

SUPPORTING RELATIONSHIPS WITH
VIDEO CHAT

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By

MATTHEW K. MILLER

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Head of the Department of Computer Science
176 Thorvaldson Building
110 Science Place
University of Saskatchewan
Saskatoon, Saskatchewan S7N 5C9
Canada

OR

Dean
College of Graduate and Postdoctoral Studies
University of Saskatchewan
116 Thorvaldson Building, 110 Science Place
Saskatoon, Saskatchewan S7N 5C9
Canada

ABSTRACT

Video chat is often called the “closest thing to being there”, but anyone who has used video chat to maintain personal relationships or collaborate with others knows that video chat is not the same as face-to-face interaction. In this thesis, I focus on understanding how video chat can be most effectively designed and used to support relationships, helping to bridge the communication gap for distance separated people. An important difference between video chat and face-to-face interaction is potential effects of seeing oneself. In this thesis, I present two studies exploring this important caveat to supporting relationships remotely. The first study shows that the dominant interface design (which shows one’s own video feed) has measurable effects on people’s experiences and conversations in VMC. The second study focuses on a specific group of people—those with social anxiety—who may be particularly affected by self-view in video chat interfaces. This study shows that interfaces that focus on content (much like the media sharing system presented in this thesis) have the potential to minimize effects of feedback in video chat. Another key difference between video chat and face-to-face interaction is the difficulty of engaging in shared activities. Colocated friends or family members can easily share activities such as walks, movies, or board games; distance separated people have a much harder time doing the same. The work presented in this thesis introduces a synchronous media sharing system that can serve as a powerful tool for maintaining relationships. Building on this work, I show that synchronous media sharing is also useful for creating new relationships as well. Together, the system and studies presented in this thesis provide valuable new insights and techniques for the development of video chat tools that support new and sustained relationships over a distance.

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SECTION 1. BACKGROUND

CHAPTER 1. INTRODUCTION

1.1. Relationships over a distance

Relationships are fundamental to our life satisfaction [1], health [2], and well-being [3]. Feeling related to others is an intrinsic motivator—an innate human desire [4].

To enjoy the benefits of relationships, people must sustain social ties; this process of *relationship maintenance* occurs through *relationship maintenance behaviours* [5]. Researchers have catalogued many such behaviours [6, 7, 8, 9], such as positivity, openness, sharing tasks, and sharing social networks. Research shows that some maintenance behaviours are strategic (“invoked with the conscious intent to sustain the relationships”) while others are routine (“taken-for-granted, seemingly mundane, trivial, yet regularly occurring behaviours ... not used intentionally for maintenance purposes”) [9]. One behaviour consistently identified as contributing to relationship maintenance is time spent sharing activities (e.g., [8, 7, 9]).

In relationships whose members frequently spend time together face-to-face, particularly those in which members are cohabiting, a multitude of relationship maintenance behaviours occur naturally as a consequence of physical co-location. One way co-location aids relationship maintenance is through awareness; people passively get a sense of others’ moods simply by observing their expressions or behaviour and unconsciously keep up with others’ day-to-day lives observationally, e.g., by seeing a partner head out to the store or hearing a friend receive a phone call from their boss. Opportunities for many types of *strategic* maintenance behaviours can stem from such awareness, including Positivity behaviours, such as doing someone a favor or making them laugh, and Openness behaviours, such as giving advice. A second way co-location aids relationship maintenance is through naturally-occurring opportunities to share tasks (e.g., cooking, driving, cleaning, or planning); these tasks represent the most commonly-reported

routine maintenance behaviours among co-located couples [9]. In addition to behaviours naturally aided by physical co-location, people who are not distance separated can strategically employ many additional relationship maintenance behaviours easily, including joint activities, physical affection, and sharing a social network.

Many relationships function without the benefits of time spent together face-to-face. People relocating for college, work, or military deployment become distance separated from those they are close to. Others use online tools to find community, particularly people who struggle to find community in their geographic area [10, 11]. For these people, Computer-Mediated Communication (CMC) tools are the foremost or sole means of maintaining relationships. CMC tools include social network sites, text chats, phone calls, and video chat. For many people separated by distance, spending time together via video chat in particular is a primary way of communicating that plays a unique role in upholding connectedness [12, 13, 14].

In addition to romantic partners [12], family members [15, 13, 16], friends [14], and colleagues [17], there are also many situations in which video chat connects two people as they meet for the first time. For example, a virtual first date via video chat after meeting through a dating app [18]; a partner assignment in a distance education class using video [19]; or a meeting with a new coworker on a remote team that relies on video for communication [17].

The first meeting between two people is a complex series of interactions involving much seeking and sharing of information [20, 21]. When these interactions are successful, introductions are exchanged [22], then people make, receive, and reciprocate self-disclosures, leading to increased liking [23]. This cycle of disclosure also contributes to the formation of trust [24]. Trust is key to the success of many relationships that may form over video chat; for example, trust is important for successful team functioning [25, 26] and satisfaction of romantic partners [27, 28]. Therefore, just as with existing relationships, supporting successful initial interactions should be a significant consideration for designers and researchers of digital communication platforms.

One way in which people try to aid individuals meeting for the first time is with icebreaker activities. Icebreaker activities include discussion prompts or questions [29, 30], playful interactions such as games or toys [31, 32], and group tasks such as finding another person with

one's shoe size or scavenger hunts [30, 33]. Many users of icebreakers specifically cite eliciting self-disclosure as a goal [34, 35, 36]. One common icebreaker activity that can be designed to prompt self-disclosure is discussion questions, such as asking about favorite vacation destinations, childhood memories, or education. However, icebreaker questions have several drawbacks in the context of a get-to-know-you situation. The first potential drawback of icebreaker questions is that they prescribe a specific list of topics. This can be problematic because self-disclosure in initial interactions must be contextually suitable; for example, too much honesty can have neutral or even negative effects [37, 38], while positivity of self-disclosure is associated with positive effects [39, 40]. More generally, successful evolution of early relationships is characterized by disclosure of appropriate depth and topics [41, 42, 43] and reciprocating disclosure from the other person [23]; therefore, external constraints on the discussion may be harmful. A second drawback of icebreaker questions is that they offer little basis to judge the truthfulness of self-disclosures: in a one-to-one conversation between unacquainted individuals, there are few cues that can be used to judge the truthfulness of self-disclosures made in response to icebreaker questions. The number and strength of such cues is known as the *warranting value* of self-disclosure. According to warranting theory, the presence or absence of these cues moderates the effects of self-disclosures [44]; this suggests icebreaker-based disclosures may have a weaker effect on formation of closeness and trust than disclosures that are easier to verify. A third drawback of icebreaker questions is that their effectiveness in helping people form closeness and trust can be affected by individual traits such as propensity to trust or agreeableness [32], leading to differential efficacy, depending on the individuals involved. While icebreakers can certainly serve as basic conversational supports, these three drawbacks indicate that video chat users are poorly served by traditional techniques for supporting early relationships.

In new and existing relationships that do not benefit from face-to-face interaction, CMC is the means through which people must engage in the self-disclosure, trust building, and maintenance behaviors that grow and sustain interpersonal bonds. However, basic CMC systems do not offer the same shared context and abundance of options for sharing activities that physical co-location affords. Therefore, extending CMC systems with new tools for engaging in activities remotely can help support relationships even when people cannot be physically together.

1.2. Video chat interfaces and individual differences

The potential of video chat as a powerful communication tool has led to a significant body of research surrounding video chat systems. Research studying video chat has often focused on concepts such as eye contact [45, 46, 47, 48, 49, 50, 51, 52, 53, 54], performance benefits [55, 56, 57, 58, 59, 60, 61, 62, 63], and cost [64, 65]. However, the interface layout of video chat is an often-overlooked factor that may affect experiences of communication.



Figure 1. A typical video chat interface showing video feedback in the top-right corner of the screen.

The predominant interface design of video chat systems provides people with feedback from their own camera—usually presented as a small picture-in-picture window (e.g., see Figure 1). However, previous work has suggested that people may not necessarily want video feedback during a conversation, but would prefer to see feedback only if their face left the frame [66] or at the beginning of a call to adjust their position in the frame [67]. It can be distracting to see yourself in video chat [68], and even more distracting to be in a conversation in which the other person is clearly watching themselves rather than paying attention to the feed of you.

It is not surprising that seeing oneself in video chat can be disconcerting or distracting—although it is the status quo in video-based communication, seeing oneself is not the status quo in

face-to-face communication. Researchers have shown that allowing people to see their reflection in a mirror can increase sensitivity to negative feedback in a social interaction [69]. These negative effects of seeing yourself are attributed to an increase in a participant's self-awareness [69], which can facilitate aggressive behaviour in angered people [70], thwart intrinsic motivation [71], and decrease self-esteem [72]. The research using mirror manipulations suggests that seeing oneself in a video chat interface could induce self-awareness and affect resulting communication. The end result of increased self-awareness could be beneficial in some contexts and harmful in others; for example, seeing oneself can increase spontaneous self-disclosure [73], which could be beneficial in a remote therapy application, but harmful in a remote job interview.

In addition to feedback, there is a second way in which the interface layout of video chat application may shift users' focus: the content or video focus. For example, consider two people video chatting to discuss results of a recent project. Initially, the interface may include a large view of the remote user and a small, inset view of the local user. However, if one user begins sharing their screen to show some charts, the interface changes dramatically so that the video and feedback are much smaller and shifted to one side, allowing shared content to occupy the majority of the screen. Like feedback, it is not known whether switching from video-focused to content-focused layouts, which can occur with no user intervention, changes the experience of people in video chat.

The effects of video chat interfaces may be stronger for some people than others. For people who experience social anxiety—i.e., fears relating to being scrutinized, displaying anxiety to others, expressing oneself, or facing rejection [74]—a Tinder date [18], doctor's appointment [75], or banking consultation [76] scheduled over video is likely to create feelings of unease. If someone feeling anxious about a video call searches online for “video chat anxiety”, they are likely to find many articles explaining that one reason people feel anxious during video calls is the on-screen preview of their own video and that turning video feedback off could reduce their anxiety (e.g., [77, 78, 79]). Video chat is often thought of as close to “being there” [80, 16, 81], but because feedback has no analogue in face-to-face communication, it is certainly plausible that it plays a role in experiences of anxiety during video chat. Still, the effects of feedback on socially anxious users of video chat have not been tested.

Underlying the speculation that feedback aggravates experienced anxiety is the expectation that feedback increases a focus on oneself, along with the supposition that self-focus has harmful effects for people with social anxiety. One prevalent model—the Clark and Wells model [82]—proposes that social anxiety manifests in social situations as an increase in self-focused attention that involves using internally-generated information to construct a mental image of how one appears to others. This mental image, which can be an actual visualization or simply a “felt sense”, is thought to maintain social anxiety for two reasons: because socially anxious people believe the negative image is actually visible to others and because focusing on this image prevents them from observing cues in the environment that would disconfirm the image. Based on this type of model, several studies have tested whether external factors that artificially increase self-focus (e.g., mirrors) have negative consequences for socially anxious people (e.g., [83, 84, 85, 86]) and some negative effects have been observed. This perspective on self-focusing factors—that they are generally detrimental—supports the suggestion that feedback in video chat is harmful for socially anxious individuals.

While research has found some negative effects of self-focusing factors for socially anxious individuals [83, 84, 87, 86], the results have not been conclusively negative. The inconsistency of these results may partially stem from the use of different methods to increase self-focus (e.g., cameras, mirrors, speaking about oneself). Of these, mirrors are most similar to feedback in video chats. A study using mirrors [86] found that socially anxious participants in a face-to-face conversation with large mirrors placed around them did not have higher levels of fear, blushing, or negative thinking than those conversing without mirrors. The authors proposed that this is because visual feedback in a mirror provides objective information about how the individual actually appears. In the context of the Clark and Wells model, this objective information about how an individual appears in a social situation may correct untrue negative information in their mental image. This suggests that feedback in video chat could play a neutral or even protective role for people with social anxiety. This idea is bolstered by the success of a related therapeutic technique in which socially anxious patients are shown videos of themselves in past social situations, which helps correct unfounded negative impressions of their social performances and abilities [88, 89]. However, as this therapeutic technique is applied after-the-fact, it cannot be assumed that real-time video feedback has a similar effect during active social situations. Still, this perspective on self-focusing factors—that they can be neutral or beneficial—contradicts the

suggestion that feedback in video chat is harmful for socially anxious individuals. Because current research supports two perspectives on self-focusing factors (i.e., *generally detrimental* or *potentially beneficial*) and focuses on face-to-face interaction, it is not known whether feedback is harmful or helpful for socially anxious people communicating through video chat.

1.3. Video chat interfaces shared activities in video chat

Despite the perception that video chat is the closest thing to “being there” [81, 16, 80], the conversation-centered approach of standard video chat (i.e., the talking heads approach [90]) does not encourage the same array of interactions as time spent face-to-face or living together. As Rabby stated in describing distance separated romantic relationships, “without the capacity to engage in activities and to share in social events that most couples do, these relationships exist entirely in the communication that they engage in with each other. Their relationships are maintained through self-disclosure and sharing information with their partners” [91]. Further, standard video chat can also lead users to feel self-conscious when seeing themselves [13, 92] or feel that the close views create an ‘emotional weight’ not experienced in person [93]. While video chat is a powerful way to feel connected with others when apart, it does not provide fulsome support for many strategic relationship maintenance behaviours that are easily employed face-to-face, such as joint activities, physical affection, or sharing a social network, and it offers fewer opportunities for routine relationship maintenance behaviours that occur naturally and implicitly face-to-face.

To provide video chat users with more opportunities to engage in relationship maintenance, some designers have developed systems that enable specific behaviours. For example, a large class of connected devices allow low-bandwidth communication for maintaining awareness, such as when another person uses a household appliance [94, 95] or arrives at a frequent location [96, 97]. Other prototypes address distributed families with young children, e.g., with a tablet, camcorder, and tripod setup for sharing children’s outdoor activities [98] or integrated systems allowing parents and grandparents to read or play with children while video chatting [99, 100]. Finally, some systems have offered linked cameras and photo frames for enriched context sharing during video chat [101, 102]. Systems like these enable additional experiences compared to video chat alone, but do so in a highly structured way: rather than exposing a variety of behaviours like people interacting face-to-face may access, they focus on specific scenarios that

are incremental to the limited set of experiences that video chat already supports. These approaches to designing for distance separated people fail to address the breadth of behaviours available face-to-face and limit the agency of users to decide how best to support their relationship. In addition, most such systems rely on specialized hardware, which adds cost, complexity, and planning compared to integrated software solutions.

Contrary to these structured approaches, social media platforms demonstrate how software can enable a wide range of relationship maintenance behaviours over a distance, both active and passive. For example, Vitak identified four relationship strategies employed by Facebook users: Supportive Communication, Shared Interests, Passive Browsing, and Social Information Seeking [103]. The array of possibilities for communicating through Facebook (e.g., liking posts, sending birthday wishes, sharing content, forming groups, or browsing others' profiles) creates an environment in which many relationship maintenance behaviours can occur, both passively and strategically. However, social media does not serve all relationships equally. Being connected on Facebook benefits closely tied relationships less than loosely tied ones [103]. Similarly, research has found email also may serve only to keep a relationship alive, rather than make it grow deeper [104]. Additionally, while public online communication can serve to maintain relationships, it is used less among introverted people [105].

For close relationships separated by distance, the current CMC toolset contains highly structured options (e.g., games and prototype awareness/activity sharing tools) that limit the range of maintenance behaviours that may be expressed and unstructured options (e.g., standard video chat) that do little to scaffold communication or create a context in which relationship maintenance naturally occurs strategically and routinely.

1.4. Problem statement, summary of research, and dissertation outline

1.4.1. Problem statement

In sum, while video chat tools are helpful for staying connected when separated by a distance, open design questions and lacking technological supports limit their usefulness. Therefore, in this thesis I¹ present tools and studies that address the following problem:

Current video chat interfaces have limited support for forming and maintaining relationships.

This problem manifests in two main ways: first, video chat interfaces may affect experiences and conversations in ways that are not intended or understood by designers; second, video chat interfaces do not support and encourage a variety of shared activities that contribute to relationship maintenance.

1.4.2. Summary of research

Addressing the above problem requires new studies, tools, and system designs. This thesis addresses this problem in three parts. First, I present two studies that focus on *understanding how existing video chat interfaces affect users and their conversations*. Second, I present two new *tools for studying video chat*: a measure of self-disclosure (which is key to understanding how relationships are supported in video chat) and a video chat system that integrates a shared activity. Third, I present two studies that *establish this new system as an effective support for both existing and new relationships*.

1.4.2.1. Video chat interfaces

The first studies presented in this thesis answer important questions about how video chat interfaces affect users and their conversations.

1.4.2.1.1. Study 1: video chat interfaces and social experiences

¹As the sole author of this dissertation, I use “I” to describe its presentation and content. However, because the research contribution were in collaboration with others, I use “we” to refer to the specific scholarly endeavors undertaken with others. At the beginning of each chapter, I acknowledge who contributed to which aspects of the presented work in that chapter.

Given the prevalence of video chat in both the personal and professional aspects of our lives, and given that the dominant paradigm in video chat interfaces is to have visual feedback of oneself, in this study we investigated whether seeing oneself affected self-awareness in a video chat. Further, we investigated how seeing oneself affected both the interaction between pairs of participants and the resulting conversation. We created a custom browser-based video chat system that displayed no feedback of the participant or picture-in-picture feedback. We connected pairs of strangers online and presented them with a personal information exchange task in one of the two feedback interfaces. We gathered subjective measures on participants' perceived relational communication and transcribed the audio to perform semantic analysis on the conversations themselves.

Our results show that video feedback increased self-awareness and perceived relational affection and depth. However, it also increased the use of anxiety-related words and decreased the use of words expressing certainty. In addition, mixed-gender dyads rated themselves as having more social orientation with feedback than without. This was reflected in their conversations as an increase in inclusive pronouns and words expressing affiliation, and a decrease in words expressing discrepancy. The same-gender dyads rated themselves as being more task oriented than the mixed-gender dyads when feedback was provided. This task focus of the same-gender dyads was reflected in an increased use of interrogative terms (e.g., 'what', 'how') and 'you'-centric words with feedback than without—their task was to engage in an information exchange, thus the increased use of these words suggests greater task focus (i.e., asking the other participant questions about themselves).

1.4.2.1.2. Studies 2a and 2b: video chat interfaces and social anxiety

In these studies, we perform two investigations to understand the effects of feedback and content-focused interfaces for socially anxious users of video chat. In our work, we draw from Psychology and computer-supported cooperative work (CSCW) research to identify important mechanisms by which a social interaction can be affected and measured in terms of situational experience (e.g., changes in self-awareness and experienced anxiety) and desirable outcomes (e.g., self-disclosure and trust). In Study 2a, participants engaged in a get-to-know-you task (discussing icebreaker questions) using a typical video chat interface. Half of participants could see their own video during the chat (feedback on) and half could not (feedback off). Our results

show that social anxiety was only associated with greater public self-awareness and use of 2nd person pronouns such as ‘you’ when feedback was off; further, its effect on experienced anxiety was twice as large when feedback was off. When experienced anxiety was high, social anxiety was associated with discussing more icebreaker questions. Yet the number of icebreaker questions discussed predicted own- and partner- self-disclosure and trust formation only when social anxiety was low. Together, these results suggest that disabling feedback is not helpful for people with social anxiety (as previously suggested). In fact, the increased public self-awareness and larger effect on experienced anxiety observed when feedback was off suggest that disabling feedback worsens the effects of social anxiety, potentially by removing objective information that could contradict internally-generated negative information. However, people higher in social anxiety did not benefit from the icebreaker questions in the same way as people lower in social anxiety, even with feedback. This suggests feedback is helpful situationally, but not enough to equalize the experience of video chat for socially anxious people. Additional steps are needed to counteract negative effects of social anxiety, which stem from long-term and situational factors.

In Study 2b, we tested the same get-to-know-you task and feedback manipulation in the context of a content-focused video chat interface. This interface makes the remote participant’s video much smaller and shifts all video elements to a bar at the top; the majority of the screen shows the icebreaker questions with related background images to simulate viewing a slideshow or other shared content in a video chat. In the context of this interface, we did not observe any significant effects of feedback. Additionally, and unlike in Study 2a, we did not observe a significant effect of discussing more icebreaker questions on self-disclosure or trust formation at any level of social anxiety. We hypothesize that content-focused video chat interfaces may operate somewhat like non-visual CMC channels (e.g., text or voice), a context in which feelings of relative anonymity are associated with high levels of self-disclosure, including spontaneous self-disclosure [73, 106]. The hypothesis that visual elements of communication were less relevant in this interface is also consistent with the absence of feedback-moderated effects of social anxiety in Study 2b.

1.4.2.2. Tools for further study of video chat

In Study 1, we used conversational analysis to help illustrate the ways in which interface changes alter communications. In Study 2 we built further focused on conversation by asking

participants to rate how much self-disclosure they perceived in a conversation. Together, Studies 1 and 2 support the importance of understanding and evaluating video chat interfaces: even variations in interface design typically seen in commercial tools can influence conversation. These findings indicate a need for further tools that study video chat. An important first step is the development of a scale for measuring self-disclosure, formalizing the preliminary measure we used for Study 2. A further step is to go beyond interfaces common to commercial applications by creating a bespoke video chat system; we introduce a system that integrates synchronous media sharing, which enables further study of how video chat interfaces can affect and support conversations.

1.4.2.2.1. Tool 1: a measure of perceived self-disclosure

When meeting someone new, people often start a conversation by saying their name, offering other basic information, and asking questions about the other person. By sharing and receiving personal information, people begin the process of getting to know each other. This process is characterized by *self-disclosure*, i.e., communicating about one's self to other people. As relationships become stronger, people continue to engage in self-disclosure. This contributes to feelings of trust and closeness [24, 23]. The importance of self-disclosure in relationships is highlighted by several models of relationship development that center the concept of self-disclosure (see Figure 2). For example, the Social Penetration Theory [107] model submits that relationships are formed and strengthened through self-disclosure: disclosure allows people to get to know each other and become closer, and as closeness builds, self-disclosure increases. Similarly, Knapp's Staircase model [108] stresses the role of self-disclosure in early stages of a relationship in assessing compatibility for moving to a stronger relationship. Finally, Uncertainty Reduction Theory [109] suggests that people prompt for self-disclosure to help reduce the

discomfort caused by uncertainty about a new contact.

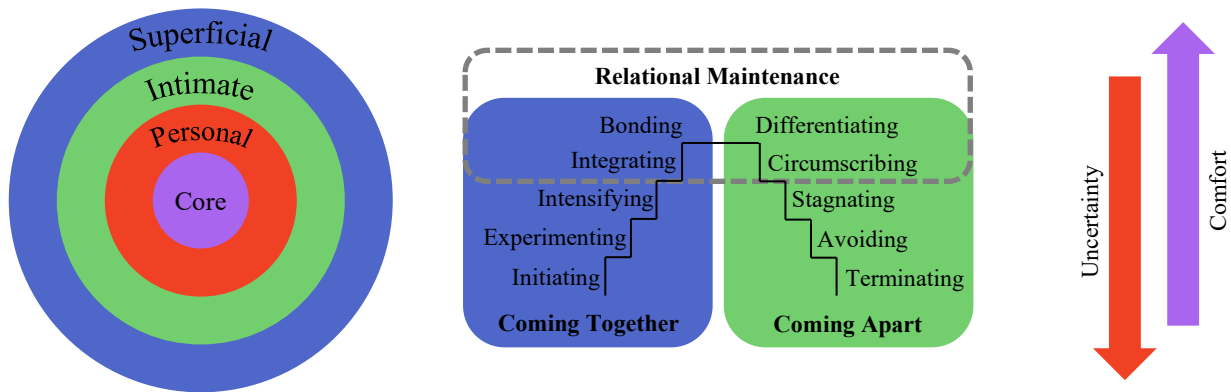


Figure 2. Three relationship models emphasizing self-disclosure: Social Penetration Theory, Knapp’s Staircase model, and Uncertainty Reduction Theory.

In the fields of human-computer interaction (HCI) and CSCW, many researchers have studied how digital communications can support new and existing relationships, both personal and professional. For example, researchers have studied whether different CMC channels are more effective for building trust [110], alter the conversational effects of social anxiety [111], or change how a potential date is perceived [112]. In all these situations, self-disclosure is a key part of the processes being studied, yet the authors chose not to measure self-disclosure. One reason for this choice may be that existing methods of measuring self-disclosure (i.e., expert rating, questionnaires, ad-hoc measures, and pronoun counting) are expensive or unsuitable for these contexts. Expert rating is a prominent method of measuring self-disclosure. However, applying expert rating is costly: conversations must be transcribed (for non-text channels), then utterances must be coded as containing self-disclosure. In some instances, a second pass is used to code additional dimensions of each disclosure (e.g., depth). An obvious alternative to expert rating is the use of *questionnaires*. Many questionnaires have been developed to measure self-disclosure, yet these measures have limited applicability to studies of single interactions through CMC, particularly interactions among strangers. For example, existing questionnaires measure self-disclosure as a long-term trait of an individual [113, 114], include items of inappropriate depth for initial interactions [115, 116, 117], focus on specific relationship types [118, 119], or focus on certain topics [120, 121]. This has led many digital communications researchers to resort to ad-hoc measures (i.e., short, unvalidated questionnaires [122, 123, 124, 125, 126]) or counting of references/pronouns (e.g., sentences containing “I” or “mine” [127, 128, 129]). For

researchers studying self-disclosure in a single interaction, existing measurement options are limited, which is a barrier to progress of the research field as a whole.

To address these gaps, we develop a scale for measuring perceived self-disclosure in a specific conversation or intervention, the Perceived Self-Disclosure Scale (PSDS). We develop a set of six characteristics the new scale should possess: situational, topic neutral, depth neutral, relationship-type neutral, channel neutral, and partner-rated. Together, these attributes ensure the measure will be broadly applicable to experimental interventions involving interaction with another person. Next, we construct a pool of items measuring perceived self-disclosure, focusing in particular on the *amount* dimension of self-disclosure.

In Study 3, we asked participants to use our new items to rate the amount of self-disclosure in three videos. We perform an exploratory factor analysis for each of these three applications of the scale, ultimately resulting in a five-item, unidimensional scale. These five items show good factor loadings and high internal consistency in this initial study. In Study 4, we gather a larger sample to confirm the intended unidimensional structure of the scale.

1.4.2.2.2. Tool 2: synchronous media sharing system

Tool 2, a synchronous media sharing system, allows us to investigate whether the flexible usage possibilities of social media platforms, which enable a range of relationship maintenance behaviours, can inspire tools that better support maintenance for close relationships. Many relationships among close ties are maintained by communication via video chat [12, 13, 14], even for hours at a time and with weekly or even daily frequency [130, 14, 12]. Therefore, designs supporting these relationships may benefit from providing flexibility through appropriate tools that support autonomy in choosing how relationships are maintained within the context of a high bandwidth communication channel that supports deep connections.

Despite the flexibility and ubiquity of media sharing, opportunities to use shared media are far more limited for people seeking to enact relationships through video chat than for those interacting asynchronously or face-to-face. Video chat systems have largely ignored media other than the callers' video feeds, text chat, and limited emoji reactions. When video chat apps do support sending text, images, or videos, the functionality is typically hidden by default and is not designed for synchronized viewing in the case of videos. Yet explicit support is needed; even in

business contexts, where more general tools for remote collaboration in video chat exist (e.g., [17, 131, 132, 133]), researchers have called for the development of better tools for sharing media [134]. The lack of a technical standard for accessing metadata, embedding, and controlling playback of online media, intellectual property concerns, and a fear that shared media would be overwhelming [135] all contribute to the lack of an integrated system for synchronous media sharing and video chat.

Given the paucity of integrated tools for general purpose media sharing in video chat, researchers and designers do not know how people might make use of such a system and whether or not synchronous remote media sharing in video chat affords a means to enact relationships through a shared activity. Therefore, we design and implement a system that focuses on avoiding technical barriers and artificial limitations on how shared media is used. Additionally, because the use of media in communication is extraordinarily varied, personal, and complex, we follow a design for appropriation approach, focusing in particular on two of Dix’s guidelines for appropriation [136]: “allow interpretation” and “support not control.” To allow participants to make their own interpretations of what should be shared, we focus on sharing arbitrary web links rather than limiting to a specific source or content type. To support not control, we focus on providing all users with shared control over the media viewing experience and avoid imposing any specific pace or style of viewing. Based on these guidelines, we develop a prototype video chat system that integrates synchronous online media viewing.

1.4.2.3. Effectiveness of a shared activity in video chat among strangers and friends

1.4.2.3.1. Study 5: synchronous media sharing for relationship maintenance

In this study, we show how a powerful and flexible, yet underexplored, tool for remote interaction—synchronous media sharing—can enable a variety of relationship maintenance behaviours through appropriative use. Media sharing is a popular activity in which people find images, videos, and documents and show them to others. In face-to-face contexts, sharing media such as physical and digital photos [137, 138, 139, 140], TV shows [141, 142, 143], and videos on handheld devices [131, 144, 145] is a rich source of interaction [146, 137, 138, 139, 147, 140]. To investigate synchronous media sharing over a distance, we use our new system, which integrates explicitly supported media sharing with video chat and focusing on avoiding technical barriers. We use a design-for-appropriation approach to facilitate the personal and complex roles

media can play in communication, and support openness by allowing any URL to be shared and giving all callers simple, synchronized controls. We deployed an observational study of our prototype system with friend triads, analyzing subjective perceptions and experiences, and objective behaviours and uses. First, our results show that our system succeeded at integrating a powerful new communication tool within video chat. For a 15-minute call, people shared many items (7.6 each on average), including videos (51%), images (28%), articles (9%), and products (3%). Participants found the experience to be enjoyable and social (e.g., groups laughed for 19% of the call). Most importantly, conversations in our study demonstrate that this tool creates a context where many relationship maintenance behaviours can be expressed using media, including self-disclosure (e.g., sharing a video about their hometown), giving ‘gifts’ using knowledge of others’ interests (e.g., sharing a video they knew would make the group laugh), and referencing shared identities (e.g., sharing student memes).

Our results illustrate that focusing on creating a rich shared experience rather than on enabling a specific maintenance behaviour can support users in choosing how best to maintain a variety of relationships. We discuss four dimensions on which shared activities can be designed to support flexibility: channel flexibility, focus flexibility, control flexibility, and activity flexibility. Our system shows how flexible joint activities like synchronous media sharing can be successfully supported over a distance and allow for a range of relationship maintenance behaviours to be expressed, which will help people care for, cultivate, and preserve distributed friendships.

1.4.2.3.2. Study 6: synchronous media sharing for relationship formation

Given the limitations of icebreaker questions in supporting initial interactions, we considered alternative ways of supporting people in getting to know each other. Our specific interest in supporting self-disclosure, trust formation, and relatedness via video chat led us to consider synchronous sharing of media from online sources as a support for new relationships. We know from research of asynchronous communication through text messages [148, 149, 150] and social media platforms [151, 152, 153, 154] that media can be used to support conversations and engage in self-disclosure.

In this study, we perform a study of unacquainted pairs communicating through video chat. Half of the pairs engage in a standard icebreaker task, and the other half engage in synchronous media sharing. Our results suggest that media sharing promotes a unique form of self-disclosure

that occurs both through conversation and through the media itself. Further, our results support media sharing as increasing the warranting value of self-disclosures compared to icebreaker questions. Our study demonstrates that compared to icebreaker questions, media sharing can lead to similar levels of trust formation and greater feelings of relatedness, which we suggest may be attributed to an increased ability to personalize and control self-disclosures in this condition. Finally, our results indicate that media sharing's effectiveness in supporting trust formation is not affected by agreeableness, unlike icebreaker questions. We discuss why media sharing offers these benefits and how video chat users and designers can leverage media sharing to support initial interactions. Media sharing is a novel approach to supporting people as they meet for the first time that offers unique ways to self-disclose, increases warranting of self-disclosures, provides robust support for building trust, and leads to greater relatedness when compared to a standard icebreaker approach.

1.4.3. Dissertation outline

This dissertation is presented in five Sections. The remaining chapter in this section, Related Work, discusses previous research that supports and informs the following work. Research areas discussed include video chat (including uses, interfaces, and effects), relationships (focusing on how relationships are formed and maintained, and the roles of self-disclosure and trust), and shared activities (establishing their importance to relationships and the state of support for sharing activities over a distance).

The following section, *Video chat interfaces*, presents Studies 1 and 2. These studies reinforce the importance of studying video chat interfaces and provide valuable insights for users and designers of video chat systems. The third section, *Tools for further study of video chat*, includes a validation of the self-disclosure measure introduced in Study 2; Studies 3 and 4 are presented to support this validation. Additionally, the design and development of a custom video chat application with integrated synchronous media sharing capabilities is presented. The fourth section, *Effects of video chat among strangers and friends*, presents Studies 5 and 6. These studies focus on understanding how the new video chat system presented in the previous section can support both new and existing relationships.

The final section of the dissertation, *Discussion and conclusion*, begins with a summary of the research presented in the preceding sections and a list of contributions. Next, a discussion is presented regarding how the present work can be applied and extended to other contexts; these include hybrid video calls, mixed reality devices, professional meetings, and heavy users of video chat.

The appendices at the end of the dissertation include complete copies of all questionnaire measures used in Studies 1 through 6 and a full list of icebreaker questions used in Studies 1, 2, and 6.

CHAPTER 2. RELATED WORK

2.1. Video chat: uses, interfaces, and effects

2.1.1. CMC and video chat

CMC is a broad term for all forms of electronic communication, including messaging, voice calls, and video chats. Video chat—a particular form of CMC—is a popular tool for staying connected and productive over a distance. Family members [15, 13, 16, 155], friends [14], and romantic partners [12] use video chat to stay connected and foster intimacy. It also allows workers to collaborate with colleagues [17, 156] and individuals to access services such as psychotherapy [157], education [158], and customer support [159]. While video communication supports existing relationships, there are also many reasons for people to meet via video chat. For example, a virtual first date [18] or initial meeting with a new member of a remote team [17] may occur via video. As video chat plays a larger communicative role in many aspects of daily life, it is important to understand how the design of video chat systems affects communication.

Generally, video chat systems use audio to transmit the speech component of the interaction (there are rare exceptions that use text [160]), so the capabilities of video chat can be thought of as a superset of audio chat. Early in the history of video conferencing, monetary cost was a major factor—for example, an estimated \$500 million was spent to develop the AT&T Picturephone system [161], which was a commercial failure—therefore early research centered around determining whether video chat offered performance benefits that made it worth the cost. In 1977, Pye and Williams [162] surveyed literature on video chat and found that video chat offers no significant benefits over audio chat in most cases. Thus, they concluded that “the research reviewed casts considerable doubt on the value of a visual channel,” a conclusion they believe

could only be altered by “fundamental technological breakthroughs, which reduced the cost of video to negligible amounts”. Of course, the internet and hardware advances have since done just that, meaning the debate over video is now much subtler.

Since Pye and Williams’s review, research has continued to bear out a lack of performance benefit for video chat over audio chat. Day and Schneider found no difference in patient participation or outcomes for remote psychotherapy over audio chat or video chat [55], and Campbell et al. [56] found no difference between channels in performance on a telemedicine medication sorting task. Boyle et al. found no difference between the two channels in performance on a map communication task [57]. Ochsman and Chapanis compared audio and video channels for a problem-solving task, finding no differences in speed for problem solving [58, 59]. Likewise, Green and Williges found no speed differences for a writing task when conducted over audio or video [60]. Radford et al. found no differences in decision quality when using the two channels for group decision making [61]. Finally, Sprecher found no differences in liking when people met via audio or video chat [62]. In the few cases where performance differences are found, they tend to be small (e.g., small performance benefits in a design task [63]). The variety of contexts and outcomes studied in this body of work suggests that video chat in general offers little to no performance benefits over audio alone. Even in studies documenting no performance benefits though, users have expressed a preference for video [163, 63, 162].

A preference for video chat may seem arbitrary in the context of the large number of studies failing to document a performance advantage for video chat, but the two mediums do differ in other ways. One study found that users communicating via video chat were more efficient and better at coordinating their conversation than those using audio chat [57], though another study failed to observe an increase in efficiency [61]). A study of video and audio in telemedicine found that video chat decreased ratings of workload for patients and increased recall of information from the conversation [56]. A further study found that video is better than audio in affording conversational fluency, and that it afforded greater awareness of attentional focus [164]. This effect was confirmed by Watts et al. who also documented that visual cues in video chats allow participants to monitor their partner’s attentional status in a way that is not possible in audio chats [165]. Unsurprisingly, video chat eases speaker identification compared to audio [166]. Goodman-Deane et al. note this benefit, and find that this is of particular importance to

Chinese users who report increased difficulty in speaker identification compared to western users [167]. In sum, the literature supports a role of visual cues in increasing efficiency and ease of conversation, factors that may contribute to user preference for video. The greater amount of information conveyed by video also creates increased feelings of social presence (“being there”) [163], another potential contributor to user preference.

A notable exception in the literature to the general lack of performance benefits for video chat is seen in negotiation tasks. Veinott et al. found video improved task performance for non-native speakers compared to audio alone [168], an effect attributed to the need to negotiate meaning and common ground for the non-native speakers [169]. Dong and Fu also found benefits of video in a negotiation task. When difficulty or conflict in the task were high, video led to more equal outcomes than audio alone [170]. The authors attribute this to the conversational style of the video participants, which involved exchanging smaller pieces of information at a time. Interestingly, the benefits of video may be limited to negotiations that are based on participants’ own views. Short found video to outperform audio for a negotiation task when arguing based on personal views, but the opposite effect was observed when arguing based on assigned views [171]. People have been found to decode emotions more reliably via video than audio alone, a potential reason for better performance in negotiation tasks over video [172].

Video has also been found to increase trust in an information exchange task, compared to participants using audio alone [173]. This may affect how conversations are experienced. One study found that users experienced greater involvement and homophily when using audio chat to converse rather than video. However, when one participant was asked to be deceptive, video chat outperformed audio on the same measures [174]. Increased trust when communicating over video may contribute to this difference.

2.1.1.1. Gender in CMC

Gender differences exist in terms of behaviour during video chat; for example, when adjusting cameras, women adjust the camera to show more of themselves in the field of view than men [175]. Female pairs in a negotiation task over video chat appeared to show higher levels of trust [176] as well as a language of fairness and acknowledgment [177, 178], compared to male pairs. These differences extend beyond video chat and suggest that gender composition affects how users interact with each other through CMC.

In a decision task that was performed over email, female-only groups sent more words per message, were more satisfied with the group process and reported higher levels of group cohesion than male-only groups [179]. Generally, these differences between gender groups appear to be driven by the fact that male-only groups show lower participation than mixed or female groups [180]. Male behaviour in dyads appears to be affected by the gender of their interaction partner. For example, men appear to be more likely to become friends with women than men on Facebook; women on the other hand show no bias towards any gender in their likelihood of friendship [181]. Comparing mixed-gender and same-gender groups in a problem-solving task showed that men in mixed-gender conditions talked significantly more than men and women in the same-gender condition [182]. Overall, a mixed-gender composition appears to significantly affect the dynamic of a dyad. Investigating the effect of gender composition in dyads performing a negotiation task showed that mixed-gender dyads outperformed same-gender dyads; the authors argue that mixed-gender compositions lead to higher levels of cooperation and information sharing [176]. Mixed gender pairs appear to like each other more and exhibit higher levels of self-disclosure in computer-mediated interactions [183]. Pairing people with someone from the same gender or another gender appears to strongly effect the dynamics of the subsequent interaction.

2.1.2. Video chat interfaces

2.1.2.1. Feedback

One interface element most video chat users will encounter is a preview of their own video feed. For example, Microsoft Teams, Google Meet, Apple Facetime, and Zoom all include feedback by default. However, user control over video feedback is not consistent. For example, at the time of writing, Zoom's desktop app allows feedback to be disabled and includes feedback in the always-on-top overlay when screensharing, but Microsoft Teams does not allow feedback to be disabled, and does not include feedback in its always-on-top overlay for screensharing. On web and mobile platforms, where API availability can limit always-on-top modes, feedback options are even less consistent. For example, Google Meet's web app does not allow feedback to be disabled entirely and does not include an always-on-top overlay for screensharing at all. Although almost all modern systems afford video feedback, its use was less consistent in early video chat solutions. For example, some systems had no feedback [184], had it turned off by

default [67], or provided it as option that obscured the remote video entirely (meant as a temporary preview) [185].

Research has found most video chat users prefer feedback to be available [157, 68], although some early studies suggested that users only wanted feedback at the start of a call [67] or if their face left the frame [66], and some specialized systems have not offered feedback (e.g., [186, 187]). In a research context, several studies have disabled feedback, but not as a manipulation (e.g., [188, 189, 190, 191]). Wegge [192] performed two studies of feedback: one manipulated the size of feedback and found that large feedback views can aggravate the effects of test anxiety; the other manipulated the availability of feedback and found an intensification of certain negative emotions after simulated call problems when feedback was off. It has also been suggested that video feedback could help increase eye contact, important for establishing interpersonal trust [193].

Video feedback allows people to see themselves, much like a physical mirror. Outside the context of video chat, mirrors are a common manipulation in self-awareness research [194, 195], and video feedback has also been used to manipulate self-awareness (e.g., during a text-chat [73]).

2.1.2.2. Video-focused vs. content-focused interfaces

Beyond simply turning feedback on or off, most video chat applications support a variety of interface layouts. We reviewed documentation for some of the most prominent video chat services in 2022 to understand what layout options they offer [196, 197, 198, 199]. For one-to-one calls, common layouts include a picture-in-picture view (most of the interface dedicated to the other person's feed and feedback is shown as a smaller window overtop) and side-by-side view (local and remote participant shown beside each other at equal size). For group calls, common layouts include automatic switching (the majority of the screen dynamically showing the current active speaker) and tiled or grid views (many videos on-screen at once with sidebars or switching for overflow). For both one-to-one and group calls, all systems reviewed also support screensharing or presentation views. In these scenarios, the default layout typically dedicates most of the screen to the shared content and shows several small participant videos on one side or shows the current speaker inset over the content (though grid layouts are often offered too).

In this thesis, I focus on two broad classes of video chat interfaces that reflect many of the most popular layouts. The first, *video-focused*, includes layouts that dedicate most of the screen to the video call. The second, *content-focused*, includes layouts that dedicate most of the screen to content such as a presentation or shared screen.

2.1.3. Video chat, self-awareness, and social anxiety

2.1.3.1. Self-awareness

To understand how feedback affects our interactions over video chat, we must consider how seeing ourselves affects our self-focus. Self-focus has both a private and public dimension: public self-focus includes attention to the aspects of the self that are able to be perceived by others (e.g., physical appearance, mannerisms); whereas private self-focus includes attention to internal and personal features that cannot be perceived (e.g., memories, feelings) [200]. When self-focus is dispositional (i.e., a stable personality trait), it is referred to as self-consciousness; however, when self-focus is situational (i.e., a state that can be manipulated), it is referred to as self-awareness [201]. Increased private self-focus tends to intensify and crystalize affect, motives or standards that are salient to an individual. Conversely, public self-focus heightens a person's perception of themselves as subject to the evaluation of others—thus they experience appraisal apprehension and may attempt to modify their behaviour to meet the expectations of others, even if these expectations are incongruent with their own individual standards [194].

2.1.3.1.1. Inducing self-awareness

Although self-consciousness is a personality trait, situational self-awareness can be induced in a variety of ways. For example, by hearing a recording of your own voice [202], seeing your image in a mirror [72], being in the presence of video cameras [202], or being in front of an audience that makes eye contact with you [203]. Laboratory studies that induce heightened self-awareness often use mirror manipulations. For example, Carver [70] used a mirror manipulation on a sample of participants who condoned punishment and found that the presence of the mirror increased the intensity of an electric shock that participants administered to a confederate. The authors explained that the mirror manipulation directs attention toward the self, and that increased self-awareness facilitates aggression in angry people by making them more aware of their angry affect. Interestingly, the presence of a mirror did not affect the shocks that were administered by those who do not condone punishment. In mirror manipulations, researchers

tend to justify the presence of the mirror with a cover story; however, in the case of video chat, the presence of the video feedback is expected and does not need to be explained or justified. Because mirror manipulations have been used to induce both public self-awareness (generally using full-length mirrors) and private self-awareness (generally using small mirrors of the face and head) [194], it is presently unclear what effect video feedback will have on self-awareness in the context of video chat.

2.1.3.1.2. Effects of self-awareness

When people are more self-aware, they become more conscious of their own presence, attributes, and emotions [204]. Carver and Scheier [204] demonstrated that in the presence of a mirror, participants low in trait self-consciousness completed sentences with more self-focus than external-world focus. Mirror manipulations have also been shown to thwart intrinsic motivation, as they involve a controlling form of external regulation [71]. Self-attention generated through praise [205] appears to increase the effort made by participants, but can impair skilled performance. This negative effect of self-awareness is not surprising as previous research has shown that people high in the self-consciousness trait (which often shows effects similar to manipulating self-awareness) are more susceptible to choking under pressure due to the increased conscious attention to the self that disrupts automatic execution [206].

2.1.3.1.3. Self-awareness in social interactions

Self-awareness also affects our interactions with others. In 1959, Goffman [207] argued that when an individual is interacting with another and attending fully to that interaction, then things progress smoothly; however, if that individual instead becomes focused on themselves, then their attention and concern could be shifted away from the interaction itself toward how that interaction will be perceived by others. This increased concern with how one is being perceived could greatly affect the interaction between two individuals. Fenigstein [69] tested this idea and showed that increasing self-awareness (using a mirror manipulation) of two female participants increased responsiveness to the evaluations of others—specifically, it heightened negative response to negative evaluation and increased positive feedback to positive evaluations. In the context of CMC, Joinson [73] manipulated self-awareness by presenting a video feed of a participant on their own display—this video was not transmitted anywhere—and showed that increased private self-awareness, combined with lower public self-awareness increased

spontaneous self-disclosure during a text chat. In our research, we manipulate self-awareness by presenting feedback of the participant in the video chat interface and measure the impact on communication.

2.1.3.2. Social anxiety

Video chat is valuable in satisfying the need for relatedness [16, 14, 12, 4], but its benefits might not be accessible to all users. Some people find socializing challenging because they experience a high degree of fear and unease in social situations [208, 209], known as *social anxiety*. Social anxiety is characterized by a fear of situations that involve interactions with unfamiliar people and intense concerns about the associated scrutiny and potential for negative evaluation [74]. In the U.S., prevalence of social anxiety disorder is 7.1% (past year) or 12.1% (lifetime) [210]. However, a severity spectrum is the most accurate depiction of social anxiety; one can experience a high degree of social anxiety but not meet the diagnostic criteria for social anxiety disorder [211].

Socially anxious people experience greater difficulties forming and maintaining relationships [208, 212]. As a result, these individuals tend to have fewer close friends [213] and are less accepted or even ignored by others [214, 215]. They also have a greater risk of being bullied [216, 217] and differing levels of social competence that can lead to victimization by others [218]. In higher-disclosure situations, people with social anxiety do not reciprocate and increase self-disclosure [219]. Untreated, social anxiety can lead to more mental health challenges, including depression [220] and unhealthy coping strategies such as substance abuse [221].

Several models [222, 211, 223, 82] indicate self-focused attention is an essential component in maintaining social anxiety. People with social anxiety hold firm beliefs about the importance of making a good impression on others [82] and worry about coming across badly [224, 225], but fail to satisfy their own expectations [226, 227]. Social situations are interpreted as a threat and lead to a chain of cognitive, affective and behavioural responses [228, 229, 211]; these responses include shifting to an internal focus of attention, using internal information to infer how one appears to others, engaging safety behaviours [230], and worrying before and after socializing [231]. The negative internal inferences play a causal role in the experience of anxiety during social situations [232].

2.1.3.1. Social anxiety and digital interactions

The effects of social anxiety can also occur in digital context. As with face-to-face communications, socially anxious people experience more negative emotions and fewer positive emotions across CMC mediums [233]. Research has been inconclusive on whether social anxiety is associated with higher use of CMC [234, 233], but it does appear to be associated with a preference for CMC compared to face-to-face communications [235, 234].

Some research has addressed the use of video chat specifically by people with social anxiety. As expected, video chat increases state anxiety among socially anxious people [236]. Research suggests socially anxious people generally do not spend more time looking at the feedback in video chat than non-anxious people [236], though a study of women speaking to a male confederate found that those higher in social anxiety looked at the feedback more when the confederate was critical and less when asking the confederate questions compared to those low in social anxiety; further, time spent looking at the feedback predicted self-rated anxiety [237].

2.2. Relationships: maintenance, self-disclosure, trust

2.2.1. Relationships: types and maintenance

Relationships are fundamental to our life satisfaction [1], health [2], and well-being [3]. Feeling related to others is an intrinsic motivator—an innate human desire [4]. People have many types of relationships, including friendships, family ties, romantic partnerships, and colleagueships.

To enjoy the benefits of relationships, people must sustain social ties; this process of *relationship maintenance* [5] occurs through *relationship maintenance behaviours* [5]. Researchers have catalogued many such behaviours [6, 7, 8, 9], such as positivity, openness, sharing tasks, and sharing social networks. Research shows that some maintenance behaviours are strategic (“invoked with the conscious intent to sustain the relationships”) while others are routine (“taken-for-granted, seemingly mundane, trivial, yet regularly occurring behaviours ... not used intentionally for maintenance purposes”) [9]. One behaviour consistently identified as contributing to relationship maintenance is time spent sharing activities (e.g., [8, 7, 9]).

Relationship maintenance is a valuable perspective for designing tools to support people in enacting relationships remotely, as it describes how relationships are built and sustained. Specifically, relationship maintenance is defined as keeping a relationship in existence, in a specified condition, in satisfactory condition, or in repair [5]. Maintenance occurs in all relationship types, through behaviours such as togetherness communication, openness, and sharing tasks [5], but research focuses on friends, families, and romantic partners [5].

Much research and design work has sought to create tools for maintaining relationships over a distance. Many such tools focus on low-bandwidth communication for maintaining awareness or sharing activities. For example, some systems use synchronized devices such as lamps, trash bins, TVs [94], and cups [95] to allow users to stay aware of each others' routines; other systems use vibrotactile cues [96] or specialized displays [97] to allow users to stay aware of each others' whereabouts. Still other systems allow users to send signals not transmitted by standard CMC tools, e.g., the physical sensation of a kiss [238], or drawings on the body of a remote partner laying in bed [239]. Reviewing 143 artifacts for creating relatedness when separated, Hassenzahl et al. found six strategies employed by designs like these: awareness, expressivity, physicalness, gift giving, joint action, and memories [240]. Such strategies replicate individual aspects of sharing a physical space, particularly by staying aware of others' activities around the home and making small communications with little effort. Combining multiple such designs may even create a broader range of options, but bundling designs that target specific behaviours for maintaining relatedness still creates a patchwork of possible communications that do not easily flow from one to another. For example, becoming aware that a friend is sitting for a cup of tea when physically co-located could be an opportunity to ask for an opinion, show a recently taken photo, or grab a deck of playing cards; becoming aware that a friend is sitting for a cup of tea through an awareness system when physically apart has inherent value, but does not create an opportunity for frictionless chaining of other relationship maintenance behaviours. Of the six strategies, joint action may have the most potential to create flexible usage and incorporate a variety of behaviours. As Hassenzahl et al. [240] note, co-location creates "frequent, strong, diverse, and enduring" behavioural interdependence while people separated by distance "act autonomously and their behaviors have no impact on the other"; though it is joint action that can create behavioural interdependence, current use of the strategy by designers is "rather restricted."

2.2.2. Self-disclosure and relationship maintenance

Because communication and openness are key methods of maintaining relationships, research regarding self-disclosure provides a valuable lens on how relationships can be enacted and supported. Self-disclosure is particularly relevant to distance-separated relationships, because these relationships are typically maintained through communication and self-disclosure rather than shared activities [91].

This work considers self-disclosure a fundamental concept for digital relationships and seeks to measure it, so it is important to define self-disclosure more precisely. Jourard provided one of the most basic definitions of self-disclosure: “the process of making the self known to other persons” [241]; while certainly capturing the overall meaning of self-disclosure, this definition leaves some open questions. First, does *intentionality* play a role in self-disclosure? While unintentional acts could be considered self-disclosure, theoretical interest in self-disclosure has centered around “deliberate” [242] or “willful” [115] self-disclosure. However, researchers of online self-disclosure have noted that online platforms can reduce individual control over the information disseminated about them [126], suggesting an increased importance of unintentional self-disclosure in online contexts. Second, does the *medium* of communication matter? Derlega and Grzelak [243] defined self-disclosure as “any verbal message that formally begins with the word ‘I’ (for instance, ‘I think,’ ‘I feel’) or any other verbal message about the self”; Wheelless and Grotz [244] more broadly consider self-disclosure “any message about the self that a person communicates to another”. The distinction is particularly relevant in digital communications, where sharing online media such as photos, videos, and links is a prevalent form of communication (e.g., social media platforms [148, 245, 246, 247] and text messages [248, 249, 150]). Researchers focusing on online self-disclosure have tended to use the broader interpretation, which better encapsulates the variety of ways people communicate online. For example, Mazer et al [126] consider “pictures, [posts about] hobbies, and messages” shared on Facebook as potential communicators of self-disclosure; Kim and Dindia [250] highlight shared pictures as “a central component of online self-disclosure.” Given our focus on online interactions, we define self-disclosure as *making information about one’s self available to others*. While broad, this definition reflects the fact that online self-disclosure can occur in a variety of ways and that the role of intentionality is less clear in online interactions.

Beyond defining self-disclosure, researchers have defined many ways in which self-disclosure can be characterized. Derlaga et al. [21] list *privacy regulation* (the degree of control both parties have over the protection and ownership of the information), *truthfulness*, *informativeness*, *effectiveness* (“how successful the discloser and the disclosure recipient are in accomplishing important goals via their behaviors, e.g., developing a closer relationship or keeping a social distance from the other person”), *content*: (facts about one’s self vs. subjective opinions and feelings, info solely about one’s self vs. info about relationships and interactions with others), whether it is *personalistic* (uniquely intended for a recipient or intended for anyone), and *responsiveness* (“how much each person's reactions are perceived as understanding, validating, and caring”). Wheelless [114] lists *intent* (conscious choice to disclose), *amount*, *positiveness*, *depth*, and *honesty*. While not exhaustive, these two lists illustrate how numerous the theoretical facets of self-disclosure are.

Research about whether self-disclosure is higher in CMC than face-to-face has been inconclusive [251, 250], but several specific factors (e.g., anonymity, visual anonymity, and lack of eye contact) are associated with higher self-disclosure in CMC, including spontaneous self-disclosure [73, 106].

2.2.2.1. Measuring self-disclosure

Studies of CMC interactions have used multiple methods of assessing self-disclosure. One method is counting of pronouns or self-references (e.g., “I”, “my”) either directly (e.g., [252, 127, 128, 253, 129]) or as part of a machine learning model (e.g., [254, 255, 256]). A second method is expert coding (e.g., [73, 257]). A third method is questionnaires (e.g., [115, 113, 118, 119, 258, 120, 121, 123, 125, 116])

2.2.3. Self-disclosure and trust

Trust represents a person’s “willingness to be vulnerable based on positive expectations about the actions of others” [259]. Trust is a vital component of many types of relationships. For example, trust is important for satisfaction in romantic relationships [28, 27] and effective team functioning [25, 26].

Video chat is used both to maintain existing relationships and to connect with others for the first time. People may meet via video for many reasons, such as joining a distributed team,

consulting a medical professional, or engaging in a virtual first date. In all these situations, forming trust is important: trust is key to team functioning [25, 26], doctor-patient relationships [260, 261], romantic partners' satisfaction [27, 28]. Researchers have specifically recommended more CSCW researchers consider how CSCW tools can support trust [262, 263].

Self-disclosure plays a key role in building trust: receiving and reciprocating self-disclosure allows people to learn about each other and create trust, facilitating further disclosure [24]. Icebreakers are a popular tool for aiding people in getting to know each other and forming trust; a frequently cited goal of icebreaker activities is eliciting self-disclosure [34, 35, 36]. This is consistent with Social Penetration Theory, which argues that self-disclosure is the mechanism through which relationships are initiated and strengthened [107]; Knapp's Staircase model of relationships [108], which stresses self-disclosure's usefulness in assessing compatibility for deepening of new relationships; and Uncertainty Reduction Theory [109], which indicates that prompting for self-disclosure is a way of lessening discomfort due to uncertainty in new relationships.

Beyond situational factors (e.g., the amount of self-disclosure in the conversation), some individual traits may affect the formation of trust and closeness in new relationships. The most obvious such factor is propensity to trust, i.e., a person's general readiness to trust other people [264]. Another factor previous research has identified as affecting outcomes in icebreaker exercises is agreeableness, a personality trait with characteristics including "forgiving attitudes, belief in cooperation, inoffensive language, [and] reputation as a pushover" [265]. Depping et al. found that discussion-based icebreakers are less effective than alternative activities when agreeableness is low [32].

2.2.3.1. Warranting

In digital contexts, Walther and Parks [266] define *warranting* as the ability to connect a person's online presentation to a physical body (or "corporeal self"). This definition raises two important concepts: the ability of a person's online presentation to differ from their physical self, and the existence (or absence) of contextual cues that enable observers to assess these differences. Walther and Parks suggest when people receive disclosures in digital communications they must assess the warranting value of the information, i.e., whether it was communicated in a way that allows it to be verified. Initial conceptions of warranting considered

explicit verification of information by others as the main indicator of warranting [267], but the meaning of the term has broadened to include “any cue that authenticates or legitimizes an online self-presentation” [44]. When more cues or indicators about the truthfulness of information are present, the information is said to have higher warranting value. For example, information about a person provided by a third party can be perceived as having greater warranting value than information provided by a person directly [268]. People may take advantage of increased warranting value by sharing links to information about themselves provided by a third party [269], sharing information that is verified by others involved in the information [270], or sharing specific information that is perceived as easy-to-verify (as the receiver can assume that the sharer would not lie about something that could easily be verified) [271]. In all these cases, warranting value is higher because cues are present that help the receiver to assess the truthfulness of the information. According to warranting theory, the presence or absence of these cues moderates the effects of self-disclosures [44]; therefore, warranting value is important for supporting trust formation via self-disclosure.

2.3. Shared activities

2.3.1. Shared activities for relationship maintenance

Shared activities are tasks, hobbies, entertainment, or games done with others, for example house-cleaning, cooking, eating, reading, playing games, watching television [12], walking, hiking, sports [272], listening to music, or browsing the web [273]. Activities are a common way of maintaining relationships. People engage in parallel activities (e.g., one person cleaning while another cooks) or shared activities (e.g., going for a walk or watching a movie) both face-to-face and remotely, but sharing activities can be more challenging when remote [12, 274].

Shared activities can support relationship maintenance because they allow people to engage in relationship maintenance behaviors such as positivity, openness, offering assurances, managing conflict, and sharing tasks or chores [275].

2.3.2. Shared activities over a distance: support and interfaces

With the rise of CMC, researchers have studied how relationships can be maintained remotely. This supports friends and family who want to maintain awareness [276] and closeness

[277] when separated by distance and the many proximate relationships, particularly among young people, using CMC as a major communication method [278, 14, 279].

Unlike face-to-face relationships, most opportunities for remotely maintaining relationships via shared activities are asynchronous. On social media sites, these include ‘passing of virtual tokens’ like images, videos, and quizzes [280] and asynchronous games with turn-taking, item request, and high score mechanics [281]. CMC can enable richer, synchronous shared activities that contribute to relationship maintenance, such as multiplayer gaming. Relationship maintenance actions in online gaming predict closeness in friends who communicate less via other means [282], and frequent online gamers have identified relationship maintenance as a motivator for their internet use [283]. Beyond gaming, some prototypes exist for sharing other activities synchronously. These include systems for distributed families [98] (using a tablet, camcorder, and tripod for sharing children’s outdoor activities), for parents and grandparents [99, 100] (integrating video chat with reading or play), and for enriched context sharing [101, 102] (via linked cameras and photo frames). Video chat users want to share activities: a survey found that 57% share activities via video and 71% feel shared activities give a sense of togetherness [93]. However, even synchronous video chat systems do little to support the breadth of activities that people share to face, which has led to ad-hoc solutions for activities in video calls, including cooking, visiting pets, playing instruments [93], eating, watching movies, playing video games [12], and sharing everyday routines [277]. This has spurred calls for system-supported activities [93, 284, 285, 274], which can be used to enact relationships [286].

A desire for shared activities in video chat is unsurprising. Users of standard video chat (i.e., talking heads [90]) can feel self-conscious when seeing themselves [13, 92] or feel that the close views create an ‘emotional weight’ not experienced in person [93]. Shared activities in video chat may reduce focus on these issues, creating a more natural experience, just as people share myriad activities in person beyond talking. Further, just as sharing activities—even “trivial” or “mundane” routines—plays a large role in maintaining relationships face-to-face [9], sharing activities in video chat may provide a context where a variety of relationship maintenance behaviours are prompted or expressed naturally within the context of an overarching activity.

2.3.3. Media sharing as a shared activity

2.3.3.1. Current uses of media in communication

Our goal of creating a software-based shared activity that offers flexibility and integration with communication led us to focus on media sharing. Media sharing is an especially interesting activity because media plays a dual role in communication. Media's more direct role is as a medium for communicating. In social media and text chats, emoji [287], stickers [288], images, and reaction gifs [289] can add emotion. On social media sites, media is a medium for communicating aspects of people's online personae [151]. As a communication medium, media is particularly compelling because usage is flexible and users frequently appropriate media. Unintended and personalized usage has been observed in emoji [290, 291], stickers [288], photos [147], and other graphics [292].

The second role of media is giving context to conversations through other mediums. In face-to-face contexts, sharing music [146] and photos [137, 138] can create a basis for conversation. As Chalfen [140] explained, "pictures don't 'say' anything"; "the common statement that pictures 'say' something is shorthand for a social process" (pg. 121-122). TV can support conversation too. A survey [141] finding 40% of TV viewers talk during shows and 20% discuss them later concluded that TV can act as "a social facilitation device, to provide a context for gathering together." Talking during or about TV is also common, e.g., among children [142], co-located couples [143], and Twitter users [293, 294]. Media's role is particularly diverse online [295]: it can create new conversations [296], groups [297], and even interactions (e.g., live streaming [298, 299]).

2.3.3.2. Online media's potential as a shared activity for maintaining relationships

While we are inspired by the social potential of media, we also reviewed previous prototypes that added remote social experiences to TV, evaluating the ability of users to attend to both conversation and viewing. A study [300] of the AmigoTV system [301] found audio communication more preferred than text. Another study [302] found that users can navigate audio communication during TV. Yet later work [303], using the STV3 prototype, found mixed preferences for audio and text communication, and a final study [304] found text easier to use. Research adding video chat to TV [284] found it can be enjoyable, but the most successful configuration relied on pre-recorded shows and a second screen for video chat. The study found

complexity, synchronization, and audio echo as barriers. In sum, mixed results and low adoption suggest TV does not readily support higher-fidelity remote social experiences.

Several factors make online media well suited to address barriers that limited TV's success as a synchronous shared activity. First, most online media is available for free and on-demand. Second, online media provides many options (e.g., the 400 hours of video added to YouTube each minute [305]), which facilitates tailoring to different relationships [306] and appropriation. Finally, online media is shorter in form. As most TV content is 30-60 minutes, social TV viewers constrain conversation timing, length, and volume to fit the program, and off topic ('Non-sequitur') comments can negatively affect the experience [302]. By contrast, most YouTube videos range from seconds to 10 minutes [307, 308]. The end of short videos is a natural place for interaction; in a study [309], social viewers given 1-minute breaks between short videos increased their pace of messaging during breaks. Online media's suitability for social viewing is confirmed in practice—a survey found social viewing as a motivator was associated with a lower likelihood of viewing TV compared to online video [310]. Additionally, research systems have successfully allowed synchronous remote viewing of some online media in the context of text-based communication [311, 312, 309].

Despite the suitability of online media for social viewing, in the context of video chat barriers remain for synchronous remote sharing using existing tools. In the case of videos, these include splitting a screen between media and video chat, manual synchronization, audio feedback [12], initiating the experience, choosing content [284], and synchronization offsets that can 'ruin' the experience [279]. These barriers have led to calls for integrated tools [313, 284]. Even in work contexts, where many video chat collaboration tools exist [17, 131, 132, 133], there are calls for better media sharing tools [134]. Due to these barriers and calls, we support our study with a novel video chat system that integrates synchronous media sharing. This allows us to explore the potential of well-supported and flexible activities for enacting and maintaining relationships online.

2.4. Measures

The studies in this thesis use a variety of measures to understand how video chat supports relationships. These measures fall into five categories: long-term traits of participants,

momentary states of participants, experiences in a single interaction, characteristics of a relationship, and conversational measures; the first four of these categories include questionnaire-based measures, while the last includes objective measures of a conversation. Complete copies of these measures are available in Appendix B.

2.4.1. Traits

Trait measures assess aspects of people that are expected to be relatively stable over long period of time (i.e., months to years); we used the following trait measures:

- **Ten Item Personality Index: Agreeableness** [314] This scale assesses the big five personality factors. Our research used only the two items for agreeableness.
- **General Disclosiveness Scale** [114] This scale measures a person's general propensity to self-disclose on five dimensions: intent, amount, positiveness, depth, and honesty/accuracy.
- **General Trust Scale** [264] This scale measures a person's general propensity to trust others using six items (e.g., "Most people are trustworthy").
- **Liebowitz Social Anxiety Scale, Self-Report (LSAS)** [315] This scale measures social anxiety using 24 items representing common social situations (e.g., "Speaking up at a meeting"). All items are scored twice: once for how much fear the person would experience in that situation on a 4-point scale from "none" to "severe" and a second time for how often the person would avoid that situation on a 4-point scale from "never (0%)" to "usually (67-100%)". Total scores range from 0-144. Research suggests that the self-report version of the scale is a useful screening tool for social anxiety and, like the clinician assessed version, a threshold score of 30 is useful for distinguishing between non-anxious and anxious people [316]. For reference, larger scale studies have found mean scores of 44.07 among 31,243 cross-cultural participants [317] and 34.7 among UK college students [318].

2.4.2. States

State measures assess aspects of people that are expected to fluctuate even in a short time period (e.g., over the course of minutes or hours); we used the following state measures:

- **Situational Self-Awareness Scale** [44] is a 9-item scale that measures self-awareness along three dimensions: private, public, and surroundings. Public self-awareness measures how much people are concerned about the way others are viewing them, e.g., “Right now I am self-conscious about the way I look”. Private self-awareness measures the consciousness of a person’s own thoughts and feelings, e.g., “Right now, I am aware of my innermost thoughts”. Self-awareness of surroundings measures a person’s awareness of their environment, e.g., “Right now, I am conscious of what is going on around me”. This scale has been used to measure state changes in self-awareness, for example, as a result of using a mirror manipulation [44].
- **State-Trait Anxiety Inventory: State Subscale** [319] The state subscale of this instrument measures anxiety at the time. It includes 20 items (e.g., “I feel at ease”), and was scored on a 7-point Likert scale. Instructions ask, “how you feel right now, that is, at this moment”. To distinguish from social anxiety (a trait), we refer to state anxiety after the call as ‘experienced anxiety’.

2.4.3. Experiences in an interaction

Measures regarding one’s experience in an interaction ask people to think back about a specific intervention and rate different aspects of the experience; we used the following experiential measures:

- **Post-Experimental Intrinsic Motivation Inventory** [4, 320] This scale measures enjoyment, perceived value, and satisfaction of the need for relatedness after a specific experimental intervention. The relatedness subscale in particular includes eight items (e.g., “I feel close to this person”; “It is likely that this person and I could become friends if we interacted a lot.”).
- **Measure of Perceived Self-Disclosure** This scale measures how much self-disclosure a one perceives another person made in a single conversation or intervention using five items. It is developed as part of this thesis to support investigations of video chat; for details, see CHAPTER 5.
- **Measure of Perceived Self-Disclosure: ad-hoc version** This scale is a preliminary version of the previous measure. The scale includes six items, all of which were part

of the item pool used to develop the final version of the measure. The ad-hoc version of the Scale was used in Study 2; its successful application within Study 2 prompted the development of the formalized version described in CHAPTER 5.

- **Measure of Perceived Warranting** Existing measures relating to warranting focus on deceit [321] or focus on specific cues that are relevant in social media contexts but not expected to vary in a one-to-one chat (e.g., whether the person could influence or control what information is available) [322]. Therefore, to support our research we constructed a cue-neutral measure including three items that focus on the ability to determine whether self-disclosure was accurate regardless of specific cue. Three items are included: “It was easy to determine whether the information I learned about this person was truthful, exaggerated, or made up”; “I could tell whether the information I learned about this person was an accurate picture of their real life or not”; and “I could easily identify which information I learned about this person was true and which information was not true.”
- **Relational Communication Scale** [323] measures emotional and relational aspects of communication (e.g., depth and involvement), which previous research suggests are distinct from its content [324, 325]. We included the following sub-scales, which were assessed through 50 items: Involvement, Affection, Similarity, Depth, Receptivity, Composure, Formality, and Task versus Social Orientation. The first five constructs relate to the intimacy of the conversation. The scale asked users to rate their own actions in the conversation, rather than their partner’s, e.g., “I was interested in what he/she had to say”.

2.4.4. Relationships

Measures regarding relationships ask people to think about a specific relationship and rate different aspects of the relationship; we used the following relational measures:

- **Interpersonal Trust Scale** [32] This scale measures interpersonal trust and is suitable for loose platonic relationships [32]. It includes 11 items (e.g., “I would be willing to let this person make decisions for me”; “This person would treat me fairly and justly”; “This person would be honest and truthful with me.”).

- **Friendship Maintenance Scale** [326] This scale measures frequency of maintenance behaviours including positivity, supportiveness, openness, and interaction.
- **Basic Psychological Need Satisfaction Scale: Relationship Domain** [327]. Measures satisfaction of basic needs in the relationship.

2.4.5. Conversational measures

Conversational measures are computer measures based on the content (i.e., words or timing) of a conversation; we used the following conversational measures:

- **Microsoft Azure Speech to Text Service** [328] This tool allowed us to machine-transcribe audio recordings from our studies.
- **Linguistic Inquiry Word Count (LIWC)** [329] This tool allows for semantic analysis of text, including transcriptions of a conversation, by counting how often words from different categories appear in a corpus of text. In our studies, we use a variety of metrics measured by LIWC. These include overall word count, pronouns (1st person pronouns, 2nd person pronouns, and other types of pronouns), and words relating to anxiety, social orientation, agreement, and gender (i.e., affect, positive emotions, negative emotions, anxiety, social, affiliation, friends, negate, compare, interrogate, discrepancy, tentative, certainty, difference, assent, female, male).

SECTION 2. VIDEO CHAT INTERFACES

CHAPTER 3. VIDEO CHAT INTERFACES AND SOCIAL EXPERIENCES

3.1. Citation and role of collaborators

This work was published at the ACM CHI Conference on Human Factors in Computing Systems; the full citation is:

Matthew K. Miller, Regan L. Mandryk, Max V. Birk, Ansgar E. Depping, and Tushita Patel. 2017. Through the Looking Glass: The Effects of Feedback on Self-Awareness and Conversational Behaviour during Video Chat. In Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (CHI '17). Association for Computing Machinery, New York, NY, USA, 5271–5283. DOI: <https://doi.org/10.1145/3025453.3025548>

🏆 Received Honourable Mention for ranking in the top 5% of submissions at the conference

Several authors contributed to this work. All authors worked together to generate research questions, develop a study plan, select measures, analyze results, and write findings and discussion. I was primarily responsible for system development, data collection, and data processing; Dr. Birk provided the survey system and helped oversee data collection.

3.2. Research contributors

Although seeing your own video feedback is the predominant interface design in video chat, self-awareness research suggests that seeing oneself could induce self-consciousness and affect interaction. Testing for these effects is an important step in addressing this dissertation's problem statement regarding the unintentional effects of video chat interfaces. Therefore, we created a custom video chat application and asked pairs of strangers to engage in an online personal information exchange task with or without video feedback.

Through this study, we make several contributions. First, we show that visual feedback in video chat interfaces increases self-awareness and affects a person's perceived ability to relationally communicate. Second, we show that visual feedback increases social

accommodation in conversation—particularly for mixed-gender dyads. Reduced expressions of conviction and discrepancy and increased expressions of social affiliation suggest that participants were more concerned with how others perceived them when they could see their own video feed. Third, we discuss how the increased conversational accommodation when feedback was provided—particularly for mixed-gender dyads—has implications for the design of video chat interfaces in contexts from remote therapy to online dating.

3.3. Background and motivation

This study establishes interface design as an important factor in people’s experiences with video chat. We focus on one interface element—video feedback—that some people find distracting [68] or at times unnecessary [66, 67]. Because this element has become a standard part of video chat interfaces, understanding its effects is critical both for making informed decisions around switches from face-to-face to remote communication and data-driven designs for future video chat interfaces.

3.3.1. Research questions

Using our custom browser-based video chat system and connected pairs of strangers in an online experiment either with feedback of themselves or without. Our work was guided by our five main research questions:

- RQ1.** Does seeing themselves increase self-awareness?
- RQ2.** Does seeing themselves affect their perceived ability to relationally communicate?
- RQ3.** Does seeing themselves affect the conversation itself?
- RQ4.** Do subjective differences resulting from visual feedback depend on the type of dyadic pairing?
- RQ5.** Does seeing themselves differentially affect the conversations of same- or mixed-gender pairings?

3.4. Study 1

3.4.1. System

To study how people react to seeing their own video feedback, we needed a system that allowed us to manipulate the feedback interface and present the participants with discussion topics. Further, we needed a system that worked within a web browser to give us flexibility in testing with online participants who have different systems and setups.

Modern browsers support the WebRTC standard, which facilitates interoperable, standards-based peer-to-peer data transfer. This allows for the creation of native video chat software on the web. However, a peer-to-peer architecture does not lend itself to recording the video data, which we needed for subsequent analyses. To enable recording the videos, we used Kurento Media Server [330]. Kurento Media Server can establish WebRTC connections to multiple clients and act as a go-between, which also records all the data. We used node.js to host the webpages and other content for the video chat website. Both Kurento Media Server and node.js ran on an Ubuntu 14.04 server. Participants were asked to complete the task using Chrome or Firefox browsers, which support the WebRTC standard.

3.4.2. Video chat task

The video chat client page featured a large preview of the remote partner's video, and a smaller preview of the local user's video, which is configurable in our system. Beside the video was a small text block, which was synced between both participants. This allowed us to present discussion questions to participants as they chatted. During the video chat, participants were presented with common icebreaker questions. The complete list of questions used is included in Appendix A. We created the list from a variety of online sources of social icebreaker questions as well as including our own questions. The questions were designed to facilitate conversation; however, we did not include questions that were very personal in nature or inward-facing (e.g., What do you really like about yourself? What is your earliest memory?). We did not want to induce self-awareness through the questions themselves, as participants were likely to progress through the discussion topics at different paces.

A “next” button allowed users to move on to the next question when they were ready. When participants clicked the ‘next’ button, the system advanced to the next question for both the local and remote participants. Once either user clicked the “next” button, it was disabled for 20 seconds; this feature helped pace the conversation and we included a sufficient number of questions so that participants would not run out of topics before the conversation time ran out. After 8 minutes of conversation, a warning was shown that the video chat would be ending soon and they should say goodbye. We included this feature after pilot studies revealed that participants sometimes connected with each other during the chat and wanted a chance to wrap up the conversation and say goodbye. After a further 20 seconds, the video chat ended and users were redirected to the post-study surveys.

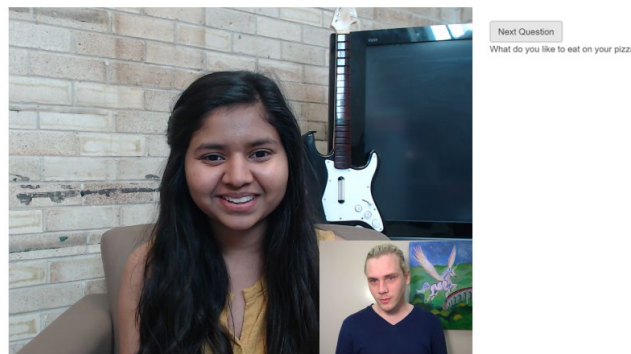


Figure 3. The video chat system with the optional local preview turned on.

3.4.3. Experiment conditions

Our experiment was designed to study the effects of video feedback. Participants were placed in pairs, and each pair was assigned to one of the two feedback conditions. In the feedback condition, participants had feedback of themselves during the video chat (see Figure 3), whereas in the second condition, they had no feedback. Both members of a pair were always in the same condition (either both received feedback or they both did not).

3.4.4. Measures

We used three measures: the Situational Self-Awareness Scale, the Relational Communication Scale, and LIWC conversational analysis (see Section 1.2.4).

3.4.5. Participants

We recruited 110 participants through Amazon's Mechanical Turk (MTurk), which connects requesters of tasks with paid workers online. MTurk has been shown to be reliable as a recruitment tool for research in human-computer interaction [331]. To remove participants who did not carefully complete the surveys from further analyses, we identified careless responses by response time, response patterns and consistency metrics as suggested by Maede and Craig [332]. First, we removed participants who completed three or more questionnaires with an average response time per item under 1.5 seconds (N=10), identifying those who just clicked through without paying attention to the items. Second, we looked for zero variance cases, identifying participants who took their time but answered all items in the same manner, indicating noncompliance (N=0). Third, we calculated the variance within each subscale and removed participants who demonstrated responses more than three standard deviations above the mean variance on three or more subscales (N=13). Using these methods, we removed a total of 23 participants from subsequent analyses. After outliers were removed, 87 participants (50 female) were included in further analyses. Participants received compensation of \$10 USD and the study took an average of 25.79 minutes to complete. Ethical approval was obtained from the University of Saskatchewan behavioural research ethics board, and participants were asked to give informed consent at the beginning of the task. To comply with ethical guidelines, the task was only available to workers from the USA who were at least 18. Additionally, only workers with an approval rate above 90% were offered the task as a means of quality control.

3.4.6. Procedure

Participants completed the experiment remotely on the web. Participants first read about the study and provided informed consent. Participants then verified the system requirements, and were shown a preview of their own webcam to verify that audio and video were working correctly and they were visible in the picture. Figure 4 shows this verification interface. After verifying the requirements, participants were forwarded to a lobby page where they waited for a partner to chat with. When a partner was found, they were forwarded to the previously-described video chat page. Following the video chat, they completed the experience questionnaires (i.e., self-awareness and relational communication). They also completed demographic questions and we gathered several validated scales on traits known to interact with self-awareness (i.e.,

personality [314], basic psychological needs satisfaction [333], self-consciousness [334], and self-monitoring [335]); however, these trait scales were not used in subsequent analyses in this work.

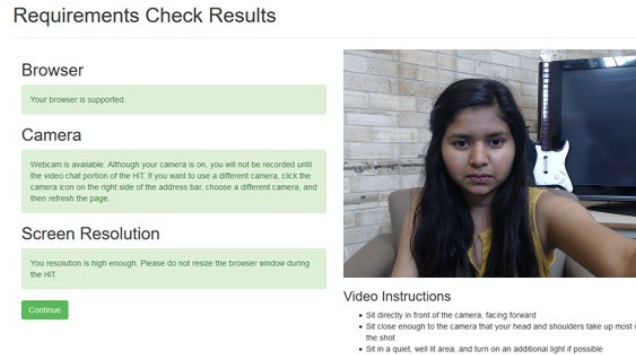


Figure 4. Checking requirements and camera setup.

3.4.7. Data analyses

Survey data were aggregated within a participant for each individual construct.

Audio files were transcribed and then processed with the Linguistic Inquiry Word Count (LIWC) tool for semantic analysis [329]. Rather than including the complete LIWC categories, we included categories that relate to anxiety, social orientation, agreement, and gender (i.e., affect, positive emotions, negative emotions, anxiety, pronouns, I, we, she/he, they, social, affiliation, negate, compare, interrogate, discrepancy, tentative, certainty, difference, assent, female, male) as related literature suggests that social orientation and agreement could be affected by self-awareness [201]; whereas, the gendered words could be affected by the gender pairing.

Data were analyzed with SPSS 24. We conducted Multivariate Analysis of Variance (MANOVA) with video feedback (on, off) and gender pairing (same-gender, mixed-gender) as between-subjects factors on the dependent measures related to subjective experience (i.e., self-awareness, relational communication), and the semantic categorization of the conversation content (see previous paragraph). Alpha was set to 0.05.

3.5. Results (Study 1)

Table 1. Means, Standard Deviations, F-values, and p-values for the two feedback conditions and the tests of main effects.

	Visible m (SD)	Not Visible m (SD)	F	p
SA of surroundings	5.44 (1.01)	4.49 (1.50)	11.43	0.00
Private SA	5.40 (0.95)	4.96 (1.32)	3.88	0.05
Public SA	4.69 (1.87)	4.71 (1.77)	0.01	0.92
Involvement	6.19 (0.64)	6.11 (0.66)	0.42	0.52
Affection	5.74 (0.76)	5.43 (0.71)	4.10	0.05
Receptivity/Trust	5.97 (0.51)	5.95 (0.61)	0.24	0.63
Depth	5.31 (0.70)	4.86 (0.80)	7.37	0.01
Similarity/Inclusion	6.00 (0.68)	5.88 (0.67)	0.72	0.40
Composure	5.67 (0.77)	5.66 (0.74)	0.01	0.95
Formality	2.43 (0.81)	2.44 (0.88)	0.03	0.87
Social Orientation	4.37 (1.05)	4.01 (1.15)	1.79	0.18
Total pronouns	22.00 (2.14)	21.21 (2.44)	3.52	0.06
I	8.00 (2.00)	8.05 (1.62)	0.00	0.98
We	0.86 (0.79)	0.62 (0.64)	1.55	0.22
You	4.49 (2.04)	4.25 (1.35)	0.94	0.34
She/He	0.68 (0.93)	0.52 (0.63)	0.72	0.40
they	0.60 (0.53)	0.53 (0.50)	0.14	0.71
Negations	1.98 (0.97)	2.21 (1.17)	1.39	0.24
Comparatives	2.36 (1.01)	2.66 (1.24)	2.19	0.14
Interrogatives	2.68 (1.28)	2.55 (0.91)	0.67	0.42
Affect Words	7.52 (2.35)	7.33 (1.60)	0.10	0.75
Positive emotion	6.41 (2.28)	6.28 (1.53)	0.07	0.79
Negative emotion	1.07 (0.70)	0.99 (0.69)	0.07	0.79
Anxiety	0.29 (0.37)	0.12 (0.26)	5.52	0.02
Social Words	10.63 (2.28)	9.73 (1.53)	4.27	0.04
Male referents	0.53 (0.64)	0.44 (0.49)	0.48	0.49
Female referents	0.50 (0.90)	0.43 (0.59)	0.09	0.77
Discrepancy	3.79 (2.07)	4.18 (1.94)	0.31	0.58
Tentativeness	5.12 (1.97)	5.19 (1.66)	0.00	0.99
Certainty	1.33 (0.59)	1.65 (0.91)	4.36	0.04
Differentiation	4.39 (1.52)	4.50 (1.30)	0.06	0.80
Affiliation	1.76 (0.94)	1.52 (0.79)	0.88	0.35
Assent	4.18 (2.56)	4.61 (2.52)	0.41	0.52

Increased self-awareness has been shown to increase sensitivity to the feedback of others in social interactions [69]; because a social conversation depends on people being responsive to their partner, it is likely that self-awareness will affect the nature of the resulting conversation.

We expect that providing feedback will increase the self-awareness of participants in a similar manner to the mirror manipulations used in self-awareness research that showed increases in private self-awareness [73, 194]. We expect that increased self-awareness will affect the subjective perceptions of participants' own conversational ability. In addition, we expected that increased self-awareness from displaying video feedback would change the conversation itself, which we operationalized with the semantic categorization of the words used.

3.5.1. Effects of feedback

We first looked at how seeing feedback of themselves affected participants' conversations. Table 1 shows the means, standard deviations, F values, and p values for the main effect of feedback on all measures.

3.5.1.1. Does seeing themselves increase self-awareness?

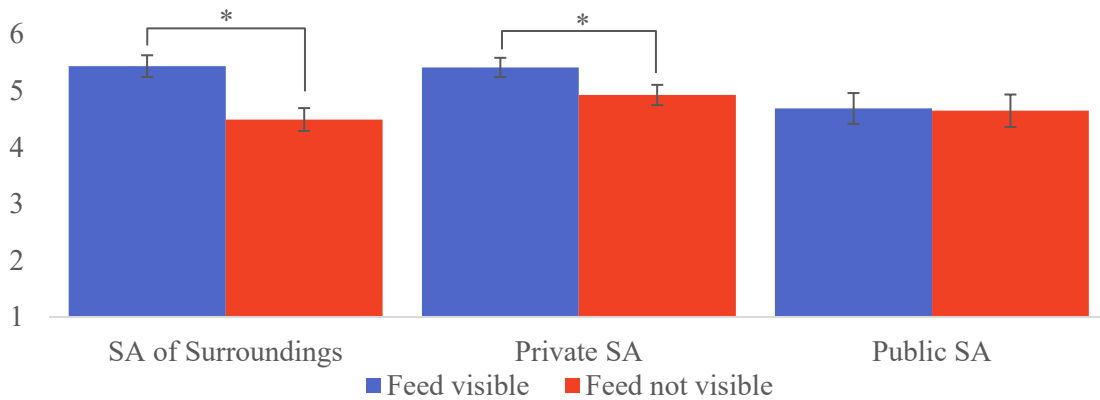


Figure 5. Mean (\pm SE) responses for the three self-awareness (SA) scales (1-7, where 7 is higher agreement), * $p < .05$.

We expected that seeing themselves would affect participants' self-awareness similar to the mirror manipulations that were used in [194]. The MANOVA showed a main effect of feedback on situational self-awareness ($F_{1,83}=11.4$; $p=.001$, $\eta^2=.12$) and a marginal effect on private self-awareness ($F_{1,83}=3.9$; $p=.052$, $\eta^2=.05$); these results are shown in Figure 5. No effect was found on public self-awareness ($F_{1,83}=.01$; $p=.921$). The effect showed that self-awareness was higher

when feedback was visible, confirming our expectations that being able to see themselves would increase the self-awareness of video chat participants.

3.5.1.2. Does seeing themselves affect their perceived ability to relationally communicate?

The MANOVA showed main effects of feedback on conversational affection ($F_{1,83}=4.1$; $p=.046$, $\eta^2=.05$) and conversational depth ($F_{1,83}=7.4$; $p=.008$, $\eta^2=.08$); these results are shown in Figure 6.

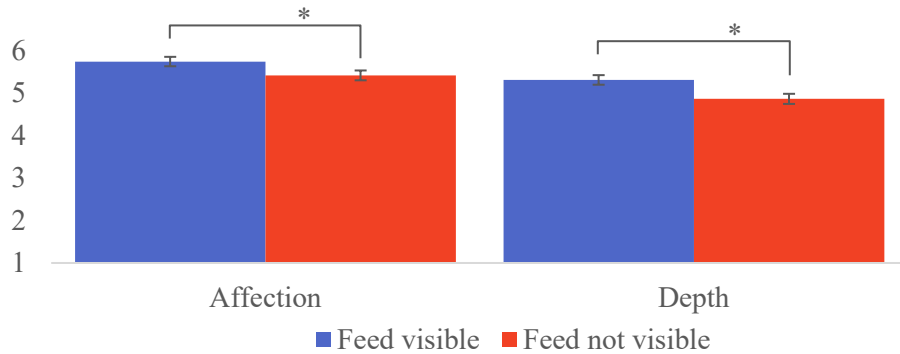


Figure 6. Mean (\pm SE) responses for the affection and depth subscales (1-7, where 7 is higher agreement), $*p\leq.05$.

The effects show that both affection and depth were higher when feedback was visible. Recall that they were rating their own contribution to the conversation, suggesting that seeing themselves helped participants feel more capable of communicating affection to their partner and speaking about topics in depth, rather than at a shallow level. There were no main effects of feedback on relational similarity ($F_{1,83}=.72$; $p=.397$), involvement ($F_{1,83}=.42$; $p=.518$), or social orientation ($F_{1,83}=1.8$; $p=.184$).

3.5.1.3. Does seeing themselves affect the conversation itself?

The MANOVA showed a main effect of feedback on several semantic categories (see Figure 7). Specifically, visual feedback increased the use of words related to anxiety, e.g., “worried”, “fearful”, ($F_{1,79}=5.5$; $p=.021$, $\eta^2=.07$) and decreased the use of words that express certainty, e.g., “always”, “never” ($F_{1,79}=4.4$; $p=.040$, $\eta^2=.05$). The use of social-facing words also increased with feedback, e.g., “mate”, “talk” ($F_{1,79}=4.3$; $p=.042$, $\eta^2=.05$). These results suggest that seeing feedback of themselves increased their social accommodation—their conversation became more social in content, and they decreased their use of terms expressing certainty. It also suggests that seeing themselves resulted in increased expression of anxiety; it is unclear whether they were

feeling more anxious or simply expressing their anxiety more. All other semantic categories were not significantly different between feedback conditions (see Table 1).

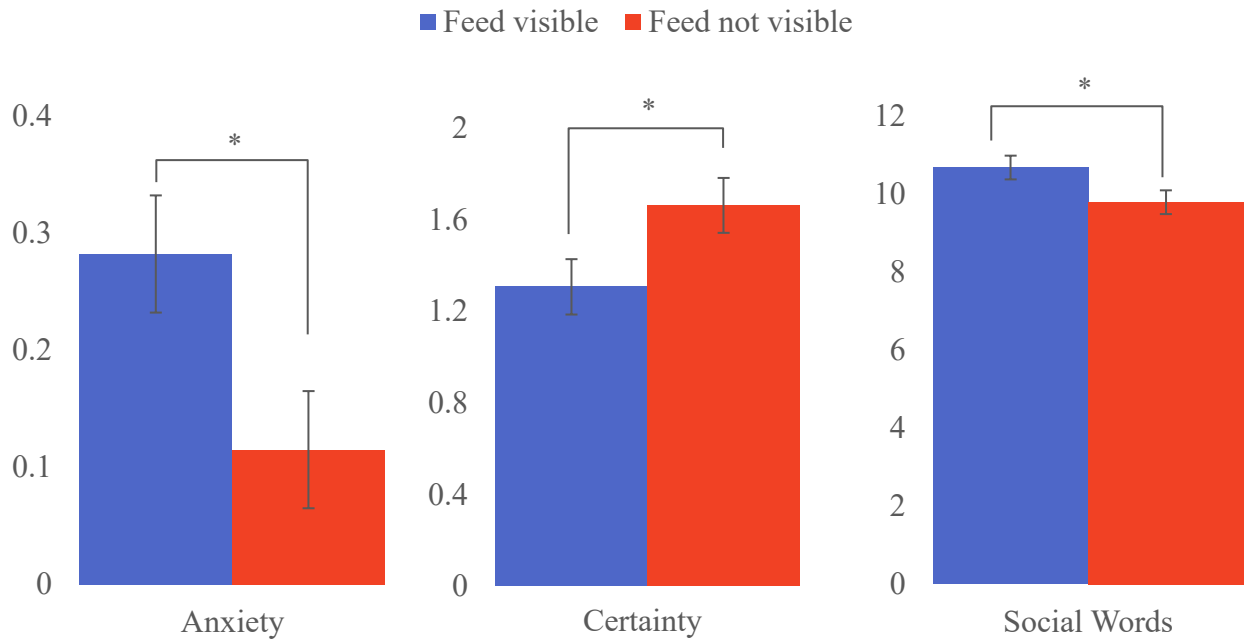


Figure 7. Mean (\pm SE) of the word counts from LIWC, * $p < .05$.

3.5.2. Effects of the dyadic pairing

Previous literature on video chat has suggested that gender dyad pairings can play a role in CMC, for example, that mixed-gender dyads had more self-disclosure in text chat [183]. We expected that the dyadic pairing would affect the interaction; however, we were more interested in how video feedback would differentially affect dyads, depending on their gender pairings.

3.5.2.1. Do subjective differences resulting from visual feedback depend on the type of dyadic pairing?

There was a significant interaction of pair type (i.e., same-gender, mixed-gender) and feedback on task versus social orientation (see Figure 8; $F_{1,83}=4.6$; $p=.036$, $\eta^2=.05$). No other scales showed a significant interaction. Pairwise comparisons show that for same-gender dyads, there was no difference in their task orientation depending on feedback; however, for mixed-gender dyads, showing the feed of themselves resulted in a significant increase in social orientation. This increased social orientation over task orientation for mixed-gender dyads

implies that those participants were more oriented toward socializing than completing the assigned task, which should also be reflected in the conversation itself.

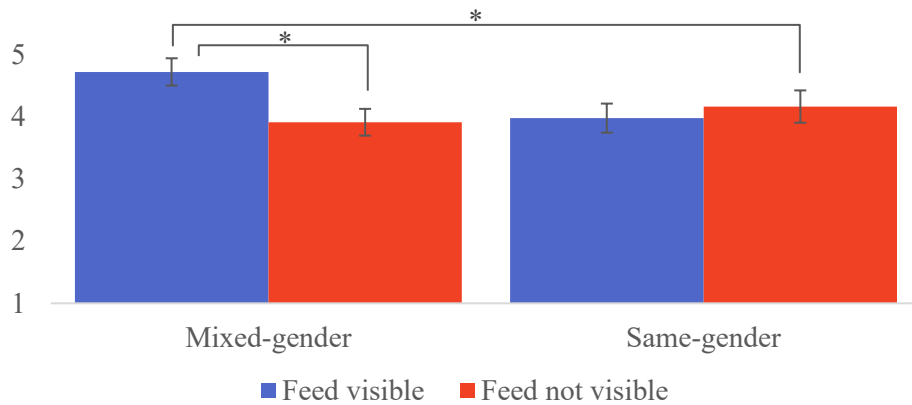


Figure 8. Mean (\pm SE) responses for task versus social orientation (where 1 is task and 7 is social orientation), * $p < .05$.

3.5.2.2. Does seeing themselves differentially affect the conversation of same-gender or mixed-gender pairings?

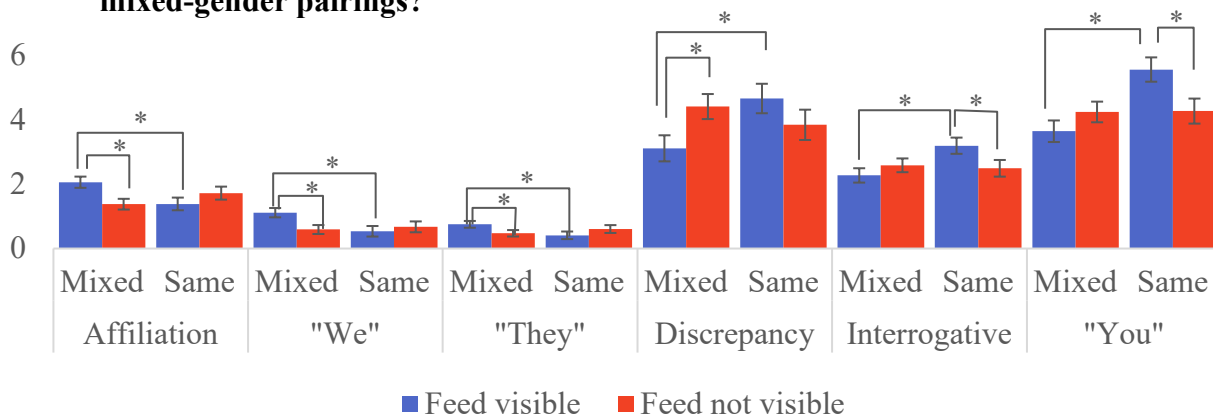


Figure 9. Mean (\pm SE) of the significant interactions of gender pairing (mixed vs same) and feedback on word counts, $p < .05$.

The MANOVA showed several interactions of gender pairing and feedback presentation on the semantic categories (see Figure 9). Mixed-gender dyads (who reported being more socially oriented when feedback was provided) exhibited a higher use of words expressing affiliation, e.g., “friend”, “social” ($F_{1,79}=7.5$; $p=.007$, $\eta^2=.09$) when feedback was present. They also had a significantly higher use of “we” ($F_{1,79}=4.6$; $p=.035$, $\eta^2=.06$) and “they” ($F_{1,79}=4.5$; $p=.037$, $\eta^2=.05$) when feedback was present, suggesting a social orientation. Furthermore, their use of

words that indicate discrepancy, e.g., “could”, was lower ($F_{1,79}=6.0$; $p=.017$, $\eta^2=.07$) when feedback was present.

Same-gender pairs showed no difference in the use of those words depending on whether or not feedback was shown. On the other hand, same-gender dyads used more interrogational, e.g., “how”, “when, words ($F_{1,79}=4.6$; $p=.036$, $\eta^2=.06$) when feedback was present and used “you” more frequently ($F_{1,79}=7.0$; $p=.010$, $\eta^2=.08$) when feedback was present. Because our task was to engage in an information exchange task, the increased use of these words suggests a greater focus on the task at hand (i.e., asking the other participants questions about themselves). There were no other significant interactions between feedback and dyad.

3.6. Discussion (Study 1)

We summarize our findings, situate them in literature, discuss their implications for the design of video chat interfaces, and present opportunities for future work.

3.6.1. Summary of findings

We have several important findings.

First, we found that visual feedback in video chat interfaces increases self-awareness.

Second, visual feedback increases a person’s perceived ability to relationally communicate.

Third, visual feedback increases social accommodation, as seen in reduced expressions of certainty and greater use of socially-focused expressions.

Fourth, this increased social focus is particularly strong for the mixed-gender dyads, who had increased ratings of social orientation over task orientation when visual feedback was present. This social orientation was reflected in their reduced use of expressions of discrepancy and increased use of expressions of social affiliation.

Fifth, the same-gender dyads showed more task focus when feedback was provided, which was reflected in their greater use of task-related words with feedback than without.

3.6.2. Explanation of findings

Our results show increases of social accommodation—operationalized by increases in subjective ratings and conversational behaviour—when participants saw video feedback during conversation. These results suggest that participants were more concerned about how others perceive them when they could see themselves. Literature on self-focus and self-awareness provides explanations for why we are more concerned about how we are perceived when we see feedback of ourselves. Goffman [207] theorized that if an individual who is interacting with another is attending fully to that interaction, then conversation will be smooth; however, if that individual instead becomes self-focused, then their attention could be shifted away from the interaction and toward how that interaction will be perceived by their interaction partner. Fenigstein et al. [201] showed this effect experimentally—i.e., when attention is directed toward the self, the concern with how one is being perceived by others increases; in contrast, when self-attention is low, feedback from others is not as important. In our video chat experiment, we see this concern for how others perceive us in multiple ways: partners become more socially focused and accommodating; they express greater affiliation and less conviction.

This increased presentation concern is expressed most notably in the results of our mixed-gender dyads, who displayed the greatest social accommodation and social orientation. Previous work has shown that presentation concern (through increased private self-awareness, combined with lower public self-awareness) increases the propensity for spontaneous self-disclosure in a text chat [73] and also that mixed-gender pairs exhibit greater self-disclosure in text-based communication [183]. Although we did not explicitly test for self-disclosure, the reduced use of interrogatives and the reduced use of the 2nd person pronoun ‘you’ in mixed-gender dyads in the video feedback condition suggests that participants in mixed-gender dyads have been talking more about themselves.

It may seem counterintuitive that seeing oneself ultimately increases social accommodation; however, research in self-awareness theory helps to explain how self-directed attention translates into being concerned about how others perceive us. By facilitating self-presentation concerns, self-directed attention is ultimately expressed as social accommodation—people form expectations about how they are perceived by others and start to unconsciously accommodate to these implicit expectations [69].

3.6.3. Implications for design

Providing video feedback in video chat interfaces increases self-awareness and increases self-directed attention. This has implications for the design of video chat interfaces—manipulating self-awareness and performance concerns as a result of self-directed attention can be leveraged for benefit in some interaction contexts but may be harmful in others.

3.6.3.1. Video-mediated communication

There are several ways in which increased self-directed attention affects video-mediated communication (VMC). Previous work has not examined how seeing oneself affects conversation in a video chat context. Our work shows interesting effects on both the conversation itself and on how people perceive their relational communication. However, the effects of our results depend on the interaction's context.

3.6.3.2. Distributed teams

Distributed teams allow companies to connect knowledge workers from all over the world. Over the course of a project, team members have different communicational needs, which would differently benefit from including visual feedback of the participants. In the beginning, it is important to create social bonds and facilitate trust and group cohesion between teammates [336]. Self-awareness induced through video feedback might create a more sociable atmosphere that facilitates group cohesion. In later phases of the group work, planning and implementations of strategies take priority; thus, no feedback might be the more suitable design as increased self-awareness might detract from the participant's problem solving abilities [336].

3.6.3.3. Job interviews

The increase in remote and distributed work has also increased the demand for remote job interviews using video communication [337, 177]. Interviewing over video-mediated communication technology is less expensive than bringing candidates in for an in-person interview, and allows an organization to evaluate a greater range of candidates. One concern of organizations is the ability of interviewers to spot impression management strategies (e.g., flattery) used by the applicants; interviewers with high trust and low cognitive ability are less likely to spot deceptive strategies [338]. Our results suggest that increased self-awareness might be harmful for interviewers, because the increased self-directed attention adds to the cognitive

load and makes them less likely to spot—and thus even more exposed to—impression management strategies.

3.6.3.4. Customer service

Customer service and technical support services are beginning to transition from audio-only communication to video chat. Our results suggest that the person providing the service or support would benefit from seeing their video feedback, as it would facilitate social accommodation. In the context of providing services to a frustrated client, greater social accommodation by the service provider may ensure that clients feel heard and assisted.

3.6.3.5. Online dating

Online dating is a rapidly-growing platform that connects strangers seeking new relationships with each other through computer-mediated communication [339]. Communication patterns in online dating, however, expose some very troubling trends regarding harassment and inappropriate approaches of men towards women. In the United States, 42% of female users have been contacted by someone in a way that made them feel harassed or uncomfortable [339]. These behavioural patterns can be linked to the differential social norms stemming from anonymity in the online environment [340]. Online dating platforms predominantly use text chat, which lacks any self-awareness-inducing feedback. In this domain, design that induces self-awareness might encourage users to adhere to the social norms they would follow in face-to-face interactions and exhibit more pro-social behaviours, which would ultimately facilitate conversation and potentially improve online interactions.

3.6.3.6. Remote psychotherapy

Maladaptive forms of heightened presentation concern as a result of increased self-awareness have been tied to mental disorders, e.g. social-anxiety, eating disorder, and drug abuse [341, 86, 342]. A common approach for people suffering from anxiety is attentional retraining [343], which trains people to shift attention away from negative to neutral cognitions and actually helps to reduce self-directed attention [344]. Supporting these systems to vary self-awareness would allow participants to contrast experienced anxiety as a result of self-directed attention under feedback and no-feedback, providing them with valuable tools for managing anxiety. Moreover, in the context of remote therapy, conducted with an online psychotherapist over video chat [157],

our findings support the idea that the presence of visual feedback for both the patient and the therapist must be carefully considered to avoid unintentional self-directed attention.

3.6.4. Limitations and future work

Our study reveals several interesting findings, but also opens the opportunities for future work.

Our study used a personal information exchange task between strangers over Amazon's Mechanical Turk. Participants were prompted to have a conversation by asking each other questions. This is a specific use context and we expect that results may depend on both the context and task.

First, our same-gender dyads were comprised of two females or two males interacting. Previous work on communication in dyads suggests that patterns are different when the pair is comprised of two men or two women [176]. We could not investigate the breakdown of the same-gender dyads at the level of male dyads or female dyads, due to our sample size; however, this is an important avenue for future work.

Second, we collected data on the traits of participants, such as their personality, self-consciousness and degree of self-monitoring. Again, our sample of participants is not large enough to consider the between-subjects effects of feedback and gender pairing, while also integrating individual differences into our analyses. Future work should consider the differential effects of video feedback on people with different personalities, and levels of self-efficacy, self-monitoring, and life satisfaction.

Third, the increased social accommodation from video feedback was likely useful in the context of a personal information exchange; however, the reduced use of expressions of certainty and discrepancy are likely not helpful in the context of problem-solving, brainstorming, negotiating, or other task-focused exchanges. We would like to explore how feedback affects communication in other tasks—particularly those that benefit from participants feeling permitted to disagree with each other and express confidence in their opinions.

Fourth, our manipulation connected two strangers. It is possible that results would differ for interactions between people with various pre-existing relationships. We would like to explore

how the design of video chat interfaces affects communication between friends, romantic partners, family members, or co-workers.

Fifth, our manipulation used dyads. There are complex interactions that occur in group conversations, and it is unclear how our results extend into remote communication involving more than two parties.

Sixth, our experiment was conducted with a particular user group—workers on Mechanical Turk. We found that our participants used this shared connection in their conversation and often talked about their work on Mechanical Turk. However, we were paying people to be part of our experiment and extending our findings into volitional participation in the context of personal or professional communication is of interest to us.

Finally, we demonstrate results in terms of participants' subjective ability to communicate and in conversation behaviour. Although we would have liked to record the gaze of participants to determine how much they looked at their own video feed, conducting the study in a lab with an eye tracker would have compromised the ecological validity of people engaging in VMC in the familiar environment of their own homes. Furthermore, extending our results by showing how video chat interface design affects subsequent task performance, trust facilitation, or feelings of intimacy would provide a translation of our results, and aid in our understanding of how technology-mediated communication patterns affect our collaborative work and relationships.

3.7. Conclusion (Study 1)

Video-based communication is becoming a common way for people separated by distance to communicate in both personal and professional contexts; however, the status quo of providing participants with a video preview of themselves is in direct contrast to how our face-to-face interactions are structured. Including video feedback in our study tended to increase the attention that participants directed towards themselves, increasing their awareness of themselves as social beings, and increasing their concern for how they were being perceived by their partner. The *looking glass self* refers to our self-view that is shaped by our understanding of how others perceive us [345]. In video-mediated communication, who we see when we peer into the looking glass can be affected by interface design choices as simple as whether or not to provide video feedback. As video chat increasingly governs our interactions with others over a distance in

domains from online dating to customer service and remote psychotherapy to job interviews, we must acknowledge the influence that interface designers have over how our online social interactions unfold, how we see ourselves as a result of these interactions, and ultimately how we build and maintain relationships online.

CHAPTER 4. VIDEO CHAT INTERFACES AND SOCIAL ANXIETY

4.1. Citation and role of collaborators

This work was published at the ACM CHI Conference on Human Factors in Computing Systems; the full citation is:

Matthew K. Miller, Martin Johannes Dechant, and Regan L. Mandryk. 2021. Meeting You, Seeing Me: The Role of Social Anxiety, Visual Feedback, and Interface Layout in a Get-to-Know-You Task via Video Chat. Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems. Association for Computing Machinery, New York, NY, USA, Article 339, 1–14. DOI: <https://doi.org/10.1145/3411764.3445664>

Three authors contributed to this work. All authors worked together to generate research questions, develop a study plan, and select measures. I led the data collection, analysis, and writing work, with coauthors assistance and guidance.

4.2. Research contributors

The results of Study 1 support further investigation of video chat interfaces' effects; although the growing number of video chat users includes socially anxious people, it is not known how video chat interfaces affect their interpersonal interactions. Building on the findings of Study 1 in this context is a meaningful extension of our work, as the manifestation of Social Anxiety could interact with the effects of video chat interfaces observed in Study 1. This further addresses this dissertation's problem statement regarding the unintentional effects of video chat interfaces.

We make several contributions to address the knowledge gap regarding video chat interface effects among socially anxious individuals. First, we show through studies 2a and 2b that interface decisions can change communication and experiences for video chat users with social anxiety. Second, we establish that common advice online suggesting feedback increases anxiety and should be turned off is not helpful for socially anxious people and may actually cause greater

experienced anxiety. Given the potentially beneficial role of feedback observed in Study 2a, we recommend that video chat applications ensure feedback is always available (at least optionally), including during screensharing or multitasking. Third, we find that although video chat interfaces differ between applications and often automatically change to accommodate shared content or users joining/leaving the call, these changes are not simply cosmetic and may have unintended effects on communications. As with feedback, we recommend that designers of video chat applications ensure that users can control layout changes if desired and that people planning activities over video chat consider how the layout of the chat may affect desired outcomes.

4.3. Background and motivation

The findings of Study 1 suggest that video chat interfaces can have meaningful effects on people's experiences and conversations in video chat, including their self-awareness. Self-focused attention is thought to play a key role in the experience of social anxiety [82], and online resources have suggested people experiencing anxiety during video chat turn off feedback to (e.g., [77, 78, 79]). However, the effects of video feedback on experiences of social anxiety have not been experimentally verified. Therefore, in Studies 2a and 2b we investigate how feedback affects experiences of social anxiety in the context of two video chat interfaces.

4.3.1. Research questions

In traditional and content-focused interfaces:

- RQ6.** Do social anxiety and feedback affect self-awareness in video calls?
- RQ7.** Do social anxiety and feedback affect experienced anxiety in video calls?
- RQ8.** Do social anxiety and feedback affect conversations in video calls?
- RQ9.** How do social anxiety and feedback influence the icebreaker exercise?

4.4. Measures

We used several measures in both of our studies; for details of these measures, see Section 1.2.4. Internal consistency (Cronbach's Alpha; α) is reported for Study 2a (S2a) and Study 2b (S2b); for state measures, before (B) and after (A) values are reported. *Liebowitz Social Anxiety Scale, Self-Report (LSAS)* (α : S2a=.958; S2b=.956), *Situational Self-Awareness Scale* (α : S2a-private=.780 (B), .741 (A); S2a-public=.869 (B), .795 (A), S2a-surroundings=.745 (B), .891 (A));

S2b-private=.614 (B), .717 (A); S2b-public=.831 (B), .939 (A); S2b-surroundings=.722 (B), .843 (A)), *State-Trait Anxiety Inventory: State Subscale* (α : S2a=.965 (B), .955 (A); S2b=.972 (B), .963 (A)), *Measure of Perceived Self-Disclosure: ad-hoc version* (α : S2a=.798; S2b=.822), *Interpersonal Trust Scale* (α : S2a=.917; S2b=.900), *Linguistic Inquiry and Word Count (LIWC2015)*.

4.5. Study 2a: traditional (video-focused) interface

In Study 2a, we test how social anxiety and feedback affect experiences and conversations in video chat.

4.5.1. Methods

4.5.1.1. Participants

60 participants (age: $m=36.360$, $SD=12.985$; gender: man=36, woman=24, non-binary=0) were recruited using Amazon's Mechanical Turk [331] and paid 12 US\$. The study typically took 40-50 minutes to complete, and matchmaking was manually supervised to ensure waits did not exceed 15 minutes. The Mechanical Turk task was limited to US workers with an approval rate of at least 90% on 100 or more HITs. In addition to the 60 participants who completed the study, some people were compensated but did not finish did not due to issues connecting video calls over diverse network topologies or waiting too long for a partner ($N=23$), request for withdrawal ($N=1$), procedural errors ($N=5$). Unfortunately, some people also dropped out without contacting us ($N=38$), making compensation impossible. Social anxiety in the sample measured using the LSAS averaged 47.367 ($SD=25.832$); video chat usage in the sample was high (63.33% at least weekly, 83.33% at least monthly, 5% never). After matchmaking, 30 pairs were formed ($wm=16$, $ww=4$, $mm=10$).

4.5.1.2. System

The study used a custom web-based video chat application. The interface was built using Bootstrap and React. The server was built using NodeJS. Video calls use WebRTC, routed through Kurento media server [346] for recording. The interface was video-focused, with a large view of the remote participant, an optional inset view of the local participant (feedback), and a bar at the side for displaying icebreaker questions (see Figure 10).

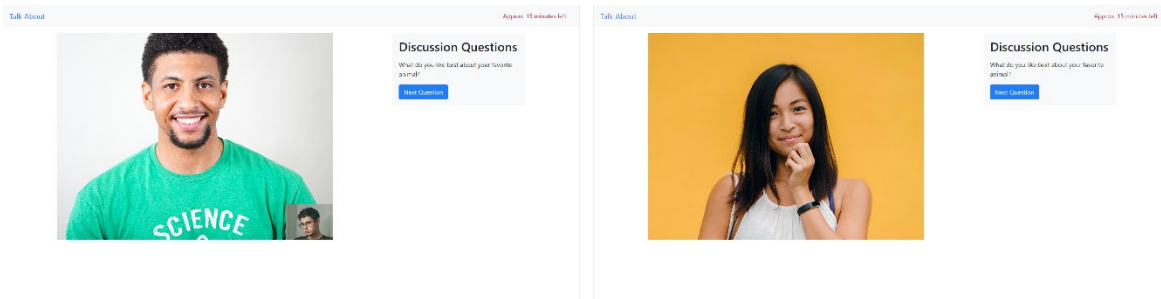


Figure 10. Video Chat system used in Study 2a with feedback on (left) and off (right).

4.5.1.3. Procedure

After providing informed consent, participants completed questionnaires for demographics, social anxiety and states (self-awareness, experienced anxiety). Next, participants were told that a video chat with discussion questions would begin; the instructions noted, “The questions are there to start a conversation, so please feel free to talk about whatever comes to your mind.” Matchmaking for the chat was done on a first-in, first-out basis; once a partner was found, both partners confirmed that they could see and hear each other before the timer and discussion questions began. Icebreaker questions were shown one-at-a-time and both partners always saw the same question. A “Next” button allowed participants to move to the next question (this disabled both callers’ Next buttons for 20 seconds). Icebreakers included questions such as “What do you like to eat on your pizza?”, “If you could live in any period of history, when would it be?”, and “What is the best present you ever received?”. The call lasted 15 minutes; time remaining was displayed. Half of the participants used the system with feedback off, and half with feedback on; partnered participants were assigned the same feedback condition. After the call, participants completed questionnaires for states (self-awareness, experienced anxiety) and outcomes (self-disclosure, trust).

4.5.2. Analysis

We used regression analysis to test our hypotheses because it offers greater statistical power than testing for group-level differences between participants low or high in social anxiety; further, regression analyses allow us to understand how multiple factors contribute to people’s experiences in video calls. Analyses were performed using IBM SPSS Statistics 27 [347] and the PROCESS macro [348]. For purposes of interpreting regression coefficients, note that questionnaire data was coded for analysis as mean scores in the range of 0-3 (LSAS) or 0-6 (all

other scales) and LIWC pronoun data was coded as percentages of total word count in the range 0-100.

Our approach to analysis was to test for effects of social anxiety while including feedback as a moderator, which allows us to test if feedback weakens or strengthens the effects of social anxiety in video calls.

4.5.3. Results

4.5.3.1. Do social anxiety and feedback affect self-awareness in video calls?

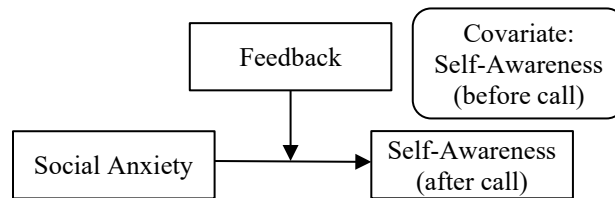


Figure 11. Moderation model for self-awareness.

Previous research has suggested that a causal mechanism for effects of feedback on socially anxious people may be changes in self-awareness [83]. Therefore, our first goal was to understand how social anxiety affected participants' self-awareness, and whether these effects were different when feedback is on or off. To do so, we used a moderated regression model (see Figure 11) for each of the three aspects of self-awareness. The models include presence of feedback as a moderator to test whether feedback changes the relationship between social anxiety and self-awareness. Because participants completed the study at home, their self-awareness could have been affected by their surroundings; therefore, before-call self-awareness was included as a covariate to control for environmental effects.

For private self-awareness and self-awareness of surroundings the overall models were significant ($R=.492$, $p=.004$ and $R=.509$, $p=.002$ respectively). However, in both cases the interaction effect of social anxiety and feedback was not significant ($b=-.279$, $p=.330$ and $b=.049$, $p=.895$ respectively), and therefore a moderated effect was not supported for either private self-awareness or self-awareness of surroundings. Simple regression tests show a direct effect of social anxiety was also not supported for either private self-awareness or self-awareness of surroundings ($b=-.156$, $p=.575$ and $b=.210$, $p=.561$ respectively). For public self-awareness, the overall model was significant ($R=.555$; $p\approx.000$) and the interaction effect of social anxiety

and feedback was also significant ($b=-.796$, $p=.033$). Probing the interaction showed a significant conditional effect of social anxiety on public self-awareness when feedback was off ($b=1.147$, $p=.042$), but not when it was on ($b=-.445$, $p=.347$).

4.5.3.2. Do social anxiety and feedback affect experienced anxiety in video calls?

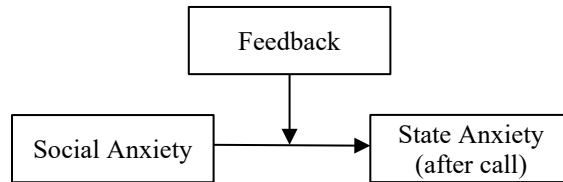


Figure 12. Moderation model for experienced anxiety.

Our second goal was to understand how social anxiety translates into experienced anxiety during video calls; this is the most direct test for the suggestion that feedback exacerbates the effects of social anxiety [77, 78, 79] (a suggestion bolstered by research indicating that self-focusing factors have negative effects [83, 84, 87]). As with self-awareness, we used a moderated regression model (see Figure 12). State anxiety before the call would be expected to relate to social anxiety (not simply external factors), so it was not used as a covariate.

The full model was significant ($R=.640$, $p\approx.000$) and the interaction effect of social anxiety and feedback was also marginally significant ($b=-.404$, $p=.051$). Probing the interaction effect revealed a significant conditional effect of social anxiety both when feedback was off ($b=1.596$, $p\approx.000$) and when feedback was on ($b=.787$, $p=.004$). However, the magnitude of social anxiety's effect on experienced anxiety was approximately twice as large when feedback was off.

4.5.3.3. Do social anxiety and feedback affect conversations in video calls?

Our third goal was to determine whether social anxiety affected the conversation, providing a behavioural measure to complement our findings based on self-reported anxiety. Given that the focus of the video chat was a get-to-know you task, we expected the main topics participants discussed to be related to themselves and their partners. Therefore, we measured usage of three types of pronouns expected to appear in such a conversation: 1st person singular (e.g., I, me, mine), 1st person plural (e.g., we, our, us), and 2nd person (e.g., you, your). We used a moderated regression model to test for an effect of social anxiety on usage of each pronoun type, moderated

by feedback. For 1st person singular, the model was not significant ($R=.299$, $p=.166$). For 1st person plural, the model was significant ($R=.477$, $p=.003$), but the interaction of feedback and social anxiety was not ($b=.146$, $p=.235$); a simple regression test showed that higher social anxiety was associated with lower use of 1st person plural pronouns regardless of feedback ($b=-.341$, $p=.008$). For 2nd person, the model was significant ($R=.385$, $p=.033$). The interaction of feedback and social anxiety was also significant ($b=-1.334$, $p=.017$), indicating a significant moderation. Probing the interaction showed a significant conditional effect of social anxiety on 2nd person pronoun use when feedback was off ($b=2.399$, $p=.005$), but not when feedback was on ($b=-.269$, $p=.712$).

4.5.3.4. How do social anxiety and feedback influence the icebreaker exercise?

Our fourth goal was to determine whether social anxiety affected the success of the icebreaker questions in fostering self-disclosure and trust; while tests relating to self-awareness, experienced anxiety, and pronoun use provide focused indicators of how feedback and social anxiety affect conversations, analyzing self-disclosure and trust provides a greater understanding of whether these abstract effects translate into different outcomes. To do so, we first examined whether social anxiety affected participants' usage of the icebreaker questions. Again, we used a moderated regression analysis, with a model evaluating an effect of social anxiety on number of icebreaker questions discussed, as moderated by feedback. The overall model was slightly above the threshold for significance ($R=.347$, $p=.065$), though the interaction effect of social anxiety and feedback was significant ($b=-2.974$, $p=.034$) and post hoc probes showed a significant conditional effect of social anxiety when feedback was off ($b=5.612$, $p=.001$) but not when feedback was on ($b=-.336$, $p=.850$). While the results of the model cannot be interpreted confidently because the overall model fit was not significant, the conditional effects may indicate that feedback plays a role but the overall explanatory power of feedback was not significant. Based on our previous finding that the conditional effect of social anxiety on experienced anxiety was larger when feedback was off but still significant when feedback was on, we suspected that experienced anxiety (which may reflect the presence of feedback and other factors) may have more explanatory power; therefore, we re-ran the model using experienced anxiety by the end of the call as the moderator rather than feedback. As predicted, the overall model including experienced anxiety was significant ($R=.377$, $p=.034$) and the interaction effect of social anxiety and experienced anxiety was also significant ($b=3.061$, $p=.010$). Post hoc probes at the 16th and

84th percentiles of experienced anxiety showed no significant conditional effect of social anxiety when experience anxiety was low ($b=-.179$, $p=.924$) but a significant effect when it was high ($b=6.475$, $p=.007$).

Secondly, we tested whether social anxiety changed the effectiveness of the icebreaker task. We used a model of the expected mechanism of the icebreaker task: that answering more icebreaker questions has an indirect effect on interpersonal trust that is mediated by increased self-disclosure (see Figure 13). Being a mediation analysis, this model is tested in two parts: one with Self-Disclosure the IV and one with Trust as the IV; R and p values are provided for each IV. We test whether social anxiety affects this mechanism by including social anxiety as a moderator for the effect on self-disclosure. As with other models, we include feedback as a moderator for the effect of social anxiety. For post hoc probes in this model, “lower” and “higher” levels of social anxiety refer to the 16th and 84th percentiles.

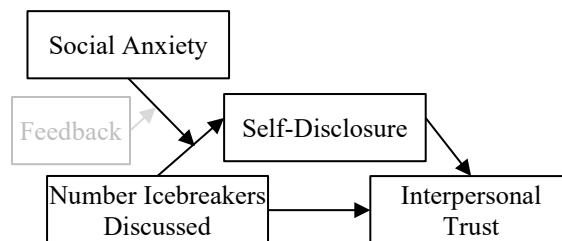


Figure 13. Moderated mediation model for effectiveness of the icebreaker questions

Participants rated self-disclosure and interpersonal trust for their partners, not themselves. Therefore, we tested the model using the ratings from their partner of how much they self-disclosed and engendered trust. The overall model was significant (self-disclosure: $R=.527$, $p=.013$; interpersonal trust: $R=.481$, $p=.001$), but no interactions including feedback were significant so it was pruned from the model. With feedback removed, the model was significant (self-disclosure: $R=.491$, $p=.001$; interpersonal trust: $R=.481$, $p=.001$). Regarding self-disclosure, there was a significant interaction of social anxiety and the number of icebreakers discussed ($b=-.079$, $p=.037$). Probing the interaction showed a significant conditional effect of number of icebreakers discussed on self-disclosure at lower levels of social anxiety ($b=.073$, $p=.023$) but not at higher levels ($b=-.018$, $p=.505$). Regarding the overall model for interpersonal trust, the confidence interval for the index of moderated mediation ($[-.090, .000]$) terminated at 0, indicating a marginally significant moderation of the mediated effect. Probing the interaction

showed a significant conditional indirect effect of number of icebreakers discussed on interpersonal trust at lower levels of social anxiety (CI: [.005, .073]) but not at higher levels (CI: [-.043, .017]).

The model using partners' ratings confirmed that social anxiety moderated the effect of discussing more icebreaker questions on participants' own self-disclosure. However, this does not test whether a participant's own social anxiety moderated the effect of discussing more icebreaker questions on their partner's self-disclosure. Therefore, we tested the same model (see Figure 13), but using ratings of the partner's self-disclosure and engendered trust. Once again, the overall model including feedback was significant (self-disclosure: $R=.552$, $p=.006$; interpersonal trust: $R=.481$, $p=.001$) but no interactions involving feedback were significant so it was pruned from the model. With feedback removed, the overall model was significant (self-disclosure: $R=.538$, $p\approx.000$; interpersonal trust: $R=.481$, $p=.001$). A similar pattern of results was observed as with user's own self-disclosure and engendered trust. Regarding the partner's self-disclosure, there was a significant interaction of number of icebreakers and the participant's own social anxiety ($b=-.115$, $p=.002$). Probing the interaction showed a significant conditional effect of number of icebreakers discussed on the partner's disclosure at low levels of social anxiety ($b=.095$, $p=.002$) but not at high levels ($b=-.036$, $p=.166$). Regarding the overall model for interpersonal trust, the confidence interval for the index of moderated mediation ([-.115, -.011]) did not include 0, indicating a significant moderation of the mediated effect. Probing the interaction showed a significant conditional indirect effect of number of icebreakers discussed on interpersonal trust at low levels of social anxiety (CI: [.012, .079]) but not at high levels (CI: [-.061, .008]).

4.5.4. Explanation of results

Social anxiety significantly affected the video chat experience. Our analysis does not support a direct relationship between social anxiety and self-awareness overall; the moderation analysis revealed that social anxiety was significantly associated with public self-awareness only when feedback was off. Increased public self-awareness is consistent with the Clark and Wells model of social anxiety, which involves fixating on an internal model of how one is perceived by others. This suggests that feedback in fact reduces focus on this model or provides objective feedback that counters heightened concerns of how one is being perceived.

Our results also confirmed, as expected, that social anxiety led to higher experienced anxiety by the end of the call; however, the moderation analysis showed that this effect was significantly stronger when feedback was off. This is consistent with the findings regarding self-awareness: since higher levels of social anxiety were associated with more public self-awareness when feedback was off, and this public self-awareness among socially anxious people reflects a fixation on negative assumptions about how others are perceiving them [82], it is logical that the association between social anxiety and experienced anxiety was stronger when feedback was off. This is also consistent with the observed effect on conversational behaviour: social anxiety was associated with greater use of 2nd person pronouns (e.g., you, your) when feedback was off, which may represent an attempt by more socially anxious participants to shift focus away from themselves when experiencing greater anxiety. This interpretation is consistent with our result showing that social anxiety was associated with an overall lower use of 1st-person plural pronouns (e.g., we, us).

Our results confirm that social anxiety also affected participants' likelihood to discuss icebreaker questions. We could not confirm that feedback itself moderated this relationship. Given that the number of questions discussed is likely the product of many factors (including the traits and behaviour of both people in a conversation), it is possible that feedback does play a role but one that was too small to confirm with the statistical power of our study. However, we were able to confirm a relationship between social anxiety and number of icebreakers discussed moderated by experienced anxiety. Experienced anxiety reflects the presence of feedback as well as other factors, so it is sensible that considering experienced anxiety creates a stronger model of the relationship between social anxiety and discussing icebreakers than considering feedback alone.

Higher social anxiety was associated with discussing a greater number of icebreaker questions when experienced anxiety was high. There are multiple potential explanations for this finding. First, because the icebreaker questions provide a change of subject without the need to suggest a new topic, people higher in social anxiety may fall back on advancing through the icebreaker questions as a safe tool to change focus when they experience high levels of anxiety during the call. Second, the icebreaker questions may fail to generate a sustained discussion for participants higher in social anxiety who are experiencing higher levels of anxiety; therefore, these

participants and their partners may move through more questions. Both of these interpretations suggest that moving through more icebreaker questions reflects safety behaviour on the part of socially anxious participants: avoiding deeper discussions of a topic or shifting focus to their partner by asking a new icebreaker.

Our analysis of the icebreakers' effectiveness is consistent with the view that socially anxious participants used them differently. A significant moderation effect showed that the number of icebreakers discussed predicted self-disclosure (both for the participant and their partner) only when social anxiety was lower. Further, a mediation analysis revealed that there was a significant positive effect of answering more icebreakers on interpersonal trust (mediated by self-disclosure) only for participants lower in social anxiety.

In sum, our results confirm that people higher in social anxiety experience more anxiety when meeting others via video chat. The use of feedback may be helpful in reducing negative effects of social anxiety in video chat. However, our analysis of the icebreaker task suggests that feedback is not sufficient to ensure that people higher in social anxiety benefit from a get-to-know-you task as those lower in social anxiety do.

4.6. Study 2b: content-focused interface

In Study 2b, we test how social anxiety and feedback affect experiences and conversations in video chat when the chat interface is content focused. Content-focused interfaces (e.g., screen-sharing or presentation views) are very common in video chat systems, and significantly reduce the size of visual aspects of the call. Previous research has indicated that both self-disclosure [73] and self-awareness [204] may be impacted by reducing the prominence of visual communications; therefore, it is important to understand whether the effects of feedback and social anxiety are consistent in this context.

4.6.1. Methods

4.6.1.1. Participants

60 participants (age: $m=39.560$, $SD=12.446$; gender: man=32, woman=28, non-binary=0) were recruited using Amazon's Mechanical Turk and paid 12 US\$. As in Study 2a, some additional people started but did not finish the study due to issues connecting video calls over

diverse network topologies or waiting too long for a partner (N=19), procedural errors (N=5), or dropping out without contacting us (N=22). Social anxiety in the sample measured using the LSAS averaged 46.233 (SD=24.731); video chat usage in the sample was high (50% at least weekly, 76.67% at least monthly, 1.67% never). After matchmaking, 30 pairs were formed (wm=16, ww=6, mm=8).

4.6.1.2. System

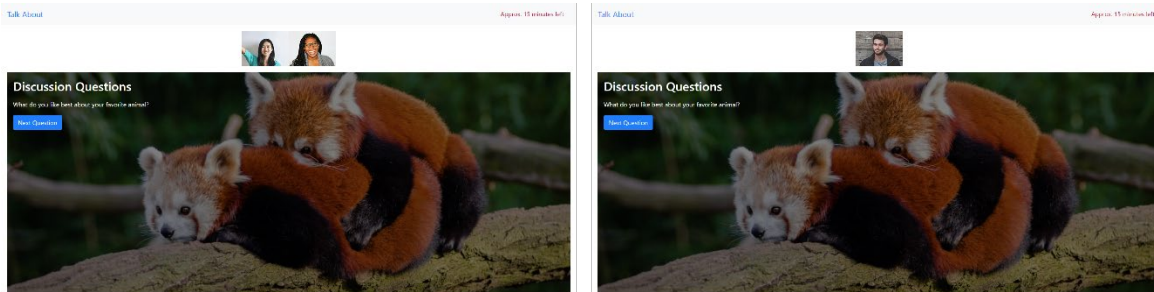


Figure 14. Video Chat system used in Study 2b with feedback on (left) and off (right).

The system used in Study 2b was a modified version of the system from Study 2a (see Figure 14). In this version, the videos are shifted to the top and the icebreakers occupy most of the screen and have backgrounds. Compared to Study 2a, the remote person's video is much smaller, but the feedback is the same size.

4.6.1.3. Measures, procedure, and analysis

The measures, procedure, and analysis used in Study 2b were the same as Study 2a.

4.6.2. Results

4.6.2.1. Do social anxiety and feedback affect self-awareness in content-focused video calls?

The same models used in Study 2a were tested. Although the models were significant for all three aspects of self-awareness (private: $R=.651$, $p\approx.000$; public: $R=.567$, $p\approx.000$; surroundings: $R=.498$, $p=.004$), there were no significant interactions of social anxiety and feedback. Simple regression tests showed no significant direct effect of social anxiety (private: $b=-.151$, $p=.530$; public: $b=.531$, $p=.185$; surroundings: $b=.191$, $p=.539$).

4.6.2.2. Do social anxiety and feedback affect experienced anxiety in content-focused video calls?

The same model used in Study 2a was tested. The model was significant ($R=.515$, $p=.001$), but there was not a significant interaction of feedback and social anxiety ($b=.048$, $p=.874$). A simple regression test confirmed a significant association of social anxiety and experienced anxiety regardless of feedback ($b=1.178$, $p\approx.000$).

4.6.2.3. Do social anxiety and feedback affect conversations in content-focused video calls?

The same models used in Study 2a were tested. The model for 1st person singular pronouns was not significant ($R=.191$, $p=.551$). The model for 1st person plural pronouns was significant ($R=.421$, $p=.012$), but there was no significant interaction of feedback and social anxiety; a simple regression test showed that higher social anxiety was associated with lower use of 1st person plural pronouns regardless of feedback ($b=-.487$, $p=.001$). The model for 2nd person pronouns was not significant ($R=.166$, $p=.667$).

4.6.2.4. How do social anxiety and feedback influence the icebreaker exercise in content-focused video calls?

The same models used in Study 2a were tested. The models testing for a direct effect of social anxiety on number of icebreakers discussed using feedback or experienced anxiety as a moderator were both not significant ($R=.286$, $p=.186$; $R=.106$, $p=.887$, respectively).

The models testing for a moderating effect of social anxiety on the effectiveness of discussing more icebreaker questions in generating more self-disclosure were also not significant with feedback (own self-disclosure: $R=.330$, $p=.506$; partner self-disclosure: $R=.294$, $p=.671$) or without (own self-disclosure: $R=.239$, $p=.344$; partner self-disclosure: $R=.207$, $p=.479$, respectively). To understand whether this reflected an overall change in the efficacy of the icebreaker task compared to Study 2a, we pruned social anxiety from the model. After pruning, the model for self-disclosure was not significant ($R=.183$, $p=.162$); i.e., the number of questions discussed did not significantly predict self-disclosure regardless of social anxiety. Further, while the model for interpersonal trust was significant ($R=.394$, $p=.008$), only the direct effect of self-disclosure was significant ($b=.318$, $p=.006$), not the direct effect of number of icebreakers discussed ($b=-.024$, $p=.338$).

4.6.3. Explanation of results

In the content-focused interface of Study 2b, we were not able to confirm a significant role of social anxiety on self-awareness, use of 2nd person pronouns, participation in the icebreaker task, or effectiveness of the icebreaker task. While social anxiety was significantly associated with experienced anxiety and reduced use of 1st person plural pronouns, the effects were not moderated by the use of feedback.

Our analysis of the icebreaker questions suggests a possible reason why fewer effects of social anxiety were observed in Study 2b. In Study 2b, the number of icebreakers discussed did not significantly predict self-disclosure at any level of social anxiety. One reason for this may be that the content-focused interface operated more similarly to a visually anonymous context than to a typical video chat. Previous research has found that the amount of self-disclosure in CMC, including spontaneous self-disclosure, is higher in visually anonymous contexts [73, 106]. The content-focused interface significantly reduces the size of the partner's video and also adds significant non-communicative visual elements, which may draw focus away from the visual aspect of communication. While not actually visually anonymous, the content-focused interface significantly deprioritizes the visual aspect of the communication. This may mean participants in Study 2b were more likely to engage in self-disclosure whether or not they chose to discuss many icebreaker questions. Even though self-disclosure was not significantly predicted by the number of icebreakers discussed in Study 2b, the overall level of self-disclosure in Study 2b ($m=4.125$, $SD=.995$) was still similar to Study 2a ($m=4.350$, $SD=.934$).

The possibility that the content-focused interface operates somewhat like a visually anonymous context may also explain why fewer effects of social anxiety (and no effects of feedback) were observed in Study 2b. People higher in social anxiety often report a preference for non-visual CMC compared to face-to-face interaction [235, 234]. By deprioritizing the visual aspects of communication (both reducing the size of the remote person on the local screen and the size of the local on their partner's screen), the content-focused interface may therefore increase comfort and attenuate the influence of social anxiety on important factors in communication, such as self-awareness and conversational behaviour.

4.7. Discussion (Study 2)

Our results indicate that in a video-focused chat interface, feedback played a protective role by reducing the effects of social anxiety. This contradicts speculation online that feedback aggravates social anxiety and a common hypothesis in research (e.g., [83, 84, 87]) that self-focusing factors are necessarily negative for socially anxious people. However, our results are consistent with research finding no negative effects of a mirror manipulation among socially anxious participants [86], which the authors suggested could be explained by the access to objective information on how one is seen by others that mirrors provide. If the objective information theory is valid, feedback in video chat may be even more effective than mirrors since it shows the exact image and perspective others see. Concerns about the accuracy of objective feedback are supported by findings in video feedback therapy (retrospective viewing of videos from social situations intended to correct negative self-perceptions). In video feedback therapy, socially anxious participants sometimes discount objective feedback on the basis that negative behaviours were exhibited to others yet not picked up by the camera [89]; in video chat, feedback represents exactly what others see, therefore socially anxious people may be less likely to conclude that they are exhibiting negative behaviours to others that they cannot see in the feedback.

Given our findings that feedback does not play a negative role for socially anxious participants, we reconsidered why the idea that it is negative persists, and is popularized by media during times of increased reliance on video chat for communication, such the COVID-19 pandemic of 2020 (e.g., [77, 78, 79]). Of course, a primary reason could be that it seems intuitive when no distinction is made between self-focusing factors that provide objective feedback (e.g., mirrors, video) and ones that do not (e.g., cameras, talking about oneself). However, a second reason for the inconsistency may be differing amounts of experience using video chat. Early perceptions on the need for feedback were mixed [67, 66], but feedback has become ubiquitous in modern systems; similarly, individual attitudes toward and comfort with video chat differ as people become experienced users [349, 17]. Therefore, it is possible that video feedback is associated with uneasiness partially because people are unaccustomed to it—a potential effect not observed in our studies as the vast majority of participants reported that they use video chat at least a few times per month (Study 2a: 91.667%, Study 2b: 93.333%).

In Study 2a, we found that social anxiety increased public self-awareness and use of 2nd person pronouns only when feedback was off, and that social anxiety's effect on experienced anxiety was larger when feedback was off. Yet discussing more icebreakers was not effective in generating more self-disclosure and trust for people high in social anxiety, regardless of whether feedback was on or off. We propose two reasons why feedback may attenuate situational effects of social anxiety, yet still not prevent negative outcomes. First, social anxiety was still associated with greater experienced anxiety when feedback was on, even though the effect was smaller. Second, if feedback does play a protective role by providing objective information, this information would only relate to a subset of socially anxious individuals' self-perceptions. For example, blushing, fidgeting, or facial expressions would be visible in video, but intonation, responsiveness, and speech patterns would not. Further, as socially anxious people's self-perceptions have been proposed to form based on long-term memory, internal cues, and external cues [350, 351], it cannot be expected that feedback would counter all such negative perceptions. Finally, as avoidance of social situations is a fundamental characteristic of social anxiety [74], long-term differences in experience with social skills would clearly not be corrected by a single situational factor.

In the context of our video-focused interface, the icebreaker activity did not support people higher in social anxiety in getting to know someone in the same way as people low in social anxiety. This suggests that the effectiveness of icebreaker tasks, which are designed to increase comfort and speed of getting to know others, is altered by social anxiety. In the content-focused interface, which featured a much smaller video of the remote person and other visual elements, we observed no effect of icebreaker use on self-disclosure at all levels of social anxiety. Therefore, interfaces that reduce focus on video elements may help equalize experiences between people with differing levels of social anxiety. However, this equalization is achieved via a decoupling of disclosure from icebreakers for all participants, rather than an increase in the effectiveness of the icebreakers for socially anxious participants. We speculate that this finding is due to the content-focused interface functioning more like a visually anonymous setting, and therefore participants engaged in self-disclosure whether or not icebreakers were used. If this interpretation is confirmed in future studies, it could suggest that meeting new people in video chat could be more equally facilitated by shared content than by icebreaker questions. However, it also raises the concern that some problematic behaviours associated with visually anonymous

communication [352] could be more likely to occur in video chat when video elements are reduced.

4.7.1. Design implications

4.7.1.1. General video chat systems

Previous research outside the context of social anxiety indicates that there are situations in which disabling feedback could be desirable [353], and our research suggests that retaining feedback is also desirable in some situations. Therefore, video chat applications should ensure feedback is under user control. One particular area in which current video chat applications could improve is keeping feedback visible when multitasking. When multitasking, some video chat apps include an always-on-top view of the call but fail to include the user's own feedback in this view. Others fail to include an always-on-top view entirely, particularly systems implemented as web apps, a context in which (as of 2020) APIs for always-on-top views have only recently emerged [354].

Video chat applications increasingly offer multiple interface options (e.g., grids, rows, digitally composed “together” views [355], presentation modes). Our results suggest that changing the visual prominence of different communicative elements may affect conversations held through video chats, and the experienced anxiety of participants. Further research is needed to evaluate the many different layouts supported by modern video chat applications and gain a better understanding of how these layouts affect experiences and conversations. However, as with feedback, ensuring that changes to interface layouts are controllable by users will support both individual preferences and additional recommendations resulting from future studies of interface layouts.

4.7.1.2. Video chat systems for remote therapy

Given the effects of feedback we observed among socially anxious participants, designers of video chat systems used in the context of remote psychotherapy should be particularly cognizant of the role feedback can play. This could be reflected both by increasing the prominence of controls in the system relating to feedback and explicitly noting that feedback can affect users. Further, specialized systems for counselling or psychotherapy could allow mental health professionals to monitor or even control the visibility of feedback on their patients' systems.

These recommendations extend beyond social anxiety because, for example, feedback can contribute to delusional thinking among people with thought disorders [189] or be distracting during therapy [356].

4.8. Limitations and future work (Study 2)

Studies 2a and 2b illuminated several effects of feedback and interface layout for video chat users, particularly those with social anxiety. However, the generalizability of our results is somewhat limited by the need to choose a specific task (get-to-know-you) and relationship (stranger dyads). Generalizability of our results to people diagnosed with social anxiety disorder is also limited by the use of a non-diagnosed sample. However, the LSAS is useful for screening in social anxiety assessment and many of our participants scored above recommended thresholds for consideration of social anxiety disorder [316]; while higher scores alone do not indicate a diagnosis, our sample does appear to include significant representation of people who experience social anxiety.

Our ability to understand all effects of feedback was also limited by our sample size. Some research suggests additional factors could be considered, for example the effects of feedback can differ based on the gender composition of pairs [353] and the effectiveness of retrospective video feedback in therapy is lower when individuals also have physical appearance anxiety [357]. However, as we already investigated the role of two factors (feedback and social anxiety), exploring additional factors such as gender pairing or physical appearance anxiety at the same time would only be possible with a much larger sample.

Finally, our ability to conclude firmly about the role of differing video chat layouts was limited by the inclusion of a second interface only in a follow-up study (Study 2b).

A primary goal of future work should be to evaluate whether our results are consistent among people diagnosed with social anxiety disorder. The effects of feedback should also be investigated in the context of generalized social anxiety disorder, as mirror manipulation effects have differed by social anxiety subtype [358].

Future work should directly compare a variety of video chat interfaces to understand how they affect conversations (e.g., feedback equal in size to other participants, group chat layouts using a

grid, dynamic interfaces that change with the active speaker). Future work should also explore the effects of feedback in additional contexts, for example in usage by work colleagues or romantic partners.

4.9. Conclusion (Study 2)

As video chat increasingly pervades many aspects of life, people with social anxiety are likely to be uniquely affected by the idiosyncrasies of video-based communication. Yet existing advice for dealing with these effects is based on speculation about how factors such as video feedback might intersect with social anxiety. Contrary to this advice, we show that in a typical video chat interface, feedback lessens the translation of social anxiety into experienced anxiety and attenuates related effects such as higher public self-awareness and use of 2nd person pronouns that were observed when feedback is off. We also show that using the icebreaker task does not facilitate more self-disclosure or interpersonal trust for people high in social anxiety, even with feedback. In the context of a content-focused interface, in which the videos of both participants were reduced, we observe no effects of feedback, and an overall pattern suggesting a significant reduction in relevance of visual aspects of communication. Our results confirm that feedback and interface layout affect video chat users, especially those with social anxiety, in previously unknown ways. For designers of video chat, the size and availability of features on screen is not simply a matter of aesthetics or functional requirements but an important factor in the communications carried by their systems.

SECTION 3. TOOLS FOR FURTHER STUDY OF VIDEO CHAT

CHAPTER 5. DEVELOPING A MEASURE OF PERCEIVED SELF-DISCLOSURE

5.1. Citation and role of collaborators

This work was published—as part of a larger project—at the ACM CSCW Conference on Computer-Supported Cooperative Work; the full citation is:

Matthew K. Miller and Regan L. Mandryk. 2021. Meeting with Media: Comparing Synchronous Media Sharing and Icebreaker Questions in Initial Interactions via Video Chat. *Proc. ACM Hum.-Comput. Interact.* 5, CSCW2, Article 374 (October 2021), 26 pages. DOI: <https://doi.org/10.1145/3479518>

This work was done in collaboration with my supervisor Dr. Mandryk. I led the item generation, evaluation design, data collection, analysis, and writing for this work, under the guidance of Dr. Mandryk.

5.2. Research contributors

This work contributes a measure of perceived self-disclosure that is applicable to a variety of digital interactions. The development of this measure is supported by the ad-hoc measure used in Study 2, which proved useful in understanding trust formation. Additionally, as a tool that aids in understanding conversational effects within video chat, this measure helps address the dissertation’s problem statement regarding unknown effects of video chat interfaces on conversation.

We develop and validate the final version of our self-disclosure measure through two studies (Studies 3 and 4). Despite the important role of self-disclosure in relationships, research of CMC has frequently omitted a measure of self-disclosure—a deficit cause in part by limitations of existing measures. Our new measure has many potential applications in understanding and

validating the design of CMC tools for supporting self-disclosure, and in turn the formation and maintenance of relationships.

5.3. Background and motivation

Studies of CMC interactions have focused on three methods for measuring self-disclosure, counting pronouns or self-references, expert coding, and questionnaires. However, there are limitations to these existing tools. Counting of pronouns or self-references requires transcription for audio/video communication, has limited accuracy (e.g., failing to include the statement “books are the best way to unwind” yet including the statement “I’m having trouble hearing you”), and does not consider non-verbal communication. Expert coding, while likely more accurate than counting of pronouns or self-references, may still require transcription of audio or video communication and is expensive and time consuming to conduct. Self-assessment or partner-assessment via questionnaires has been successfully applied in certain CMC contexts, but existing measures have limited applicability for several reasons.

First, some questionnaires focus on self-disclosure as an individual trait rather than as a phenomenon of a specific relationship. For example, the Self-Disclosure Scale [113] includes items such as “I talk about my spiritual life to people”, “I tell my problems to my friends”, and “I make sure that all my friends know my interests.” Similarly, the General Disclosiveness Scale [114] includes items such as “I often discuss my feelings about myself”, “I normally express my ‘good’ feelings about myself”, and “I usually talk about myself for fairly long periods at a time”.

Second, many existing questionnaires of self-disclosure focus on long-term relationships, and therefore include highly personal topics not relevant for initial interactions. For example, the Jourard Self-Disclosure Scale [115] asks how much self-disclosure people have made over the course of a relationship in specific areas, but many items reference topics unlikely to be discussed with a new contact (e.g., religious, political, and moral views; income and debts; and body-image and sexual performance). Similarly, Miller et al.’s Self-Disclosure Index [116] (including Finkenauer et al.’s [117] adapted version for romantic partners) mentions “deepest feelings”, “worst fears”, and “things I have done which I feel guilty about”.

Third, questionnaires are often specific to a certain relationship. For example, the Instructor Self-Disclosure Scale [118, 119] is designed for students assessing their instructors (e.g., “My

instructor often gives personal examples in class.”). Similarly, the Development in On-Line Relationships scale [258] focuses on strictly web-based relationships and social media platforms.

Fourth, many questionnaires are specific to a certain topic. For example, the Emotional Self-Disclosure Scale [120] asks whether people disclose feelings such as depression, discouragement, envy, anger, and calmness. The Sexual Self-Disclosure Scale [121] asks about sexual behaviours, values, preferences, and attitudes.

To work around these limitations, a number of researchers have created ad-hoc subjective measures of self-disclosure [359, 122, 123, 124, 125] or have attempted to modify existing measures to purpose [360]; many of these studies consider digital and initial interactions, further supporting the need for a validated scale of self-disclosure relevant to these situations. Like this previous work, Study 2 used an ad-hoc measure of self-disclosure; the initial success of this measure further motivated the development of a formalized version.

In this work, we describe the development and validation of a scale of a measure of perceived self-disclosure that addresses the described limitations of prior approaches.

5.4. Desired characteristics of the self-disclosure measure

A measure of self-disclosure suitable for digital and initial interactions should have several properties not available in existing measures:

- **Situational.** The measure should refer to a specific conversation or intervention, rather than long-term descriptor of a specific relationship or individual (i.e., a person’s disclosiveness).
- **Topic Neutral.** Given the short nature of an initial interaction, probing about disclosure on specific topics could lead to skewed responses as some people happen to share about a given topic within the first meeting while others do not.
- **Depth Neutral.** The measure should not reference self-disclosures that would be of inappropriate depth for an initial interaction (e.g., morality, sexuality, or finances).
- **Relationship-type Neutral.** For broadest applicability, the measure should apply to multiple types of relationships (e.g., colleagues meeting for the first time or new friends).

- **Channel Neutral:** The measure should assess both verbal and non-verbal self-disclosure, to allow self-disclosure made through digital means to be assessed holistically. Additionally, terms that are overloaded in some digital contexts (e.g., ‘shared’) should not be used.
- **Partner-rated.** Because the most commonly studied outcomes in initial interactions (trust and closeness) are generally partner-rated, research assessing how self-disclosure contributes to these outcomes should also use a partner-rated self-disclosure measure. Additionally, researchers have questioned the accuracy of self-reporting self-disclosure [361].

5.5. Item development

Wheless [114] suggests that self-disclosure includes dimensions of intent, amount, positiveness, depth, honesty. However, for a partner-perceived measure, only depth and amount could reasonably be assessed. Further, in initial interactions depth appears less likely to vary than amount, so we focus on amount of self-disclosure.

We constructed eight items for the measure (meeting the suggestion that the item pool be at least 50% larger than the intended measure [362]). The items include placeholders for the specific intervention being studied; examples of interventions that may be used are “call”, “video chat”, “text chat”, or “conversation”.

- i. I learned a lot about them.
- ii. Based on the <intervention>, I could easily describe their personality to someone else.
- iii. They revealed a lot of information about themselves to me.
- iv. I did not find out very much about them during the <intervention>. (R)
- v. They wanted to give me a sense of who they are.
- vi. A good portion of the <intervention> was focused on them.
- vii. They tried to shift the focus away from themselves during the <intervention>. (R)
- viii. By the end of the <intervention>, I knew quite a few details about them.

To focus the questions on the current intervention, we included the following instructions for the measure: “Thinking about the <intervention>, how much do you agree or disagree with the

following statements about the person in the <intervention>?” All applications of the measure presented in this work used a 7-point Likert scale with the following labels: strongly disagree, disagree, somewhat disagree, neutral, somewhat agree, agree, and strongly agree.

5.6. Study 3: item selection and internal validity

The first step of validating our new measure was to select the final set of items and establish the internal validity of the measure.

5.6.1. Participants

Fifty-nine participants were recruited using Amazon Mechanical Turk (gender: man=44, woman=14, non-binary=1; age: $m=34.54$, $SD=11.227$). Participants were 18 years or older, US-only, and had an approval rate of at least 90% on at least 500 HITs.

5.6.2. Procedure

At the beginning of the study, participants completed a demographics questionnaire. Next, participants viewed three videos (see Stimuli below for details). After each video, participants completed the eight items developed for our measure. Presentation order of the three videos was counterbalanced between subjects. To ensure participants watched the videos completely, the player’s controls were hidden and the study system did not advance to the next page until the video finished playing. The study took approximately 15 minutes on average, participants were remunerated with \$3 USD, and the study was approved by the Research Ethics Board of the University of Saskatchewan.

5.6.3. Stimuli

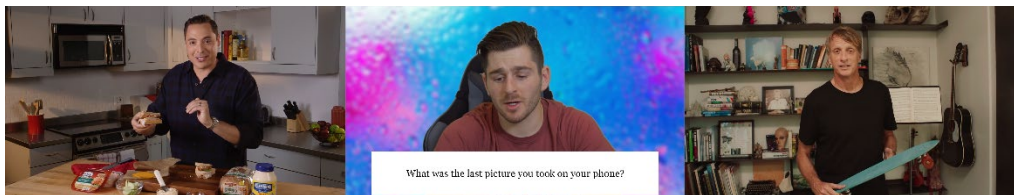


Figure 15. The three videos used in our study: Low-Disclosure (left), High-Disclosure - Conversational (middle), and High-Disclosure - Narrative (right).

We chose three videos for our study. The videos were edited for length, so each one was three minutes long; as part of this edit, branding or logo elements relating to the creators or uploaders of the videos were removed.

- **Low-Disclosure:** we selected an instructional video, *Jeff Mauro - Mesquite Smoked Turkey & Apple Club* (<https://youtu.be/MiUu-vfon8g>). The video was chosen to be comparable to the others in terms of number of people and amount of speaking but contain minimal self-disclosure. The video was edited to remove text that identified the presenter as a “celebrity chef and sandwich expert.”
- **High-Disclosure - Conversational:** we selected an interview style video, *73 Questions With Tony Hawk* (<https://youtu.be/7f4P9unmhdQ>). The video features a single person walking around their house while a camera follows him, and another person (off-screen) asks them questions. The questions include “How much are you skateboarding these days?”, “How did your parents feel as you started spending more and more time in the skate park?”, and “What would you say is the moment your career completely changed?”.
- **High-Disclosure - Narrative:** we selected a Q&A video, *When I'm Gonna Propose (Q&A)* (<https://youtu.be/-4zNEMq3loI>). The video features a single presenter reading questions aloud then answering them. The questions include “Would you ever consider dyeing your hair?”, “When are you going to marry your girlfriend?”, and “What was the last picture you took on your phone?”. The original video featured screenshots of social media posts showing the questions (which were submitted by followers of the channel); the video was edited to replace these with plain text captions of the question (see Figure 15, middle).

5.6.4. Measures

We used the following measures:

- **Demographics:** The questionnaire included questions about age, gender, and frequency of using video chat, using social media, and viewing online media.
- **Measure of Perceived Self-Disclosure:** we included the 8 items constructed for development of this measure. The instructions were written as “Thinking about the video

you just watched, how much do you agree or disagree with the following statements about the person in the video:”, and items referred to “the video”.

5.6.5. Results

5.6.5.1. Reliability

Cronbach’s alpha for the complete item set was high in all three conditions (Low-Disclosure: 0.897, High-Disclosure - Conversational: 0.861, High-Disclosure - Narrative: 0.864).

5.6.5.2. Item selection

To determine which items were best suited for the final measure, we ran an EFA (exploratory factor analysis) for each of the three conditions (PAF, Oblimin Rotation). In the first condition, one factor emerged; however, in the other two conditions two factors emerged (see Table 2).

Table 2. Factor loadings for the 8-item measure of perceived self-disclosure.

	Low-Disclosure	High-Disclosure - Conversational		High-Disclosure - Narrative	
	Factor 1	Factor 1	Factor 2	Factor 1	Factor 2
Item i	0.914	0.827	-0.197	0.886	-0.056
Item ii	0.638	0.594	-0.336	0.595	-0.251
Item iii	0.869	0.839	-0.236	0.872	-0.025
Item iv	0.594	0.649	0.097	0.612	0.123
Item v	0.771	0.869	0.12	0.784	-0.277
Item vi	0.701	0.519	0.524	0.573	0.176
Item vii	0.555	0.38	0.535	0.492	0.863
Item viii	0.793	0.819	-0.101	0.719	-0.228

The three factor analyses revealed that some items were not loading on a single factor as intended in the higher disclosure conditions. The items that loaded most highly on the second factor were ii, vi, and vii. This suggests that the use of the word ‘personality’ in item ii may have tapped into a different or more specific aspect of self-disclosure than the other items. Similarly, the references to conversational balance in items vi and vii did not assess the same underlying construct as other items, perhaps because rating someone as dominating focus in a conversation is perceived as rude. Because these three items did not perform as intended, they were removed from the pool, leaving five items in the final version of the measure.

After removals, Cronbach's alpha was .892, .888, and .881. Re-running the EFA shows a single factor solution in conditions one (KMO=.853, $\chi^2=179.202$, $df=10$, $p=.000$, variance explained=64.463%), two (KMO=.854, $\chi^2=179.566$, $df=10$, $p=.000$, variance explained=64.737%), and three (KMO=.865, $\chi^2=162.730$, $df=10$, $p=.000$, variance explained=62.508%); see Table 3 for factor loadings.

Table 3. Factor loadings for the 5-item measure of perceived self-disclosure.

	Low-Disclosure	High-Disclosure - Conversational	High-Disclosure - Narrative
Factor	Factor 1	Factor 1	Factor 1
Item 1	.926	.865	.908
Item 2	.891	.844	.886
Item 3	.655	.610	.636
Item 4	.690	.850	.714
Item 5	.817	.826	.775

5.6.5.3. Manipulation check

To test for effectiveness of the measure in discriminating between the videos, we analyzed the responses for each condition using the five items retained (see Figure 16 for means). A repeated-measures ANOVA showed significant differences between the three conditions ($f_{2,116}=131.967$, $p=.000$, $\eta^2_{\text{partial}}=.695$). Bonferroni corrected post-hoc tests show significant differences between the low-disclosure and the high-disclosure - conversational condition ($p=.000$) and high-disclosure - narrative condition ($p=.000$) but not the two high-disclosure videos ($p=.675$). This confirms that the narrative and conversational Q&A videos both resulted in higher ratings than the cooking videos.

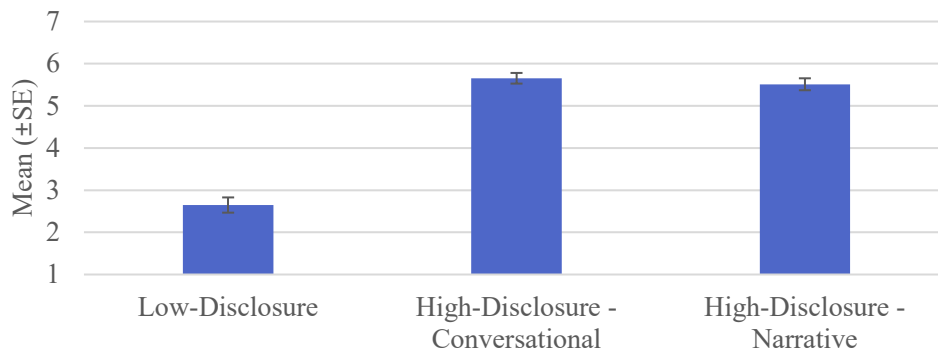


Figure 16. Mean perceived self-disclosure response by condition.

5.7. Study 4: confirmatory factor analysis

Having selected five items in Study 3, the next step to validating our measure was to perform a study with a larger sample, allowing us to conduct a confirmatory factor analysis (CFA). We took a similar approach to Study 3, but selected two videos instead of three to balance the cost of a larger sample size.

5.7.1. Procedure

At the beginning of the study, participants completed a demographics questionnaire. Next, participants viewed two videos (see *Stimuli* below for details). After each video, participants completed the new perceived self-disclosure measure. Presentation order of the two videos was counterbalanced across participants. To ensure participants watched the videos completely, the player's controls were hidden and the study system did not advance to the next page until the video finished playing.

5.7.2. Stimuli

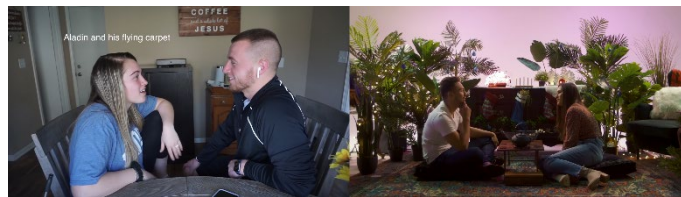


Figure 17. The two videos used in our study: Low-Disclosure (left), and High-Disclosure (right).

We chose two videos for our study (see Figure 17). For greater consistency with expected use cases of the measure, we selected videos that included two people for this study. The videos were edited for length, so each one was four minutes long.

- **Low-Disclosure:** we selected a video featuring a young couple doing various internet ‘challenges’, *2020 QUARANTINE GAMES // 6 Fun Couples Challenges To Do During Lockdown* (<https://youtu.be/KPWaNMtd5Q>). In our edit of the video, the couple does challenges involving quickly eating a fruit snack, eating six saltine crackers in a minute, fitting cookies in their mouths, and reading lips while wearing headphones. While the video contained very little self-disclosure, we removed a few instances of self-disclosure in our edit (e.g., discussion of their quarantine experience that prompted the video, or

mentions of a movie they enjoyed that inspired one of the challenges). The edited video included 67 conversational turns and 336 words spoken by the speaker who was rated by participants.

- **High-Disclosure - Conversational:** we selected a video of a young couple discussing questions from cue cards, *Her First Date in Years. Can a Single Mom Find Love?* (<https://youtu.be/MA4i0CdyD18>). In our edit of the video, questions on the cue cards included “When was the last time you cried?”, “What is your ultimate dream?”, “What is your relationship with your parents like?” and “What is a difficult experience that made you the person you are today?”. The edited video included 67 conversational turns and 369 words spoken by the speaker who was rated by participants.

In both videos, the woman was the speaker whose self-disclosure was rated.

5.7.3. Measures

We used the following measures:

- **Demographics:** The questionnaire included questions about age, gender, and frequency of using video chat, using social media, and viewing online media.
- **Measure of perceived self-disclosure:** We included the 5 items selected for the final measure. Since the videos included two people, an image of the speaker to be rated was shown at the top of the questionnaire; the instructions were written as “Thinking about the video you just watched, how much do you agree or disagree with the following statements about the person in the video pictured above:”; items referred to “the video”.

5.7.4. Participants

Two-hundred thirty-five participants were recruited using Amazon Mechanical Turk (gender: man=158, woman=71, non-binary=2, not specified=4; age: $m=38.34$, $SD=11.207$). Participants were excluded from analysis if they spent longer than 4 minutes on a questionnaire ($N=7$), spent longer than 6 minutes on a video ($N=21$), or answered the self-disclosure measure with 0 variance (i.e., choose the same answer for all items prior to reverse-coding; $N=7$). After exclusions, 200 participants remained (gender: man=130, woman=65, non-binary=2, not

specified=3; age: m=38.32, SD=10.944). This sample size is adequate for a CFA, particularly when accompanied by additional factor analyses on other samples [362].

The study took approximately 12-15 minutes on average, participants were remunerated with \$3 USD, and the study was approved by the Research Ethics Board of the University of Saskatchewan. Participants were 18 years or older, US-only, and had an approval rate of at least 90% on at least 500 HITs.

5.7.5. Results

5.7.5.1. Reliability

Cronbach’s alpha for the complete item set was good in both conditions (Low-Disclosure: .907, High-Disclosure: .794).

5.7.5.2. CFA

The CFA was performed using SPSS Amos, and tested fit using a model of a single-dimensional measure. Multiple metrics can be used to assess the model’s fit; the metrics and thresholds recommended by Hu and Bentler [363] are provided in Table 4. The model for our single-factor questionnaire performed well in the condition with self-disclosure: χ^2/df was good, the p-value was significant, and all other metrics show a good or great fit. In the Low Self-Disclosure condition, the p-value for the test of absolute fit was not significant; given that the model performed well on all tests of relative fit, this may simply reflect the fact that the sample size was limited (as the χ^2 test is sensitive to sample size). As the model performed well in all tests for the higher disclosure condition, the CFA shows the model performs well under intended usage conditions.

Table 4 Key metrics from CFA for high- and low-disclosure conditions.

Metric	Low-Disclosure	High-Disclosure	Thresholds
χ^2/df	1.421	2.246	< 3 good
p-value	0.213	0.047	< .05
CFI	0.997	0.983	>.95 great; >.90 traditional
TLI	0.994	0.966	>.95 great; >.90 traditional
RMSEA	0.046	0.079	<.05 great <.10 acceptable
PCLOSE	0.458	0.181	>.05

5.7.5.3. Manipulation check

To test for effectiveness of the measure in discriminating between the videos, we analyzed the responses for both conditions (see Figure 18 for means). A repeated-measures ANOVA showed significant differences between the two conditions ($f_{1,199}=420.518$, $p=.000$, $\eta^2_{\text{partial}}=.679$). This confirms that the measure discriminated between the high- and low-disclosure videos.

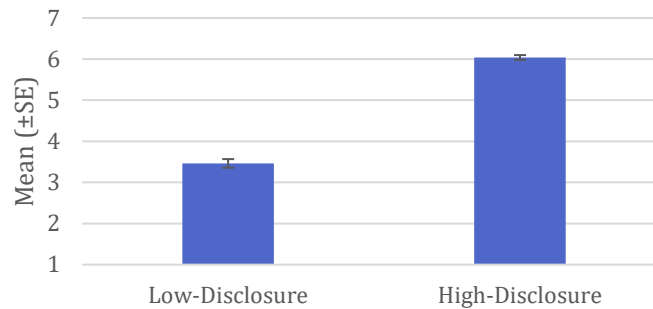


Figure 18. Mean perceived self-disclosure response by condition.

5.8. Discussion (Studies 3 and 4)

5.8.1. Summary of findings

Through two studies in different contexts, we show that our measure is a valid tool for assessing how users make and receive self-disclosures in digital environments. We constructed items that overcome limitations of previous scales relating to self-disclosure: our new measure can be applied to single interventions even when individuals are previously unacquainted and does not focus on a single topic, relationship type, or communication channel.

In Study 3, we eliminate underperforming items that contributed to a two-factor structure, creating a unidimensional five-item measure. We demonstrate that the measure responds as expected to different video stimuli, discriminating between high- and low-disclosure videos. To confirm that the measure's structure is as intended, we gather a larger sample in Study 4 and conduct a CFA. In this larger study, we demonstrate that the intended single-factor model fits the observed responses in all relative measures of fit, and in absolute fit under the expected context of use. Again, the measure shows a strong ability to discriminate between lower and higher self-disclosure stimuli in this study.

In our two studies, we test the measure in various contexts: we included video stimuli with men and women as targets of the perceived self-disclosure ratings, using monologue-style and conversational stimuli. This provides strong evidence for the applicability of our measure in various digital interactions.

5.8.2. Situating the perceived self-disclosure measure

Our new measure was designed to have broad applicability, in particular avoiding a focus on specific relationship types, topics, and communication channels. This unique approach means the measure is appropriate for research regarding various CMC and face-to-face situations. However, this does not mean it is appropriate in all situations. In particular, the measure includes phrasing such as “learned a lot about them” and “I knew quite a few details about them”. In the type of controlled intervention the measure is designed for (e.g., a single video call or a hangout in a synchronous digital environment), these questions are expected to capture self-disclosure as there are no other sources of information about the person. However, researchers using the measure should consider whether an intervention allows information to be communicated in other ways (e.g., observing someone’s interactions with others while playing a game together). In many cases this is not undesirable (e.g., information communicated through a profile photo, clothing choices, room décor, or shared photos can all be considered self-disclosure); however, researchers studying self-disclosure should be careful to define what is considered self-disclosure in their work, especially if non-verbal behaviours are included.

Our measure is rated by the person receiving the disclosure. It is important to be clear that this may differ from expert-rated self-disclosure. For example, the recipient’s knowledge and personal familiarity with the topic of the disclosure may affect their judgement of its importance. Further, as effective self-disclosure is characterized by reciprocation [125], a disclosure made in response to the other person’s disclosure may also be perceived as more important. For research questions such as how a system can promote self-disclosure or whether self-disclosures in an invention lead to formation of trust, this measure may more accurately capture the actual phenomenon of interest: the degree of self-disclosure perceived by the receiver. It is important that researchers studying self-disclosure be clear about who is rating it, a suggestion that researchers have previously made [251].

A final consideration for users of the measure is that it focuses on a single dimension of self-disclosure, amount. Researchers have suggested at least a dozen potential dimensions of self-disclosure [21, 114], so the current measure obviously does not capture all facets. However, for studies in which self-disclosure is not a primary focus, long scales with many subscales may not fit into the experimental design or planned analysis. Further, a particular strength of this measure is that it can be applied to initial interactions, a situation in which many facets of self-disclosure are less likely to be relevant.

5.8.3. Future directions for perceived self-disclosure and CMC

Much research regarding self-disclosure over the past decades has centered on whether CMC increases self-disclosure compared to face-to-face communication (e.g., see reviews by Kim and Dindia [250] or Nguyen et al. [251]). However, this work has not revealed consistent differences between CMC and face-to-face communication when it comes to the amount people self-disclose. Further, for researchers seeking to support self-disclosure in digital contexts, use of CMC is a given. Therefore, future work can provide greater value for users of digital tools by focusing on self-disclosure in digital spaces specifically.

An initial question for researchers studying digital spaces is how to encourage people to engage in self-disclosure, particularly when people are meeting for the first time. Icebreaker activities are one way in which people try to support initial interactions and elicit self-disclosure [34, 35, 36]. However, many icebreakers do not translate to digital environments (e.g., scavenger hunts) and even those that do (e.g., discussion questions) are not designed specifically for digital environments. Some research suggests that games are a promising and authentically digital way to support new relationships [32]. Still, other means that work within existing digital spaces in which people meet (e.g., Slack or Instagram) could offer significant benefits in supporting new relationships.

One important area of study for self-disclosure in CMC is the use of media for disclosure. Research has suggested that media such as photos, videos, and articles can be used in text messages [148, 149, 150] and social media platforms [151, 152, 153, 154] to support conversations and engage in self-disclosure. However, this research leaves several open questions, for example: Do users perceive self-disclosure through media as similar in amount or

depth to self-disclosure made through verbal or textual communication? Do people perceive sharing of third-party media (e.g., sending a link to a video) as self-disclosure? Which features of digital environments (e.g., granular privacy controls, targeted sharing, supported methods of communication) alter perceptions of self-disclosure?

A final question regarding self-disclosure in digital spaces is whether self-disclosure that is shared broadly (e.g., a tweet) is perceived similarly to targeted self-disclosure (e.g., a DM). Researchers have studied factors that influence public self-disclosures from the perspective of the discloser [364, 365] as well as factors that influence the ability of public self-disclosures to generate feelings of closeness [366]. However, more direct comparisons could further shed light on the ability of people to get to know each other in multiple ways online. For example, when self-disclosures are made in a group video chat, are they perceived as having the same weight as disclosures made in a one-to-one chat? Similarly, can viewing someone's social media profile prior to meeting them play a similar role to receiving a message in which they introduce themselves?

By understanding the degree to which people perceive another as having self-disclosed, researchers can gain new insights into these questions.

5.9. Limitations and future work (Studies 3 and 4)

In this work we tested our measure in several contexts through a series of studies. Together these studies provide strong evidence for the internal and external validity of the measure. However, there are some limitations. Study 3 had a limited sample size of 60 participants, a majority of whom were men. However, this limitation is counterbalanced by the larger sample size in Study 4 (200), which supported the desired single-factor structure of the measure, and additional factor analyses performed in the other studies.

Our sample consisted of North American participants only. This choice is useful for limiting confounding effects of culture when participants rated fixed targets (i.e., people in videos), but means that possible cultural variations in the measure's performance are unknown.

We did not test whether ratings generated using our scale are comparable to an expert coding of self-disclosure. This can be seen as a limitation, although the measure is not designed to

measure self-disclosure in the same way as expert coding, which does not take into account the receiver in measuring self-disclosure.

Future work should continue to assess the measure's performance in larger sample sizes and other countries or cultures. Previous work has shown that gender differences exist both in expert-rated [367] and self-rated [368] self-disclosure. Therefore, future work including objective (i.e., expert coded) measures of self-disclosure should assess whether gender differences exist in perceived self-disclosure of another person. Similarly, researchers should investigate the relationship between objective self-disclosure made by an individual and perceived self-disclosure assessed by their conversational partner. For example, researchers may investigate whether perceived similarity of the individuals, reciprocity of disclosure, or communication medium influence the relationship between objective and perceived self-disclosure.

5.10. Conclusion (Studies 3 and 4)

Forming and maintaining relationships is an important part of daily life. Whether for work or personal reasons, people use digital tools to meet and keep up with other people. However, researchers of digital interactions have limited and expensive options for understanding self-disclosure in these contexts. In this work, we develop and validate a measure of perceived self-disclosure that is applicable to a variety of digital interactions. Though theory tells us that self-disclosure is a key part of relationships, CMC researchers have often overlooked the role of self-disclosure by considering only associated outcomes, such as trust and closeness. Understanding whether digital systems support or promote self-disclosure provides researchers with the ability to understand how their systems engender trust or closeness, supporting informed decisions about the design of digital communication platforms.

CHAPTER 6. SYNCHRONOUS MEDIA SHARING SYSTEM

6.1. Citation and role of collaborators

This work was published—as part of a larger project—at the ACM CSCW Conference on Computer-Supported Cooperative Work; the full citation is:

Matthew K. Miller and Regan L. Mandryk. 2021. Meeting with Media: Comparing Synchronous Media Sharing and Icebreaker Questions in Initial Interactions via Video Chat. *Proc. ACM Hum.-Comput. Interact.* 5, CSCW2, Article 374 (October 2021), 26 pages. DOI: <https://doi.org/10.1145/3479518>

This work was done in collaboration with my supervisor Dr. Mandryk. I led the design and implementation of the system, under the guidance of Dr. Mandryk.

6.2. Research contributors

This work contributes an integrated system for synchronously viewing online media and video chatting within a web-based interface. By enabling studies of a non-traditional video chat interface, this system supports research that addresses this dissertation’s problem statement regarding the limitations of traditional video chat interfaces for relationship maintenance.

The system features the ability to make accounts and groups. Each group has a queue on online media, which all members can add to at any time. When a group starts a video call, all members see the media from the queue synchronously while video chatting. Shared controls allow any group member to control the media being presented.

6.3. System background and goals

Our previous studies suggest that interfaces can have unintended conversational effects. Providing a content-focused interface may create a more equalizing experience that does not

place undue focus on users' video feeds. Additionally, previous research suggests that shared activities are necessary but poorly supported for remote relationships. Therefore, we introduce a system that supports a shared activity and focuses the interface on undertaking media sharing together rather than the more traditional focus of user video feeds.

Inspired by existing varied and personal uses of online media, we take a design-for-appropriation approach. We focus on two of Dix's guidelines for appropriation [136], *support not control* and *allow interpretation*, while also considering his general suggestion to create openness in possible usage. Implementing explicit media sharing support in video chat with a focus on enabling flexible usage rather than creating a specific intended pattern of interaction aligns with our goal of studying how shared activities can support a rich set of relationship maintenance behaviours.

6.4. Design framework

Systems designed for synchronous remote media sharing face many design choices. In this lightweight framework, we identify eight key design issues that must be considered and the main ways in which each can be realized.

Communication Channel(s): Like any remote communication system, possible channels for communicating about shared media include video, audio, text, emoji, and others.

Integration: A system for remote media sharing may be implemented as a standalone application or integrated into a communication platform. When integrated, media sharing could be implemented as the major focus of the system, as one of several primary features, or as a secondary feature.

Supported Content Type(s) and Source(s): Many media types exist online (e.g., videos, images, and articles) and media may come from many sources (e.g., YouTube, CNN, or Pinterest) or users' devices (e.g., photos or screenshots). Systems can support a mix of these types and sources.

Degree of Media Synchronization: Shared media may be individually viewed or synchronized. Three levels of synchronization exist: *None*—users individually view media; *Item-level*—users see the same item at the same time; and *Within-item*—users see the same item at the

same time and the consumption state (e.g., video seek time, article scroll position, or image number in a gallery) is synchronized.

Content Management: Systems must provide the ability to transmit media items or manage a shared collection of media items. This could be a standard text chat for sharing links or a shared collection (e.g., a list, album, or pinboard).

Content Visibility: In face-to-face media sharing, visibility can be managed physically by showing or hiding a device. Digital systems can allow everyone to see all items in the collection, or limit visibility until items are ‘presented’.

Playback Ordering: For synchronized systems (item-level or within-item), a ‘current’ item facility must be provided. Once the current item is viewed, systems can take several approaches for playback ordering: *Modal Search*—the system enters a search mode allowing users to add another item; *Shared Choice*—users select an item from the collection, e.g., by voting or choosing the first nominated item; or *Automatic Choice*—an item from the shared collection automatically becomes the next item, e.g., using a queue (first added, first viewed) or stack (last added, first viewed).

Playback Control: In digital media sharing systems, control may be shared by all users or available only to the uploader of the current item (like the physical device or remote holder in face-to-face and TV-based media sharing).

6.5. System design

To support media sharing as a shared activity, we designed an augmented video chat system (see Figure 19). Existing uses of online media are varied and personal, so we take a design-for-appropriation approach. We focus in particular on two of Dix’s guidelines for appropriation [136], *support not control* and *allow interpretation*, while also considering his general suggestion to create openness in possible usage of a system. Following these guidelines while implementing explicit support for media sharing in video chat aligns with our goal of studying how synchronous remote media sharing may be used for relationship maintenance.

Communication Channel(s): Our system is motivated by supporting people in maintaining relationships remotely, so we use video for communication; video is a rich channel that is

popular among people maintaining relationships by spending time together using CMC [93, 12, 16].

Integration: Our system integrates communication and media sharing. This is motivated by technical issues in non-integrated systems [284], difficulty managing multiple tools on screen in ad-hoc approaches [12], and calls for integration with communication tools [313]. We position media sharing as a primary feature by splitting the interface, with shared media on the right and user video feeds on the left. A larger focus on media was considered (with shared media in the center and user videos on either side), but a left-right split may ease conversation by making visual attention more explicit [284]. As initiating media sharing can be a barrier [284], we also avoid restricting media sharing to a certain mode or menu. In sum, our system balances communication and media sharing as equally important parts of a shared activity.

Supported Content Type(s) and Source(s): Our system provides broad support for different content types and sources by supporting arbitrary-URL and drag-and-drop sharing, which fits our goal of allowing users to interpret what should be shared. The system explicitly supports video, image, article, and product media types; other types can still be shared but will be represented by a link only.

Degree of Media Synchronization: We implement within-item synchronization with a shared media stage. The stage shows a single item (the same for all users) from the queue as an embedded view, with its title at the top, its source URL at the bottom, and the middle of the stage adapted to its type. Videos are shown using an embedded player with seek, play/pause, and volume controls. Image(s) are shown embedded in the stage; if multiple images were found in the shared link, they are shown one at a time in a gallery with next/previous buttons. Articles are shown as a scrollable view of the article's body. Products are shown in a simple layout featuring price, description, and images. Finally, other items are shown as a link and a note that their content type could not be detected. Within-item synchronization is applied to videos by synchronizing play, pause, and seek actions between all users. We chose within-item synchronization for videos because previous work has cited manual synchronization as a barrier [12, 284] and found offsets in remote playback can render the experience "ruined" [279].. Within-item synchronization is also applied to image galleries such that the currently-shown image is synchronized at all times. Within-item synchronization was not applied to articles

because reading (unlike video playback) occurs at an individual pace and was not applied to products because the bulk of their information is visible without scrolling.

Content Management: We take the shared collection approach, using a queue structure. Queued items are shown as a thumbnail if one was found, or a random colour if not. Three buttons appear when hovering on items: ‘preview’ (shows an embedded preview of the item), ‘bump’ (moves the item to the top of the queue) and ‘delete’.

Content Visibility: The queue is available before a call begins. We expect this to let users focus on shared viewing during calls, rather than seeking content. As the queue is visible anytime, items shared by other users are blurred and cannot be previewed, bumped, or deleted. This lets everyone experience the surprise or humor of items together.

Playback Ordering: We implement *Automatic Choice* ordering, using the queue. During calls, the queue of remaining items is shown below the media stage, separated by a ‘Next’ button allowing any user to advance to the next item. We were motivated by a simple queue’s fairness and understandability, but added ‘bump’ to preserve flexibility.

Playback Control: Anyone, not just an item’s sharer, can use the ‘Next’ button and the controls in the media stage.

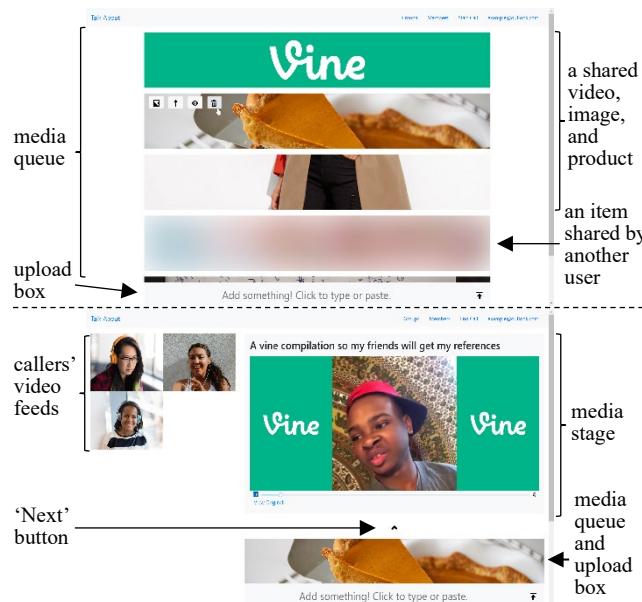


Figure 19. Top: out-of-call view (queue). Bottom: in-call view (caller video feeds, media stage, and queue).

To enable flexibility and allow users to interpret what should be shared, we support media sharing by pasting arbitrary URLs or dragging-and-dropping. Pasted or dropped items are placed in a shared collection called the *queue*. This queue is displayed in the out-of-call view (see Figure 19, top), allowing items to be added before a call begins. We expect adding media before calls will let users focus on viewing during calls (though users can continue to add to the queue during calls as well). Queued items are shown as thumbnails if one was found, or a random solid colour if not. The items show three buttons on hover: ‘preview’ (shows an embedded preview of the item), ‘bump’ (moves the item to the top of the queue) and ‘delete’. To ensure everyone can still experience the surprise or humor of items together, other users’ items in the queue are blurred and cannot be previewed, bumped, or deleted.

Our system integrates communication and media sharing in one system because prior work has identified technical issues in non-integrated systems [284], shown difficulties with managing multiple tools on screen in ad-hoc approaches [12], and called for integration [313]. Because our system is motivated by supporting people in maintaining relationships remotely, we use video for communication. Video is a rich channel that is popular among people maintaining close relationships by spending time together using CMC [93, 12, 16].

We integrate communication and media sharing by splitting the in-call view (see Figure 19, bottom), placing media sharing functionality on the right and user video feeds on the left. A larger focus on media was considered (with media in the center and user videos on either side), but the left-right split may ease conversation by making visual attention more explicit [284]. As initiating media sharing can be a barrier [284], we also avoid restricting media sharing to a certain mode or menu.

As the queue shifts to the right side during a call, a viewer called the *media stage* appears at the top of the queue. The media stage lets everyone consume the shared media together by displaying a single item from the queue to all users, with its title at the top, its source URL at the bottom, and a type-dependant view in the middle. Videos are shown in an embedded player with seek, play/pause, and volume controls. Images are shown embedded in the stage; if multiple images were found in the shared link, they are shown one at a time in a gallery with next/previous buttons. Articles are shown as a scrolling view of the article’s body and products are shown in a simple layout featuring price, description, and images. Other items are shown as a

link only. A ‘Next’ button shown between the stage and the queue allows users to move to the next item in the queue up to the stage.

While the media stage ensures all users see the same item, within-item synchronization is also applied to videos by synchronizing play, pause, and seek actions for all users. We chose within-item synchronization for videos because previous work has cited manual synchronization as a barrier [12, 284] and found offsets in remote playback can render the experience “ruined” [279]. Within-item synchronization is also applied to image galleries such that the currently-shown image is synchronized at all times. Within-item synchronization was not applied to articles because reading (unlike video playback) occurs at an individual pace and was not applied to products because the bulk of their information is visible without scrolling.

To allow users to share the task of operating the media sharing system, anyone, not just an item’s sharer, can use the ‘Next’ button and the controls in the media stage.

6.6. System implementation

Our system’s interface is a web app implemented using ReactJS and ReactStrap and hosted by NodeJS. The underlying system includes three main components, implementing media sharing, video calling, and synchronization. *Media sharing* is implemented using the Diffbot Automatic API (<https://www.diffbot.com/products/automatic/>) to get each item’s type (video, image(s), article, product, or other) and metadata and using Firebase to store the queue. *Video calling* is implemented using WebRTC. We use Kurento Media Server [330]. rather than a peer-to-peer approach. Kurento records the video streams and reduces the uplink needed for group chat by broadcasting a single outgoing stream per client to all other users. Call signaling uses WebSocket connections to the NodeJS server, running the ws library (<https://github.com/websockets/ws>). *Synchronization* is implemented using the same sockets as call signaling. As a quality check, we analyzed logs of the 2723 WebSocket ping-pong messages [369] sent in Study 5. Round-trip latency for these messages (on our internal network) was under 10ms on average and over 100ms in less than 1% of all cases. Thus, the potential for significant variations in the timing of synchronization messages was minimal. Observationally, no perceptible offsets in synchronization were noted in testing or by our participants.

SECTION 4. EFFECTS OF VIDEO CHAT AMONG STRANGERS AND FRIENDS

CHAPTER 7. SYNCHRONOUS MEDIA SHARING FOR RELATIONSHIP MAINTENANCE

7.1. Role of coauthors

This work was done in collaboration with my supervisor Dr. Mandryk. I led the study design, data collection, analysis, and writing work; Dr. Mandryk assisted with defining research questions and measures, analysis, and writing.

7.2. Research contributors

In this work, we show how a flexible activity—media sharing—can be leveraged in a synchronous context with appropriate system support and allows people to use the activity for numerous relationship maintenance behaviours. This work helps address the dissertation’s problem statement, that users are constrained in their ability to maintain relationships when limited to a traditional video chat interface.

In Study 5, we first show that participants successfully shared and discussed a range of media over our system (described previously in CHAPTER 6), including images, articles, videos, and products. Next, we confirm that the experience is enjoyable by measuring time spent talking and laughing along with participant ratings. Finally, we identified appropriate uses of the activity that enact relationship maintenance behaviours including self-disclosure, reinforcing common ground, articulation work, joint planning, giving ‘gifts’ tailored to friends’ interests.

7.3. Background and motivation

Our first study of the new system was to confirm that synchronous media sharing supports a range of relationship maintenance behaviours, meaning it can be successfully used in a flexible and broadly applicable way to support remote relationships

7.3.1. Research questions

The goals of our study are to determine whether our system allows people to engage in relationship maintenance practices and to observe how they appropriate the system to do so. Prior work shows video chat users want to share activities [12, 277, 279], and shared activities need system-level support [93]. Specifically, media sharing is a desirable activity [279, 12, 284], despite barriers in ad-hoc solutions [279, 12, 284]. Thus, we do not focus on replicating prior work on the value of shared media or activities by comparing our system to standard video chat. Rather, we focus our evaluation on three questions: *Given an integrated system for synchronous media sharing and video chat:*

RQ10. How will users choose to use the shared activity?

RQ11. Will participants enjoy the experience?

RQ12. What types of relationship maintenance behaviours will participants exhibit?

7.4. Study 5

We studied our system in use with friend triads. Friendships are a commonly studied relationship type (e.g., [304, 370, 284, 313, 371, 372]) and a motivating group for building shared activities [93]. We chose groups of three to show our system generalizes beyond pairs and balance the recruitment and analysis costs of larger groups. We expect friend triads to provide results that address our research questions, which future work can build on in other contexts, such as pairs or romantic partners. As an initial study of our system, we focus on an in-lab context, minimizing the effects of individual context and personal device differences to allow cross-group aggregations. The study received approval from the research ethics board at the University of Saskatchewan. Participants provided informed consent.

7.4.1. Procedure

Participants were given a demonstration of adding, deleting, previewing, and bumping queued items and using the shared stage. Then they completed the study in separate rooms using Chrome on provided laptops. First, participants took 10 minutes to answer questionnaires. The system then notified them: “You’ll have some time (about 10 minutes) to look for content you want to share with your friends. Feel free to browse the web for things to share.” Participants had 10

minutes to browse, starting when they all finished the surveys. Next, a message saying a video chat would start and a 20 second countdown were shown.

During the video chat, participants viewed the items together using the shared media stage. The system did not enforce how fast participants went through the queue or how many items they viewed. They could add, delete, or bump items during the call, which lasted 15 minutes. Next, a message saying the video chat would end soon and a 20 second countdown were displayed. Finally, they completed a second set of questionnaires.

7.4.2. Measures

Our demographics survey asked age and gender; frequency of social media, online media, and video chat use; and the length and type of the group's relationship. Previous work on CMC in friendships has been inconsistent (e.g., finding content-related [370, 373, 309] or personal [304] communication dominant in social TV). Therefore, we situated our research by assessing participants' frequency of maintenance behaviours with the Friendship Maintenance Scale and their satisfaction of basic needs in the relationship with the Basic Psychological Need Satisfaction Scale: Relationship Domain (see Section 1.2.4 for details of this measure).

We recorded browsing history, video calls, and actions in the system. The calls were transcribed in Audacity by selecting utterances and labelling them with transcriptions. Utterances were defined as laughter or speech separated by at least 1 second of silence. Utterances were then categorized into categories from Ducheneaut et al. [302]. Transcription and categorization were done by a single author who also reviewed the calls and shared media to ensure accurate recognition of content references.

Finally, we used the Intrinsic Motivation Inventory (IMI) to measure enjoyment, value, and relatedness as a result of using the prototype system (see Section 1.2.4 for details of this measure).

7.4.3. Participants

Participants were recruited via the University website. Each person who signed up arranged for two friends to join them; each person received \$10. While recruitment was not specifically

limited to students, all participants were students and not distance separated, which we discuss as a limitation.

Thirty individuals participated (Gender: F=19, M=11; Age: M=20.77, SD=2.30). The vast majority of them used social media and online media daily; all participants used both at least monthly. Video chat use was less frequent, with all participants reporting its usage, but ranging from daily to yearly, with the vast majority using video chat a few times per month or more.

For each of the 10 groups, descriptions of how long members had known each other were converted to 3 pairwise values then averaged to one group value. Groups had known each other for 56.63 months on average (SD=70.98), or 4.72 years, ranging from 1 month to 20 years. Groups' gender compositions varied: FFF=5, FFM=1, FMM=2, MMM=2. As shown in Table 5, participants rated their friendship maintenance with group members between casual and close friends and were satisfied in these relationships at levels between roommates and best friends.

Table 5. Friendship Maintenance Scale scores and reference values [326] (11-pt scale). Basic Psychological Needs Satisfaction—Relationship Domain scores and reference values [327] (7-pt scale). Values are mean (SD).

Scale	Subscale	Our Study	Reference Values		
			Best Friend	Close Friend	Casual Friend
FMS	Positivity	5.15 (0.95)	7.19 (3.65)	5.76 (3.28)	4.68 (2.01)
	Support	6.52 (0.63)	9.20 (1.61)	8.00 (2.05)	6.27 (2.00)
	Openness	6.69 (1.12)	8.67 (1.86)	7.69 (2.12)	6.34 (1.67)
	Interaction	6.86 (1.23)	8.56 (1.45)	7.35 (1.67)	5.24 (1.73)
			Best Friend	Roommate	Adult Figure
BPNS	N/A	5.96 (0.51)	6.23 (0.79)	5.36 (1.17)	4.78 (1.21)

7.5. Results (Study 5)

We organize our results by our three research questions.

7.5.1. How will users choose to use the shared activity?

7.5.1.1. Searching for media before the call

Prior to the call, participants browsed the web for content to share. Individually, participants visited an average of 33.27 pages (SD=19.48) from 5.40 unique websites (SD=3.10). Across all participants, 70 websites were viewed: 53 were viewed by only one participant, and the most viewed were YouTube (30 participants), Google (30), Pinterest (7), me.me (5), Twitter (4), Tumblr (4), Amazon (4).

7.5.1.2. Sharing media before the call

On average, participants shared 7.60 (SD=5.93) items, including 3.87 videos (SD=3.33), 2.11 images (SD=5.27), 0.70 articles (SD=1.24), 0.23 products (SD=0.63), and 0.63 other links (SD=1.07). In 8 of the 10 groups, at least one item was shared after the call started, but the majority (>80%) of content was shared before the call began.

Table 6. Number of media items viewed and remaining unviewed in the queue (per group). Values are mean (SD).

Type	Video	Image	Article	Product	Other
Viewed	8.20 (3.74)	6.30 (13.59)	1.30 (2.00)	0.60 (1.07)	1.40 (1.65)
Unviewed	3.40 (4.45)	0.20 (0.63)	0.80 (1.03)	0.10 (0.32)	0.50 (0.85)

7.5.1.3. Viewing media during the call

On average, groups viewed 17.80 media items (SD=16.76) and had 5.00 unviewed in the queue (SD=5.68); see Table 6 for types. On average, video playback occupied 54.79% of the call (SD=32.41%). Five of the ten groups exhausted their queue during the call; four of them shared more and the fifth simply chatted for the duration.

7.5.2. Will participants enjoy the experience?

7.5.2.1. Participant ratings

The IMI (5-pt scale) showed that participants agreed the experience was interesting/enjoyable and valuable. 100% of responses to the interest/enjoyment (M=4.26, SD=0.44), value (M=4.03, SD=0.25), and relatedness (M=4.55, SD=0.39) subscales were above neutral. By comparison, a study combining TV viewing and Skype chat [284] found 81% of responses regarding enjoyment were above neutral.

7.5.2.2. Speaking and laughing

Groups spent 46.27% (SD=17.55%) of the call speaking and laughing on average. Further analysis was done at an individual level to avoid confounding effects of overlapping utterances. Of the call, each participant spent an average of 17.71% (SD=7.33%) speaking, 9.76% (SD=8.60%) laughing, and 72.53% (SD=12.55%) silent. Participants spent more time laughing during video playback (10.76%) than when no video was playing (8.44%). Conversely, participants spent less time speaking during videos (14.69%) than outside videos (22.32%); however, during video playback conversation levels were only reduced by about one third.

7.5.2.3. Conversational topics

Utterances were labelled using Ducheneaut et al.'s categories [302]; see Table 7 for frequencies. Phatic responses (i.e., communication with a social rather than informative function—composed mainly of laughter in our study) were very frequent, followed closely by topics relating to the shared media (Content and Context). Logistical communication (i.e., speech relating to operating the system or coordinating the experience) was also frequent.

Each category's frequency was compared with Enjoyment ratings; see Table 7. Phatic utterances (mostly laughter) significantly correlated with Enjoyment. While Ducheneaut et al. [302] suggest Non-sequitur conversation negatively affects social TV experiences, our results do not support the same conclusion for social online media viewing.

Table 7. Speech utterances categorized by topic and correlations between Enjoyment and these categories. Frequencies are mean (SD); correlations are 2-tailed Pearson Correlations; p-values Bonferroni corrected.

Category	Phatic	Content	Context	Logistical	Non-sequitur	Study	Other
%	36.28	30.55	4.34	14.49	9.18	2.29	2.88
Frequency	(10.57)	(12.05)	(3.85)	(9.39)	(9.48)	(3.43)	(4.18)
Correlation	0.793*	0.303	-0.258	-0.636	-0.129	-0.539	-0.478
P-value	0.042*	1.000	1.000	1.000	1.000	1.000	1.000

7.5.3. What types of relationship maintenance behaviours will participants exhibit?

While sharing online media may appear impersonal, it presents many opportunities for personal interactions and performing relationship maintenance behaviours. Our analysis of system logs and conversational transcripts shows that participants used media in many ways to support social interaction and enact relationship maintenance behaviours. Quotes in this section are identified by group (1-10) and within-group participant (1-3); horizontal lines in block quotes delimit separate conversations.

7.5.3.1. Self-disclosure through shared media

Openness and self-disclosure have been identified as common relationship maintenance behaviours in romantic relationships [6] and friendships [374]. Shared media can support and provoke self-disclosure. The value of public self-disclosure (e.g., on Facebook) through media has been questioned [375]; however, small-group video chat may be more suitable for this kind of sharing as it more closely mimics small-group photo sharing face-to-face [137]. Further, this

context allows significant others to acknowledge the media's meaning in a shared experience, which can strengthen its meaning for the sharer too [376, 377].

Shared media can support self-disclosure in multiple ways, including conveying personal information, providing reference points for people to share perspective on or identify with, and supporting people in sharing updates, experiences, and opinions.

7.5.3.1.1. Personal

Shared media can be personal in nature; even publicly available items can have personal meaning. For example, one person discussed Haida Gwaii, the archipelago where she grew up, during a video about the area (see Figure 20, Left):

P6-1: This makes me miss this so much, ahh
P6-2: Oh wow!
P6-1: Massett – that's where my brother lives!
P6-2: He lives in that building?
P6-3: The shack?
P6-1: No, he lives in Massett
P6-2: Oh, okay, that's
P6-3: Ah
P6-2: [laugh]
P6-1: It's a longhouse
P6-2: [laugh]
P6-1: [laugh] Okay I've grown up with those guys and they're like very, very quiet
P6-2: You actually, you know those guys?
P6-1: Oh yeah. Everyone knows each other on Haida Gwaii

7.5.3.1.2. Reference

Shared media can also provide a reference that participants can describe from their own perspective, e.g., a video showing an egg served with ketchup and rice (see Figure 20, Middle) prompted a discussion of food in the context of participants' birth countries:

P1-1: Do you really eat rice in your country?
P1-3: Uh, yeah.
P1-1: Oh, ok.
P1-2: But not with ketchup.
P1-1: Oh, yeah, no, nobody eat with ketchup.

7.5.3.1.3. Identification

Shared media also supports less direct self-disclosure. Participants compared people or events in media to their own personalities, ambitions, or lives. Identifying with media let them communicate personal information they may not otherwise have thought to share or been able to describe. Some cases were longer, e.g., this reference to YouTuber Trisha Paytas (see Figure 20, Right):

P7-2: Trisha is goals.
P7-1: [laugh]
P7-3: I love her. Like I wanna be her. I want this life. I wanna eat pizza and be a skinny legend, this is all I want.
P7-1: [laugh]
P7-2: She, she has liposuction.
P7-3: She what?
P7-2: She has, like, liposuction.
P7-3: Girl, she still looks good and eats pizza. That’s all you need in life. And look at this, this is such an iconic video.
Like I’m gonna dress like that for Halloween, honestly.
P7-1: [laugh]



Figure 20. Stills from videos referenced as self-disclosure. Left: the video about the area where P6-1 grew up. Middle: the video mentioning ketchup on rice discussed by G1. Right: the video featuring YouTuber Trisha Paytas that prompted P7-3 to say they “wanna be her.”

More often, participants briefly indicated that they identify with elements of the media, e.g., a participant (P4-2) mentioning “That looks like the quality of tape jobs I do on my athletes.” Most of these expressions were metaphoric, describing the media as if it actually depicted the participants, e.g., these expressions (separate conversations are delimited with horizontal lines):

P8-2: Me and Sarah. Me and Sarah.

P9-3: Literally me. That was me.

P8-3: A mood. Me. Me this weekend.

P7-2: Oh, true though. Oh, true, me.

P8-2: It’s me.

P9-1: Is she dead? Me. Dead.

This usage mirrors Not-Selfies [154], a kind of self-disclosure through “visual self-representation consisting of images that do not feature the likenesses of the people who share them, but instead show objects, animals, fictional characters, or other things”. Like many of our participants’ references, not-selfies often use metaphorical hashtags (e.g., #currentstatus, #me, or #GPOY—‘gratuitous picture of yourself’) that suggest the image is a photo of the sharer, but are not meant literally. Such usage can allow self-disclosure that is difficult through literal or explicit means due to complex and conflicting identities [153].

7.5.3.1.4. Updates

Shared media also prompted participants to give day-to-day life updates. For example, one participant (P9-3) shared the product page for a pair of pants that she had ordered “because they are so sad, because they still haven’t come in ... I feel bad. I hope I come home and they’re magically on my front step cause I’ve been

waiting for them”. Another shared a gallery of Halloween costumes and checked in on her friends’ plans:

P4-3: Do you have plans for Halloween?
P4-2: I don’t think so, no, do you?
P4-3: No, not really, but I wanna. I think I’ll go out on Saturday.
P4-2: Yeah, I just don’t really want to.

7.5.3.1.5. Experiences

Shared media provided a context for sharing broader experiences, beyond the day-to-day, e.g., discussing experiences with makeup during a makeup tutorial:

P4-3: I just wish I could do eye shadow that well.
P4-2: I wish I could do makeup period.
P4-3: True. Very true. Yeah, cause
P4-1: With you on that. I don't even have a brush. If I do eyeshadow, I use my finger.
P4-3: Finger?
P4-2: Me too
P4-3: [laugh] I love it. I have brushes, but I don't know how to use them.
P4-2: [laugh]
P4-3: I don't know. I always want my makeup to be like subtle enough that you can't notice that it's like there, you know? But then I'm like, if I try and do eyeshadow, and then I see it, I'm like 'uh oh'.
P4-2: Yeah.
P4-1: You're wearing it?
P4-3: [laugh]

7.5.3.1.6. Opinions

Shared can prompt disclosure of opinions. In one case, a participant (P10-2) remarked during a video that “Samsung is shit”, and another (P10-3) agreed, “Exactly”. In another case, participants watched UFC. One (P3-1) said “I was a big fan of Connor, but then, but like, Khabib is a really good fighter too” and another (P3-2) concurred, “Yeah Khabib is uh, good too, yeah.” Finally, during the video Does Rowan Atkinson Want Mr. Bean To Come Back?, P3-2 said, “He should retire from Mr. Bean, yeah.” His friends (P3-1, P3-3) agreed: “Yeah”, “Maybe it’s getting old”.

Beyond these specific behaviours, sharing is always an implicit act of self-disclosure, because the choice of what to share online reflects people’s online personae [151].

While our system allows photo and video uploading from the local device in addition to the web, this was not used in the study because laptops were provided. Sharing personal media could be even more popular. Sharing day-to-day or personal photos is common in other mediums such as messaging [378], email [138], and dedicated apps [379], and can support maintaining connectedness remotely [380].

7.5.3.2. Common ground through shared media

A second common relationship maintenance behaviour is the establishing or reaffirming of common ground. Communities of people share common ground—defined by Clark [381] as “mutual knowledge, mutual beliefs, mutual assumptions and other mutual attitudes” (pg. 6), and the acquaintedness of a relationship is “defined largely by the type and amount of personal common ground two people have” (pg. 115-116) [382]. Clark suggests most personal common ground is formed from joint conversational or perceptual experiences [381]; our prototype affords both.

7.5.3.2.1. *Personal idioms*

One type of common ground is personal lexicons or personal idioms—phrases, expressions, and gestures with a special meaning in a relationship [382]. Personal idioms can indicate closeness in romantic relationships [383] and friendships [384]. Personal idioms can be generated by co-located shared media experiences (e.g., a funny moment from a TV show referenced in unrelated conversation) [385]. Personal idioms are a long-term phenomenon, thus difficult to observe in our study; however, we saw groups repeat phrases referentially, evidencing media’s capacity to create shared reference points, which further use could solidify as personal idioms. For example, a participant (P8-2) mentioned “Bro this gives me baby fever. Why’d you put this up here?”; another (P8-3) agreed: “trying to give me baby fever”. About 13 minutes later a video of a young child was shared, prompting a participant (P8-3) to ask “Have you seen this? Oh my god Alex, if you think you have baby fever!” In another group, during a video about people with red hair, a participant (P4-1) asked, “Why are you thinking of gingers?” and the sharer (P4-3) said it was because she had a crush on someone with red hair. Five minutes later, that participant (P4-3) said that she shared a video because “[she] just [had] babies on the mind”, prompting her friend (P4-1) to tease: “babies and gingers”, and her (P4-3) to respond “I was also looking up puppies, so simmer down. And Arianna Grande. It’s not special.” Like personal idioms is the practice of lexical entrainment, in which people converge on terms and verbal labels over time [386]. Interactions in our system were brief, but repeated use of terms such as “gingers” or “baby fever” suggests that conversation in our system might be subject to lexical entrainment—and its collaborative benefits [387, 388]—over time.

7.5.3.2.2. Mutual membership

Another type of common ground in relationships is mutual membership in broader identities or groups. If two people are aware that they are both members of a community, the communal common ground that stems from that community becomes part of their personal common ground [381]. Online media can support the construction of broad collective identities (e.g., the video “memes” of the It Gets Better project, featuring LGBT people explaining how their struggles improved with time [389], or memes shared in the #YoSoy132 Movement, which reference past revolutionary figures to reinforce the movement’s identity as “heir of the values and ideals of a long tradition of protest” [390]). In our study, several groups shared memes referencing community membership. A group of students (G4) shared a meme about first-year students, a group of veterinary students (G6) shared a meme about vet school, and a group of computer science students (G7) shared programming memes (see Figure 21). These memes act as a reminder that all viewers are among the in-group of a larger collective identity (since people outside the group cannot fully access the meme’s humour [391]). The memes do not provide a significant conversational basis (all viewers identify with them already); their usage is consistent with Zappavigna’s description of meme usage in social media “for social bonding rather than for sharing information” [392].



Figure 21. Memes that reinforce group context and commonalities.

7.5.3.3. The shared task of media sharing

A third relationship maintenance behaviour we observed is taking care of routine tasks and chores together, or ‘sharing tasks’ [6]. People using our system negotiate media sharing together because operating shared controls requires discussion. Logistical talk was common in our study (see Table 7), but not a focus in the social TV study that generated the categories [302]. In our study, shorter media items and shared controls likely increased the opportunity and need for logistical talk, compared to TV. With shared control, users need to communicate to ensure actions are not duplicated (e.g., if two people press ‘Next’ at the same time they may skip an

item inadvertently). This sort of task-based discussion can contribute to group experiences. CSCW often discusses support for articulation work (the work of working together [393, 394]) in terms of system usability or communication efficiency and effectiveness (e.g., [395]). In leisure contexts, articulation work, such as the distributed cognition board game players perform to cooperatively accomplish play [396], may have an important social function. In digital board games, ‘chores’ (e.g., moving objects, keeping score) could be automated, but contribute to the sociability of playing together [397]. Similarly, logistical talk may encourage interaction and the sense of a shared experience for social viewers. For example, because our prototype did not show who shared items, users sometimes asked who had shared them. These discussions tended to prompt not only an answer but also an explanation of why they chose to share the item. In our study, we saw articulation work expressed in a variety of ways. Most prominently, many groups agreed verbally each time they moved forward to the next item, e.g.:

P9-1: Kay, next one?
P9-2: Yeah.
P5-1: Next? Okay?
P5-3: Next video.
P5-1: Yeah. I don't like this video. There's nothing to talk about.
P8-3: Alright, let's, let's look at the next one.
P8-2: Okay Next one? Yeah.

Use of other controls was often confirmed verbally as well, e.g., noting (P8-3) “I'm just gonna forward time” and confirming (P8-1) “Okay, one more time”. For long videos, participants frequently discussed how much to watch, e.g.:

P8-1: I love this. We can watch the whole video.
P8-2: Kay wait how long do we watch this for?

P9-3: Should we watch it? Yeah?
P9-1: It's 6 minutes.
P9-3: Oh My God.
P9-2: Maybe we'll just like watch the
P9-3: We'll just watch a couple.

P8-3: It's so cute! Yeah let's watch the whole thing.
P8-2: Okay.

Participants guided their friends' viewing experiences too, by providing context and explanation, pointing out key moments, or noting when parts were less salient, e.g.:

P1-1: So, this is about some eggs for, from a dollar to 89 dollar.

P10-3: Wait for it ... No, no, just watch it, see how it goes.

P7-3: Watch the next two vines. The rest don't matter.

P6-2: [This] was cool, but can we skip ahead to like the end part?

7.5.3.4. Expressing others' interests through shared media

A fourth relationship maintenance behaviour is expressing knowledge by choosing activities or topics of interest to others. On most social media platforms, sharers must consider a broad audience, which restricts what they want to share [398]. Small-group sharing provides freedom and can leverage awareness of the receivers' knowledge and tastes, which can signal closeness [399], increase the value of the communication [400], and allow for inside jokes [296]. Considering the receivers when sharing media may also benefit the sharer, just as putting thought into a gift can lead to higher social connection for the giver [401].

Participants used sharing to show they knew their friends' interests and were conscious of them. For example, a participant (P4-3) explained, "I didn't read this. I just Google'd it just for jokes you guys. I just knew that you guys would laugh". In one group, a participant (P5-3) shared a video about food and her friend (P5-1) said, "This, they gonna make me hungry". Her other friend (P5-2) remarked, "This is why I didn't share it. I wanted to share this video", acknowledging concern for the others. People also showed consciousness of their friends' time by saying they should not feel obligated to watch an entire video or read a long article:

P6-1: Oh, I just liked this song. You can skip it if you want though.

P4-2: Should we watch it, or no?

P4-1: Don't feel like you have to.

P4-2: Don't worry about it now. Watch it another time.

P6-3: We don't have to read it. I just wanted to know more about it.

Others simply chose not to share longer videos, e.g., a group member (P8-1) who explained, "I tried to find Vine videos and they just kept coming up like 12 minutes long."

7.5.3.5. Planning using shared media

Finally, planning is an act with a dual role in relationship maintenance. First, making plans suggests the relationship has a future and thus is an assurance behaviour [6]. Of course, plans are an expectation that they will later be enacted. Thus, plans occasion shared activity, an additional relationship maintenance behaviour [7]. Media can support planning; shared media in text messaging has supported Making dining reservations and purchasing recommendations [248, 378]. Multiple groups in our study used shared media to facilitate planning. One participant (P3-2) shared guitar strings from Amazon, which the group agreed they would buy together for an upcoming performance. Another group (G5) made plans to go to a fried chicken restaurant after

seeing fried chicken in a video. More speculatively, two groups (G3 and G6) discussed vacationing together to destinations from the shared media.

7.6. Discussion (Study 5)

7.6.1. Communicational grounding and sharing activities

A primary concern with mixing socializing and activities such as viewing media (particularly videos) is the notion that users cannot converse and view concurrently [135]. Our results indicate conversing during media consumption was not difficult in our study. A possible explanation lies in the theory of Communicational Grounding [402], which enumerates six constraints on grounding afforded by face-to-face conversation (copresence, visibility, contemporality, audibility, simultaneity, and sequentiality). Video chat affords all of the constraints except copresence. Adding a synchronized media stage to video chat may provide some of the benefits of copresence. People using our system can be confident that everyone is seeing the same thing (as long as they perceive it as reliable). Further, the left-right split between video chat and shared media may have made visual attention more explicit [284], aiding people in assessing what others were looking at. By adding some benefits of copresence to video chat, without copresence itself, our prototype provides robust support for conversational grounding.

7.6.2. Conversation and shared activities

Our choice of a shared activity, online media, is also supportive of conversation. In some activities, such as social TV, off-topic comments can detract from the experience and viewers constrain their conversations to the activity [302]. Our participants took the opposite approach, constraining the activity to support conversation. Online media is typically short, making natural breaks frequent, and as our system imposed no constraints on pace, break lengths were up to the participants. Further, most media chosen by our participants had little narrative or structure (e.g., Vine compilations, “Top 10” lists or videos), so missing content due to conversation was likely not concerning. This is evidenced by our finding that conversation was reduced by only 1/3 during video playback. Users were hesitant to complete long videos or read entire articles (sometimes recommending others finish later), suggesting that they perceived the social aspects

of the experience as more important than viewing the content. With longer narrative arcs, TV content is less suited to these patterns of accommodating content to support conversation.

7.6.3. The system was robust and appropriable

Our system design contributed to its success. We provided simple controls and built-in synchronization. The use of headphones prevented audio echo. Laptops are a natural fit for online media and video communication: a single device for content and conversation helped avoid the complexity of placing hardware around a room. As we ran our study over an internal network, significant video quality or latency issues were not present. In sum, our prototype overcomes many technical barriers found in ad-hoc [12, 284, 279] and TV-based [284] media sharing. Further, as media varies in form and use, we designed the system to be appropriated, in particular following the principles *allow interpretation* and *support not control* [136]. The system supports arbitrary URLs, and participants made their own interpretations of what should be shared, choosing a range based on their interests and relationships. By synchronizing the shared media stage and giving all users shared control (rather than imposing a pace or viewing style), we also facilitated conversation around articulation work, which—consistent with studies of players performing distributed cognition to cooperatively accomplish play [396, 397]—contributed positively to group experience.

7.6.4. Media sharing can be used to self-disclose and establish common ground

There are a variety of actions and behaviours that help people maintain relationships, including self-disclosure [6, 374]. Our system supported self-disclosure through media sharing in various ways: directly, as a reference point for perspective sharing, and via identification with media elements. Media supported sharing of long-standing experiences and opinions as well as updating friends on day-to-day life. These myriad types of self-disclosure were not explicitly prompted by the system, but observed in how groups appropriated the prototype to enact their relationships through media sharing choices. Other CMC technologies can facilitate self-disclosure [251], including video chat to some degree [73], but the range of ways media sharing in our system afforded implicit self-disclosure in particular shows potential for a subtle and nuanced way of maintaining relationships that is more embedded in current face-to-face practices.

As relationship acquaintedness is defined largely by common ground [382], systems that support establishing common ground are likely to foster relationship formation and maintenance. Our participants established common ground via personal idioms, media signalling mutual membership in a group, and potentially lexical entrainment. Other online systems *leverage* common ground, e.g., forums for discussing a shared passion for gaming [403], urban exploration [404], music [405] or a TV show [406]; however, our prototype facilitates both leveraging and *establishing* common ground via paired media sharing and conversation.

7.6.5. Contextualizing remote media sharing

People in geographically proximate relationships easily share media asynchronously when apart (e.g., via messaging [148] or Facebook [246]) and synchronously when spending time together (e.g., by physically sharing devices [407, 144, 145]). People in distance-separated relationships face barriers to synchronous media sharing while spending time together via video chat [279, 12, 284]. Our system was not designed to supplant asynchronous approaches to media sharing, but rather to give video chat users ability to choose the most appropriate tool when messaging and when spending time together via video chat. A synchronous video chat context has unique benefits: it allows users to share a task—a maintenance behaviour less common in distance-separated relationships [408] that involves coordination and cooperation; it supports temporal discussion in videos—easing forms of self-disclosure like references or identification to specific moments in videos; and it can convey context such as appearance and surroundings [273, 277, 409], attentional cues [164], and non-verbal expressions [410]—providing an informationally enriched context with cues relevant to expressing others' interests through media. At the same time, our study confirms that synchronous media sharing supports some relationship maintenance behaviours that could also occur asynchronously. Thus, while some studies of social media platforms have excluded non-text sharing (e.g., [411, 256, 412]), future studies of social media or text chats should not discount the potential of shared media to communicate personal information or play a role in supporting relationships, even if the media is third-party or from public websites. Further, designers of asynchronous tools like text chat should consider features like temporal commenting on shared videos that support media-based relationship maintenance behaviours.

7.6.6. Flexibility in shared activities

Rich shared activities have the potential to move beyond the set of behaviours fostered by plain CMC or specialized awareness tools while allowing users to mix a variety of maintenance behaviours in a single experience. This potential is heightened when activities are chosen and designed to enable flexibility; we discuss four ways flexibility was reflected in our work.

Channel flexibility: The activity of sharing media has been previously supported in channels like face-to-face communication or text-chat. For example, Facebook allows videos to be viewed synchronously while text chatting [413], Spotify allows shared music playback controls while physically co-present [414], and YouTube allows videos in text chat without playback synchronization [415]. Our prototype successfully enabled synchronous media sharing in video chat, suggesting that existing media sharing platforms could be designed to also integrate higher-bandwidth remote communication such as audio or video chat. Offering channel flexibility in shared activities would allow users to access a range of maintenance behaviours and to leverage shared activities within existing communication patterns.

Focus flexibility: Our results indicate that designers of shared activities should consider focus flexibility: the ability of users to switch between activity and conversing. As some maintenance behaviours occur through discussion, systems that can prompt a variety of maintenance behaviours may benefit from also supporting users in switching from activity to conversing (or doing both at once). An example of another activity that could benefit from this approach is online multiplayer gaming. Most games do not offer the ability to pause the game while playing online [416] but allowing pause functionality when players are members of a close-tie relationship could allow them to more easily mix conversation with play. This is similar to Daniel et al's guideline that for games to be "Socially Adaptable" they should support interruptibility [416].

Control flexibility: Shared activities can offer distance separated people the ability to share a virtual space. While ad-hoc approaches to shared activities can allow people to individually perform matching actions (e.g., starting a video at the same time or cooking a meal at the same time), system supported shared activities like ours allow a single experience and control set to be presented to all users and each person's actions to directly influence others' experiences.

Enabling control flexibility by giving everyone access to shared controls allows users to decide who will operate aspects of the activity and discuss what actions they should take.

Activity flexibility: The variety of ways in which media was used to support relationship maintenance behaviours in our study shows how some shared activities inherently offer flexibility in usage. Participants in our study shared from a variety of websites and utilized the multiple supported content types. Designers focusing on shared activities can choose activities that offer multiple uses to enable many people to benefit from their design in ways that are tailored to their preferences and the type of relationships they are maintaining digitally. In work contexts, whiteboards have been identified by Tang et al. [417] as powerful for their flexibility and ability to support transitioning between modes and activities; this is partly because they offer “powerful primitives” like layout, partitioning, and color. Tang et al. identify Greenberg and Rounding’s Notification Collage [418] as an example of how digital work tools can also benefit from powerful primitives, in this case shared information elements like live video, collages, screenshots, and websites. Our findings show that similar primitives (online videos, images, articles, and products) can be as powerful in the home as they are in the workplace.

7.6.7. Sharing media is a means of enacting relationships

Personal information exchange is one of the ways intimacy is fostered within relationships [6, 374] and conversation is a key means of exchanging personal information [275]. However, conversation over video chat can feel formal or stilted [52] as the interaction between parties is often limited to talking, with some support for performing [279, 12], and limited support for activity-based communication on an ad-hoc basis [12, 93, 277]. Our prototype gave people a context that facilitated conversation and a popular activity to do that seamlessly integrated with video chat. Our findings demonstrate that participants enjoyed the joint activity and appropriated the system to express a variety of relationship maintenance behaviours.

In physically proximate relationships, activities are a form of relationship maintenance. From ones that simply provide an environment to chat (e.g., walking, getting coffee) to those that provide a context for talking (e.g., board games, going to a gym) to those that preclude concurrent conversation (e.g., going to a movie, seeing a band), physically proximate friends have options for shared activities to enact relationship maintenance. We show that flexible

design allows activities like online media sharing to serve as powerful tools for enacting relationship maintenance remotely with activity-based communication.

7.7. Limitations and future work (Study 5)

While our work is motivated by a variety of relationships, our study focused on friends in a university context. Various relationship lengths were represented, but the participants' ages meant that friendships in later stages of life, which may have different dynamics [419], were not. Additionally, groups were physically proximal friendships; romantic, familial, and distance-separated relationships were not explored. The duration of the study limited our ability to measure the system's effect on relationships. For existing friendships, a brief intervention would not be expected to measurably change the relationship's state; the effect on closeness will be explored in future work.

Video chat's uses overlap with other CMC mediums, leading to work on the relative value of video and other mediums like messaging (e.g., [61, 164, 163]). Therefore, future work should also determine whether supporting media sharing in video chat changes the communication mediums people use (in terms of frequency or motivations). Distance-separated couples are of particular interest for a long-term study since many are frequent users of video chat and ad-hoc solutions to shared activities.

In the current study, participants used provided devices in a lab. Thus, our system's support for building a queue over time or uploading users' own media were not exercised. Our study demonstrated numerous ways online media can support personal communication, like self-disclosure, but sharing photos that people took themselves is common face-to-face [138] and a very direct form of self-disclosure. Future work should examine whether sharing items over time and using people's own photos support the types of personal communication identified in our study or potentially enable additional uses for shared media in video calls.

7.8. Conclusion (Study 5)

Relationships are a key part of our lives that people increasingly wish to maintain via digital tools. Compared to people spending time together face-to-face, people maintaining relationships digitally do not have access the same range of strategic maintenance behaviours. They also face

challenges maintaining awareness, which contributes to routine maintenance behaviours; even with awareness supports, transitioning seamlessly from awareness to other maintenance behaviours can be a challenge. We believe that powerful and flexible tools that support people in sharing activities over a distance and also support transitioning between a variety of maintenance behaviours can help enable some benefits of physical time together for people who are separated by a distance. Building on an inherently flexible activity, media sharing, we show how appropriate design can successfully support shared activities more difficult to accomplish over CMC and allow people to decide how best to employ them in maintaining relationships. To do this, we developed a prototype that supports synchronous online media viewing in group video calls. In a study, we first show that participants successfully shared and discussed a range of media over our system, including images, articles, videos, and products. Second, we found that participants enjoyed the experience; they rated it as enjoyable and spent the call talking and laughing. Third, we identified ways that participants appropriated the activity of sharing and viewing online media together to enact relationship maintenance behaviours: through self-disclosure, by reinforcing common ground, with articulation work, via joint planning, and by giving ‘gifts’ tailored to friends’ interests. By giving people the opportunity to engage in synchronous media sharing over a distance—a joint activity that affords a variety of relationship maintenance behaviours—our system may lead to technologies that support stronger and deeper distributed friendships.

CHAPTER 8. SYNCHRONOUS MEDIA SHARING FOR NEW RELATIONSHIPS

8.1. Citation and role of collaborators

This work was published at the ACM CSCW Conference on Computer-Supported Cooperative Work; the full citation is:

Matthew K. Miller and Regan L. Mandryk. 2021. Meeting with Media: Comparing Synchronous Media Sharing and Icebreaker Questions in Initial Interactions via Video Chat. *Proc. ACM Hum.-Comput. Interact.* 5, CSCW2, Article 374 (October 2021), 26 pages. DOI: <https://doi.org/10.1145/3479518>

This work was done in collaboration with my supervisor Dr. Mandryk. I led the study design, data collection, analysis, and writing work; Dr. Mandryk assisted with defining research questions and measures, analysis, and writing.

8.2. Research contributors

In this work, we propose synchronously sharing online media as a more flexible, robust, and effective alternative to traditional icebreakers for facilitating initial interactions in video chat. Like Study 5, this work helps address the dissertation's problem statement regarding constraints on people's ability to maintain relationships when limited to a traditional video chat interface. However, this work differs in that it focuses on new relationships, showing the benefits of a media sharing interface observed in Study 5 can be leveraged in multiple contexts.

We make several contributions. First, we demonstrate that synchronous media sharing with our system (described previously in CHAPTER 6) is as effective as a traditional icebreaker approach for supporting trust formation among unacquainted dyads. Second, we show that media sharing is associated with greater levels of perceived warranting and relatedness than the

icebreaker technique. Finally, we show that trust formation under the media sharing condition is not affected by individuals' agreeableness, unlike in the icebreaker condition.

8.3. Background and motivation

Trust, closeness, and the experience of relatedness are important outcomes in personal and professional settings. For new relationships in particular, people use supports to promote these outcomes. Icebreakers are one such support, with a goal of promoting conversation and prompting self-disclosure. Yet icebreakers do not promote personalization of topics, flexibility, or context that establishes truthfulness. Building on our findings in Study 5, which established media sharing as an enjoyable activity that can support relationships maintenance behaviors such as self-disclosure within existing relationships, in this work we test whether media sharing can also be a useful alternative to icebreaker activities for new relationships.

8.3.1. Hypotheses

In this work, we test the following hypotheses:

- H1.** Instances of conversational self-disclosure will be lower in the media sharing condition.
- H2.** Perceived self-disclosure will not significantly differ between the two conditions.
- H3.** The warranting value of self-disclosures will be higher in the media sharing condition.
- H4.** Compared to icebreakers, media sharing will result in similar or greater levels of trust.
- H5.** Compared to icebreakers, media sharing will result in similar or greater levels of relatedness.
- H6.** Use of media sharing will reduce the effect of propensity to trust on trust formation compared to icebreakers.
- H7.** Use of media sharing will reduce the effect of agreeableness on trust formation compared to icebreakers.

8.4. Study 6

In Study 6 we evaluate the potential of synchronous remote media sharing in video chat to support relationship formation through a user study. We focus on pairs of strangers interacting, which avoids complicating group dynamics and allows existing measures designed for one-to-

one relationships to be applied. Our study compares the use of synchronous media sharing to a standard relationship building approach, icebreaker questions, in a between-subjects design.

8.4.1. Methods

8.4.1.1. Participants

Participants were recruited by announcements to students and staff (not including instructors or faculty) at the University of Saskatchewan. Two participants were scheduled for each timeslot. In total, 74 participants completed the study; three pairs were removed from analysis due to technical issues with the call. After these removals, 68 participants remained (gender: non-binary=1, man=36, woman=31; age: $m=24.220$, $SD=6.291$).

8.4.1.2. Measures

We used several measures in our study; for details of these measures, see Section 1.2.4. All questionnaire measures used 7-point Likert scales. Internal consistency (Cronbach's Alpha; α) is reported. Scales used were: *Measure of Perceived Self-Disclosure* ($\alpha=.820$), *General Disclosiveness Scale* (α : intent=.657; amount=.701; positiveness=.786; depth=.640; honesty/accuracy=.755), *General Trust Scale* ($\alpha=.787$), *Ten Item Personality Index: Agreeableness* ($\alpha=.467$; note that this value is consistent with the original validation study for this scale [314]), *Measure of Perceived Warranting* ($\alpha=.779$), *Interpersonal Trust Scale* ($\alpha=.891$), *Post-Experimental Intrinsic Motivation Inventory: Relatedness* ($\alpha=.875$), and *Linguistic Inquiry and Word Count (LIWC2015)*.

8.4.1.3. Procedure

Participants arrived at separate rooms so they would not see each other at the beginning of the study. Participants provided informed consent, then completed questionnaires regarding traits (propensity to trust and disclose, agreeableness). They then watched a video explaining how to use the video chat system. In the media condition, the video showed how to add and view media. In the icebreaker condition, the video showed how to view the icebreakers. Next, participants had 10 minutes to prepare for the call. In the media condition, participants used this time to add media to the system. In the icebreaker condition, participants used this time to review a complete list of the icebreaker questions (the same icebreakers were used as in Study 1; see Appendix A for a complete list). After the preparation time, the video call was started automatically. During

the call, the shared media or icebreakers were shown on one side of the interface and the participant videos were shown on the other side. The call lasted 15 minutes; a warning was shown 20 seconds before the end to allow participants to say goodbye. After the call, participants completed a second set of questionnaires regarding perceptions and outcomes of the call (perceived self-disclosure and warranting, relatedness, and trust).

Due to the need to work from home during the COVID-19 Pandemic of 2020, our lab-based study was interrupted. The study system was already designed to operate over the internet and walk participants through the procedure unattended (to allow one experimenter to conduct the experiment across two rooms), so it was decided that the study could continue remotely. To allow the study to run remotely, slight modifications were made: a system requirements check was added to verify camera and microphone functionality and a text chat was automatically opened in a second tab in case participants needed to contact the experimenter. In total, 40 of our participants were in-lab and 28 participated from home. At-home participants were recruited through the same announcement system as in-lab participants. In both cases, participants did not interact with each other prior to the video chat. When in-lab participants met face-to-face for honorarium payment after the study, many expressed surprised at learning they had been in the same area of a building; anecdotally, this suggests limited consciousness regarding their relative proximity when compared to the at-home participants. Further, an exploratory analysis showed no significant effects of location (in-lab vs. at-home) and no significant location \times condition interaction effects on any dependent variables used in our study.

8.4.1.4. System

Like the previous study, Study 6 used our custom video chat application with synchronous media sharing functionality. For the media sharing condition, the system's media sharing functionality was used (see Figure 22, bottom). For the icebreaker condition, a modified version of the system was used. In this version, when a call is not active, the list of icebreakers is shown on screen rather than a media queue. When the call begins, the icebreakers are displayed rather than shared media content (see Figure 22, top).

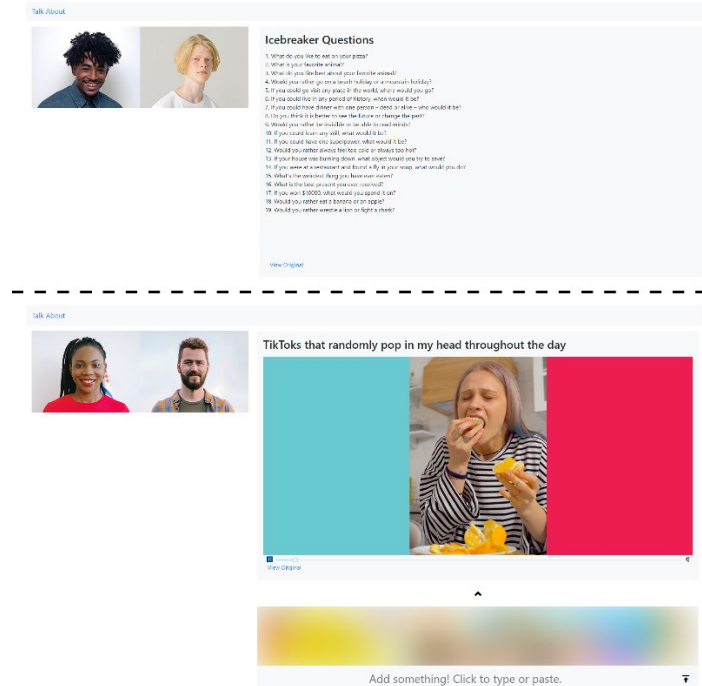


Figure 22. Screenshots of the study system showing the interfaces for the icebreaker condition (top) and media sharing condition (bottom).

8.5. Results (Study 6)

8.5.1. Descriptive statistics of media sharing

Given that synchronous media sharing among strangers has not previously been studied, we begin our results with a brief descriptive summary of how participants in the media sharing condition used the media sharing functionality.

Participants shared 5.265 media items on average. Table 8 shows the average number of items shared broken down by type. As participants were in pairs for the call, pairs had about 10 media items available to view on average.

Table 8. Number of items shared per participant. Values are mean (SD).

Video	Image	Article	Product	Other	Total
1.74 (1.29)	0.74 (1.73)	0.71 (1.22)	0.18 (0.52)	1.91 (2.67)	5.26 (3.20)

During the call, pairs viewed an average of 6.824 items (SD=3.540), leaving an average of 3.706 items unviewed (SD=4.455). Only three pairs viewed all shared items by the end of the call; these pairs chatted for the remainder of the time.

Across all participants, links from 50 unique websites were shared. The five most commonly shared sites are shown in Table 9; the 45 sites not shown were shared only 1 or 2 times. Results suggest that our use of YouTube as an example source in the video demonstration at the start of the study influenced participants' choice of sources. However, given the breadth and amount of content on YouTube, we do not expect this significantly biased the content participants shared in terms of topic.

Table 9. Most commonly shared websites and most commonly shared categories (for YouTube links only); values are totals across all participants.

Site	Number Links Shared
YouTube	58
TikTok	7
Instagram	6
Google (Image Search)	3
Reddit	3

Category	Number Links Shared
Music	12
Comedy	8
People & Blogs	8
Howto & Style	7
Entertainment	7
Sports	5
News & Politics	4
Education	2
Film & Animation	2
Science & Technology	2
Gaming	1

Based on the prevalence of YouTube links in our dataset, we retrieved category information for these items for further insight into the types of content shared. These categories, which were assigned by the video creators and retrieved using the YouTube API, reveal a variety of item types were shared. The websites and categories suggest that participants used media sharing to support varied conversations, e.g., to bring up a song they liked or were interested in, to share a laugh over a TikTok or Comedy video, or to discuss more serious topics like news or science.

8.5.2. Comparing icebreakers and media sharing

To compare the effectiveness of icebreakers and media sharing, we conducted a (M)ANCOVA analysis using condition as the independent variable and propensity to trust, disclosiveness, and agreeableness as covariates. The dependent variables of interest were measures relating to self-disclosure (perceived self-disclosure, conversational self-disclosure,

and perceived warranting) and call outcomes (trust and relatedness). In this section, analyses were performed at a dyad level due to interdependence of call outcomes, means are estimated marginal means, and p-values are Bonferroni corrected.

To determine which of the dependent variables should be analyzed together in a MANCOVA analysis, we conducted a correlation analysis (see Table 10). This analysis showed several significant pairwise correlations among perceived self-disclosure, perceived warranting, trust, and relatedness, but none involving conversational self-disclosure; therefore, conversational self-disclosure was analyzed using an ANCOVA while the other four DVs were analyzed together in one MANCOVA. Regarding the MANCOVA, Box’s Test of Equality of Covariance Matrices was significant ($p=.019$) but did not meet the threshold for concern ($p<.001$) [420], Laverne’s Test of Equality of Error Variances was non-significant for each DV (p ranging from .093 to .804). The omnibus test for the MANCOVA was significant ($F_{1,25}=2.917, p=.045$); since our analysis included a single two-level IV, this statistic is the same regardless of type (Pillai’s trace, Wilks’ lambda, Hotelling’s trace, Roy’s largest root). Regarding the ANCOVA, Laverne’s Test of Equality of Error Variances was non-significant ($p=.349$).

Table 10. Two-Tailed Pearson Correlations of Independent Variables. * $p<.05$

	Perceived Self-disclosure	Conversational Self-disclosure	Perceived Warranting	Trust	Relatedness
Perceived Self-disclosure	—				
Conversational Self-disclosure	0.15 ($p=0.40$)	—			
Perceived Warranting	0.40 ($p=0.02$)*	-0.17 ($p=0.32$)	—		
Trust	0.26 ($p=0.14$)	-0.10 ($p=0.56$)	0.28 ($p=0.10$)	—	
Relatedness	0.38 ($p=0.03$)*	-0.29 ($p=0.09$)	0.21 ($p=0.22$)	0.35 ($p=0.03$)*	—

8.5.2.1. Self-disclosure

Conversational self-disclosure was estimated using the number of first-person pronouns used in the conversation. Conversational self-disclosure was lower in the media sharing condition ($m=6.878, SE=.307$) than in the icebreaker condition ($m=7.899, SE=.327$). This difference was significant in the ANCOVA ($F_{1,27}=4.467, p=.044, \eta^2=.142$). Therefore, we accept H1. This suggests that the amount of disclosure made directly through conversation was lower when media sharing was used.

Levels of perceived self-disclosure were similar in the icebreaker condition ($m=4.738$, $SE=.232$) and media sharing condition ($m=4.862$, $SE=.232$). The MANCOVA confirms that there is no significant difference ($F_{1,25}=.128$, $p=.724$, $\eta^2=.005$), and we accept H2. This suggests that despite a reduction in direct conversational disclosure when media sharing was used, icebreakers and media sharing lead to a similar amount of perceived disclosure through the call.

8.5.2.2. Warranting

Warranting was higher in the media sharing condition ($m=5.132$, $SE=.221$) than the icebreaker condition ($m=4.358$, $SE=.221$). The MANCOVA confirms this difference was significant ($F_{1,25}=5.391$, $p=.029$, $\eta^2=.177$), therefore we accept H3. This suggests that participants could more easily evaluate the accuracy of disclosures made in the context of media sharing than disclosures made in the context of icebreaker questions.

8.5.2.3. Trust

Ratings of trust were similar in the media sharing and icebreaker conditions (respectively: $m=4.631$, $SE=.145$; $m=4.663$, $SE=.145$). The MANCOVA confirms that there is no significant difference ($F_{1,25}=.021$, $p=.885$, $\eta^2=.001$), therefore we accept H4.

8.5.2.4. Relatedness

Relatedness was higher in the media sharing condition ($m=5.553$, $SE=.142$) than the icebreaker condition ($m=5.028$, $SE=.142$). The MANCOVA confirms this difference was significant ($F_{1,25}=6.043$, $p=.021$, $\eta^2=.195$), therefore we accept H5. This indicates the media sharing resulted in greater feelings of relatedness by the end of the get-to-know-you task than icebreaker questions.

8.5.3. Other conversational differences between icebreakers and media sharing

While not guided by a specific hypothesis, we also performed an exploratory analysis of potentially relevant categories from the LIWC transcript analysis. These included overall word count, pronouns other than 1st person pronouns, and words relating to affiliation, social topics, and friends. We once again compared icebreakers and media sharing in a MANCOVA analysis using condition as the independent variable. In this section, analyses were performed at a dyad level and p-values are Bonferroni corrected. Table 11 shows the results of our analysis for relevant LIWC categories.

Based on the word counts from LIWC and the 15 minute call length in our study, speaking rates were approximately 140 words per minute in the icebreaker condition and 110 words per minute in the media sharing condition; these are comparable to an analysis of Skype interviews which found an average word count of 8,443 and an average call length of 68.1 minutes, a speaking rate of approximately 120 words per minute [421]. In terms of overall word count, there was an approximately 20% reduction in word count in the media sharing condition. This is not unexpected given that our descriptive analysis of media sharing revealed video content was the most commonly shared type of media, and that videos include audio content that might displace some conversation time.

Table 11. Comparison of LIWC results between the Icebreaker and Media Sharing Conditions. Example words are provided for each category. Values are mean (SD). Word Count is an absolute value; other categories are percentages of total word count. *p<.05

	Examples [329]	Icebreakers	Media Sharing	Comparison
*Total Word Count	(N/A)	1077.12 (237.19)	855.09 (270.06)	$F_{1,25} = 6.49, p = .02, \eta^2 = .17$
1st P. Plural Pronouns	we, us, our	0.74 (0.45)	0.85 (0.33)	$F_{1,25} = 0.72, p = .40, \eta^2 = .02$
*2nd P. Pronouns	you, your, thou	3.92 (0.79)	2.99 (0.89)	$F_{1,25} = 10.36, p < .01, \eta^2 = .24$
*3rd P. Singular Pronouns	she, her, him	0.39 (0.21)	0.77 (0.61)	$F_{1,25} = 6.06, p = .02, \eta^2 = .16$
3rd P. Plural Pronouns	they, their, they'd	0.56 (0.28)	0.71 (0.37)	$F_{1,25} = 1.72, p = .20, \eta^2 = .05$
*Impersonal Pronouns	it, it's, those	7.42 (1.33)	9.08 (1.68)	$F_{1,25} = 10.11, p < .01, \eta^2 = .24$
Affiliation	ally, friend, social	1.69 (0.59)	2.05 (0.55)	$F_{1,25} = 3.36, p = .08, \eta^2 = .09$
Social	mate, talk, they	9.20 (1.13)	8.91 (1.43)	$F_{1,25} = 0.44, p = .51, \eta^2 = .01$
Friends	buddy, neighbor	0.16 (0.12)	0.27 (0.25)	$F_{1,25} = 2.30, p = .14, \eta^2 = .07$

Regarding other pronouns, usage of 1st person plural and 3rd person plural pronouns did not significantly differ between conditions. Usage of 2nd person pronouns (e.g., ‘you’) was significantly lower in the media sharing condition. This may be explained by a reduction in explicit questioning of conversational partners. When using icebreaker questions, a common response may be to give a quick answer then follow up with a question such as “what about you?” or “what do you think?”, a pattern less likely when sharing media. Usage of 3rd person singular pronouns (e.g., ‘she’, ‘him’) and impersonal pronouns (e.g., ‘it’, ‘those’) was higher in the media sharing condition; this is consistent with the presence of content that participants could reference in conversation.

Regarding other categories, use of words expressing affiliation was higher in the media sharing condition but did not reach the level of significance ($p = .076$); use of social words and words relating to friendships did not significantly differ between the two conditions.

8.5.4. Individual traits in icebreakers and media sharing

To understand how individual traits affect the success of icebreakers and media sharing in forming trust, we performed a regression analysis on the data from each condition. We used a regression analysis to accommodate multiple continuous trait variables as predictors of trust. For each of the two conditions, we performed a linear regression with trust as the dependent variable and propensity to trust or agreeableness as independent variables. Disclosiveness was not included as an independent variable because a participant's own disclosiveness was not expected to affect the amount that they trusted their partner. As this section focuses on individual traits, analyses were performed at an individual level.

8.5.4.1. Propensity to trust

In the icebreaker condition, there was a significant association between propensity to trust and the amount participants trusted their partners ($B=.340$, $p=.021$). In the media sharing condition, there was not a significant association between propensity to trust and the amount participants trusted their partners ($B=.323$, $p=.077$). While the effect was significant only in the icebreaker condition, the similarity of the beta values suggests only moderate support for H6.

8.5.4.2. Agreeableness

In the icebreaker condition, there was a significant association between agreeableness and the amount participants trusted their partners ($B=.285$, $p=.036$). In the media sharing condition, there was not a significant association between propensity to trust and the amount participants trusted their partners ($B=.044$, $p=.688$). Therefore, we accept H7.

8.6. Discussion (Study 6)

In this section, we provide a brief summary of our results; discuss potential explanations for media sharing's ability to support self-disclosure, warranting, and relatedness; and explain how video chat platforms can use media sharing to bolster new relationships.

8.6.1. Summary of results

Our results supported our first five hypotheses, which together signify that media sharing is a unique but effective alternative to icebreakers with some specific benefits. By supporting our first three hypotheses (H1-H3), our results suggest that media sharing itself can act as a form of

self-disclosure that complements disclosure made through conversation, and that media sharing also increases the warranting value of self-disclosures, possibly by providing an objective source or basis for shared information. Building on these results, we confirmed that media sharing resulted in similar levels of trust as icebreaker questions, and greater levels of relatedness (H4, H5). This suggests that media sharing can be equally effective as icebreakers in helping new acquaintances form trust, and also more effective than icebreakers in supporting feelings of closeness and friendliness.

In terms of individual traits (H6 and H7), we found only moderate evidence for H6 (a reduction in the effect of propensity to trust on trust formation when using media sharing). However, we did observe an effect of agreeableness on trust formation only in the icebreaker condition, supporting H7.

8.6.2. Media sharing and self-disclosure

Our results suggest that compared to icebreakers, media sharing was associated with a lower level of conversational self-disclosure but not a lower level of perceived self-disclosure. This suggests that media sharing itself acts as a form of self-disclosure: by expressing themselves through shared media, participants were perceived as communicating a similar amount of information about themselves despite the transcription analysis that suggested a reduction in self-disclosure through conversation. The idea that non-verbal communication can function as self-disclosure is not new: Derlega et al. [21] note that although self-disclosure “is usually studied as a *verbal* activity ... it may also refer to *nonverbal* messages that are intended to communicate information.”

Our findings support the idea that synchronous media sharing is a specific form of non-verbal communication that plays a role in self-disclosure. This is consistent with other types of media sharing. In face-to-face contexts, sharing media can serve as a touchpoint for self-disclosure through storytelling [137]. On social media platforms, asynchronous media sharing is a medium for communicating aspects of people’s online personae [151] and sharing about oneself is a primary motivator for its use [296]. Some social media users expressly intend to share media with strangers, even meeting others through media sharing [422]. However, social media users have concerns relating to privacy of self-disclosures made through media [423, 296]; the role of

self-disclosive media sharing in new relationships on social media platforms may be reduced as users limit public disclosures due to privacy concerns. By contrast, the one-to-one synchronous context considered in our study could provide a unique opportunity to engage in self-disclosive media sharing with a new acquaintance without engaging in broad public sharing.

8.6.3. Media sharing and trust formation

Research suggests that self-disclosure is a key component of trust formation. However, despite observing lower levels of conversational self-disclosure in the media sharing condition, we did not observe a difference in trust at the end of the call. We suggest three potential reasons for this finding:

First, our results suggest that perceived self-disclosure was not reduced in the media sharing condition. Therefore, information conveyed through other aspects of a get-to-know you task (e.g., the choice of media to share) may be equally relevant to trust formation as the information stated directly in conversation.

Second, our results indicate that the media sharing environment was perceived as having higher warranting value than the icebreaker environment. Because media provides objective, third-party information, self-disclosures based on media may be easier to validate. Further, the implicit self-disclosure made through media choices is a behavioural indicator of one's self [151]—and therefore also may be perceived as easier to validate than a simple statement made in conversation. In either case, an increase in the ability to validate self-disclosure may make each disclosure more valuable in formation of trust, which could make up for a reduction in the number of direct disclosures.

Third, the disclosures made through media sharing may be more effective in forming trust. The icebreaker questions used do not provide information particularly relevant to evaluating the trustworthiness of a person. Because media sharing does not suggest specific topics and could support sharing about any topic that can be found online, participants may have chosen to present information that is more favorable to the formation of a new relationship.

8.6.4. Media sharing and relatedness

Our study revealed that media sharing led to significantly higher levels of relatedness than icebreaker questions. Relatedness is one of three needs posited by Self-Determination Theory as innate needs whose satisfaction can contribute to motivation, well-being, and mental health [4]. The particular Relatedness scale used in our study asked participants to reflect on whether interacting with their partner through video chat satisfied the need for relatedness, specifically asking about feelings of closeness, trust, interest in future interactions, and likelihood to become friends in the future. Therefore, increased levels of relatedness indicate a significant advantage of media sharing in formation of early relationships.

A variety of factors may account for the greater experience of relatedness in media sharing compared to icebreakers. One reason media sharing leads to higher relatedness could be that media sharing allows people to self-disclose in ways that are more suitable for development of early relationships, leveraging the benefits of self-disclosure that is appropriate in terms of honesty [37, 38], positivity [39, 40], depth, and topic [41, 42, 43]. While the choice of what media to share was made mainly before the conversation in our study (much like the icebreakers were fixed ahead of time), media may still allow participants to better tailor their self-disclosure both before the call and during the conversation. Before the call, media choices are made individually by the interlocutors, unlike pre-written icebreakers; this could be leveraged to choose topics that are more positive and relevant to the individual. During the call, shared media may facilitate a much broader array of comments or responses than a straightforward icebreaker question; this could be leveraged by participants to tailor their comments in real time based on ongoing assessments of the conversation. To be clear, we are not suggesting that participants consciously considered each of these factors; rather, the flexibility of media sharing compared to icebreakers may simply allow individuals to naturally follow established norms for initial interactions.

A second potential factor that may have contributed to the greater experience of relatedness in the media sharing condition is that participants shared a task. Sharing tasks can be beneficial in social situations. For example, players of board games share a distributed cognition task that requires them to “negotiate rules, articulate play, co-ordinate actions, [and] co-operate to enact rules” [396]. This task not only allows them to cooperatively accomplish play, but also serves an

important social function. In digital board games, ‘chores’ (e.g., moving objects, keeping score) could be automated, but contribute to the sociability of playing together [397]. In our media sharing system, participants have shared controls and therefore must work together as they review media (e.g., deciding when to move to the next media item, how much of a video to view, or whether a video should be paused for discussion). Jointly operating a synchronized media sharing system may have contributed to feelings of relatedness among our participants.

A third explanation for the higher feelings of relatedness in media sharing may be increased support for formation of common ground. Clark [381] defines common ground as “mutual knowledge, mutual beliefs, mutual assumptions and other mutual attitudes” (pg. 6) and argues that acquaintedness is “defined largely by the type and amount of personal common ground two people have” (pg. 115-116) [382]. Clark suggests that common ground is mainly formed through joint conversational or perceptual experiences [381]. As the media sharing condition offered a shared perceptual experience and conversation, it may better support the formation of common ground. This possibility is supported by previous research indicating that shared media experiences in particular can support interpersonal solidarity among friends through the creation of shared references [385].

8.6.5. Individual traits and trust formation

In line with previous work by Depping et al. [32], we found that propensity to trust in general was associated with trust formation in the icebreaker condition. While the association was not significant in the media sharing condition, it was approaching significance. Like the game used as an alternative by Depping et al., our media sharing condition did offer participants a shared activity. However, Depping et al. suggest that trust formation through their game was not susceptible to effects of propensity to trust specifically because the game included elements of risk and interdependence; media sharing does not include such elements. Therefore, media sharing may not be as effective as games at reducing the effects of propensity to trust in get-to-know-you activities.

In our study, agreeableness was a significant predictor of trust formation for people in the icebreaker condition. This is consistent with Depping et al.’s suggestion that the effectiveness of icebreaker questions in generating trust is affected by agreeableness [32], and more general

findings that agreeableness plays a significant role in initial interactions [424]. However, agreeableness was not a significant predictor of trust formation in the media sharing condition. People high in agreeableness are described as “good-natured, cooperative, and trustful” [425]; specifically, the instrument used in the present study refers to the attributes sympathetic, warm, critical, and quarrelsome (the latter two reverse-coded) [314]. Ensuring that even people low in these qualities benefit equally from a get-to-know-you task is a significant advantage of media sharing over icebreaker questions. In particular, previous research indicates that when both members of an unacquainted dyad are low in agreeableness there is a “negative synergy effect” that includes lower self-disclosure, use of 1st person pronouns, and development of rapport [424]. While our sample size does not allow us to explore actor \times partner interactions like these, the result that media sharing’s effectiveness in generating trust was not influenced by agreeableness is a promising indicator for the potential of media sharing to avoid this kind of negative synergy and promote more equitable outcomes.

8.6.6. Applying media sharing in existing video chat systems

People meet via video chat for a variety of reasons; these could include a virtual first date via video chat [18], a partner assignment in a distance education class [19], or onboarding to a virtual team [17]. Our work shows that media sharing could benefit video chat users in situations like these by providing increased warranting value of self-disclosures, robust support for building trust, and greater relatedness in comparison to a standard icebreaker approach. However, previous work studying friendships and family relationships suggests people face a variety of technical challenges when attempting to synchronously share online media without system-level support [279, 12, 284]; the success of media sharing in our study may be partially attributed to the system-level support for collecting and synchronizing media. Therefore, existing video chat systems seeking to support new relationships could benefit from system-level support for media sharing. Because media sharing does not prescribe specific topics, such support could be undertaken even in systems designed for both personal and professional use. A final benefit of supporting new relationships with media sharing functionality is that this functionality could have other applications (e.g., potentially addressing calls for system-supported activities that support existing relationships [93, 284, 285, 274] or calls for better media sharing support in professional video chat software [134]).

A small number of existing video chat systems do offer system-level support for synchronous media sharing (e.g., Facebook Messenger’s “Watch Together” feature [426]). Our research suggests that these systems could promote media sharing functionality as a way to kick off new relationships (e.g., with a prompt at the beginning of a chat, or a notification during a pair’s first video call). As a further step, systems that already offer curated media viewing suggestions to individual users could leverage this information to pre-seed a queue with media items of potential interest to both people in a video call. From a user perspective, people who are meeting someone for the first time (or leaders such as teachers and managers who arrange initial interactions among others) could select systems that do support media sharing.

8.7. Limitations and future work (Study 6)

As an initial study of synchronous media sharing’s potential in a get-to-know-you task via video chat, our study has several limitations. First, we focused only on pairs of participants because group conversations include complicated interactions and are more difficult to assess using surveys. Second, our sample size did not allow us to explore effects of gender pairings; previous work has shown that gender composition of pairs can affect trust formation in CMC environments [176]. Third, we focused only on North American participants; research suggests even among English speaking countries, preferences for prompted or unprompted self-disclosure in initial meetings can vary [427]. Fourth, we studied only a single 15-minute meeting; while the first time people meet is a standard place for icebreakers to be used, additional behavioural measures of trust over time could offer a fuller picture of trust formation in the early stages of relationships. Finally, each participant experienced only one condition because of the need to manage overall study length and participant attentiveness; this limited our ability to gather data such as preferences between icebreaker questions and media sharing.

In our current work, we investigated two individual traits that may affect trust formation in icebreaker tasks (propensity to trust and agreeableness). Our work builds on previous work suggesting individual traits are significant factors in initial interactions [32], further supporting that future work investigating formation of closeness and trust should consider individual traits. Specifically, future work should consider other individual traits that may affect the ability of media sharing to support trust formation. Continued efforts in this area could also leverage

alternative analyses to study these effects; although the split regression in our study allowed us to study continuous trait variables, it has limited ability to draw direct comparisons.

Our current study allowed participants to share a variety of media types (images, videos, articles, products, and other links); future work should consider whether specific media types are more or less effective at supporting early relationships. Each media type could be hypothesized to hold benefits or drawbacks in a get-to-know-you task; for example, videos may result in reductions in total conversation, but also may convey more information than other media types. Therefore, an empirical comparison would guide future systems in supporting the most effective kinds of media. Similarly, in our current study participants shared media that varied greatly in content (e.g., news, music, comedy); future work may leverage qualitative or conversational analysis to understand whether different content types are more or less effective at encouraging discussion that fosters early relationships, such as self-disclosure.

Given that a common reason to meet people is when joining a team, future work should investigate how media sharing could mix with other onboarding tasks. For example, future work could consider whether a system could mix media shared by participants with media provided by a company for onboarding new employees as a form of meeting new coworkers while remotely training for a new job. Previous research has also indicated that business meetings generally could benefit from more advanced media sharing capabilities in video chat software [134], suggesting future systems integrating synchronous media sharing functionality could support multiple use cases.

8.8. Conclusion (Study 6)

Getting to know others is a fundamental part of our lives. In personal and professional contexts people need to meet others, form trust, and experience relatedness. Icebreaker tasks are one way to promote conversation and prompt self-disclosure among unacquainted people, but may have drawbacks related to a lack of context, personalization, and flexibility. In this work, we show that synchronous media sharing is a viable alternative to traditional conversational icebreakers for people meeting via video chat that offers several advantages. Compared to a traditional approach, synchronous media sharing promoted equal levels of perceived self-disclosure and trust, greater levels of warranting and relatedness, and formation of trust not

susceptible to individual differences in agreeableness. Rather than considering video chat as a potentially inferior place to meet [428, 110], we show that this synchronous digital context can be leveraged to build new interactive experiences that effectively support people in getting to know each other.

SECTION 5. DISCUSSION AND CONCLUSION

CHAPTER 9. DISCUSSION

9.1. Summary of the research

Video chat continues to grow in popularity as a tool for supporting relationships. However, video chat is not identical to face-to-face communication. Unique features of video chat include feedback, disturbances to eye contact, lack of physical shared space, and limitation to gesturing. This work focuses on feedback, a relatively understudied aspect of video chats that may be particularly impactful in social situations.

In Study 1, we establish that feedback in video chat interfaces has measurable impacts on people's experiences, a phenomenon with no real-world analogue. By demonstrating that feedback impacts self-awareness, we make a foundational contribution to the study of video chat in interpersonal relations; self-awareness is highly influential in terms of behaviour, e.g., affecting aggression [70], intrinsic motivation [71], and self-esteem [72]. Therefore, a systematic factor that increases self-awareness during communication warrants further study.

Study 1 confirms that feedback can influence behaviour by demonstrating significant effects of feedback on relational communication and the conversation itself: feedback was shown to increase rating of affection and depth as well as use of words relating to anxiety and socializing. Additionally, Study 1 showed further effects that depended on dyad pairing: for mixed-gender pairs, feedback was associated with greater social focus (as opposed to task focus) and use of social words, first person plural pronouns, and third person plural pronouns. Conversely, same-gender pairs used more interrogational words and second person pronouns when feedback was enabled. In sum, Study 1 confirms that video chat interfaces, and particularly the presence of feedback, are a meaningful factor in communications.

Study 2 builds on the findings of Study 1 by testing a similar manipulation but focusing on the experience of individuals with social anxiety. Researchers have theorized that the experience of Social Anxiety involves an increase in self-focused attention [82]. Therefore, is it reasonable to believe that an interface element that effect self-awareness could also impact experiences of social anxiety. Additionally, research suggesting that mirrors are not harmful to socially anxious individuals [86] contrasts with findings that other self-focusing factors can be harmful (e.g., [83, 84, 85, 86]) and online advice that feedback is harmful (e.g., [77, 78, 79]). Resolving the ambiguous role of feedback in experiences of socially anxious individuals is an important extension of our findings from Study 1 and has clear implications for designers and users of video chat systems.

Study 2a considers the role of feedback in a traditional video chat interface (i.e., one where the video feeds occupy the majority of the interface). In this kind of interface, video feedback was associated with a reduction in the effects of social anxiety: compared to no feedback, turning feedback on eliminated the association between social anxiety and self-awareness during the call and weakened the association between social anxiety and experienced anxiety. When experienced anxiety was lower, an association between social anxiety and using more icebreaker questions was also eliminated. Together, these results suggest that feedback can play a helpful role, potentially reducing the effects of social anxiety by providing objective feedback.

Study 2b replicates the setup of Study 2a, but in the context of a content-focused interface (i.e., an interface in which the video feeds are smaller and off to the side). In this interface we did not observe any relationship between feedback and experiences of social anxiety. A key difference from Study 2a is that use of icebreaker questions did not predict self-disclosure at any level of social anxiety; this may suggest that the content-focused interface results in a similar experience to visually anonymous communication. This conclusion is bolstered by the general reduction in effects of social anxiety and feedback within Study 2b. Balancing visual communication with content may help to create an experience that is more comfortable and consistent regardless of an individual's level of social anxiety.

Building on the possibility that content-focused interfaces can create comfortable and equitable experiences that support self-disclosure, we explore the potential for a synchronous media sharing interface to support relationships in video chat. This exploration is supported by

two tools: first, a new measure of perceived self-disclosure and second, a synchronous media sharing system. The new measure of self-disclosure is unique in that it can apply to digital contexts and situations in which people are meeting for the first time. This was accomplished by constructing items that refer to a specific conversation and do not specify a particular topic, depth, relationship type, or communication channel. In Study 3, we select a subset of the constructed items to form a final scale with five items. In Study 4, we perform a confirmatory factor analysis, confirming that the scale performs well under the envisioned usage conditions. The final scale is a useful tool for understanding how different manipulations of a video chat environment affect people's conversations. The choice to focus on one specific aspect of conversations—self-disclosure—allows for a short scale that can easily be accommodated in a variety of experimental designs while also providing a measure that is highly important for both formation and maintenance of relationships [24, 107, 108, 109].

The second new tool—the synchronous media sharing system—leverages observations made in Studies 1 and 2 about how video feedback and content can change people's focus and experience in a video call. Additionally, this system builds on observations by researchers that existing video chat systems should do more to support people in maintaining relationships by engaging in shared activities [93, 284, 285, 274]. We situate this system with a design framework that identifies eight important design issues synchronous media sharing systems must consider: communication channel(s), integration, supported content type(s) and source(s), degree of media synchronization, content management, content visibility, playback ordering, and playback control. By creating an integrated system, we are able to explore more of this design spaces than ad-hoc approaches that simply combine local media playback with video calls. Our final system includes a queue for organizing content as a group ahead of time, but obscures some information about others' content so no surprises are ruined. Once users have collected media in a queue, they can engage in a video call using the system. During the video call, media is presented within the video chat interface; synchronization and shared controls ensure all users see the same thing at the same time and anyone can take charge.

In Study 5, we show that the new media sharing system is successful at creating an enjoyable experience and solves a number of technical barriers that are experienced when using non-integrated media sharing. In our study, groups of three friends used the system to collect media

then review it together in a video call. Participants all agreed that the experience was enjoyable, and groups were able to view an average of 8.20 media items together during the 15-minute call. Further, analysis of conversations and media sharing behaviours revealed that media sharing can support a wide variety of relationship maintenance behaviours including self-disclosure, establishing common ground, sharing a task, expressing others' interests, and planning.

In Study 6, we show another promising application for synchronous media sharing systems: supporting new relationships. In new relationships, making, receiving, and reciprocating self-disclosures leads to liking [23] and trust [24], which is crucial for many kinds of relationships [25, 26, 27, 28]. Therefore, it is important that technology supports these important outcomes in a way that is reliable for many people. The results of Study 6 confirm that media sharing is a robust way of supporting trust: its effectiveness at supporting trust formation was not impacted by individuals' agreeableness. Additionally, compared to a standard icebreaker approach media sharing led to increased warranting and relatedness while engendering similar levels of trust.

9.2. Contributions

The major contributions of this thesis are:

1. Experimental support for the conjecture that video chat interfaces affect experiences and conversations
2. Experimental support for the role of feedback and content in reducing the expression of social anxiety within a video call
3. A measure of perceived self-disclosure
4. The design and prototype implementation of an integrated video chat and synchronous media sharing system
5. An evaluation of synchronous media sharing's potential for support existing relationships
6. An evaluation of synchronous media sharing's potential for support new relationships

9.3. Applications in other video-based communication contexts

9.3.1. Hybrid meetings

Hybrid meetings include both in-person and remote participants. Our research suggests that video chat interfaces may have differential effects for people in these situations because participants in the meetings do not all use the same interface.

For remote participants, the meeting experience may be similar to that of a fully-remote meeting in terms of interface. In particular, most platforms offer video feedback and generally include controls for this aspect of the interface. However, remote participants often face challenges accessing shared media [134]: if an in-person participant connects to a projector or display in the room, this content may not be shared with remote participants. Therefore, video chat systems that include system-level support for media sharing are well suited to providing equitable experiences in hybrid meetings.

For in-person participants, the meeting may be experienced through a variety of interfaces in addition to one's real-world surroundings. Meeting content may be shown on a projector or screen for the room as well as individuals' computers or mobile devices. The lack of a standard and individual interface for in-person participants may mean that video feedback is available inconsistently or not at all for these participants. Because Study 1 confirmed that video feedback can increase self-focused attention and affect people's focus and conversations, this may be one way in which hybrid meetings can result in inequitable experiences. Therefore, hybrid meeting technology may create more equitable experiences for remote participants if differences are minimized between in-person and remote interfaces.

While access to media may be easier for in-person attendees (regardless of whether sharing is integrated into the system or not), the experience of viewing media may differ. The results of Study 2b suggest that a content-focused interface may reduce people's focus on a video chat. This is consistent with the experience of remote participants in a hybrid meeting, who are likely to see participant video feeds shrink on-screen to accommodate shared content. By contrast, in-person participants continue to be surrounded by other participants; although media may draw people's attention away from other people in the room, there is no corresponding reduction in the prominence of other in-person attendees.

9.3.2. Mobile

In many respects, video chat on mobile devices may be similar to computers. However, screen size is a significant difference between the two experiences, and this may lead to differing interface designs. In terms of video feedback, the smaller screen may constrain the size of feedback; depending on the size, users may not be able to see details beyond general framing and lighting. Our findings in Study 2 suggests that feedback can play a helpful role by providing objective feedback for people with social anxiety; however, it is less clear how a smaller feedback view (that may not show details such as blinking, eye contact, blushing, or small facial expressions) would affect people's experiences.

A second difference between mobile and computer-based video chat is the possibility that the camera is hand-held. If users hold the mobile device in their hand, they may need to look at the video feedback more often in order to ensure that their face stays in the frame. In this case, the self-focusing effects of video feedback observed in Study 1 may be even stronger for mobile users.

9.3.3. AR/VR

Virtual and Augmented Reality are important new venues for video-based communication, offering the potential to create situations more similar to in-person meetings or ones that have no real-world analogue whatsoever.

A primary difference between chatting in AR/VR and traditional video chat is the lack of a standard interface: chat apps in VR have tried to simulate in-person meetings with digital worlds that look like a meeting room (e.g., [429]) or more creative spaces (e.g., [430]). Therefore, video feedback would not be included in a typical AR/VR chat application.

Another key difference between chatting in AR/VR and standard video calls is a lack of cameras. Because current AR/VR systems generally require a headset to be worn, capturing a person's face with cameras is not easily done. Researchers have proposed using cameras around the eyes to capture footage inside the headset that can be combined with footage from outside the headset to create a video feed with the headset "removed" [431]). However, a simpler solution to

this problem is to represent people in the call as avatars. Using avatars may reduce the need for video feedback because people know that their appearance is fixed.

An alternative to the avatars in a virtual world paradigm is the holoportation paradigm [431]. In this paradigm, two parties are captured in full 3D and injected into each other's spaces using AR or VR. In the AR version of the system, video feedback is not included. In the VR version of the system, a form of feedback is included because people can look down at the virtual reconstruction of their body, but no feedback is available for their face.

For both AR and VR, the shared virtual world presents an opportunity for shared activities that go beyond simply talking. Studies 3 and 4 showed that media sharing can be a useful activity for supporting new and existing relationships when using video chat. Viewing media together while in VR is a promising extension of this work, and media sharing could play a similar role in this context. However, much like media sharing embraced the online context of video chat, shared activities for people communicating in AR/VR could embrace the 3D context with playful or spatial interactions.

9.4. Applications in professional situations

Business meetings via video chat continue to increase. A major driver for the use of video chat is distributed teams, which are common in business and education settings [432]. However, tightly-coupled synchronous work is rarer for remote workers [433, 434], suggesting that there are gaps in support for undertaking this kind of work remotely.

Compared to other professions, such as customer service, office workers are at heightened risk for specific social anxiety (anxiety tied to specific other individuals) due to group and hierarchy structures [435]. Therefore, technologies that support interaction within these structures should be particularly mindful of how social anxiety may affect people as they communicate. Our findings suggest that a content-focused interface may attenuate effects of social anxiety in meetings; therefore, having shared content on-screen during remote meetings (e.g., meeting minutes, a digital whiteboard, or relevant documents) may be helpful for creating equitable experiences.

One particular challenge that can occur in business meetings is sharing media in a way that makes it accessible to all participants (particularly when meetings include remote and in-person participants) [134]. This suggests that both consumer- and business-oriented video chat tools can benefit from synchronous media sharing tools. While our work focuses on demonstrating the utility of media sharing for developing and maintaining personal relationships, a flexible media sharing tool could have many serious applications as well. The traditional approach for sharing content in video meetings is screensharing, with limited amounts of interaction via “remote control” [436]. The need to end one person’s screenshare before another begins or manually share control with a single other person limit the flexibility and convenience of screensharing. While some commercial tools are embracing the benefits of integrating content with video calls (video calls in Google Docs [437] or whiteboards [438] and third-party apps [439] in Microsoft Teams calls), these have not yet focused on sharing media such as videos, images, and articles.

9.5. Heavy users of video chat applications

While video chat has become a popular medium with widespread use, some people use video chat much more than others. One reason people may use video chat more than average is maintaining a long-distance romantic relationship. For people in a long-distance relationship, video chat is a unique tool that can provide presence while separated and is often used to engage in activities or “hang out” for extended periods of time [12]. Unlike more casual users, who may meet only to talk, people in long-distance relationships often turn to shared activities so they have something to do while spending longer periods of time together on video chat [12]. For these people, our work suggests that content-focused video chat interfaces could have a number of benefits. First, Study 2 showed that a content-focused interface may attenuate effects of social anxiety; this is important because social anxiety affects romantic relationships: social anxiety is associated with interpersonal stress in close relationships [440] and for women social anxiety is associated with wanting, receiving, and providing less support within a romantic relationship [209]. While a change in video chat interface cannot be expected to completely alter the nature of a relationship, for people who communicate primarily through video chat, it may be an important factor in improving outcomes. Second, our media sharing system showed that integrating content into a video chat interface can be an effective way to support media sharing that does not face the same barriers as ad-hoc solutions; by making media sharing more

technically feasible, a content interface can aid romantic partners in finding an activity they can do together while hanging out via video chat. Third, Study 3 revealed that media sharing can support a variety of relationship maintenance behaviours; this means that media sharing not only provides a way to pass the time together, but also a way to engage in behaviours that strengthen relationships.

Distributed teams “work together on a mutual goal or work assignment, interact from different locations, and therefore communicate and cooperate by means of information and communication technology” [441, pp. 459-460]. The need to communicate through technologies means that like long-distance relationships, distributed teams may rely heavily on video-mediated communication. One consequence of this is that there are fewer opportunities for informal interactions, which occur frequently at in-person workplaces [442]. Some researchers have proposed always-on video chat solutions for these situations; such solutions link two or more remote sites with a persistent video call (e.g., [443, 444]). The results of Study 1 indicate that having video feedback can increase self-awareness, which may be harmful in cases such as problem solving [336]; therefore, such systems should consider ensuring that feedback is controllable by users and sized appropriately.

Our results highlight the potential of content-focused video chat interfaces, an approach which has also been explored in the case of persistent video connections. Tee et al. proposed continuous screensharing as a way to maintain awareness of what others in a group are working on and allow people to spark a conversation [445]. Our work highlights that adding media to a call can support comfort and conversations, which suggests that a continuous screensharing approach could also be useful within video meetings. While video meetings generally include an option to start screensharing, smaller continuous screensharing views may promote sharing of content and facilitate people in transitioning to content-based modalities.

9.6. Future Work

9.6.1. Group Video Calls

Much of our research has studied one-on-one calls. However, group calls are common both for personal reasons (e.g., a family gathering) or professional ones (e.g., a team meeting). Future

work should examine whether the effects of feedback are different in group calls. This is especially true in the case of hybrid meetings, because several in-person attendees may be captured by a single camera feed. In this case, the feedback view may include other people, potentially complicating its effects. Further, the effects of feedback may be reduced for in-person participants who direct more visual attention to the other in-person participants than to the video call.

Our work demonstrated that synchronous media sharing can scale beyond pairs to groups of three (with system support). Future work may consider how additional features can make the system scale to even larger group sizes (e.g., using a push-to-talk or automatic muting feature during video playback, or using a roles feature to manage who has access to shared controls and avoid conflicting commands). Designing synchronous media sharing for large group calls is likely to create conflicts between beneficial aspects of synchronous media sharing (e.g., shared control or open communication) and technical limitations of synchronous media sharing (e.g., the need to share a single audio channel or coordination problems). Therefore, designers should consider how systems can minimally limit communication and shared control while still resulting in a manageable and enjoyable experience.

9.6.2. Spatial Video Chat

Spatial video chat systems allow users to move video feeds (and in some cases shared content) in a virtual environment (e.g., [446, 447, 448, 449, 450]). Two major advantages of such systems are naturally partitioning the shared audio channel (by only presenting audio from participants who are nearby in the virtual environment) or allowing discussion and referencing of shared content (by moving content into the shared environment and positioning video feeds relative to the content in a way that allows pointing and gesturing). Rather than a passive element on one side of the screen, these systems use video feedback as a primary interface for control of the call; therefore, future work should study whether the effects of video feedback are larger or otherwise different in these systems.

9.6.3. AR/VR

Current commercial and research systems for AR/VR communication do not include feedback; however, Study 2a suggests that feedback can play a protective role for people higher

in social anxiety. Therefore, future work should study whether the addition of feedback in AR/VR communications plays a similar role for people higher in social anxiety.

In Study 5, we show that the adding synchronous media sharing to video chat can help people spend time together remotely while engaging in an enjoyable activity that supports relationship maintenance behaviours. We focused on synchronous media sharing as an activity because media sharing is a common digital activity and media sharing is popular in asynchronous communications, suggesting that a synchronous digital environment could also be a useful context for media sharing with proper system support. However, video-based communication in AR/VR goes beyond the experience of video chat, aiming to fully immerse people in a shared virtual environment or virtually “position” them within each other’s physical environment. Therefore, future work should consider what kind of shared activities are useful in AR/VR. In particular, future work should consider whether activities traditionally associated with digital contexts (e.g., media sharing, video games) or face-to-face contexts (e.g., jigsaw puzzles, sharing a meal, or going for a walk) are more useful for maintaining relationships in the AR/VR context.

9.6.4. Media sharing in the long-term

Studies 5 and 6 showed that synchronous media sharing can be a useful tool for supporting formation and maintenance of relationships. However, both studies focused on a single intervention, using time immediately before the call to find media for sharing. Future work should study how media sharing is used over a longer period of time, which may differ in several ways. First, for romantic partners or friend groups, people may be able to build up a queue of media over several days prior to a call. This could offer opportunities such as adding pictures and videos of day-to-day occurrence (e.g., of a meal they ate or a party they went to) or adding media while browsing websites or apps rather than only during a focused search time (e.g., realizing while watching a YouTube video that it would be interesting to share with friends). Therefore, future work should consider whether media sharing can support additional kinds of relationship maintenance behaviours not discovered in Study 5.

For people not yet acquainted, having a personal “introduction” media queue could be a way to save media that are particularly useful in initial encounters; for example, a person may include a photo of themselves, a video about their hometown, and a photo gallery of their favorite

musicians. Future work should consider whether having such a queue and developing its content over the course of multiple initial interactions could reduce the pressure associated with making a positive first impression or allow people to curate a set of content particularly useful for supporting positive outcomes such as self-disclosure and trust.

9.6.5. Other activities in video chat

Our work centers synchronous media sharing as a promising activity for supporting relationships in video chat. However, other activities may also be useful in this context. Existing work has established that video games, combined with audio chat, can be a useful tool to support new [32] and existing [12, 451] relationships. Future work should consider whether there are additional benefits to using video chat during gaming for supporting relationships. While video game streaming has popularized the idea of one-way video streams of both the player and a game, the concept of bi-directional video calling during gameplay remains underexplored.

In serious contexts, there is often a need to share activities during video calls in order to accomplish work objectives. For example, people in a video meeting may need to create an interface design, draft a press release, or develop an investment pitch slide deck. These content creation and editing tasks require separate tools, such as a document editor, in addition to the video calling software. Our system demonstrates that integrating a shared activity into a video chat interface can help address technical barriers that are faced when using multiple disparate tools simultaneously. Therefore, future work should consider whether integrating content editing applications and video chat can similarly ease the experience of working together in video calls. While this type of integration has recently emerged in some commercial systems [437, 438, 439], research has not yet confirmed whether and how such integration benefits collaboration.

CHAPTER 10. CONCLUSION: SUPPORTING RELATIONSHIPS WITH VIDEO CHAT

10.1. Supporting existing relationships

Relationships play a large role in many aspects of life. In people’s personal lives, romantic relationships, familial relationships, and friendships are all ways that people satisfy the need to feel relatedness with others and enjoy the benefits of interpersonal bonds. Professional relationships, for example with a doctor, therapist, or personal trainer, allow people to access support and services. In the workplace, collegial relationships between supervisors, supervisees, and colleagues form the social fabric of a team.

Many relationships, personal and professional, exist over a distance; these relationships center around communication performed using digital technologies [91]. In particular, using video chat is a way to get a unique sense of togetherness when apart [12, 13, 14]. All relationships need to be sustained through relationship maintenance, but distance can make this process more difficult. Our work demonstrated that adding system-level support for doing activities together helps bridge gaps in relationship support for video chat users. A shared activity is not only a way to pass time together, but also a potential supporter of many relationship maintenance behaviours, including ones that are easily experienced when spending time together face-to-face.

As of 2022, video chat is commodified: services allow any app or website to easily integrate video chat functionality (e.g., [452, 453]) and consumers can access quality video chat services at no cost (e.g., [454, 455]). Additionally, new communication technologies including VR and AR show promise for offering an even greater sense of presence. Yet our research underscores that communication tools should not only strive for a feeling of “being there” but also for the power of being there—that is, the ability to undertake tasks and activities together. The commodification of video chat presents a tremendous opportunity for new systems to capitalize

on the potential of system-supported shared activities: integrating video chat with other digital experiences is easier than ever before. Leveraging our findings in the context of current and future technical advances offers great promise for addressing the problem statement set out in this thesis, that the utilitarian design of traditional video chat interfaces limits people's ability to share experiences and therefore maintain relationships remotely

10.2. Supporting new relationships

The importance of relationships in many aspects of life not only requires people to maintain relationships, but also to form new ones. Forming a new relationship is a complicated process: people need to communicate about themselves, engaging in self-disclosure as they get to know each other. Self-disclosure helps people form trust and closeness—cornerstones of personal and professional relationships.

Our research shows that activities in video chat can help support the formation of new relationships, with robustness to individual differences that can alter the effectiveness of get-to-know-you supports. This is an encouraging extension of our work to support existing relationships, which strongly supports the idea giving people the ability to easily do things together while video chatting can be useful in multiple contexts. While our work did not study serious contexts, the clear overlaps with business needs to present, discuss, and even collaborate on content remotely further support the need for video chat systems to fortify media sharing supports. Extending our findings to the context of new relationships, strengthens the claim that system-supported shared activities such as media sharing can address the problem of maintaining relationships remotely by demonstrating robust support in differing relationship contexts.

10.3. Supporting individual differences within relationships

Our work shows that video chat is not only a passive transmitter of information: the interface of a video chat system affects both the experience and actual communications of people using it. Our studies show that feedback in particular is an important factor; this is a key contribution as most previous research on video chat has focused on factors such as eye contact and video or audio quality. Understanding how feedback affects people's experiences in video calls can help designers optimize the interface of their systems to different situations, such as a first introduction, a therapy session, or an online date. Our research also showed that feedback plays a

unique role for people with social anxiety, being associated with a reduction of anxiety related effects. This contribution not only has immediate applications for people seeking to manage anxiety during video calls, but also shows that video chat systems have the potential to alter the expression of individual traits. Other research has suggested that video chat interfaces could be modified to help autistic people comfortably use video chat [456]. The expanding body of research regarding different experiences in video chat offers a promising glimpse at how digital tools can support all people in connecting with other through technology. Our advances in this area make important strides in addressing the remaining portion of this dissertation's problem statement, that traditional video chat interfaces can have unintended effects on individuals or conversations; as research continues to unravel the details of these effects, more informed and purposeful choices will foster desirable outcomes in video calls.

10.4. Futures of video chat

The ubiquity of video chat presents an incredible opportunity for users and designers. People can connect with friends, family, and colleagues anywhere in the world with growing ease, a trend which promises to continue with growing device capabilities and internet speeds. As video chat platforms mature, designers can focus on new optimizations and functionality that support equitable, entertaining, and personal experiences with others, regardless of physical distance.

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Appendix A. LIST OF ICEBREAKER QUESTIONS

1. What do you like to eat on your pizza?
2. What is your favorite animal?
3. What do you like best about your favorite animal?
4. Would you rather go on a beach holiday or a mountain holiday?
5. If you could go visit any place in the world, where would you go?
6. If you could live in any period of history, when would it be?
7. If you could have dinner with one person – dead or alive – who would it be?
8. Do you think it is better to see the future or change the past?
9. Would you rather be invisible or be able to read minds?
10. If you could learn any skill, what would it be?
11. If you could have one superpower, what would it be?
12. Would you rather always feel too cold or always too hot?
13. If your house was burning down, what object would you try to save?
14. If you were at a restaurant and found a fly in your soup, what would you do?
15. What's the weirdest thing you have ever eaten?
16. What is the best present you ever received?
17. If you won \$10000, what would you spend it on?
18. Would you rather eat a banana or an apple?
19. Would you rather wrestle a lion or fight a shark?

Appendix B. SURVEY INSTRUMENTS USED IN STUDIES

Following is a complete list of the validated instruments used in our studies, including the instructions, Likert options, and items presented to participants. For all studies except Study 1, item order was randomized between participants. Where applicable, the subscale of each item and a marker for reverse coding (“R”) are listed in square brackets; these were not visible to participants.

B.1. Study 1

B.1.1. Situational self-awareness scale

Instructions: A number of statements which people have used to describe themselves are given below. Read each statement and indicate how you thought during the chat. There are no right or wrong answers. Do not spend too much time on any one statement. Use the following scale to record your answers:

Likert options: strongly disagree, disagree, somewhat disagree, neutral, somewhat agree, agree, strongly agree

Items:

1. Right now, I am keenly aware of everything in my environment. [Self-Awareness of Environment]
2. Right now, I am conscious of my inner feelings. [Private Self-awareness]
3. Right now, I am concerned about the way I present myself. [Public Self-awareness]
4. Right now, I am self-conscious about the way I look. [Public Self-awareness]
5. Right now, I am conscious of what is going on around me. [Self-Awareness of Environment]
6. Right now, I am reflective about my life. [Private Self-awareness]
7. Right now, I am concerned about what other people think of me. [Public Self-awareness]
8. Right now, I am aware of my innermost thoughts. [Private Self-awareness]
9. Right now, I am conscious of all objects around me. [Self-Awareness of Environment]

B.1.2. Relational communication scale

Instructions: Please take a moment to think about your interaction with your partner in the previous exercise. Please rate how much you agree or disagree with the following statements that describe this interaction.

Likert options: strongly disagree, disagree, somewhat disagree, neutral, somewhat agree, agree, strongly agree

Items:

1. I was highly involved in the conversation. [Involvement]
2. I showed enthusiasm while talking to him/her. [Involvement]
3. I was not fully engaged in the conversation. [Involvement; R]
4. I acted bored by the conversation. [Involvement; R]
5. I was interested in what he/she had to say [Involvement]
6. I created a sense of distance between us. [Involvement; R]
7. I was detached during the conversation [Involvement; R]
8. I acted like I was enjoying the conversation. [Affection]
9. I displayed pleasantness toward him/her. [Affection]
10. I acted like I disliked him/her. [Affection]
11. I communicated coldness rather than warmth. [Affection]
12. I showed affection toward him/her. [Affection]
13. I was unreceptive to what he/she had to say. [Trust; R]
14. I tried to win his/her trust [Trust]
15. I was open to his/her ideas. [Trust]
16. I appeared honest and truthful when communicating with him/her. [Trust]
17. I was unwilling to listen to him/her. [Trust; R]
18. I was sincere in communicating with him/her. [Trust]
19. I didn't care what he/she thought. [Trust; R]
20. I tried to establish rapport with him/her. [Trust]
21. I tried to move the conversation to a deeper level. [Depth]
22. I showed no desire for further interaction with him/her. [Depth; R]

23. I created an air of familiarity between us. [Depth]
24. I tried to create a more personal relationship with him/her. [Depth]
25. I kept the conversation at an impersonal level. [Depth; R]
26. I acted like we were good friends. [Depth]
27. I made the conversation seem superficial. [Depth; R]
28. I made him/her feel we were similar. [Inclusion]
29. I tried to establish common ground with him/her. [Inclusion]
30. I made differences between us evident. [Inclusion; R]
31. I made him/her feel like we didn't have a lot in common. [Inclusion; R]
32. I acted like I was more powerful than him/her. [Inclusion; R]
33. I treated him/her like an equal. [Inclusion]
34. I was calm and poised with him/her. [Composure]
35. I expressed annoyance with him/her. [Composure; R]
36. I revealed feelings of tension while talking with him/her. [Composure; R]
37. I was comfortable talking with him/her. [Composure]
38. I acted relaxed and at ease while talking with him/her. [Composure]
39. I acted frustrated with him/her. [Composure; R]
40. I was engaged and active while interacting with him/her. [Composure]
41. I acted nervous in his/her presence. [Composure; R]
42. I kept the interaction at a formal level. [Formality]
43. I tried to make the conversation informal. [Formality; R]
44. I tried to make the conversation very businesslike. [Formality]
45. I tried to make interaction easygoing and relaxed. [Formality; R]
46. I took a casual approach to the conversation. [Formality; R]
47. I was as interested in building a good relationship as in completing the task at hand. [Task vs. Social Orientation]
48. I wanted to stick to the main purpose of the discussion. [Task vs. Social Orientation; R]
49. I was very work-oriented. [Task vs. Social Orientation; R]
50. I was more interested in having a social conversation than completing the assignment. [Task vs. Social Orientation]

B.2. Study 2

B.2.1. Liebowitz social anxiety scale, self-report

For this scale, the same set of items are scored twice: once with Instructions 1 and Likert options 1 then a second time with Instructions 2 and Likert options 2.

Instructions 1: This measure assesses the way that social phobia plays a role in your life across a variety of situations. Read each situation carefully and answer two questions about that situation. First, please rate **how anxious or fearful you feel in the described situation**. If you come across a situation that you ordinarily do not experience, imagine “what if you were faced with that situation,” and then rate the degree to which you would fear this hypothetical situation.

Likert options 1: None, Mild, Moderate, Severe

Instructions 2: Second, please rate how often you **avoid the situation**. If you come across a situation that you ordinarily do not experience, imagine “what if you were faced with that situation,” and then rate how often you would tend to avoid it.

Likert options 2: Never (0%), Occasionally (1-33%), Often (34-66%), Usually (67-100%)

Items:

1. Telephoning in public.
2. Participating in small groups.
3. Eating in public places.
4. Drinking with others in public places.
5. Talking to people in authority.
6. Acting, performing or giving a talk in front of an audience.
7. Going to a party.
8. Working while being observed.
9. Writing while being observed.
10. Calling someone you don't know very well.
11. Talking with people you don't know very well.
12. Meeting strangers.
13. Urinating in a public bathroom.

14. Entering a room when others are already seated.
15. Being the center of attention.
16. Speaking up at a meeting.
17. Taking a test.
18. Expressing a disagreement or disapproval to people you don't know very well.
19. Looking at people you don't know very well in the eyes.
20. Giving a report to a group.
21. Trying to pick up someone.
22. Returning goods to a store.
23. Giving a party.
24. Resisting a high pressure salesperson.

B.2.2. Situational self-awareness scale

The instructions, Likert options, and items for this scale were the same as in Study 1.

B.2.3. Measure of perceived self-disclosure: ad-hoc version

Instructions: Thinking about the conversation you just had, how much do you agree or disagree with the following statements about the person you spoke to:

Likert options: Strongly disagree, Disagree, Somewhat disagree, Neutral, Somewhat agree, Agree, Strongly agree

Items:

1. I learned a lot about them.
2. They revealed a lot of information about themselves to me.
3. I did not find out very much about them during the video. [R]
4. They wanted to give me a sense of who they are.
5. A good portion of the video was focused on them.
6. By the end of the video, I knew quite a few details about them.

B.2.4. State-trait anxiety inventory: state subscale

Instructions: A number of statements which people have used to describe themselves are given below. Read each statement and then, using the scale below, **indicate how you feel right now, that is, at this moment**. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

Likert options: Strongly disagree, Disagree, Somewhat disagree, Neutral, Somewhat agree, Agree, Strongly agree

Items:

1. I feel calm [R]
2. I feel secure [R]
3. I am tense
4. I feel strained
5. I feel at ease [R]
6. I feel upset
7. I am presently worrying over possible misfortunes
8. I am satisfied [R]
9. I feel frightened
10. I feel comfortable [R]
11. I feel self-confident [R]
12. I feel nervous
13. I am jittery
14. I feel indecisive
15. I am relaxed [R]
16. I feel content [R]
17. I am worried
18. I feel confused
19. I feel steady [R]
20. I feel pleasant [R]

B.2.5. Interpersonal trust scale

Instructions: Below you can read a number of statements about the person who you spoke with in the video chat. Read each statement and rate how much you agree or disagree with it.

Likert options: Strongly disagree, Disagree, Somewhat disagree, Neutral, Somewhat agree, Agree, Strongly agree

Items:

1. I would expect this person to play fair.
2. I could expect this person to tell the truth.
3. I could count on this person to be concerned about my welfare.
4. I would feel very uncomfortable if this person had to make decisions, which would affect me personally. [R]
5. I could rely on this person to react in a positive way if I exposed my weaknesses to them.
6. I could rely on this person to keep the promises they make.
7. I would be willing to let this person make decisions for me.
8. This person would be honest and truthful with me.
9. I feel like I could trust this person completely.
10. This person would treat me fairly and justly.
11. I feel that this person could be counted on to help me.

B.3. Study 3

B.3.1. Item pool for construction of measure of perceived self-disclosure

Instructions: Thinking about the video you just watched, how much do you agree or disagree with the following statements about the person in the video

Likert options: Strongly disagree, Disagree, Somewhat disagree, Neutral, Somewhat agree, Agree, Strongly agree

Items:

1. I learned a lot about them.
2. Based on the video, I could easily describe their personality to someone else.

3. They revealed a lot of information about themselves to me.
4. I did not find out very much about them during the video. [R]
5. They wanted to give me a sense of who they are.
6. A good portion of the video was focused on them.
7. They tried to shift the focus away from themselves during the video. [R]
8. By the end of the video, I knew quite a few details about them.

B.4. Study 4

B.4.1. Measure of perceived self-disclosure

Instructions: Thinking about the video you just watched, how much do you agree or disagree with the following statements about **the person from the video pictured above**:

Likert options: Strongly disagree, Disagree, Somewhat disagree, Neutral, Somewhat agree, Agree, Strongly agree

Items:

1. I learned a lot about them.
2. They revealed a lot of information about themselves to me.
3. I did not find out very much about them during the video. [R]
4. They wanted to give me a sense of who they are.
5. By the end of the video, I knew quite a few details about them.

B.5. Study 5

B.5.1. Friendship maintenance scale

Instructions: Thinking about the friends who are participating in the study with you today, how often do you and your friends...

Likert options: Never, Rarely, Sometimes, Often, All the time

Items:

1. Express thanks when one friend does something nice for the others? [Positivity]
2. Try to make each other laugh? [Positivity]

3. Ignore each other? [Positivity; R]
4. Not return each other's messages? [Positivity; R]
5. Talk about each other behind friends' backs? [Positivity; R]
6. Threaten to end the friendship because of something that happened? [Positivity; R]
7. Try to be upbeat and cheerful when together? [Positivity]
8. Plan specific activities to do together? [Positivity]
9. Blame each other for bad things that happen? [Positivity; R]
10. Reminisce about things you did together in the past? [Positivity]
11. Make sacrifices for each other? [Positivity; R]
12. Become angry with each other? [Positivity; R]
13. Try to make the each other "feel good" about who they are? [Support]
14. Let each other know you accept them for who they are? [Support]
15. Support each other when one of you is going through a difficult time? [Support]
16. Talk about your friendship? [Support]
17. Apologize for something that happened? [Support]
18. Compliment each other? [Support]
19. Let each other know you want the relationship to last in the future? [Support]
20. Listen without making any judgment? [Support]
21. Provide each other with emotional support? [Support]
22. Phone, e-mail, or message each other? [Support]
23. Make compromises when you disagree about something? [Support]
24. Write cards or letters to each other? [Support]
25. Share your private thoughts with each other? [Openness]
26. Repair misunderstandings? [Openness]
27. Give advice to each other? [Openness]
28. Show signs of affection toward each other? [Openness]
29. Have intellectually stimulating conversations? [Openness]
30. Go to social gatherings together? [Interaction]
31. Do favors for each other? [Interaction]
32. Visit each other's homes? [Interaction]
33. Make an effort to spend time together even when you are busy? [Interaction]

34. Do new or unique activities together? [Interaction]
35. Get together just to hang-out? [Interaction]
36. Celebrate special occasions together? [Interaction]
37. Work together on jobs or tasks? [Interaction]

B.5.2. Basic psychological need satisfaction scale: relationship domain

Instructions: When answering this following questions, think about the group of friends who are participating in this experiment with you. Please respond to each statement by indicating how true it is for you.

Likert options: Disagree strongly, Disagree moderately, Disagree a little, Neither agree nor disagree, Agree a little, Agree moderately, Agree strongly

Items:

1. When I am with this group, I feel free to be who I am.
2. When I am with this group, I feel like a competent person.
3. When I am with this group, I feel loved and cared about.
4. When I am with this group, I often feel inadequate or incompetent. [R]
5. When I am with this group, I have a say in what happens, and I can voice my opinion.
6. When I am with this group, I often feel a lot of distance in our relationship. [R]
7. When I am with this group, I feel very capable and effective.
8. When I am with this group, I feel a lot of closeness and intimacy.
9. When I am with this group, I feel controlled and pressured to be certain ways. [R]

B.5.3. Intrinsic motivation inventory

For this scale, there are two sections with different instructions and items.

Instructions 1: Reflect on your experience in the video chat and rate your agreement with the following statements.

Likert options 1: Strongly disagree, Disagree, Neutral, Agree, Strongly agree

Items 1:

1. I enjoyed doing this activity very much [Interest/Enjoyment]
2. This activity was fun to do. [Interest/Enjoyment]
3. I thought this was a boring activity. [Interest/Enjoyment; R]
4. This activity did not hold my attention at all. [Interest/Enjoyment; R]
5. I would describe this activity as very interesting. [Interest/Enjoyment]
6. I thought this activity was quite enjoyable. [Interest/Enjoyment]
7. While I was doing this activity, I was thinking about how much I enjoyed it.
[Interest/Enjoyment]
8. I believe this activity could be of some Value to me. [Value]
9. I think that doing this activity is useful [Value]
10. I think activities like this are important to do [Value]
11. I would be willing to do this again because it has some Value to me. [Value]
12. I think doing this activity could help me [Value]
13. I believe doing this activity could be beneficial to me. [Value]
14. I think this is an important activity. [Value]

Instructions 2: Reflect on the people who are participating in the study with you today and rate your agreement with the following statements.

Likert options 2: Strongly disagree, Disagree, Neutral, Agree, Strongly agree

Items 2:

1. I felt really distant with these people. [Relatedness; R]
2. I really doubt that these people and I would ever be friends. [Relatedness; R]
3. I felt like I could really trust these people. [Relatedness]
4. I'd like a chance to interact with these people more often. [Relatedness]
5. I'd really prefer not to interact with these people in the future. [Relatedness; R]
6. I don't feel like I could really trust these people. [Relatedness; R]
7. It is likely that these people and I could become friends if we interacted a lot. [Relatedness]
8. I feel close to these people. [Relatedness]

B.6. Study 6

B.6.1. Measure of perceived self-disclosure

The Likert options, and items for this scale were the same as in Study 4; the instructions were different to refer to a conversation as opposed to the prerecorded video used in Study 4.

Instructions: Thinking about the conversation you just had, how much do you agree or disagree with the following statements about the person you spoke to:

B.6.2. General disclosiveness scale

Instructions: Please rate the following statements to reflect how you communicate with other people in general.

Likert options: Strongly disagree, Disagree, Somewhat disagree, Neutral, Somewhat agree, Agree, Strongly agree

Items:

1. When I wish, my self-disclosures are always accurate reflections of who I really am. [Intent]
2. When I express my personal feelings, I am always aware of what I am doing and saying. [Intent]
3. When I reveal my feelings about myself, I consciously intend to do so. [Intent]
4. When I am self-disclosing, I am consciously aware of what I am revealing. [Intent]
5. I do not often talk about myself. [Amount; R]
6. My statements of my feelings are usually brief. [Amount; R]
7. I usually talk about myself for fairly long periods at a time. [Amount]
8. My conversation lasts the least time when I am discussing myself. [Amount; R]
9. I often talk about myself. [Amount]
10. I often discuss my feelings about myself. [Amount]
11. Only infrequently do I express my personal beliefs and opinions. [Amount; R]
12. I usually disclose positive things about myself. [Positiveness]
13. On the whole, my disclosures about myself are more negative than positive. [Positiveness; R]

14. I normally reveal "bad" feelings I have about myself. [Positiveness; R]
15. I normally express my "good" feelings about myself. [Positiveness]
16. I often reveal more undesirable things about myself than desirable things. [Positiveness; R]
17. I usually disclose negative things about myself. [Positiveness; R]
18. On the whole, my disclosures about myself are more positive than negative. [Positiveness]
19. I intimately disclose who I really am, openly and fully in my conversation. [Depth]
20. Once I get started, my self-disclosures last a long time. [Depth]
21. I often disclose intimate, personal things about myself without hesitation. [Depth]
22. I feel that I sometimes do not control my self-disclosure of personal or intimate things I tell about myself. [Depth]
23. Once I get started, I intimately and fully reveal myself in my self-disclosures. [Depth]
24. I cannot reveal myself when I want to because I do not know myself thoroughly enough. [Honesty; R]
25. I am often not confident that my expressions of my own feelings, emotions, and experiences are true reflections of myself. [Honesty; R]
26. I always feel completely sincere when I reveal my own feelings and experiences. [Honesty]
27. My self-disclosures are completely accurate reflections of who I really am. [Honesty]
28. I am not always honest in my self-disclosure. [Honesty; R]
29. My statements about my own feelings, emotions, and experiences are always accurate self-perceptions [Honesty]
30. I am always honest in my self-disclosures [Honesty]
31. I do not always feel completely sincere when I reveal my own feelings, emotion, behaviors or experiences. [Honesty; R]

B.6.3. General trust scale

Instructions: Below you can read a number of statements. Read each statement and rate how much you agree or disagree with it.

Likert options: Strongly disagree, Disagree, Somewhat disagree, Neutral, Somewhat agree, Agree, Strongly agree

Items:

1. Most people are basically honest
2. Most people are trustworthy.
3. Most people are basically good and kind.
4. Most people are trustful of others.
5. I am trustful.
6. Most people will respond in kind when they are trusted by others.

B.6.4. Ten item personality index: agreeableness

Instructions: I see myself as:

Likert options: Strongly disagree, Disagree, Somewhat disagree, Neutral, Somewhat agree, Agree, Strongly agree

Items:

1. Critical, quarrelsome. [R]
2. Sympathetic, warm.

B.6.5. Measure of perceived warranting

Instructions: Thinking about the conversation you just had, how much do you agree or disagree with the following statements about the person you spoke to:

Likert options: Strongly disagree, Disagree, Somewhat disagree, Neutral, Somewhat agree, Agree, Strongly agree

Items:

1. I could tell whether the information I learned about this person was an accurate picture of their real life or not.
2. It was easy to determine whether the information I learned about this person was truthful, exaggerated, or made up.
3. I could easily identify which information I learned this person was true and which information was not true.

B.6.6. Interpersonal trust scale

The instructions, Likert options, and items for this scale were the same as in Study 2.

B.6.7. Post-experimental intrinsic motivation inventory: relatedness

Instructions: Reflect on the person you communicated with in the study today and rate your agreement with the following statements.

Likert options: Strongly disagree, Disagree, Somewhat disagree, Neutral, Somewhat agree, Agree, Strongly agree

Items:

1. I felt really distant with this person. [R]
2. I really doubt that this person and I would ever be friends. [R]
3. I felt like I could really trust this person.
4. I'd like a chance to interact with this person more often.
5. I'd really prefer not to interact with this person in the future. [R]
6. I don't feel like I could really trust this person. [R]
7. It is likely that this person and I could become friends if we interacted a lot.
8. I feel close to this person.