen friendships.

Additionally, recent research has identified certain potential risks of using AI to mediate friendship interactions:

- AI may provide advice that is inappropriate or harmful to you and your loved ones
- Using AI too much in this context may lead to over-reliance on this technology for handling social problems
- AI tends to frame even social problems in a logical or analytical way, which may diminish the importance of your and your friend's emotional experiences

Here are some ways to mitigate the risks of using AI in this context, if you still choose to do so in the future:

- Use AI as a brainstorming partner instead of having it directly tell you what to do
- Check its suggestions with your own gut feeling and maybe someone else you trust
- Be aware of your own values and notice if you are using AI to avoid the inherent discomfort of troubleshooting a social situation

[Contact information of main investigators included]

B.4 Visual used to introduce the speculative setting of the study



Figure B.1: This single visual depicts an individual seeking support from an AI chatbot to help resolve a relationship challenge. *Note: the imagery portion of this visual were created with the assistance of AI, but the linguistic content was not.*