

Self-Disclosure in Social Virtual Reality: The Influence of Information Management Dynamics, Social Presence, and Privacy Concerns

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Abstract

Social virtual reality (SVR) aims to recreate embodied social experiences similar to those offline. However, concerns about privacy and safety have hindered its widespread adoption. This study examines how information disclosure and perceived control over information in SVR are influenced by 1) boundary permeability (e.g., interruptions from an unknown external user) and 2) identifiability of one's conversation partner (e.g., access to their offline profile). We also explore how different social presence perceptions and privacy concerns may mediate these relationships. Comparing the experiences of participants ($n = 94$) randomly assigned to four different mock interview scenarios, we find the perceived actorhood of one's conversation partner mediated the positive relationship between offline profile access and disclosure. Additionally, more permeable environmental boundaries led to significantly lower levels of disclosure. Qualitative responses emphasized SVR's limitations in saliently conveying nonverbal expressions. Implications for future research and the design of SVR as a viable communication medium are discussed.

CCS Concepts

• Security and privacy → Privacy protections; • General and reference → Experimentation; • Social and professional topics → User characteristics; • Applied computing → Psychology.

Keywords

social virtual reality, immersive communication systems, privacy, information control, information disclosure

ACM Reference Format:

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1 Introduction

Social virtual reality (SVR)—an immersive virtual environment through which individuals interact—attempts to create embodied social experiences resembling those that occur offline [57, 68]. SVR has been deployed across a variety of social contexts, such as watching movies [95], working collaboratively with others [35, 82, 94], and engaging in educational experiences [40, 50]. Research has demonstrated instances in which SVR allowed for more intimate interpersonal closeness than voice or video communication channels [15]. Yet, perceived user privacy and safety vulnerabilities [26, 102] may be preventing SVR from becoming a mainstream communication channel.

This study aims to inform more effective communication in SVR, investigating how situational factors impact users' perceptions, as well as their actual behaviors, in an interpersonal interaction. Although we recognize the existence of many relevant situational factors that may impact interpersonal communication, we focus on two that have received both active scholarly and practical attention. Previous literature suggests that **1) boundary permeability** (e.g., interruptions from an unknown external user) and **2) identifiability of one's conversation partner** (e.g., access to their offline profile) may shape communication in SVR. Boundary permeability is essential to information management in SVR, as permeability exceeding expectations may negatively impact users' sense of immersion and perceived privacy. For example, users may feel a lack of privacy akin to that experienced across communication technologies that fell victim to "Zoom bombing" [39]. Identifiability of one's conversation partner is also critical to information management in SVR, as research has found users to be significantly more comfortable disclosing with others who they are familiar with [68]. Invoking both of these situational factors, a recent qualitative study found eavesdropping on supposedly private conversations and impersonating another individual's identity were among the most common privacy concerns with SVR [1]. Motivated by this work, we examine the influence of these factors on the extent to which individuals interpersonally disclose [61] and perceive control over shared information [73] in SVR. Further, to investigate the psychological mechanisms by which these factors influence disclosure and perceptions of information control, we explore the extent to which these effects may be mediated by users' social presence perceptions and privacy concerns.

We draw on a sample of university students ($n = 94$) who underwent a mock interview in virtual reality. We find perceived actorhood of the interviewer—a dimension of social presence—positively

mediated the relationship between the identifiability of one's conversation partner and disclosure (both actual and perceived). Additionally, when boundaries were more permeable during the interview experience, participants exhibited significantly lower levels of actual disclosure. Of note, we found neither manipulated situational factors nor mediators (i.e., privacy concerns, social presence) influenced perceptions of information control. Qualitative analysis of participants' comparison of their SVR interview to previous face-to-face (Ftf) interviews revealed SVR's limitations in saliently conveying nonverbal expression, aligning with our quantitative results.

We argue that interpersonal experiences in SVR are heavily dependent on perceptions of social presence. Corroborative quantitative and qualitative analyses show that when individuals believe they are in the presence of their communication partner—both in terms of the latter's relative salience and legitimacy as a genuine social actor—they feel more comfortable disclosing personal information. This means that SVR designers should think critically about 1) giving users the option to get to know others' offline identity, 2) preventing unknown third-party actors from intruding on private conversations, and 3) prioritizing the amplification of social presence in SVR to permit increased user comfort and trust when disclosing to other users. On a theoretical level, this study contributes the first application of communication privacy management theory (CPM) [83] to SVR while also providing empirical support for calls to investigate social presence as a multidimensional user experience [28]. In turn, this paper reveals implications for design and research related to information management in SVR.

2 Related Work

2.1 SVR as a Channel Affording Uniquely Rich Social Experiences

SVR has emerged as a distinct communication channel through which individuals can establish meaningful personal relationships, necessitating the disclosure of often personal information. For example, researchers have observed the features contributing to social presence in SVR allow anxious individuals to develop social skills that may translate offline [107]. Individuals have even taken to consuming alcohol with others in SVR [16]. Although SVR has become yet another medium for interpersonal communication, its affordances make it unique. *Affordances* are aspects of a technology that provide possibilities for user action [34]. For instance, SVR affords embodiment, by which users perceive their virtual body as their own biological body [30]. Recent research has explicitly demonstrated the strength of SVR as an interpersonal communication medium through comparing its social affordances to those of other communication mediums, finding it provides a higher degree of anonymity than Ftf communication and higher social presence and information control than other mediated communication channels [27]. Cummings & Ingber [27] provide evidence of the promise of SVR as an effective and distinct medium for interpersonal communication as compared to other mediated and Ftf communication channels. Yet, little is known about *why* SVR users share personal information in SVR and how existing sharing habits may be improved to more closely resemble Ftf interactions.

2.2 Information Management in SVR

Communication privacy management theory (CPM) provides a suitable framework for studying the dynamics of information management in SVR. This theory contends people form boundaries around their information with *co-owners* (i.e., receivers of information). In order to maintain control over these boundaries, Petronio [83] argues individuals (i.e., information owners) create a set of privacy rules that ultimately govern the future of their shared information. One characteristic of information boundaries is *permeability*, or the extent to which information can be visible to people who are not designated co-owners [83]. When boundaries are permeable, unintended parties have easier access to information intended to remain private. By contrast, establishing boundaries with low permeability heightens information owners' perception of control over their personal information through forbidding exposure beyond identified co-owners. Petronio [83] conceptualizes the breaking of established privacy rules and intrusion upon expected boundaries as *privacy turbulence*.

CPM has been applied across a variety of communication mediums including smart speakers [53] online messaging [49, 93, 97], e-commerce [74], social networking sites [25, 67, 71, 103, 108], health communication [13], and communications with conversational agents [89]. This body of research has demonstrated the circumstances under which individuals feel more comfortable disclosing personal information. As a result, researchers have offered recommendations for improving the strength of privacy boundaries to avoid privacy turbulence across communication mediums. Yet, there is a gap in the CPM literature in that it has not been applied to understand information management in SVR. This is critical given the growing virtual reality market, expected to be worth nearly \$29 billion by 2027 [3].

2.2.1 Platform Rules for Interpersonal Communication in SVR. Although Petronio [83] asserts privacy rules are created at the interpersonal level (i.e., between individual communicators), it is possible for rules to be governed by the platform. The embedded, static features on the platform ultimately govern perceptions and subsequent information management behaviors [90]. Shore & Prena [93] refer to this as *platform rules*, building on both CPM and information systems theory which argue technology features offer "specific types of rules" [29] (pg. 126). For example, when Trepte, Scharnow & Dienlin [96] manipulated a platform feature to showcase the disclosure of other users, participants were significantly more likely to self-disclose in turn. Bayer et al. [10] similarly highlight that ephemerality features dictate the way individuals share information with others online. It is also the features of the platform that ultimately allow information to spread outside of intended information boundaries [33]. Marwick [72] highlights Facebook's tagging feature as responsible for exposing users' sexual identity to a larger network without permission, thereby exemplifying how platform rules challenge boundary permeability and might lead to privacy turbulence. Similar work has found affordances to influence self-disclosure online [21, 106, 109], as well as to mediate the relationship between internal feelings (i.e., anxiety) and the decision to disclose via text message as opposed to face-to-face [17].

Scholars have yet to leverage CPM to understand how individuals manage information in SVR. Given its unique features and technological affordances [30], including its perceived social affordances [27] it would be fruitful to understand how information disclosure and perceptions of control over shared information—key variables within the CPM framework—are influenced by the platform rules set by SVR. Related research has revealed differences across virtual communication settings, finding users to feel more comfortable disclosing to others in an embodied avatar than through video conferencing [48]. As companies attempt to build SVR environments where people feel comfortable akin to offline interactions, it is critical to identify SVR features that would improve interpersonal communication.

2.3 Social Virtual Reality: Missing the Mark on Privacy

Similar to other mediated communication channels, scholars have identified privacy concerns in SVR [26, 43]. For example, research has revealed inconsistencies in the privacy policies across applications built for virtual reality, including those which are social [42]. Reflecting on minors' use of SVR, Maloney, Freeman & Robb [69] note the lack of accessible information in SVR platform policies must be urgently addressed so users can understand how to manage their information appropriately. Researchers have also highlighted privacy concerns related to SVR's collection of nonverbal data [6, 76, 91] and those that arise as a result of the actions of other users [11]. Hadan et al. [44] found users' lack of awareness of data collection within immersive extended reality technologies limits their ability to protect their privacy. In fact, even if someone knows how to effectively adjust their privacy settings, their data may still be implicated by the lack of setting adjustment by others with whom they interact [22]. Additionally, recent work focused on children's usage of SVR expressed concerns around surveillance, citing its diminishment to user agency [36].

2.3.1 Comfort in Co-owner Identifiability. It is possible for SVR to promote features that alleviate users' privacy concerns, thereby offering them more control over their information. CPM [83] would argue higher perceptions of control—established through limiting information access to known co-owners—encourage more disclosure. Similarly, empirical research has found people are less concerned about privacy in SVR when they have a higher degree of familiarity with the people they are interacting with. In fact, impersonation of others' identities is a common privacy concern in SVR [1]. Although many users want to conceal their offline identity in SVR for privacy reasons [52], Maloney, Zamanifard & Freeman [70] reveal in many cases participants were only comfortable disclosing personal information with someone with whom they were familiar offline. Choi [19] similarly demonstrates when individuals had more information about their conversation partner's offline profile, they felt more trust toward their online profile. Further, in their effort to build a system that reconstructed clothed humans in SVR, Wang et al [101] found participants preferred blurring their avatars with users who they did not previously know. In general, research has found that a lack of familiarity with unknown individuals heightens social anxiety [32]. Given this work, we hypothesize that when the information co-owner is identifiable in SVR—meaning there is

access to their offline profile—users will be more likely to disclose and feel control over their shared information.

H1: Co-owner identifiability in SVR will positively predict a) disclosure and b) perceptions of information control.

2.3.2 Informing Private Boundaries. As previously mentioned, an important driver of information disclosure is the sense of having protected boundaries [83]. Although SVR users have the ability to create or join private spaces where others are unable to intrude, many SVR applications are designed with a focus on shared community via public spaces [69]. SVR users acknowledge the potential for unwanted users to intrude upon conversations as a privacy concern [1]. In some instances, SVR users are present in spaces without contributing to the community dialogue (e.g., appearing to be inactive), defined as "dwellers" who disturb the peace and in some cases, incite harassment [110]. Research has also recognized the prevalence of sound intrusions, where noise from the offline world unexpectedly seeps into the SVR space (e.g., the ringing of an alarm clock) [2]. In fact, Cummings & Ingber [27] found that users perceive SVR as having a higher likelihood of interpersonal intrusion upon private conversations than FtF, text messaging, email, or voice calls.

In an effort to afford greater user privacy in SVR through boundary management, researchers have tested the effectiveness of features such as notifications of an intruder [24] and digital bubbles which mimic offline personal spaces [78, 110]. Research finds SVR users act quite differently depending on whether they are in a private or public space, though this evidence is limited to physical as opposed to verbal behaviors [45]. CPM suggests when boundaries are permeable individuals will perceive less control over their information [83]. Further, researchers have proposed the use of boundaries to enhance use safety in SVR [110]. However, this is particularly difficult in SVR environments as privacy settings could compromise the immersive experience [56]. In the context of social media, empirical work has identified boundary permeability as a platform rule and demonstrated instances where it was positively predictive of disclosure [23]. Similarly, when boundary permeability exceeds user expectations in SVR, we expect a negative impact on both disclosure and perceptions of information control.

H2: Boundary permeability in SVR will negatively predict a) disclosure and b) perceptions of information control.

2.4 Assessing the Mediating Roles of Privacy Concerns and Social Presence

The direct relationships between the manipulated SVR features and information management may be indirectly impacted by user perceptions. Choi [20] found both privacy concerns and social presence influence users' intended continued engagement with a digital communication platform. These results may extend to communication in SVR. In fact, Cummings & Ingber [27] found individuals to perceive significantly higher privacy concerns about SVR than voice calls, implying that privacy concerns may impede SVR from becoming a mainstream interpersonal communication channel. CPM [83] would agree that concerns about privacy could impact disclosure and perceptions of control. A rapidly growing body of literature suggests the presence of privacy concerns in SVR [7, 26, 36, 76, 91]. It is possible that when these privacy concerns

are heightened through situational factors, people will be more reluctant to disclose and feel less control over shared information. We predict that privacy concerns will mediate the direct effects proposed above:

H3: Privacy concerns will mediate the relationship between manipulated situational factors (co-owner identifiability and boundary permeability) and a) disclosure and b) control.

Social presence may also mediate the aforementioned relationships. In SVR, social presence has been found to increase with the inclusion of nonverbal cues from conversation partners [57]. Salantri et al. [88] found perceptions of social presence enhance trust between users in SVR. Furthermore, research beyond SVR provides evidence that social presence mediates the relationship between the features of communication platforms and level of interaction with a parasocial actor [55]. Of note, users' perceived social presence may relate to several different appraisals of a mediated other. In a recent systematic review, Cummings & Wertz [28] identified multiple distinct perceptual constructs studied within the empirical literature on "social presence". They distinguish between several different social evaluations of mediated others, including salience (e.g., I see you/detect you), actorhood (e.g., You are a real person/social actor), co-location (e.g., We are in the same place), and association (i.e., level of agreement, liking, or influence between parties). This study contributes to the development of social presence conceptualization in applying this nuanced approach to investigating the independent and relative mediating influence of different social presence constructs on information management in SVR. Specifically, we propose the following research question:

RQ1: How does social presence (overall, and in terms of specific dimensions) mediate the relationships between the manipulated situational factors (co-owner identifiability and boundary permeability) and a) disclosure and b) control?

3 Method

3.1 Study Design

To examine our hypotheses and research question, we conducted a 2 (Boundary permeability: present or absent) x 2 (Co-owner identifiability: present or absent) between-subjects experiment. We randomly assigned participants to one of four conversation conditions in SVR, which included either an identifiable co-owner ($n = 24$), a permeable boundary ($n = 20$), both of these factors ($n = 26$), or neither of factors (serving as a control group, $n = 24$).

3.2 Participants

Participants ($n = 106$) were recruited from a northeastern university in the United States and offered either course credit or a \$10 Amazon Gift Card for participation. A small portion of recruited participants were excluded from the data analysis due to technical issues ($n = 5$) or previous familiarity with the interviewer ($n = 7$),¹ resulting in a final sample of 94 participants. Participants identified as female ($n = 76$, 81%), male ($n = 15$, 16%), or preferred not to disclose their

¹The interviewer was one of the researchers on our team, who was also a member of the community of the same university from which participants were recruited. As such, some participants could recognize who the interviewer was even without access to their offline profile. For this reason, we removed these participants from the sample used for analysis.

gender ($n = 3$, 3%). Their ages ranged from 18 to 64 years old ($M = 21.87$, $SD = 5.73$). Participants identified as Asian or Pacific Islander ($n = 48$), White or Caucasian ($n = 22$), Hispanic ($n = 5$), Black or African American ($n = 2$), Middle Eastern or North African ($n = 1$), another race ($n = 1$), two or more races ($n = 8$), or preferred not to say ($n = 7$). This study was approved by a university institutional review board.

3.3 Procedure

Participants were informed that they would be taking part in a mock interview for a research assistant position. Specifically, the following information was provided:

"The interviewer — the lab research manager — is interviewing candidates for a research assistant position. The manager will ask you a series of questions. Please answer the questions thoughtfully, as if you were completing a true job interview. Additionally, while this is only a mock interview, all participants will still be evaluated on their performance. The participant that does the best on the interview will receive a \$50 Amazon gift card after the researchers have completed the study and assessed all of the candidates."

After reviewing these directions and having any questions addressed by the research assistant present in the lab, participants put on the VR headset with the help of a research assistant and entered the SVR environment. Given the impact that avatar personalization can have on users' sense of presence and social interactions [100], we created a gender neutral avatar that was standard across all participants. Participants were unable to directly view their avatar's appearance within the virtual interview setting. Within the SVR space, the participant was then greeted by the interviewer (a research confederate in a remote location) and completed the interview. All participants completed the interview session wearing a Meta Quest Pro VR headset operating at 72 Hz with a resolution of 1800x1920 pixels per eye. Additionally, hand tracking was enabled to permit a more realistic interview experience. A private interview meeting room was designed using Meta Horizon Workrooms (Figure 1)

Notably, mock interviews are a common context for studying social dynamics and perceptions [8, 81]. Our interview protocol was adapted from Villani et al. [99], with additional interview questions that followed Aron et al.'s [4] closeness-generating procedure for encouraging personal information disclosure. Interviews lasted approximately 10 minutes, with some variation depending on participant disclosure levels. After the interview, participants exited the virtual room and completed a questionnaire on a laptop present in the physical room. The questionnaire included quantitative measures presented in a random order and one open-ended response prompt. When asked, all participants in the final sample reported that the mock interview was realistic and affirmed that they took the interview seriously.

3.4 Manipulations

Consistent with Choi [19], *co-owner identifiability* was manipulated by presenting the interviewer's offline professional profile to half of the participants prior to the interview. This was the interviewer's actual LinkedIn profile, which included their name, photograph, education, and previous work experience. To manipulate *boundary*

permeability, half of the participants experienced an intrusion by a second research confederate. Midway through the interview, the intruder's avatar joined the virtual room, cited their need to set up for the next interview session, and apologized for the interruption. The interviewer requested the intruder to move to an adjacent table (Figure 2). The intruder further signified their presence in the virtual space by coughing loudly during two responses provided by the interviewee, at which point the interviewer turned their head to appear distracted by the intruder.

3.5 Measures

All items were measured on a Likert scale ranging from 1 (Strongly disagree) to 7 (Strongly agree) unless otherwise noted. All measurement items are provided in Table 1 in the Appendix.

Perceived Disclosure was measured using an abridged version of Pickard, Wilson, & Roster [84] sensitive information disclosure (SID) scale, including seven items specific to revealing intimate information. For example, "I disclosed a lot in order to answer this question truthfully," ($M = 3.78$, $SD = 1.00$, $\alpha = .75$).

Actual Disclosure was measured through participants' spoken word count throughout the interview, as has been conducted in previous research [63]. The interview recordings were transcribed using Whisper, a speech recognition model, to produce a total word count from each interview ($M = 622.94$, $SD = 314.44$).

Perceived Control over information shared during the interview was measured using a three-item scale from Krasnova et al. [59]. For example, "The virtual environment allowed me to have full control over the information I provided to others," ($M = 5.02$, $SD = 1.33$, $\alpha = .77$).

General Social Presence during the interview was measured using a four-item scale adapted from Fox & McEwan [37]. For example, "Virtual reality makes it feel like the person I'm communicating with is close by," ($M = 4.02$, $SD = 1.42$, $\alpha = .90$).

Additionally, different dimensions of social presence were independently assessed. Scales for each dimension were drawn from Cummings and Wertz's [28] thematic and content analyses of established social presence measures, which coded instruments based on the extent to which their items captured different social presence constructs. Each instrument selected for the current study had been coded as singularly or primarily measuring the corresponding social presence construct.

Actorhood of the interviewer was measured using a five-item scale from Bailenson et al. [7]. For example, "I perceived the interviewer as being only a computerized image, not as a real person," ($M = 4.38$, $SD = 1.37$, $\alpha = .79$).

Salience was measured using four items adapted from Lombard & Ditton's [65] social presence passive interpersonal scale. For example, "How well were you able to observe the body language of the people you saw/heard?" These items were measured on a 7-point scale ranging from 1 (Not well) to 7 (Very well) ($M = 3.86$, $SD = 1.44$, $\alpha = .80$).

Co-location was measured through the four-item instrument used by Nakanishi et al. [77]. For example, "I felt as if I were being viewed by the interviewer in the same room," ($M = 4.49$, $SD = 1.56$, $\alpha = .89$).

Association was measured using a six-item instrument adapted from Nowak & Bioocca [80]. For example, "I tried to create a sense of closeness with the interviewer," ($M = 4.23$, $SD = 1.10$, $\alpha = .81$).

Privacy Concerns were assessed across three separate perceptions as defined by Bracamonte et al. [14]: perceived intrusion (e.g., "I believe that as a result of communicating with someone in virtual reality, others, beyond the person I am communicating with, would know more about me than I am comfortable with"; $M = 4.04$, $SD = 1.35$, $\alpha = .88$), perceived surveillance (e.g., "I believe that my information would be monitored at least part of the time by the service provider"; $M = 4.33$, $SD = 1.47$, $\alpha = .85$), and secondary usage (e.g., "I am concerned that the service provider could use my personal information for other purposes without notifying me or getting my authorization"; $M = 4.17$, $SD = 1.74$, $\alpha = .98$) [14]. Each of these privacy concerns was measured with three items.

3.6 Methodological Limitations

Our methodology has several limitations. First, our sample consisted solely of university-level communication students, which may have resulted in participants who were more familiar with SVR and possessed a higher level of education than a more representative sample. Additionally, as with previous research [86, 87], to maintain consistency across interviews the interviewer followed a script and did not dynamically respond to participants' interview answers. This approach might have caused participants to perceive the interviewer as less authentic, leading to an experience that felt dissimilar to a real interview. Additionally, the authenticity of the interview may have also been challenged as a result of participants' incentive to win additional compensation for their performance. However, this approach has been adopted in previous experimental work to ensure greater participant involvement [62]. Moreover, this resembled a real interview, where an additional reward (i.e., employment) would be granted to the most favorable candidate.

Another limitation arose as a result of technical issues, leading to some participants' audio not being properly captured by our recording software ($n = 8$), necessitating their exclusion from analyses related to actual disclosure.² Further, though it may have plausibly enhanced the salience of our manipulation, we did not expressly inform all participants of the possibility of intrusion within their interview space to avoid priming a feeling of surveillance.

Finally, qualitative data was collected through a single open-ended response at the end of the questionnaire. While providing valuable insights, the constraint of a single open-ended question may not have allowed participants to fully articulate their experiences, thoughts, and nuanced perspectives regarding their interview experience.

4 Results

4.1 Quantitative Analysis

In order to test our hypotheses and research question, a series of parallel mediation analyses were conducted with the *bruceR* package in R [85]. Specifically, the package's PROCESS() function was used to perform mediation modeling based on Hayes' [46] PROCESS Model 4 with 1,000 resamples. Linear regression assumptions were

²These participants were included in the remainder of our analysis, as all of their self-reported data was of acceptable quality.



Figure 1: Interview setup within the virtual meeting room



Figure 2: Intruder setup at an adjacent workstation in the same virtual meeting room

met a priori through assessing multicollinearity and normality of residuals (i.e., Shapiro-Wilk normality test). The following variables were treated as mediators across models: general social presence, actorhood, salience, co-location, association, perceived intrusion, perceived surveillance, and secondary usage. In each model, we controlled for the number of actual job interviews participants had previously taken part in, as this previous experience could have an impact on performance and experience perceptions.

4.1.1 The Effect of Co-Owner Identifiability on Information Disclosure. Investigating H1a, the first parallel mediation model examined the direct and indirect effect of co-owner identifiability on perceived information disclosure. The direct effect of co-owner identifiability on participant's reported levels of disclosure was not significant. With respect to each of the mediators, actorhood of the interviewer significantly mediated the relationship between co-owner identifiability and information disclosure ($b = 0.39$, $SE = 0.16$, $p = .013$). General social presence, salience, co-location, association, perceived intrusion, perceived surveillance and secondary usage did not play a significant mediating role. Thus, the significant impact of co-owner

identifiability on perceived disclosure operated through participants' higher perception of actorhood of the interviewer, in turn providing support for H1a. Figure 3 depicts the coefficients and significance levels of the mediation pathway of this model.

To further test H1a, we ran a second mediation model with actual disclosure as the dependent variable. The direct pathway between co-owner identifiability and actual disclosure was marginally significant ($b = -115.91$, $SE = 60.88$, $p = .057$), suggesting a negative impact of identifiability on final word count. Again, perceived actorhood of the interviewer had a significant, positive mediating effect on actual disclosure ($b = 105.95$, $SE = 44.94$, $p = .018$). Additionally, the mediating role of association was marginally significant ($b = 51.24$, $SE = 30.31$, $p = .091$). General social presence, salience, co-location, perceived intrusion, perceived surveillance, and secondary usage did not play a significant mediating role. In sum, we find co-owner identifiability to have a significant impact on actual words disclosed during the interview in SVR. Further, when perceptions of actorhood of the interviewer (i.e., perceiving them as a real person) and sense of association were high, the relationship between co-owner identifiability and actual disclosure

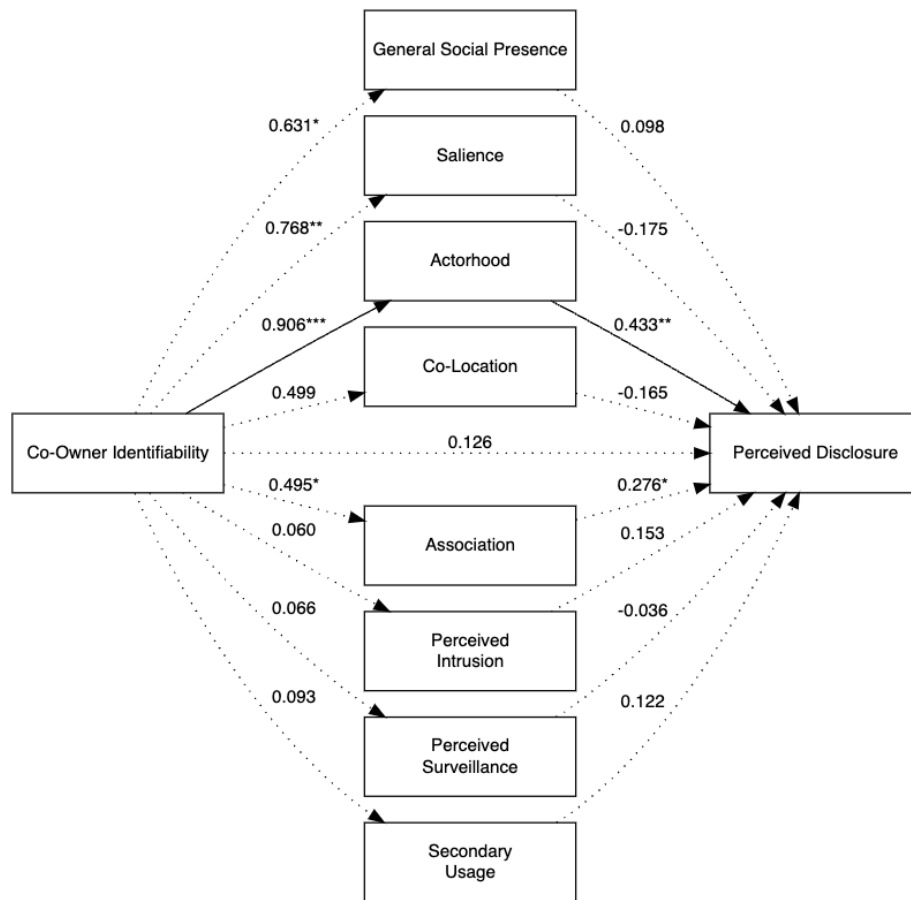


Figure 3: Parallel mediation analysis of the effect of co-owner identifiability on perceived disclosure. * $p < .05$, ** $p < .01$, * $p < .001$. Solid arrows represent pathways in which the indirect effect was significant.**

was strengthened (RQ1). Figure 4 depicts the relative linkages and significant mediation pathway of this model.

4.1.2 The Effect of Co-Owner Identifiability on Information Control. H1b stated co-owner identifiability would positively predict perceptions of information control. This hypothesis was not supported. Additionally, none of the mediating variables played a significant role between co-owner identifiability and information control. As such, neither co-owner identifiability (H1b) nor measured individual perceptions (H3, RQ1) significantly influenced perceptions of information control during the interview.

4.1.3 The Effect of Boundary Permeability on Information Disclosure. H2a stated boundary permeability would negatively predict disclosure. With respect to perceived information disclosure, this direct effect was not significant. Thus, with respect to perceived disclosure, H2a was not supported. Further, none of the indirect mediating pathways were significant, failing to provide support for H3.

However, boundary permeability had a significant negative effect on actual disclosure. When an intruder interrupted the interview

space, participants disclosed significantly fewer words. This finding provides support for H2a. This relationship was not indirectly impacted by the mediating variables. Thus, H3 is rejected. Figure 5 depicts the relative significance of the direct and indirect pathways in this mediation model.

4.1.4 The Effect of Boundary Permeability on Information Control. H2b predicted that boundary permeability would negatively influence information control. This hypothesis was not supported, as seen through the absence of a direct effect. Further, as with co-owner identifiability, boundary permeability did not indirectly alter perceptions of information control through any of the mediating pathways (H3, RQ1).

4.2 Qualitative Analysis

After completing the interview and quantitative questionnaire, participants were asked how they thought this interview was different than those conducted FtF. The purpose of this question was to provoke reflection and additional insights into users' perceptions about interpersonal communication in SVR, further contextualizing

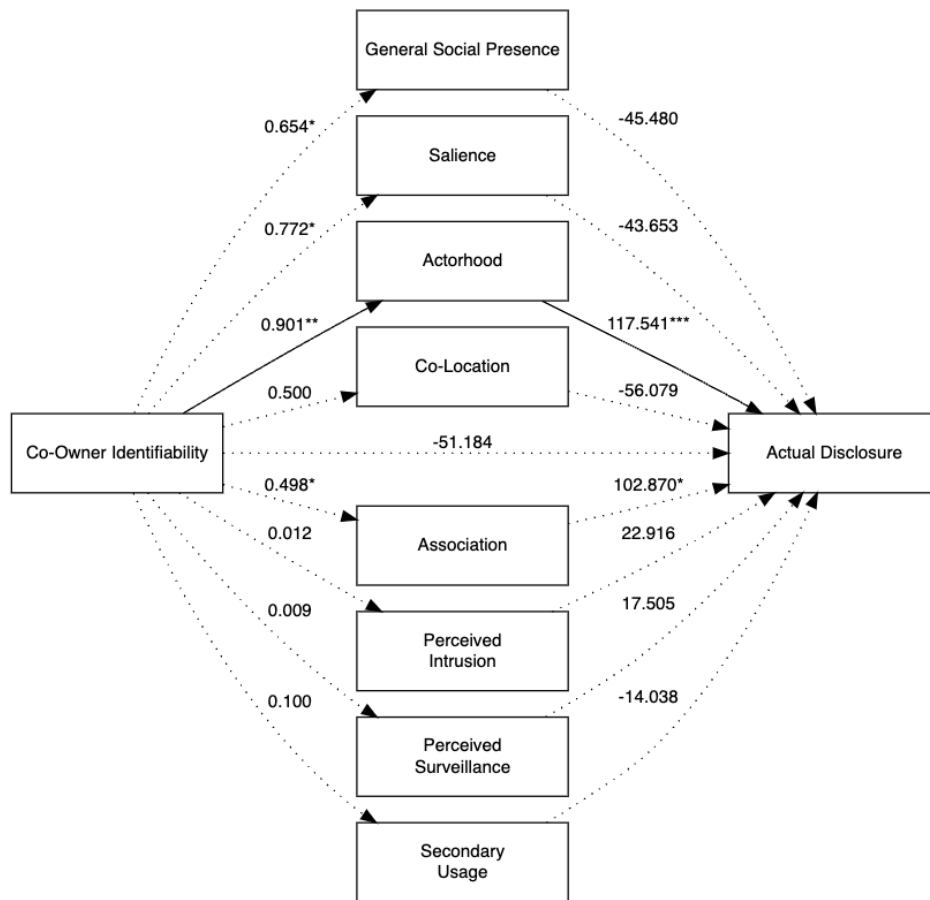


Figure 4: Parallel mediation analysis of the effect of co-owner identifiability on actual disclosure. * $p < .05$, ** $p < .01$, * $p < .001$. Solid arrows represent pathways in which the indirect effect was significant.**

significant quantitative relationships. This approach reflects the corroboration/confirmation purpose for mixed methods research [98]. The mediating role of social presence observed in the quantitative analyses prompted coding of open-ended responses along the dimensions of social presence [28]. Two researchers coded each of the open-ended responses with respect to the relative presence or absence of comments related to saliency, actorhood, co-location, and association. Inter-coder reliability was established after independent coding, obtaining greater than 75% agreement across all codes. Any initial discrepancies in coding were adjudicated through discussion to reach full agreement.

4.2.1 Ambiguous Actorhood of Conversation Partner. The prominence of perceived actorhood in the qualitative findings corroborated the significance demonstrated in the quantitative findings. While participants generally embraced the interview as an interactive conversation, some were unsure of the interviewer's underlying actorhood. Multiple participants noted difficulty in ascertaining whether the interviewer's nonverbal gestures and voice were those

of another human user. In some cases, participants lauded this aspect of the experience, highlighting potential positive aspects of this ambiguity despite being exposed to the interviewer's offline profile:

"I think the presence of another person Ftf, especially in an interview surrounding, can be very pressuring and anxiety-inducing. This interview made me feel completely different, the virtual reality made me feel very calm and intimate with the interviewer in a positive way. In which I felt less stressed and pressuring, and was able to better craft my responses during the interview. At the same time, the somewhat "robotic" sounding of the interviewer's voice also "comforted" me in a way, since I had the [impression] that I was not talking to a real person who will decide whether I land the offer or not, in which made me feel a lot more relaxed and confident in my answers."

In other instances, the unclear actorhood of the interviewer led to negative experiences for participants, including those who had been exposed to the interviewer's offline profile. For example:

"It made me feel a bit awkward and distracted because I was keep thinking that the interviewer is a real person or not."

"At times I honestly felt as if it was a recorded interview, and it very

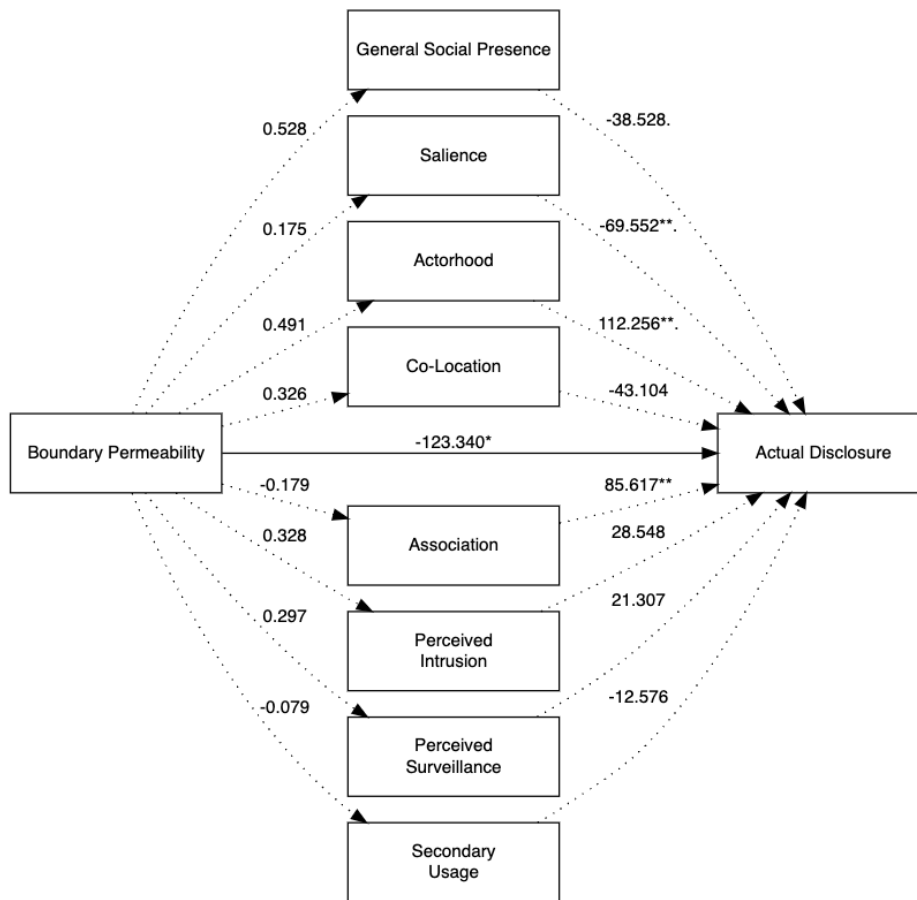


Figure 5: Parallel mediation analysis of the effect of boundary permeability on actual disclosure. * $p < .05$, ** $p < .01$, * $p < .001$. The solid arrow represents the significant direct pathway of this negative effect. No mediation pathways were significant.**

well could be since I have no way of knowing of the person is truly present there."

These responses demonstrate discomfort stemming directly from a lack of confirmation about the presence of a human interviewer.

4.2.2 Limited Social Saliency of the Avatar and Uncertainty Around Interview Performance. Participants reported that the SVR interview differed from Ftf given a lack of salient social cues from the interviewer’s avatar, which was not revealed through the quantitative findings. Even when a participant could sense that a genuine social actor was present behind the avatar, they regularly mentioned an inability to detect nonverbal or verbal validation from the interviewer. For example, one participant noted:

"For Ftf interviews, it is not hard to capture the non-verbal cues like gestures, and facial expressions. For interviews that are conducted via VR platforms, the virtual figure can not deliver an authentic representation of the real interviewer. And I think it was hard to detect subtle changes of those non-verbal cues in this virtual setting."

Other participants expressed a similar sentiment, again indicating a lack of salient non-verbal cues had implications for gauging the interviewer’s reactions or their standing in the conversation:

"It felt harder to connect with the interviewer in VR than it does in real life. Facial expressions, for example, can't be communicated at all in VR."

"It is more difficult to observe facial expressions of the interviewer, which could be positive in the sense that I could stick to my logic and not worry too much, but could also be negative in the sense that I won't be able to evaluate how well I did based on reactions from the interviewer."

In fact, some participants reported this lack of certainty may have led to a comparably more stressful experience.

"Not having any facial feedback from the interviewer made me feel less confident and less willing to engage in the interview."

Together, these quotes suggest that the absence of salient social cues from the interviewer may have undermined the interview experience.

4.2.3 SVR Permits a Sense of Shared Space. While not seen within the quantitative findings, qualitative responses revealed SVR provided participants with a relatively strong sense of shared space with other actors (i.e., co-location). Several participants felt they were in the same space as their interviewer, even recognizing the interviewer as "sitting in front of" them or referencing "the space we were in."

Notably, one participant expressed relief at being in a separate physical space during the interview, while still acknowledging the virtual connection with the interviewer:

"This felt less stressful because we were in different rooms physically despite feeling as if we were in the same room talking."

Similarly, another participant noted: *"It was a bit less intimidating, as I didn't feel as present with the interviewer. It did not feel like they were right there with me."*

As such, the sense of co-location in SVR was noticeable despite this participant's recognition of being in a different physical space. Interestingly, it appears that this was a strength of the SVR interview setup.

5 Discussion

This study evaluated individuals' experience with an interview in SVR to better understand how certain situational factors impact communication dynamics, particularly in relation to information disclosure and perceptions of control. Together, this contributes the following:

- Novel and valuable insights for SVR designers and researchers aiming to build stronger interpersonal connections within SVR environments, including the importance of 1) heightening perceived actorhood of communication partners, 2) maintaining non-permeable information boundaries to enhance disclosure and 3) incorporating more explicit social cues—particularly clear facial expressions—to make communication feel more akin to FtF interactions.
- An advancement in CPM theory, highlighting extensions as well as potential limitations when applied to the new domain of SVR.
- Empirical support for recent theoretical work advocating that social presence be evaluated as a multidimensional user experience.

5.1 Disclosure Enhanced by Genuine Sense of Others, Not Familiarity

The relationship between co-owner identifiability and perceived disclosure was positively mediated by the perceived actorhood of the interviewer. The insignificant direct effect suggests that this situational factor was not the *cause* of enhanced disclosure; rather, this relationship occurred *through* perceived actorhood. In other words, increased familiarity with the interviewer's offline profile was not sufficient for relaxing participants' information management strategies. Qualitative responses corroborate this finding, with participants inconsistently identifying the interviewer as a real person (Section 4.2.1.). It is possible that perceptions of actorhood are more important than knowing *who* an identified actor is. This

finding aligns with evidence suggesting anonymous communication mediums can yield intimate information disclosures [54, 66]. Further, this finding resembles previous research suggesting a relationship between perceived actorhood and users' openness in interpersonal communications [19, 70]. It is worth noting that access to the offline profile contributed to a stronger perception of the virtual interviewer as a legitimate social actor. While it may be useful for SVR designers to provide more information about users' offline identities, our findings suggest this will only have an impact on disclosure if perceived actorhood of those users is in turn enhanced. But, increasing access to user personal information comes with inherent privacy concerns; further, one of the appeals of SVR is its anonymous nature [68]. That being said, the capacity for SVR to increase personal information disclosure may be limited when users are by and large no more connected than other strangers on the Internet.

5.2 Maintaining Privacy Boundaries in SVR

Our findings demonstrate the importance of creating strong privacy boundaries in SVR. Participants who experienced an intrusion by an unknown actor during the interview disclosed fewer words, supporting our hypothesis that more permeable boundaries would negatively impact actual disclosure. Similar results have been demonstrated in other interpersonal communication mediums; for example, experimental research has found disclosure to be diminished when individuals feel there could be a chance their digital messages were captured by the screenshot feature [93]. Additionally, Child & Starcher [18] found individuals to be strategically ambiguous in their communications on Facebook given their knowledge that unintended audiences may access their content. The results of this study build on those which showcase the negative consequences for expression when boundaries are permeable. Further, this finding makes a theoretical contribution through demonstrating the applicability of CPM to SVR-based exchanges in that individuals may have anticipated particular information boundaries during the virtual interview [83]. Qualitative results confirm a sense of shared space with the interviewer (Section 4.2.3.); when this shared space was compromised, information disclosure was negatively impacted. Additionally, this finding supports Shore & Prena's [93] concept of platform rules, where features of the technology—here, the capacity to teleport into and occupy one's virtual setting uninvited—may influence information disclosure. This result also aligns with advocacy to create stronger information boundaries in SVR through providing notifications of an intruder [24] or digital bubbles that preclude entrance by unwanted actors [78, 110]. Future research should continue exploring optimal design interventions to prevent boundary permeability, ultimately fostering communication that mirrors closing a door offline. These efforts must carefully consider the potential negative consequences of creating non-permeable spaces in SVR, such as limiting bystander intervention in situations like harassment [12, 38]. Future research may also build on our design through assessing more SVR platform rules such as one that allows users to enter incognito mode to make them immune to data collection and surveillance [105]. Yao et al. [105] argues that features such as this could be positive for self-expression as it give users greater control over their privacy.

5.3 The Inability of SVR Features to Enhance Perceptions of Information Control

Surprisingly, neither access to the interviewer's offline profile nor boundary permeability influenced perceived control over information. Although Petronio [83] argues a lack of firm boundaries and familiarity with the information co-owner would impact perceptions of information control, research has suggested the difficulty in making people feel that they actually have control over data flows in modern digital environments [31, 60]. Our findings indicate adjustments in situational factors can not override users' baseline perceptions of control in SVR. It is possible for these results to be attributed to the highly structured nature of the interview protocol, where participants had full control over how much information they disclosed, without any external pressure to share beyond their comfort level. The controlled environment allowed for natural responses while respecting participants' privacy boundaries. As such, participants may have felt a baseline level of control over information despite the intrusion or familiarity with the offline profile of the interviewer. Future research should assess the generalizability of the impact of boundary permeability and co-owner familiarity observed here in less formal SVR communication contexts, particularly, those without the implicit power dynamic created by an interview. Additionally, to the extent that information control was influenced by the nature of the task rather than the medium itself, similar results may arise across interviews taking place in different communication mediums. Future work should evaluate the relative impact of SVR in this regard by directly comparing the same boundary permeability and identifiability manipulations for interviews held in other communication mediums (e.g., voice calls and videoconferencing).

5.4 Multidimensionality of Social Presence Experience and its Effects in SVR

Both quantitative and qualitative results indicate the importance of social presence in interpersonal interactions in SVR. Of note, previous research similarly suggests SVR permits users to perceive others as having high levels of actorhood [64]. Further, our findings resemble previous research observing social presence perceptions as a predictor of user actions, including socially conscious behaviors in virtual communication groups and [104] and general usage of digital banking technology [75]. Additionally, past work examining the sensitivity of information disclosed during interviews has found people were more comfortable disclosing sensitive topics to a human as opposed to an avatar [84], aligning with our finding regarding the significance of perceived actorhood on disclosure. Further, we found participants consistently reported limited detectable emotional and non-verbal cues, particularly facial expressions, contributed to a lack of salience and hindered understanding of one's standing with the interviewer throughout the conversation. Additionally, some participants were unable to confidently identify that they were being interviewed by a real person (Section 4.2.1.) which may be partially explained by their inability to detect social cues from the interviewer (Section 4.2.2). This was a surprising finding considering this study employed a technology that tracks non-verbal expressions (i.e., eye tracking, body movements). That

said, virtual reality designers have expressed the difficulty in replicating realistic gestures [5]. Notably, some participants found the "robotic" nature of the interaction to reduce interview pressure and anxiety, whereas others found the lack of emotional connection unsettling. This reinforces the idea that avatars in SVR struggle to deliver an authentic human representation, which poses limitations for the technology as a communication medium. Although the relative realism of body movements may not influence self-reported social presence or interpersonal distance in SVR [58], to the extent that the expression of social cues—regardless of realism—is less salient within SVR than in Ftf communication or other visual media, the technology may nonetheless negatively affect users' willingness to disclose personal information via other mediating mechanisms.

While research has found interactions in SVR in greater levels of social presence than those conducted via a conventional computer display [41], experimental evidence has yet to suggest higher levels in SVR compared to offline communications. In fact, recent research finds individuals report higher levels of social presence in Ftf communication compared to what users reported experiencing in SVR [27]. Our results support this finding, indicating SVR is not quite akin to offline communication. To this end, designers should focus on features for amplifying perceptions of social presence in SVR to better mimic Ftf communications.

Finally, these findings have theoretical implications, providing a novel empirical demonstration supporting Cummings & Wertz [28] proposal for a more nuanced approach to conceptualizing social presence. Relying solely on a more generalized treatment of social presence would fail to reveal actorhood's mediating role in the effect of co-owner identifiability on disclosure. Moreover, the fact that only one of the conceptualizations—actorhood—provided significant mediation pathways, highlights the legitimate conceptual distinction between these dimensions of social presence. Together, these findings suggest future research should continue to distinguish between these related but independent social appraisals when studying causes and effects of social presence with mediated others.

5.5 The Non-Influence of Privacy Concerns in SVR Information Management

Despite previous research suggesting privacy concerns restrict interpersonal communication in SVR [27], privacy concerns did not mediate the relationships between either of the situational factors and disclosure or perceived information control. Of note, this is not because privacy concerns were absent: descriptive statistics showcase relatively high privacy concerns related to perceived intrusion, perceived surveillance, and secondary usage. Digital resignation literature supports this finding, arguing people will disclose information regardless of the known concerns [31]. Our finding contrasts with the literature which has established a negative relationship between privacy concerns and information management online [9] (e.g., payment apps [51], location based services [92]). As noted above (See 5.3), future research should continue to explore the unique role that privacy concerns play in SVR experiences by expanding the communication context beyond a formal interview setting (e.g., gaming, casual hangouts in SVR). In fact, researchers have found disclosure to not necessarily depend on the medium;

rather, aspects such as the context of the communication and the relationship between communicators appear to drive disclosure patterns [79]. It is possible that in the context of SVR, situational factors and social presence are more important drivers of positive interpersonal interactions given that people have become increasingly resigned about their privacy within emerging technologies [47].

5.6 Practical Implications for SVR Design

The current study results provide implications for designing SVR environments that improve interpersonal communication. First, SVR platforms should consider how to enhance perceptions of actorhood when engaged with other human users. Features such as more realistic avatars, improved verbal and non-verbal synchronization, and clearer indications of user identities could foster a stronger sense of interacting with a real person, thereby encouraging more open and trusting interpersonal interactions.

Second, SVR platforms should prioritize the maintenance of expected privacy boundaries. SVR designers should consider offering intuitive privacy settings that allow users to easily control who can access their space and data. For example, real-time notifications that alert users when unexpected third-party actors enter the environment could bolster users' sense of privacy and security in SVR.

6 Conclusion

This experimental study ($n = 94$) offers compelling evidence of how situational factors influence information management in SVR, presenting a novel and impactful application of CPM. Our mixed methods findings underscore the critical role of social presence—specifically perceived actorhood of conversation partners—and the maintenance of expected privacy boundaries in promoting interpersonal disclosure in SVR. We argue that designers aiming to create SVR systems which closely replicate FtF communication must prioritize these features to foster meaningful interpersonal interactions. In turn, these insights not only provide theoretical advancement, but also actionable guidance for designing more effective mediated communication environments.

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A Questionnaire Items

All items were preceded with the following prompt: Please answer the following questions about virtual reality based on the interview you just completed.

Table 1: Survey items organized by variable

| Variable | Items | Mean (SD) | α |
|--------------------------------|--|-------------|----------|
| Perceived disclosure | <ol style="list-style-type: none"> 1. To provide a truthful answer, I provided a detailed response to the interview questions. 2. I disclosed a lot in order to answer the interview questions truthfully. 3. I provided a comprehensive answer to the interview questions. 4. I revealed sensitive information in response to the interview questions. 5. I revealed private information answering the interview questions. 6. I revealed secrets in response to the interview questions. 7. I “bared my soul” when answering the interview questions. | 3.78 (1.00) | .75 |
| Perceived control | <ol style="list-style-type: none"> 1. I felt in control over the information I provided in the virtual interview. 2. The virtual environment allowed me to have full control over the information I provided to others. 3. I felt in control of who could view my information when conversing in the virtual interview. | 5.02 (1.33) | .77 |
| General social presence | <ol style="list-style-type: none"> 1. Virtual reality allows me to determine if someone is really “there” when communicating. 2. Virtual reality makes it feel like the person I’m communicating with is close by. 3. Virtual reality makes it feel like other people are really with me when we communicate. 4. Virtual reality makes it feel like the other person is present. | 4.02 (1.42) | .90 |
| Actorhood | <ol style="list-style-type: none"> 1. I perceived the interviewer as being only a computerized image, not as a real person. 2. The interviewer appeared to be sentient (conscious and alive) to me. 3. The thought that the interviewer is not a real person crossed my mind often. 4. I perceived that I was in the presence of another person in the room with me. 5. I felt that the interviewer was watching me and was aware of my presence. | 4.38 (1.37) | .79 |
| Saliency | <ol style="list-style-type: none"> 1. How well were you able to observe the body language of the people you saw/heard? 2. How well were you able to observe the changes in tone of voice of the people you saw/heard? 3. How well were you able to observe the facial expressions of the people you saw/heard? 4. How well were you able to observe the style of dress of the people you saw/heard? | 3.86 (1.44) | .80 |
| Co-location | <ol style="list-style-type: none"> 1. I felt as if I were being viewed by the interviewer in the same room. 2. I felt as if I were talking with the interviewer in the same room. 3. I felt as if I were viewing the interviewer in the same room. 4. I felt the presence of the interviewer. | 4.49 (1.56) | .89 |
| Association | <ol style="list-style-type: none"> 1. I did not want a deeper relationship with the interviewer. 2. I tried to create a sense of closeness with the interviewer. 3. I wanted to maintain a sense of distance with the interviewer. 4. I wanted to make the conversation more intimate. 5. I was interested in talking to the interviewer. 6. I was unwilling to share personal information/feelings with the interviewer. | 4.23 (1.10) | .81 |

| Variable | Items | Mean (SD) | α |
|----------------------------|---|------------------|----------------------------|
| Privacy concerns | <i>Perceived intrusion</i> 1. ...others, beyond the person I am communicating with, would know more about me than I am comfortable with. 2. ...information about me that I consider private would be more readily available to others than I would want. 3. ...information about me would be out there that, if used, will invade my privacy. | 4.04 (1.35) | .88 |
| | <i>Perceived surveillance</i> When communicating with someone in virtual reality... 1. I believe that my information would be monitored at least part of the time by the service provider. 2. I am concerned that the service provider could be collecting too much information about me. 3. I am concerned that the service provider could monitor my activities on my mobile device. | 4.33 (1.47) | .85 |
| | <i>Secondary Usage</i> 1. I am concerned that the service provider could use my personal information for other purposes without notifying me or getting my authorization. 2. When I give personal information to the service provider, I am concerned that they could use my information for other purposes. 3. I am concerned that the service provider could share my personal information with other entities without getting my authorization. | 4.17 (1.74) | .98 |
| Open-ended reaction | How was this interview different from interviews that you have participated in face-to-face? | NA | NA |