

# Through the Looking Glass: Effects of Feedback on Self-Awareness and Conversation during Video Chat

Matthew K. Miller, Regan L. Mandryk, Max V. Birk, Ansgar E. Depping, and Tushita Patel

Department of Computer Science, University of Saskatchewan

Saskatoon, SK, S7N 5C9, Canada

{firstname.lastname}@usask.ca

## ABSTRACT

Video chat is a popular form of computer-mediated communication in a range of contexts from online job interviews to chatting with friends. Although seeing your own video feedback is the predominant interface design, self-awareness research suggests that seeing oneself could induce self-consciousness and affect interaction. 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. Feedback increased self-awareness and the use of socially-focused words, and decreased the use of words expressing certainty. In addition, mixed-gender dyads rated themselves as more socially orientated with feedback than without, which was reflected in an increased use of inclusive pronouns and affiliation words, and fewer words expressing discrepancy. However, with feedback, same-gender dyads reported greater task orientation than mixed-gender dyads – reflected in increased use of task-relevant words. We discuss design implications in contexts from remote therapy to online dating.

## Author Keywords

Video chat; self-awareness; feedback; gender; CMC; CSCW

## ACM Classification Keywords

H.5.3 Group and Organization Interfaces

## INTRODUCTION

Video chat has become a popular mode of computer-mediated communication between geographically-distributed people – for example, it connects grandparents to their remote grandchildren [20], lets distributed friends chat with each other [7, 41], fosters intimacy between romantic partners [39], and keeps families connected [1]. In addition to cultivating personal relationships, video chat is used in a range of professional contexts, such as in

distributed work teams [23], to conduct job interviews [52], to support online test-taking [60], and in remote psychotherapy [11].

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. 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 [37] or at the beginning of a call to adjust their position in the frame [40]. It can be distracting to see yourself in video chat [13], 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 [18]. These negative effects of seeing yourself are attributed to an increase in a participant's self-awareness [18], which can facilitate aggressive behaviour in angered people [9], thwart intrinsic motivation [44], and decrease self-esteem [25]. 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 [27], which could be beneficial in a remote therapy application, but harmful in a remote job interview.

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 paper we investigated whether seeing oneself affected self-awareness in a video chat. Furthermore, 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

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than ACM must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from [Permissions@acm.org](mailto:Permissions@acm.org).

CHI 2017, May 06–11, 2017, Denver, CO, USA

© 2017 ACM. ISBN 978-1-4503-4655-9/17/05...\$15.00

DOI: <http://dx.doi.org/10.1145/3025453.3025548>

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).

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.

A simple choice in interface design – whether or not to show visual feedback – influences how we view ourselves in a social interaction and how we engage in a social conversation. Video-based communication is becoming a common way for people separated by distance to communicate in both personal and professional contexts; our interface design choices have the power to influence how online relationships are formed and fostered.

## RELATED WORK

We present research on feedback in video chat and on how feedback may affect self-awareness for different people.

### Video Chat

Video-mediated communication (VMC, which we sometimes refer to as video chat) has become a popular mode of technology-mediated communication between geographically-distributed people – for example, it connects grandparents to their grandchildren who live in different cities [20], supports intimacy between romantic partners [39], and lets distributed friends chat with each other [7,

41]. In addition to being used to build and maintain personal relationships, video chat is increasingly being used in a range of professional contexts, such as in distributed work teams [23], to conduct job interviews [52], to support online test-taking [60], and even in remote psychotherapy [11].

### Feedback in Video Chat

People who use modern video chat systems such as Microsoft's Skype, Google's Hangouts, and Apple's Facetime are accustomed to seeing a small preview of their own camera feed as part of the chat interface. In addition to this layout being the default interface design, none of these video chat programs offer users an option to disable video feedback (we tested the most recent version of these applications on all the available mobile and desktop platforms). This is consistent with some findings that a majority of users prefer to see a preview of themselves during video chat [1311]. It has also been suggested that video feedback could help increase eye contact, important for establishing interpersonal trust [4].

However, other research has cast doubt on the necessity of constant visual feedback during video chat. Microsoft researchers working on NetMeeting technology found that users only wanted video feedback to adjust their positioning at the start of a call [40]. Research conducted by Hewlett Packard similarly showed that most users prefer to see feedback only if their face leaves the frame, rather than all the time [37]. This was reflected in Hewlett Packard's Halo video conferencing system, which used a large installation that fixed the cameras, seating, and environment in each Halo room, meaning that users were always within the camera frame. The system provided no video feedback to users during the chat [41].

Outside of the context of video chat, feedback has been manipulated for a variety of reasons. For example, in exploring suitable VMC interfaces for online test-tasking, Wegge [60] found that increasing the size of video feedback caused people high in test anxiety to perform worse on an oral exam taken over video conference. And several studies have removed the video feedback affordance; for example, to hide an experimental manipulation [56], to avoid negative effects during behavioral tele-health interventions involving inmates with mental illness [31], to ease anxiety about appearing on camera in the context of learning over a distance [28], and to avoid negative effects for patients with body image disorders in remote psychotherapy [34].

Although almost all modern systems afford video feedback, its use was less consistent in early video chat solutions. Some had it turned off by default [40], while others provided it as an option that obscured the remote video entirely, as it was meant as a temporary preview [55].

*Gender, Video Chat, and CMC*

There are general differences between men and women in terms of behavior during video chat; for example, when adjusting cameras, women adjust the camera to show more of themselves in the field of view than men [57]. Female pairs in a negotiation task over video chat appeared to show higher levels of trust [54] as well as a language of fairness and acknowledgment [5352], compared to male pairs. These differences extend beyond video chat and suggest that gender composition affects how users interact with each other through computer-mediated communication (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 [47]. 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 [48]. Male behavior 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 [59]. 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 [38]. 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 [54]. Mixed gender pairs appear to like each other more and exhibit higher levels of self-disclosure in computer-mediated interactions [29]. Pairing people with someone from the opposite gender appears to strongly effect the dynamics of the subsequent interaction.

When asking what the underlying factors are that influence our interactions with each other over video chat, the gender of the participant and the nature of the gender pairing (i.e., same or mixed) appears to be an important factor.

**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) [8]. 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 [17]. 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 behavior to meet the expectations of others, even if these expectations are incongruent with their own individual standards [21].

*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 [61], seeing your image in a mirror [25], being in the presence of video cameras [61], or being in front of an audience that makes eye contact with you [50]. Laboratory studies that induce heightened self-awareness often use mirror manipulations. For example, Carver [9] 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) [21], it is presently unclear what effect video feedback will have on self-awareness in the context of video chat.

*Effects of Self-Awareness*

When people are more self-aware, they become more conscious of their own presence, attributes, and emotions [10]. Carver and Scheier [10] 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 [44]. Self-attention generated through praise [3] 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 [2].

### Self-awareness in Social Interactions

Self-awareness also affects our interactions with others. In 1959, Goffman [16] 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 [18] 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 [27] 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.

### EXPERIMENTAL SYSTEM AND SETUP

We created a custom browser-based video chat system and connected pairs on 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?

### 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 [19]. 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.

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

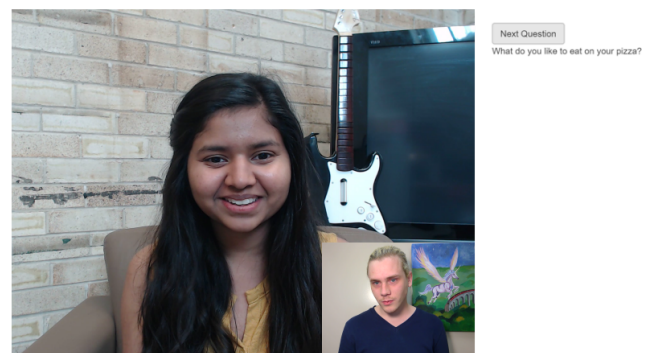


Figure 1. The video chat system with the optional local preview turned on.

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.

### 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 1), 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).

### Instruments

We used two main scales to evaluate subjective experience. Both were measured on a 7-point Likert scale from Disagree Strongly to Agree Strongly.

#### *Situational Self Awareness Scale*

The Situational Self-Awareness Scale [21] 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 [21].

#### *Relational Communication Scale*

The Relational Communication Scale [15] measures several aspects of a conversation. We included the following subscales, 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”.

### 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 [32]. 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 [35]. 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 behavioral 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.

### 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 2 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 [22], basic psychological needs satisfaction [14], self-consciousness [49], and self-monitoring [30]); however, these trait scales were not used in subsequent analyses in this paper.

## Requirements Check Results

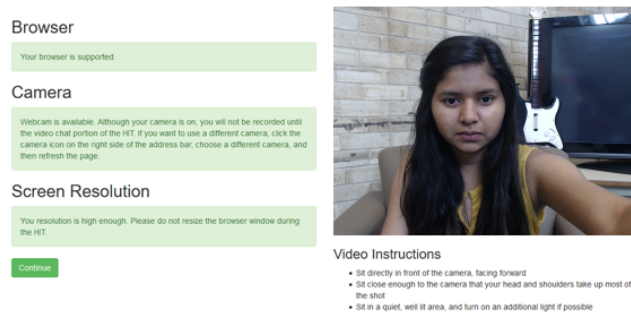


Figure 2. Checking requirements and camera setup.

## 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 [43]. 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 [17]; 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.

## RESULTS

Increased self-awareness has been shown to increase sensitivity to the feedback of others in social interactions [18] – and 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 [27, 21]. 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.

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

	Video Feedback			
	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

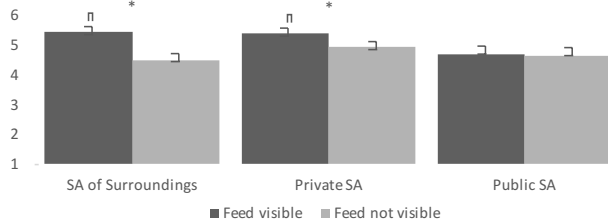
## Effects of Feedback

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.



**RQ1. Does seeing themselves increase self-awareness?**

We expected that seeing themselves would affect participants' self-awareness similar to the mirror manipulations that were used in [21]. 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 ( $F_{1,83}=3.9$ ;  $p=.052$ ,  $\eta^2=.05$ ). 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.

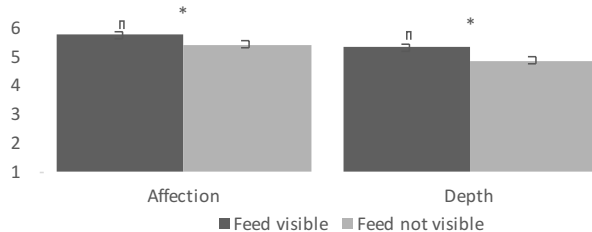


**Figure 3. Mean (±SE) responses for the three self-awareness (SA) scales (1-7, where 7 is higher agreement), \* $p \leq .05$ .**

**RQ2. 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 ( $F_{1,83}=7.4$ ;  $p=.008$ ,  $\eta^2=.08$ ).

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 ( $F_{1,83}=1.8$ ;  $p=.184$ ).

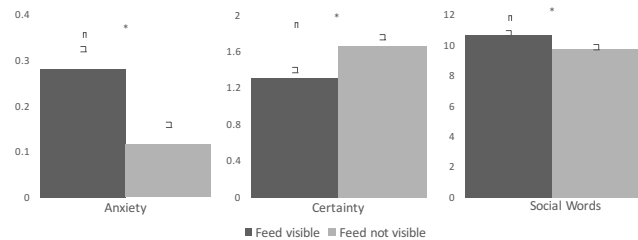


**Figure 4. Mean (±SE) responses for the affection and depth subscales (1-7, where 7 is higher agreement), \* $p \leq .05$ .**

**RQ3. Does seeing themselves affect the conversation itself?**

The MANOVA showed a main effect of feedback on several semantic categories. 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).



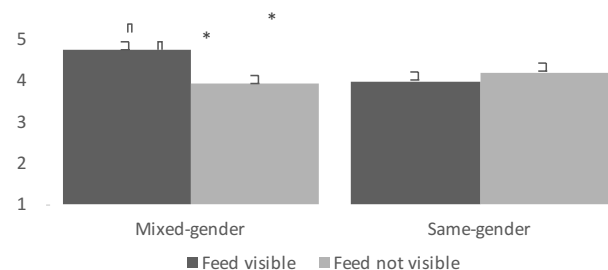
**Figure 5. Mean (±SE) of the word counts from LIWC, \* $p \leq .05$ .**

**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 [29]. 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.

**RQ4. 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 ( $F_{1,83}=4.6$ ;  $p=.036$ ,  $\eta^2=.05$ ). 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 6. Mean (±SE) responses for task versus social orientation (where 1 is task and 7 is social orientation), \* $p \leq .05$ .**

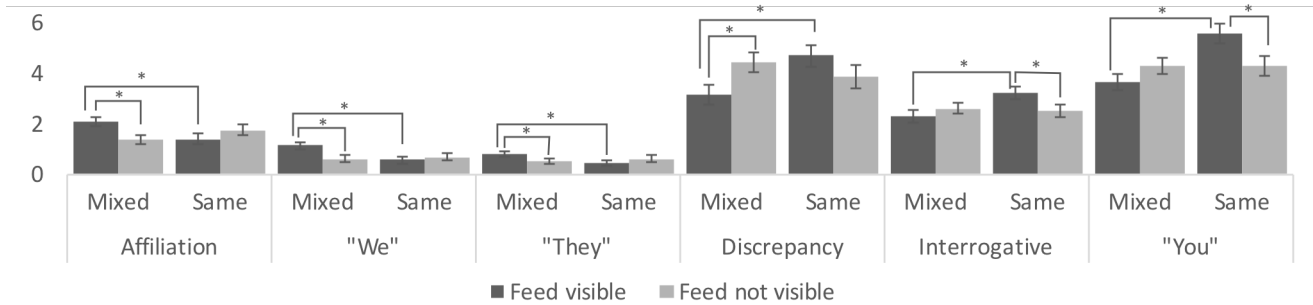


Figure 7. Mean ( $\pm$ SE) of the significant interactions of gender pairing (mixed vs same) and feedback on word counts,  $p < .05$ .

**RQ5. Does seeing themselves differentially affect the conversation of same-gender or opposite-gender pairings?**

The MANOVA showed several interactions of gender pairing and feedback presentation on the semantic categories. Opposite-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.

## DISCUSSION

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

### 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.

### 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 [16] 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. [17] 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 [27] and also that mixed-gender pairs exhibit greater self-disclosure in text-based communication [29]. Although we did not explicitly test for self-disclosure, the reduced use of interrogatives and the reduced use of the 2<sup>nd</sup> 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 [18].

### **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.

### *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.

### *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 [58]. 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 [58].

### *Job Interviews*

The increase in remote and distributed work has also increased the demand for remote job interviews using video communication [5, 52]. 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 [46]. 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.

### *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.

### *Online Dating*

Online dating is a rapidly-growing platform that connects strangers seeking new relationships with each other through computer-mediated communication [51]. 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 [51]. These behavioral patterns can be linked to the differential social norms stemming from anonymity in the online environment [45]. 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.

### *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 [26, 6, 36]. A common approach for people suffering from anxiety is attentional retraining [24], which trains people to shift attention away from negative to neutral cognitions and actually helps to reduce self-directed attention [12]. 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 [11], 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.

### **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 [54]. 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 behavior. 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

eyetracker 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.

## CONCLUSION

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 [33]. 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.

## ACKNOWLEDGMENTS

We thank members of the interaction lab for support, our MTurk participants for their devotion to focused participation in online experiments, the anonymous reviewers for valuable comments, and NSERC (SWaGUR, USRA, and CGS-M) for funding.

## REFERENCES

1. Morgan G. Ames, Janet Go, Joseph 'Jofish' Kaye, and Mirjana Spasojevic. 2010. Making love in the network closet: the benefits and work of family videochat. In *Proceedings of the 2010 ACM conference on Computer supported cooperative work*. 145-154. <http://dx.doi.org/10.1145/1718918.1718946>
2. Roy F. Baumeister. 1984. Choking under pressure: self-consciousness and paradoxical effects of incentives on skillful performance. *Journal of personality and social psychology*. 46, 3, 610-620. <http://dx.doi.org/10.1037/0022-3514.46.3.610>
3. Roy F. Baumeister, Debra G. Hutton, Kenneth J. Cairns. 1990. Negative effects of praise on skilled performance. *Basic and applied social psychology*. 11, 2, 131-148. [http://dx.doi.org/10.1207/s15324834basop1102\\_2](http://dx.doi.org/10.1207/s15324834basop1102_2)

4. E. Bekkering and J.P. Shim. 2006. Trust in videoconferencing. *Communications of the ACM*. 49, 7, 103-107. <http://dx.doi.org/10.1145/1139922.1139925>
5. Nikki Blacksmith, Jon C. Willford, and Tara S. Behrend. 2016. Technology in the Employment Interview: A Meta-Analysis and Future Research Agenda. *Personnel Assessment and Decisions*. 2, 1, 2.
6. Susan M. Bögels, Wendy Rijsemus, and Peter J. De Jong. 2002. Self-focused attention and social anxiety: The effects of experimentally heightened self-awareness on fear, blushing, cognitions, and social skills. *Cognitive Therapy and Research*. 26, 4, 461-472. <http://dx.doi.org/10.1023/A:1016275700203>
7. Jed R. Brubaker, Gina Venolia, and John C. Tang. 2012. Focusing on shared experiences: moving beyond the camera in video communication. In *Proceedings of the Designing Interactive Systems Conference*. 96-105. <http://dx.doi.org/10.1145/2317956.2317973>
8. Arnold H. Buss. 1980. Self-consciousness and social anxiety. Freeman.
9. Charles S. Carver. 1975. Physical aggression as a function of objective self-awareness and attitudes toward punishment. *Journal of Experimental Social Psychology*. 11, 6, 510-519. <http://dx.doi.org/10.1037/0022-3514.37.9.1576>
10. Charles S. Carver and Michael F. Scheier. 1978. Self-focusing effects of dispositional self-consciousness, mirror presence, and audience presence. *Journal of Personality and Social Psychology*. 36, 3, 324-332. <http://dx.doi.org/10.1037/0022-3514.36.3.324>
11. Helen Christensen, Kathleen M. Griffiths, Andrew J. Mackinnon, Kanupriya Kalia, Philip J. Batterham, Justin Kenardy, Claire Eagleson, and Kylie Bennett. 2010. Protocol for a randomised controlled trial investigating the effectiveness of an online e health application for the prevention of Generalised Anxiety Disorder. *BMC psychiatry*. 10, 25. <http://dx.doi.org/10.1186/1471-244X-10-25>
12. Josh M. Cisler and Ernst HW Koster. 2010. Mechanisms of attentional biases towards threat in anxiety disorders: An integrative review. *Clinical psychology review*. 30, 2, 203-216. <http://dx.doi.org/10.1016/j.cpr.2009.11.003>
13. Jose Eurico de Vasconcelos Filho, Kori M. Inkpen, Mary Czerwinski. 2009. Image, appearance and vanity in the use of media spaces and video conference systems. In *Proceedings of the ACM 2009 international conference on Supporting group work*. 253-262. <http://dx.doi.org/10.1145/1531674.1531712>
14. Edward L. Deci and Richard M. Ryan. 2000. The “what” and “why” of goal pursuits: Human needs and the self-determination of behavior. *Psychological inquiry*. 11, 4, 227-268. [http://dx.doi.org/10.1207/S15327965PLI1104\\_01](http://dx.doi.org/10.1207/S15327965PLI1104_01)
15. James Price Dillard, Denise Haunani Solomon, Mark T. Palmer. 1999. Structuring the concept of relational communication. *Communications Monographs*, 66, 1, 49-65. <http://dx.doi.org/10.1080/03637759909376462>
16. Goffman Erving. 1959. The presentation of self in everyday life. Garden City, NY: Anchor. 1-17.
17. Allan Fenigstein, Michael F. Scheier, Arnold H. Buss. 1975. Public and private self-consciousness: Assessment and theory. *Journal of consulting and clinical psychology*. 43, 4, 522-527. <http://dx.doi.org/10.1037/h0076760>
18. Allen Fenigstein. 1979. Self-consciousness, self-attention, and social interaction. *Journal of Personality and Social Psychology*. 37, 1, 75-86. <http://dx.doi.org/10.1037/0022-3514.37.1.75>
19. Luis López Fernández, Miguel París Díaz, Raúl Benítez Mejías, Francisco Javier López, José Antonio Santos. 2013. Kurento: a media server technology for convergent WWW/mobile real-time multimedia communications supporting WebRTC. In *World of Wireless, Mobile and Multimedia Networks (WoWMoM)*. 1-6. <http://dx.doi.org/10.1109/WoWMoM.2013.6583507>
20. Ryoko Furukawa, and Martha Driessnack. 2012. Video-mediated communication to support distant family connectedness. *Clinical nursing research*. 22, 1, 82-94. <http://dx.doi.org/10.1177/1054773812446150>
21. John M. Govern and Lisa A. Marsch. 2001. Development and validation of the situational self-awareness scale. *Consciousness and cognition*. 10, 3, 366-378. <http://dx.doi.org/10.1006/ccog.2001.0506>
22. Samuel D. Gosling, Peter J. Rentfrow, William B. Swann. 2003. A very brief measure of the Big-Five personality domains. *Journal of Research in personality*. 37, 6, 504-528. [http://dx.doi.org/10.1016/S0092-6566\(03\)00046-1](http://dx.doi.org/10.1016/S0092-6566(03)00046-1)
23. Zixiu Guo, John D’ambra, Tim Turner, and Huiying Zhang. 2009. Improving the effectiveness of virtual teams: A comparison of video-conferencing and face-to-face communication in China. *IEEE Transactions on Professional Communication*. 52, 1, 1-16. <http://dx.doi.org/10.1109/TPC.2008.2012284>
24. Yuko Hakamata, Shmuel Lissek, Yair Bar-Haim, Jennifer C. Britton, Nathan A. Fox, Ellen Leibenluft, Monique Ernst, Daniel S. Pine. 2010. Attention bias modification treatment: a meta-analysis toward the establishment of novel treatment for anxiety. *Biological psychiatry*. 68, 11, 982-990. <http://dx.doi.org/10.1016/j.biopsych.2010.07.021>
25. William John Ickes, Robert A. Wicklund, C. Brian Ferris. 1973. Objective self awareness and self esteem. *Journal of Experimental Social Psychology*. 9, 3, 202-219. [http://dx.doi.org/10.1016/0022-1031\(73\)90010-3](http://dx.doi.org/10.1016/0022-1031(73)90010-3)
26. Rick E. Ingram. 1990. Self-focused attention in clinical disorders: review and a conceptual model. *Psychological bulletin*. 107, 2, 156-176.

- <http://dx.doi.org/10.1037/0033-2909.107.2.156>
27. Adam N. Joinson. 2001. Self-disclosure in computer-mediated communication: The role of self-awareness and visual anonymity. *European journal of social psychology*. 31, 2, 177-192.  
<http://dx.doi.org/10.1002/ejsp.36>
  28. Kathleen Dodge Kelsey. 2000. Participant interaction in a course delivered by interactive compressed video technology. *American Journal of Distance Education*. 14, 1, 63-74.  
<http://dx.doi.org/10.1080/08923640009527045>
  29. Sara Kiesler, David Zubrow, Anne Marie Moses, Valerie Geller. 1985. Affect in computer-mediated communication: An experiment in synchronous terminal-to-terminal discussion. *Human-Computer Interaction*. 1, 1, 77-104.  
[http://dx.doi.org/10.1207/s15327051hci0101\\_3](http://dx.doi.org/10.1207/s15327051hci0101_3)
  30. Richard D. Lennox and Raymond N. Wolfe. 1984. Revision of the self-monitoring scale. *Journal of Personality and Social Psychology*. 46, 6, 1349-1364.  
<http://dx.doi.org/10.1037/0022-3514.46.6.1349>
  31. Philip R. Magaletta, Thomas J. Fagan, Mark F. Peyrot. 2000. Telehealth in the Federal Bureau of Prisons: Inmates' perceptions. *Professional Psychology: Research and Practice*. 31, 5, 497-502.  
<http://dx.doi.org/10.1037/0735-7028.31.5.497>
  32. Winter Mason, and Siddharth Suri. 2012. Conducting behavioral research on Amazon's Mechanical Turk. *Behavior research methods*. 44, 1, 1-23.  
<http://dx.doi.org/10.3758/s13428-011-0124-6>
  33. Lisa McIntyre. 2013. The practical skeptic: Core concepts in sociology. McGraw-Hill Higher Education.
  34. Paul McLaren, Chris J. Ball, A. B. Summerfield, J. P. Watson, M. Lipsedge. 1995. An evaluation of the use of interactive television in an acute psychiatric service. *Journal of Telemedicine and Telecare*. 1, 2, 79-85.  
<http://dx.doi.org/10.1177/1357633X9500100203>
  35. Adam W. Meade, and S. Bartholomew Craig. 2012. Identifying careless responses in survey data. *Psychological methods*. 17, 3, 437-455.  
<http://dx.doi.org/10.1037/a0028085>
  36. Tanna M.B. Mellings and Lynn E. Alden. 2000. Cognitive processes in social anxiety: The effects of self-focus, rumination and anticipatory processing. *Behaviour Research and Therapy*, 38, 3, 243-257.  
[http://dx.doi.org/10.1016/S0005-7967\(99\)00040-6](http://dx.doi.org/10.1016/S0005-7967(99)00040-6)
  37. April Slayden Mitchell, Mary G. Baker, Chen Wu, Ramin Samadani, Dan Gelb. 2010. How do I look? An evaluation of visual framing feedback in desktop video conferencing. *Tech. Rep. HPL-2010-175, HP labs*.  
<http://www.hpl.hp.com/techreports/2010/HPL-2010-175.pdf>
  38. Anthony Mulac. 1989. Men's and women's talk in same-gender and mixed-gender dyads: Power or polemic?. *Journal of Language and Social Psychology*. 8, 3-4, 249-270.  
<http://dx.doi.org/10.1177/0261927X8983006>
  39. Carman Neustaedter and Saul Greenberg. 2012. Intimacy in long-distance relationships over video chat. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. 753-762.  
<http://dx.doi.org/10.1145/2207676.2207785>
  40. Chris Nodder, Gayna Williams, Deborah Dubrow. 1999. Evaluating the usability of an evolving collaborative product—changes in user type, tasks and evaluation methods over time. In *Proceedings of the international ACM SIGGROUP conference on Supporting group work*. 150-159.  
<http://dx.doi.org/10.1145/320297.320314>
  41. Kenton O'Hara, Alison Black, and Matthew Lipson. 2006. Everyday practices with mobile video telephony. In *Proceedings of the SIGCHI conference on Human Factors in computing systems*. 871-880.  
<http://dx.doi.org/10.1145/1124772.1124900>
  42. Kenton O'hara, Jesper Kjeldskov, Jeni Paay. 2011. Blended interaction spaces for distributed team collaboration. *ACM Transactions on Computer-Human Interaction (TOCHI)*. 18, 1, 3.  
<http://dx.doi.org/10.1145/1959022.1959025>
  43. James W. Pennebaker, Ryan L. Boyd, Kayla Jordan, and Kate Blackburn. 2015. The development and psychometric properties of LIWC2015. UT Faculty/Researcher Works.  
<http://dx.doi.org/10.15781/T29G6Z>
  44. Robert W. Plant and Richard M. Ryan. 1985. Intrinsic motivation and the effects of self-consciousness, self-awareness, and ego-involvement: An investigation of internally controlling styles. *Journal of Personality*. 53, 3, 435-449.  
<http://dx.doi.org/doi:10.1007/bf00995170>
  45. Barbara A. Ritter. 2012. Say that to my face: Factors inherent to the online environment that increase the likelihood of harassing and prejudicial behavior. *Cutting-edge Technologies in Higher Education*. 5, 25-42.  
[http://dx.doi.org/10.1108/S2044-9968\(2012\)0000005005](http://dx.doi.org/10.1108/S2044-9968(2012)0000005005)
  46. Nicolas Roulin. 2016. Individual Differences Predicting Impression Management Detection in Job Interviews. *Personnel Assessment and Decisions*. 2, 1, 1.
  47. Victor Savicki, Merle Kelley, Dawn Lingenfelter. 1997. Gender, group composition, and task type in small task groups using computer-mediated communication. *Computers in Human Behavior*. 12, 4, 549-565.  
[http://dx.doi.org/10.1016/S0747-5632\(96\)00024-6](http://dx.doi.org/10.1016/S0747-5632(96)00024-6)
  48. Victor Savicki, Merle Kelley, Benjamin Ammon. 2002. Effects of training on computer-mediated communication in single or mixed gender small task groups. *Computers in Human Behavior*. 18, 3, 257-269.  
[http://dx.doi.org/10.1016/S0747-5632\(01\)00048-6](http://dx.doi.org/10.1016/S0747-5632(01)00048-6)
  49. Michael F. Scheier and Charles S. Carver. 1985. The Self-Consciousness Scale: A Revised Version for Use with General Populations. *Journal of Applied Social Psychology*, 15, 8, 687-699.



- <http://dx.doi.org/10.1111/j.1559-1816.1985.tb02268.x>
50. Michael F. Scheier, Allan Fenigstein, Arnold H. Buss. 1974. Self-awareness and physical aggression. *Journal of Experimental Social Psychology*. 10, 3, 264-273.  
[http://dx.doi.org/10.1016/0022-1031\(74\)90072-9](http://dx.doi.org/10.1016/0022-1031(74)90072-9)
  51. Aaron Smith and Maeve Duggan. 2013. Online dating & relationships. Pew Internet & American Life Project.
  52. Susan G. Straus, Jeffrey A. Miles, and Laurie L. Levesque. 2001. The effects of videoconference, telephone, and face-to-face media on interviewer and applicant judgments in employment interviews. *Journal of management*. 27, 3, 363-381.  
<http://dx.doi.org/10.1177/014920630102700308>
  53. Xiaoning Sun, Susan Wiedenbeck, Thippaya Chintakovid, Qiping Zhang. 2007. Gender talk: differences in interaction style in CMC. In *IFIP Conference on Human-Computer Interaction*. 215-218.  
[http://dx.doi.org/10.1007/978-3-540-74800-7\\_17](http://dx.doi.org/10.1007/978-3-540-74800-7_17)
  54. Xiaoning Sun, Susan Wiedenbeck, Thippaya Chintakovid, Qiping Zhang. 2007. The effect of gender on trust perception and performance in computer-mediated virtual environments. In *Proceedings of the American Society for Information Science and Technology*, 44, 1, 1-14.  
<http://dx.doi.org/10.1002/meet.1450440211>
  55. Tandberg. 2005. Tandberg Tactical MXP User Manual.
  56. Cameron Teoh, Holger Regenbrecht, David O'Hare. 2010. Investigating factors influencing trust in video-mediated communication. In *Proceedings of the 22nd Conference of the Computer-Human Interaction Special Interest Group of Australia on Computer-Human Interaction*. 312-319.  
<http://dx.doi.org/10.1145/1952222.1952289>
  57. Cameron Teoh, Holger Regenbrecht, David O'Hare. 2012. How the other sees us: perceptions and control in videoconferencing. In *Proceedings of the 24th Australian Computer-Human Interaction Conference*. 572-578.  
<http://dx.doi.org/10.1145/2414536.2414624>
  58. Bruce W. Tuckman and Mary Ann C. Jensen. 1977. Stages of small-group development revisited. *Group & Organization Management*. 2, 4, 419-427.  
<http://dx.doi.org/10.1177/105960117700200404>
  59. Shaojung Sharon Wang, Shin-Il Moon, Kyounghee Hazel Kwon, Carolyn A. Evans, Michael A. Stefanone. 2010. Face off: Implications of visual cues on initiating friendship on Facebook. *Computers in Human Behavior*. 26, 2, 226-234.  
<http://dx.doi.org/10.1016/j.chb.2009.10.001>
  60. Jurgen Wegge. 2006. Communication via videoconference: Emotional and cognitive consequences of affective personality dispositions, seeing one's own picture, and disturbing events. *Human-Computer Interaction*, 21, 3, 273-318.  
[http://dx.doi.org/10.1207/s15327051hci2103\\_1](http://dx.doi.org/10.1207/s15327051hci2103_1)
  61. Robert A. Wicklund and Shelley Duval. 1971. Opinion change and performance facilitation as a result of objective self-awareness. *Journal of Experimental Social Psychology*. 7, 3, 319-342.  
[http://dx.doi.org/10.1016/0022-1031\(71\)90032-1](http://dx.doi.org/10.1016/0022-1031(71)90032-1)