Exploring Users' Social Responses to Computer Counseling Interviewers' Behavior

Sin-Hwa Kang and Jonathan Gratch

University of Southern California - Institute for Creative Technologies

{kang,Gratch}@ict.usc.edu

ABSTRACT

We explore the effect of behavioral realism and reciprocal self-disclosure from computer interviewers on the social responses of human users in simulated psychotherapeutic counseling interactions. To investigate this subject, we designed a 3x3 factorial between-subjects experiment involving three conditions of behavioral realism: high realism, low realism, and audio-only (displaying no behavior at all) and three conditions of reciprocal self-disclosure: high disclosure, low disclosure, and no disclosure. We measured users' feelings of social presence (Copresence, Social Attraction, and Emotional Credibility), rapport, perception of the quality of users' own responses (Embarrassment and Self-Performance), emotional state (PANAS), perception of an interaction partner (Person Perception), self-reported self-disclosure, speech fluency (Pause Fillers and Incomplete Words), and verbal self-disclosure. We observed some contradictory outcomes in users' subjective reports. However, the results of objective data analysis demonstrated that users disclosed greater verbal self-disclosure (medium level of intimacy) when interacting with computer interviewers that displayed high behavioral realism and high self-disclosure. Users also delivered more fluent speech when interacting with computer interviewers that displayed high behavioral realism. The results are described in detail and implications of the findings are discussed in this paper.

Introduction

Concurrent with the growing intelligence of computer programs, one can observe the expanded application of these smart systems in various new domains, such as collecting personal information for clients in the fields of clinical treatment and marketing. Health-related public websites, in particular, have prevailed as one of the most useful applications for this purpose. These sites function by administering a survey of questions varying in levels of intimacy or invasiveness to clients (Moon, 2000). This process is integral to gathering personal information about patients while providing them with the safeguard of anonymity. Following this trend in Computer-Mediated Communication, or CMC, the use of computer avatars controlled by a human in similar settings grants the same assurance of anonymous communication in intimate conversations (i.e. "stranger on a train" phenomenon) with the added benefit of reflecting one's personality or creating a more tailored experience through the avatar. However, the use of an avatar limits users' time and location wise flexibility as the interaction via the avatar requires being there of another person who should control the avatar.

More recently, virtual human technology has introduced a solution to the limits posed by avatars. These computer-controlled agents are equipped with artificial intelligence and controlled by computers, rather than human beings. Virtual human technology currently allows intelligent virtual agents to interact with users by displaying body movements and other gestures in response to the users' speech and gestures (Rizzo et al., 2011). They also introduce an enticing new dimension to explore in communication, thanks to the secure anonymity they provide compared to videoconferences with real humans. This is particularly salient in counseling interactions where the confidentiality of clients' personal information is instrumental in encouraging them to reveal more intimate information, thereby enhancing counseling effects (Kang & Gratch, 2010). An additional benefit of using virtual agents is the

absence of time limitations on the interaction, which frequently serves as a hindrance in interactions with avatars or human counselors in face-to-face situations.

The goal of our study is to investigate the potential use of virtual agents as counseling interviewers in psychotherapeutic situations. In our previous study (Kang & Gratch, 2010), we found that people talked about themselves more when interacting with virtual agents that were described as avatars, rather than interacting with real humans in computer-mediated interactions. Based on these findings, we aim to explore the effect of different levels of behavioral realism and reciprocal self-disclosure from virtual agents on users' social responses in counseling interview interactions. Our motivations for selecting these factors and related theories supporting our exploration of the subject are described below.

1. Computers Are Social Actors (CASA) Theory: Users respond to a computer as if interacting with a human being if the computer displays even the minimal amount of social cues.

The predominant theory of users' social responses to computers in human-computer interactions is the CASA theory established by Reeves and Nass (1996). According to this theory, people respond to computers as if they were interacting with human beings, even with minimal social cues of the computers (i.e. text-based interfaces). This theory indicates that people tend to anthropomorphize mediated interfaces.

The background of this theory is based on the Ethopoeia notion, which posits (c.f. Nass & Moon, 2000; Nass, Moon, Morkes, Kim & Fogg, 1997) that people respond socially to a computer that presents human-like traits because humans are social animals. Such traits include interacting with others, using natural speech, or playing social roles (Moon & Nass, 1996; Nass et al., 1995; Moon, 2000; von der Pütten, Krämer, Gratch, & Kang, 2010). Based on the CASA model, we have previously studied human-computer interactions by substituting

users' interaction partners with computers. This allowed them to examine the application of social rules, such as perception of the interaction partner, reciprocal self-disclosure, reciprocal aid, politeness, and grouping stereotypes (von der Pütten, Krämer, Gratch, & Kang, 2010). In studies of user interactions with anthropomorphic interfaces, including virtual agents, users rated interacting with an animated talking character higher than communicating with a text-only interface (Sproull et al., 1996). Users also tended to respond with socially desirable answers to a question delivered by an anthropomorphic agent, compared to in a text-only interface or an audio-only interface, when prompted to choose between an educational documentary and entertaining program (Kraemer et al., 2003). Users also adhered to social rules and perceived virtual agents more positively when they were asked to evaluate the politeness of a virtual agent by a verbal questionnaire administered by the virtual agent itself, compared to a paper-and-pencil questionnaire (Hoffman et al., 2009). In our previous study, we (von der Pütten, Krämer, Gratch, & Kang, 2010) found no difference in the level of social effects in interactions with agents compared to avatars when both types of virtual characters displayed human-like features. However, we observed that the presence of the back-channeling behavior in the high behavioral realism condition elicited longer storytelling and greater feeling of mutual awareness from users. We concluded that these social effects were greater when people were exposed to more social cues (high behavioral realism), as opposed to less social cues (low behavioral realism), through their communication partner (interviewer), regardless of whether a virtual agent or avatar was used. We (von der Pütten, Krämer, Gratch, & Kang, 2010) proposed the *Revised Ethopoeia* concept based on this conclusion.

Contrary to these findings, Bailenson and colleagues (2006) found that users reported a greater sense of social presence when interacting with a human represented in a

videoconference or an audio-only condition compared to an "emotibox[1] (low form realism and high behavior realism)" condition. Their study also revealed that people provided greater self-disclosure in the audio-only condition than in other conditions. These findings are related to Joinson's (2001) work, which illuminated the power of text-based CMC to elicit more self-disclosure than visual CMC. Other researchers (Antheunis & Valkenburg, 2009), however, discovered no effects of visual cues on users' social responses to their interaction partners (e.g. liking of interaction partners) between text-based CMC and visual CMC. Kang and Gratch (2010) explored this subject by investigating the associations between the interactant's personality characteristics (i.e. social anxiety) and their social responses, specifically verbal self-disclosure as well as behavioral rapport and differing levels of anonymity. This was facilitated by the interaction with virtual agents (high anonymity) compared to the video interaction with a real human (no anonymity). In the study, the virtual agents were introduced as virtual avatars to users. They found that people high in social anxiety felt greater behavioral rapport by exhibiting more speech and sharing more personal information than people low in social anxiety when they interacted with virtual agents. These outcomes imply that people disclose greater personal information when their partner is less visually identifiable. The researchers concluded that self-disclosure and social presence could get higher with lean media regarding behavioral realism such as an audio (or text)-only interface or a virtual human (agent or avatar), compared to a videoconference or a face-to-face interaction. This conclusion is supported by the hyperpersonal communication perspective, which posits that people experience greater copresence and social attraction to their interaction partner when it displays less social cues (Walther, 1996). However, it must be noted that one study (Antheunis & Valkenburg, 2009) couldn't find any difference in the social effects (e.g. liking of interaction partners) present in a text-only interface versus a videoconference.

[1] Bailenson and his colleagues (2006) describe the "emotibox" as the rendering of "the dimensions of facial expressions abstractly in terms of color, shape, and orientation on a rectangular polygon."

Based on the discrepancies among these findings[2], it is not certain whether virtual agents, in general, would elicit more positive social effects compared to audio-only interfaces that previously elicited greater positive social effects in comparison to a virtual avatar controlled by a real human from a previous study (Bailenson et al., 2006). Therefore, we wanted to investigate whether there would be any difference in the level of social effects between virtual agent interviewers with high behavioral realism and audio-only interviewers. We also aimed to explore whether there would be any difference in the degree of social effects elicited by virtual agent interviewers with low behavioral realism and audio-only interviewers. This was done in case the virtual agent interviewers with high behavioral realism would not be available for various reasons, such as technical or financial limitations. To investigate these research problems, we formulated the following research questions:

RQ1: Do people respond differently to virtual agent interviewers who present high behavioral realism compared to audio-only interviewers?

RQ2: Do people respond differently to virtual agent interviewers who present low behavioral realism compared to audio-only interviewers?

Furthermore, we explored whether we would be able to replicate the findings from our previous study (von der Pütten, Krämer, Gratch, & Kang, 2010) regarding the *Revised Ethopoeia* concept in counseling interview interactions by formulating the following hypothesis:

H1: High behavioral realism in virtual agent interviewers will elicit more social effects (e.g. self-disclosure, social presence, etc.) from users' social responses compared to virtual agent interviewers displaying low behavioral realism.

[2] We explored previous findings for social effects on users' interactions with their partners, regardless of virtual agents or avatars according to the *Revised Ethopoeia* concept proposed by von der Pütten and collaborators (2010). The researchers observed no difference in the level of social effects in interactions with agents, compared to avatars, if both types of virtual characters presented human-like features.

2. Uncertainty Reduction Theory (URT): Users will be more attracted to the interviewers and more willing to reveal intimate information about themselves if the interviewers disclose personal information.

Uncertainty Reduction Theory (Berger & Calabrese, 1975) posits that people try to gather personal information from their communication partner during the uncertainty reduction processes to better understand their partner's emotions and intentions in addition to predicting their attitudes and behaviors (Berger & Calabrese, 1975; Srull & Wyer, 1989; Antheunis & Valkenburg, 2009). There are three phases of uncertainty reduction approaches: passive, active, and interactive (Berger & Calabrese, 1975; Berger et al., 1976; Antheunis & Valkenburg, 2009). People observe their communication partner inconspicuously at the initial stage of uncertainty reduction. During the active stage, people allocate their efforts toward gathering more personal information about their partner without a direct interaction with them. Lastly, at the interactive stage, people proactively communicate with their partner in order to get to know them better. It is also during this stage that the communicator's self-disclosure plays a key role in eliciting reciprocal self-disclosure from their partner (Jourard, 1971: Moon, 2000; Tidwell & Walther, 2002; Antheunis & Valkenburg, 2009). Researchers characterize self-disclosure as verbal messages that disclose personal information about the communicator, "including thoughts, feelings, and experiences" (Altman & Taylor, 1973; Collins & Miller, 1994; Cozby, 1973; Derlega et al., 1993; Moon, 2000). Studies report that a greater level of reciprocal self-disclosure among communicators elicits more attraction toward each other (Worthy et al., 1969; Bargh et al., 2002; Antheunis & Valkenburg, 2009). Therefore, researchers argue that the reciprocity of self-disclosure is critical to constructing interpersonal attraction and intimate relationships (Altman & Taylor, 1973; Jourard, 1959; Worthy et al., 1969; Antheunis & Valkenburg, 2009). Other studies have found that it's not just the quantity of self-disclosure, but more so the *quality* of self-disclosure that plays a role in producing

mutual attraction between communicators (Collins & Miller, 1994; Reis & Shaver, 1988; Antheunis & Valkenburg, 2009).

The literature in clinical psychology suggests that clients' self-disclosure is a pre-requisite for verbal psychotherapy (Digiuseppe & Bernard, 2006). This willingness to share personal information is enhanced when social connections between the client and therapist are strengthened by mutual self-disclosure (Jourard, 1971; Hooi & Cho, 2010). According to URT, this mutual self-disclosure functions in reducing clients' uncertainty about their clinical interviewers and increases their willingness to reveal intimate information about themselves. Furthermore, researchers in clinical psychology argue that clients tend to regard their counselors more highly when the counselors also disclose intimate information about themselves (MacCarthy, 1982). It is still unknown whether one can consistently achieve similar outcomes through the application of a counselor's self-disclosure in face-to-face psychotherapeutic interactions between real humans and virtual agents.

In an interview interaction between a human and a computer for marketing applications, Moon (2000) showed that interviewers' self-disclosure promoted the participant's self-disclosure and perceived attraction to the computer interviewer which solely displayed text with no images. Bickmore and colleagues (2009) found that users enjoyed communicating with a virtual agent that talked about its own fictional human-like life story more than an agent that cited another human's created life story in physical exercise counseling interactions. More recent studies (Tartaro & Cassell, 2006; Kang & Gratch, 2010; 2011) have shown that virtual agent counselors can facilitate social interactions and help develop social skills among people who have difficulty with forming social relationships. In this type of interaction, virtual agents can provide the benefit of anonymity and ensure communicators' privacy when they reveal intimate information about themselves (Kang & Gratch, 2010).

Although previous studies have explored users' engagement when interacting with computers, few studies have investigated whether users like virtual agents or audio-only

interviewers who talk about themselves in counseling situations. No other study has explored whether a counseling interviewer's level of reciprocal self-disclosure affects a person's social responses (e.g. copresence, social attraction, embarrassment, rapport, verbal self-disclosure, etc.) when they interact with a virtual agent as a counseling interviewer. Therefore, we aimed to explore how different degrees of reciprocal self-disclosure from computer interviewers would influence users' social responses. To investigate this research problem, we formulated the following research question:

RQ3: Do people respond differently to computer interviewers who provide high levels of reciprocal self-disclosure compared to other computer interviewers who disclose less intimate information or no information about themselves?

In addition, we wanted to investigate users' social reactions in response to different levels of social cues (i.e. behavioral realism) presented by computer interviewers that disclosed different degrees of reciprocal intimate information about themselves. According to the CASA theory, we expect that users will interact with virtual agent or audio-only interviewers as if communicating with real human interviewers. If our conjecture is accurate, we wonder how users will regard computer interviewers accompanied by different levels of reciprocal self-disclosure. To investigate this subject, we formulated the following research question:

RQ4: What is the effect of different levels of behavioral realism of computer interviewers that disclose different degrees of reciprocal self-disclosure on users' social responses?

Method

We explored this subject through designing an experiment involving different types of computer interviewers' Behavioral Realism and varied levels of Reciprocal Self-Disclosure from the interviewers in a counseling interview interaction. Our interview format was based on Moon's study (2000) in which a text-based computer interviewer administers questions of

gradually increasing intimacy, from casual to very intimate, to a human interviewee. Moon notes that the sequence of disclosure affects the user's perception of how appropriate it is to disclose intimate information at that given point in time. Thus, gradually increasing disclosure from less intimate to highly intimate promotes reciprocal self-disclosure (Altman & Talylor, 1973; Berg & Clark, 1986; Collins & Miller, 1994; Derlega et al., 1993; Dindia & Allen, 1995; Moon, 2000). The virtual agent interviewer in this study disclosed information about itself using its individual back story as a programmed agent. We assumed that this approach would avoid some of the ethical controversy arising from the use of virtual agent counseling interviewers employing made-up human back stories when communicating with real human users (Bickmore, 2005).

1-1. Experimental Design

The experimental design was a 3x3 factorial between-subjects experiment involving three conditions of behavioral realism: High Behavioral Realism, Low Behavioral Realism, and Audio-Only; and three conditions of Reciprocal Self-Disclosure from computer interviewers: High Disclosure, Low Disclosure, and No Disclosure. The study featured an interview-style interaction between computer interviewers (virtual agents and audio-only interfaces) and real human interviewees (users). The participants were randomly assigned to one of nine experimental conditions. Nineteen participants participated in each condition). To control for gender effects, two types of gender dyads were used in equal numbers in each experimental condition: male-male and female-female.

1) Behavioral realism

We used the Rapport Agent (see Figure 1) for a virtual agent interviewer, which was developed by Gratch and colleagues (2006) at the Institute for Creative Technologies. The agent generates listening behaviors that correspond to the verbal and nonverbal behavior of a human speaker. The agent displayed timely nonverbal feedback (i.e. head nods and body

shifts) of a virtual agent interviewer by recognizing and responding to features of an interviewee's voice and upper-body movements. The Rapport Agent has proven to elicit feelings of rapport in the interview interaction, similar to those observed in the face-to-face condition (Kang & Gratch, 2010, 2011; von der Pütten, Krämer, Gratch, & Kang, 2010).

---insert Figure 1 about here ----

For this study, we used the Rapport Agent noted above with some adjustments. The Rapport Agent normally displays nonverbal behavior denoting that the animated character is "alive" (e.g. eye blinking, saccades, and breathing) and listening behaviors (e.g. posture shifts and head nods) automatically generated by the system in response to the users´ behavior. We modified these behaviors so that the agent could carry out a more effective interview interaction. The Rapport Agent still acts as a listener, but its main purpose lies in eliciting user responses through a one-sided interview rather than a two-sided conversation. This elicitation is achieved through the agent providing personal information about itself before asking the user ten questions about themselves which promote self-disclosure. Before the interaction starts, the agent interviewer was looking to the ground to avoid eye contact with the participant. When the system started, indicated by a ping sound, the agent interviewer looked up and started to speak. We did not use a text-to-speech system, but instead prerecorded ten questions preceded by self-disclosure utterances with a female and a male voice to create each male and female agent interviewer (see Table 1). The three conditions for this factor are described below.

High behavioral realism. We used breathing, eye blinking, posture shifts and head nods. The back-channeling head nods were generated automatically by the system according to the users' behavior.

Low behavioral realism. We chose to use the breathing, eye blinking, and posture shifts, but no head nods. In this way, we achieved a rather unrealistic behavior, as the virtual agent

interviewer was simply staring at users and did not display any back-channeling head nods to respond to the users' behavior at all.

Audio-only. There was no visual displayed at all.

2) Reciprocal Self-Disclosure from computer interviewers (see Table 1)

The computer interviewers shared some of their computer back stories before asking users each of ten questions. The ten questions were composed of the questions from a low intimate one (i.e. "How old are you?") to a high intimate one (i.e. "Can you describe the last time you were sexually aroused?"). The three conditions for this factor are described below.

High disclosure. Computer interviewers preceded all ten questions with an autobiographical computer back story (e.g., "I like to listen to what people say. I have lots of patience for listening, even if you have a lot to say. What characteristics of yourself are you most proud of?"). This individual back story carried higher intimacy in this condition.

Low disclosure. Similar to Moon's research (2000), computer interviewers preceded the first three questions with an individual back story (e.g., "I was created about 3 years ago. How old are you?"). The rest of the questions preceded by a description of each question to be asked instead of providing individual back story as described in the no self-disclosure condition below. The level of intimacy of self-disclosure from interviewers in this condition was lower than the intimacy level in the high self-disclosure condition.

No disclosure, Computer interviewers asked each question without revealing any information about themselves. To remove any confounding effect due to different lengths between the three conditions (Moon, 2000), computer interviewers described the question instead of providing self-disclosure (individual back story) in this condition.

---insert Table 1 about here---

1-2. Participants

One hundred seventy one people (52% women, 48% men) from the general Los Angeles area participated in this study. They were recruited using Craigslist.com and compensated for seventy five minutes of their participation. On average, the participants were 33 years old (M = 32.98; SD = 11.390).

1-3. Procedure

Upon arrival, the participants were asked to read and sign informed consent forms. They then completed a web-based questionnaire about their demographics and personality characteristics through tools, such as the Big Five Inventory (44-item version, Benet-Martinéz, & John, 1998), Self-Consciousness Scale (Scheier & Carver, 1985), and Self-Monitoring Scale (O´Cass, 2000). Participants then received a short introduction about the equipment and were given instruction describing the counseling interview interaction. Participants in all conditions viewed the virtual agents on a 30-inch Apple display that approximated the size of a real human sitting 4 feet away. They wore a lightweight close-talking microphone and spoke into a microphone headset. In order to assess the participants' verbal and nonverbal behavior, the whole session was videotaped. The camcorder was directed towards the participants and situated directly under the screen with the Rapport Agent in combination with the stereovision camera. The interview questions were modified from ones used in Moon's study (2000) to describe computer interviewers as computer programmed agents represented by a human figure (see the image (a) in Figure 1) or audio-only. Participants were instructed to wait until the systems starts, indicating readiness by a ping sound. In an actual interview interaction, computer interviewers asked users ten questions requiring gradually increasing levels of intimate self-disclosure from the users. The typical interaction was allowed to last about thirty minutes, but users were not informed of any specific time limitation. After the interaction, the

participants completed a web based post-questionnaire that included the measurement items listed below. They were fully debriefed, given $30 and thanked for their participation.

1-4. Measurements

We assessed the users´ emotional state (PANAS), perception of a computer interviewer (person perception), self-reported experience of social presence (copresence, social attraction, emotional credibility), rapport, self-reported self-disclosure, and perception of the quality of their own responses (self-performance and embarrassment) after the interaction. We also measured the objective items such as the total number of words spoken by the user during the interaction and the percentage of pause-fillers and incomplete words users produced during the interaction to measure speech disfluency. We also carried out a qualitative analysis of the intimacy degree of users' verbal self-disclosure. The measurements items are described in detail below.

Quantitative measures. In this study, we used the *PANAS* (Positive And Negative Affect Scale: Watson, Tellegen, & Clark, 1988) containing 20 items (e.g. strong, guilty, active, ashamed etc.), which were rated on a 5-point Likert-type scale (1 = Not at all; 5 = Extremely). The positive affect items and negative affect items of the scale were separately assessed to find users' different types of affect in their interactions with computer interviewers. The Positive Affect items showed good reliability (Cronbach's Alpha= .89). The Negative Affect items also showed good reliability (Cronbach's Alpha=.87).

To measure users' perception of computer interviewers, we used the *Person Perception* scale (von der Pütten et al., 2008) that is a semantic differential with 21 bi-polar pairs of adjectives (e.g. likable-dislikable, threatening-not threatening) with a 7-point metric. The three sub-scales of Person Perception scale were obtained by running Factor Analysis that is a Principal Components Analysis with Varimax rotation (Kaiser-Meyer-Olkin Measure of Sampling Adequacy = .919, Bartlett's Test of Sphericity < .001; see Table 2). The first factor,

Likability Traits, explains 48.28% of the variance (Cronbach's Alpha= .94). The second factor, Reliability Traits, explains 8.48% of the variance (Cronbach's Alpha= .85). The third factor, Negativity Traits, explains 6.00% of the variance (Cronbach's Alpha= .54).

----insert Table 2 about here----

We measured *Social Presence* (Short, Williams, & Christie, 1976) to find communicators' feelings of being connected and together with the other. This scale contained three measures (Kang et al., 2008c): Copresence with, Social Attraction to, and Emotional Credibility about computer interviewers. These three scales contained a Likert-type 8-point metric for items (1 = Very Little; 8 = Very Much or 1 = Very Unlikely; 8 = Very Likely). The Copresence scale consisted of seventeen items. All seventeen items were adopted from the items of copresence used in Nowak and Biocca's study (2003). This measurement included two separate sets of items: "perceived other's copresence (participants' perception of their interaction partners' involvement)" and "self-reported copresence (participants' self-report about their involvement)." Items included: "S/he was intensely involved in our interaction" and "I wanted to make the conversation more intimate." Six of the items were adopted from the items of the social attraction scale used in Nowak's study (2004). Items included: "I would like to have a friendly chat with her/him" and "I think s/he could be a friend of mine." The other nine items, called emotional credibility, were created to measure interactants' emotional perceptions of their interaction partners (Kang et al., 2008c). This measurement was constructed based on elements from the emotional intelligence test that originated in the studies of Mayer and Salovey (Salovey et al., 2004). Items included: "S/he expresses feelings and emotions appropriately for the situation" and "S/he responds appropriately to positive and negative emotions." All three scales showed good reliability: Copresence (Cronbach's Alpha=.89), Social Attraction (Cronbach's Alpha=.87), and Emotional Credibility (Cronbach's Alpha=.92).

To measure users' perceived rapport in their interactions with computer interviewers, we used a scale that had been developed for previous studies with the Rapport Agent. This scale

was composed of twelve items from the *Rapport* measure created by Tickle-Degnen (Tickle-Degnen & Rosenthal, 1990). The Rapport scale (has been used in previous human-agent interaction studies (Gratch et al., 2006; 2007a: 2007b; Kang et al., 2008a; 2008b; Kang et al., 2009) and contained a Likert-type 8-point metric for items (1 = Very Little; 8 = Very Much or 1 = Very Unlikely; 8 = Very Likely). Items included: "I felt I had a connection with my partner" and "I think that my partner and I understood each other." The scale showed good reliability (Cronbach's Alpha=.87) in this study. We also included *Embarrassment* and *Self-Performance* scales (Gratch et al., 2006; 2007a; 2007b; Kang et al., 2008a; 2009) to measure users' perception of the quality of their responses. The embarrassment scale was composed of four items. The items included: "As I gave my answers, I felt embarrassed" and "I felt awkward giving my answers to my partner." The self-performance scale consisted of five items. The items included: "I found it hard to give my answers" and "I think I did a good job giving my answers." These two scales comprised a Likert-type 8-point metric for items (1 = Very Little; 8 = Very Much or 1 = Very Unlikely; 8 = Very Likely). The self-performance scale consisted of The scales showed good reliability: Embarrassment (Cronbach's Alpha=.76) and Self-Performance (Cronbach's Alpha=.84).

In addition, we created one *Self-Reported Self-Disclosure* scale with a Likert-type 8-point metric for items (1 = Very Little; 8 = Very Much or 1 = Very Unlikely; 8 = Very Likely). The one item was "How personal were your answers?"

Qualitative measures. We conducted a qualitative analysis of the users´ answers to the questions asked by a computer interviewer. We analyzed the users´ verbal behavior. The data of verbal behavior is categorized into three types of data: Total Words, Speech Disfluency, and Verbal Self-Disclosure.

For the *Total Words*, we counted total numbers of words users spoke.

For the *Speech Disfluency* (Gratch et al., 2006; 2007a; 2007b; Kang et al., 2008a; 2009), we counted the amount of Pause-Fillers (e.g. "um," "er") and Incomplete Words (e.g.

"univers-") in what users' spoke. We calculated the percentage of speech disfluency in relation to the total amount of words.

Intimacy of users' *Verbal Self-Disclosure* was calculated for their verbal responses. Two independent coders who were blind to the hypotheses, research questions, and experimental conditions were responsible for rating the intimacy of users' self-disclosure. The level of intimacy was coded from the transcription of users' verbal responses, which were broken down into a series of utterances. An utterance represents a singular idea unit that conveys one whole idea or intention (Weisband, 1992; Antheunis & Valkenburg, 2009). The coders assigned each utterance to one of three categories: self-disclosure, other self-disclosure, or no self-disclosure. Self-disclosure was defined as an utterance that properly responded to the question and disclosed intimate information about the user. Other self-disclosure was an utterance that delivered other types of personal information in addition to an answer suitably responding to the question. No self-disclosure was defined as an utterance representing a fact that did not clearly provide self-disclosure intimacy. This intimacy was rated using Altman and Taylor's three-layer categorization scheme (1973): a core layer (high intimacy), an intermediate layer (medium intimacy), and a peripheral layer (low intimacy). The core layer is comprised of self-concept, feelings, emotions, fears and other information people are reluctant to share with others. An example of this is, "I feel most guilty about cheating on my girlfriend." The intermediate layer contains attitudes, desires, or values, such as "I like to go shopping." The peripheral layer includes biographic data, such as gender, hometown, age and other information that the user would likely be share in public, such as "I am 30 years old." Scores were assigned in order to calculate the *intensity of intimate self-disclosure*. 1 denoted low intimacy, 2 denoted medium intimacy, and 3 denoted high intimacy. After assigning all the scores, coders summed the numbers to calculate how much total intimate self-disclosure each user revealed.

To calculate inter-coder reliability, we performed Krippendorff's alpha[3] (2004). The results of *Krippendorff's alpha* showed good inter-coder reliability between the two coders' disagreements: Alpha = .85; Do (Observed Disagreement) = 2485.35; De (Expected Disagreement) = 16846.55.

Results

We ran MANOVA for two independent variables (Behavioral Realism and Interviewers' Reciprocal Self-Disclosure) and dependent variables: Social Presence Scales (Copresence, Social Attraction, and Emotional Credibility), Rapport, users' perception of the quality of their responses (Embarrassment and Self-Performance), Self-Reported Self-Disclosure, PANAS (Positive Affect Scale and Negative Affect Scale), Person Perception Scales (Likability Traits, Reliability Traits, and Negativity Traits), Speech Fluency Scales (Pause Fillers and Incomplete Words), and Intimacy of Verbal Self-Disclosure (High Intimacy, Medium Intimacy, and Low Intimacy).

The results showed that statistically significant effect of the independent variable Interviewers' Reciprocal Self-Disclosure on seven dependent variables: Copresence (Social Presence), Embarrassment, Self-Reported Self-Disclosure, Negative Affect (PANAS), Likability Traits (Person Perception Scale), Incomplete Words (Speech Fluency Scale), Medium Intimacy of Verbal Self-Disclosure, and Low Intimacy of Verbal Self-Disclosure. Users felt the most embarrassment when interacting with computer interviewers presenting no self-disclosure, compared to interviewers displaying high or low self-disclosure [$F(2, 162)=4.679$; $p=.011$; partial $eta^2= .055$ (see Table 3)]. The greatest level of copresence was reported by users interacting with interviewers that talked about themselves with high disclosure, compared to the interviewers that talked about themselves with low or no

[3] Krippendorff's alpha is more sensitive than Cohen's kappa and recommended to use for assessing inter-coder reliability of quantitative ratings by two coders.

disclosure [F(2, 162)=9.279; p<.001; partial eta^2= .103 (see Table 3)]. Users reported highest negative affect when interacting with computer interviewers that did not talk about themselves compared to the interviewers that talked about themselves employing high or low disclosure [F(2, 162)=9.141; p<.001; partial eta^2= .101 (see Table 3)]. Users perceived the computer interviewer as a more likable partner displaying no self-disclosure, compared to interviewers that revealed a lot of personal information with high disclosure [F(2, 162)=6.975; p=.001; partial eta^2= .079 (see Table 3)]. Users spoke the greatest amount of incomplete words when they interacted with computer interviewers that disclosed their personal information with low disclosure, compared to the interviewers that did not talk about themselves [F(2, 162)=11.126; p<.001; partial eta^2= .121 (see Table 3)]. We observed that users disclosed the most personal information with a medium level of intimacy when they interacted with interviewers that talked about themselves with high disclosure, compared to the interviewers that revealed intimate information about themselves with low disclosure [F(2, 162)=7.526; p=.001; partial eta^2= .085 (see Table 3)]. It was also observed that users disclosed their personal information with the greatest personal information with a low level of intimacy when they interacted with the interviewers that revealed personal information with low disclosure, compared to the interviewers that talked about themselves with high or no disclosure [F(2, 162)=6.170; p=.003; partial eta^2= .071 (see Table 3)].

---insert Table 3 about here---

We also found that there were statistically significant effects of the independent variable Behavioral Realism on three dependent variables: Self-Reported Self-Disclosure, Incomplete Words (Speech Disfluency), and Medium Intimacy of Verbal Self-Disclosure. Users reported that they revealed their personal information most when they interacted with computer interviewers displaying low behavioral realism or audio-only, compared to the interviewers presenting high behavioral realism [F(2, 162)=4.624; p=.011; partial eta^2= .054 (see Table 4)]. It was observed that users presented the greatest amount of incomplete words when

interacting with computer interviewers presenting low behavioral realism or audio-only, compared to interviewers displaying high behavioral realism [F(2, 162)=5.885; p=.003; partial eta^2= .068 (see Table 4)]. It was also discovered that users revealed the greatest amount of medium level intimacy of verbal self-disclosure when interacting with computer interviewers that presented high behavioral realism, compared to interviewers that displayed low behavioral realism or audio-only [F(2, 162)=6.673; p=.002; partial eta^2= .076 (see Table 4)].

---insert Table 4 about here---

Finally, we discovered a statistically significant interaction of two independent variables (Interviewers' Reciprocal Self-Disclosure and Behavioral Realism) with one dependent variable: Medium Intimacy of Verbal Self-Disclosure. Users revealed the most self-disclosure of medium level intimacy when interacting with computer interviewers that talked about themselves with high disclosure both in the high behavioral realism condition and the low behavioral realism condition. In the audio-only condition, however, they revealed the most self-disclosure of medium level intimacy when interacting with the interviewers who did not reciprocate self-disclosure [F(2, 162)=8.323; p<.001; partial eta^2= .170 (see Table 5)].

---insert Table 5 about here---

In addition, we observed that there were moderately significant effects of the independent variable Interviewers' Reciprocal Self-Disclosure on two dependent variables: Social Attraction (Social Presence) and Self-Performance. There was a general trend of highest social attraction to the interviewer [F(2, 162)=3.012; p=.052; partial eta^2= .046) and self-performance [F(2, 162)=2.978; p=.054; partial eta^2= .035) when users interacted with computer interviewers that presented high self-disclosure, compared to the interviewers that showed low or no self-disclosure.

There were no statistically significant outcomes for the other dependent variables.

Conclusions and Discussion

We explore the social influence of behavioral realism and reciprocal self-disclosure from computer interviewers on users' subjective and objective social responses in counseling interview interactions. Based on the *Revised Ethopoeia* concept (von der Pütten, Krämer, Gratch, & Kang, 2010), higher behavioral realism would produce greater social influences on users' responses to computer interviewers when they interact with the interviewers displaying high behavioral realism compared to low behavioral realism. There is, however, some possibility of greater positive social effects on users' responses when they interact with computer interviewers with less social cues, such as audio-only interfaces, compared to virtual agent interviewers based on Hyperpersonal Communication theory (Walther, 1996). According to URT (Berger & Calabrese, 1975), people would also be more attracted to their communication partners and reveal greater personal information when they are engaged in reciprocal self-disclosure. In human-to-human counseling interactions, it has been reported that clients positively regard mutual self-disclosure from human counselors. We investigated our research questions and hypothesis based on the basic principles from these theories. To achieve behavioral realism in the virtual agent interviewers, we manipulated two factors: high behavioral realism and low behavioral realism. Bailenson et al. (2006) found that communication effects regarding users' self-disclosure were greater when the users interacted with partners displaying less visual, such as audio-only interfaces in CMC. Thus, we included a condition with audio-only interviewers that were devoid of any visual cues in our experimental design. Reciprocal self-disclosure was varied through three degrees present in computer interviewers: high disclosure, low disclosure, and no disclosure. Below are the hypothesis and research questions we addressed:

H1: High behavioral realism in virtual agent interviewers will elicit more social effects (e.g. self-disclosure, social presence, etc.) from users' social responses compared to virtual agent interviewers displaying low behavioral realism.

RQ1: Do people respond differently to virtual agent interviewers who present high behavioral realism compared to audio-only interviewers?

RQ2: Do people respond differently to virtual agent interviewers who present low behavioral realism compared to audio-only interviewers?

RQ3: Do people respond differently to computer interviewers who provide high levels of reciprocal self-disclosure compared to other computer interviewers who disclose less intimate information or no information about themselves?

RQ4: What is the effect of different levels of behavioral realism of computer interviewers that disclose different degrees of reciprocal self-disclosure on users' social responses?

Our findings and conclusions described below will respond to the hypothesis and research questions above.

The trait that had the greatest social influences on users' responses was the level of reciprocal self-disclosure employed by the computer interviewer. Behavioral realism was also found to have an effect on some users' social reactions to the interviewer. Users experienced the least amount of embarrassment in counseling interactions when they experienced high self-disclosure from the interviewers. Conversely, they experienced the highest amount of embarrassment when interacting with interviewers that talked about themselves using no self-disclosure. In other words, users likely felt more embarrassed when talking about intimate information unless the other party also revealed intimate information. Users reported the highest perceived amount of copresence and the least perceived amount of negative emotions with interviewers that highly disclosed personal information about themselves. These outcomes answer ***Q3.*** They are also supported by URT as well as the findings (MacCarthy, 1982) from human-to-human counseling interactions, which demonstrate that human clients

like human counselors who disclose more about themselves rather than counselors who reveal less information about themselves.

An in-depth look at the results for users' verbal self-disclosure showed that there was no social influence of computer interviewers on the total number of words spoken by users. However, the medium degree of users' intimate disclosure was higher when the users interacted with computer interviewers that displayed high behavioral realism compared to low behavioral realism or audio-only simulations. There was no statistically significant difference in the amount of personal information users offered at the medium level of intimacy when interacting with computer interviewers that presented low behavioral realism, compared to interviewers displaying audio-only simulations. Medium level intimate disclosure from users was also greater when they interacted with the interviewers that presented high self-disclosure compared to low self-disclosure. This finding is supported by the outcomes of previous studies where the quality of self-disclosure was more important than the amount of self-disclosure in eliciting reciprocal attraction between communicators (Collins & Miller, 1994; Reis & Shaver, 1988; Antheunis & Valkenburg, 2009). These outcomes support ***H1*** and answer ***Q1, Q2,*** and ***Q3***. There was an interaction effect between behavioral realism and Reciprocal Self-Disclosure from computer interviewers for the medium level of users' intimate disclosure. Both high behavioral realism and low behavioral realism, accompanied by high disclosure, elicited greater self-disclosure from users. However, in the audio-only interface condition, if audio-only interfaces were accompanied by no disclosure, users disclosed greater information about themselves. These tendencies imply that in order to mutually disclose information, people might expect a more humanistic back story from a virtual agent with a realistic human figure, and anticipate little to no back stories from an interaction partner that doesn't look human. Therefore, for the audio-only interfaces, it might be better not to use the interviewers' back stories to elicit self-disclosure from users. These outcomes answer the ***Q4***. One could expect that users will reveal highly intimate information

when interacting with computer interviewers that talk about themselves with high behavioral realism and high self-disclosure from computer interviewers, but these outcomes demonstrate that the one-time interaction with and one way questioning (with self-disclosure) without follow-up verbal feedback by the interviewers could prevent users from eliciting highly intimate self-disclosure. Interestingly, users disclosed less intimate information about themselves when interacting with computer interviewers who demonstrated low self-disclosure. This example illustrates users exchanging an even level of disclosure with their virtual partners just as they might have with another human being.

There were no statistically significant findings on users' self-reported level of perceived rapport, but a greater number of incomplete words was observed when interacting with computer interviewers displaying low behavioral realism, compared to high behavioral realism. This also occurred when communicating with interviewers presenting low self-disclosure, compared to no self-disclosure. There was no statistically significant difference in the amount of incomplete words users uttered when interacting with interviewers presenting high or low behavioral realism, compared to audio-only simulations. This implies that users might have felt uncomfortable when talking with computer interviewers displaying low behavioral realism and low self-disclosure. This low behavioral realism condition for virtual agent interviewers was unrealistic. This was likely due to the absence of crucial back-channeling feedback, such as nods. In the low self-disclosure condition, computer interviewers only disclosed personal information about themselves before asking the first three questions, which were low in intimacy. They stopped revealing intimate information about themselves before asking the rest of the ten questions, which were higher in intimacy. Likewise, users might have unconsciously perceived this behavior as unrealistic, thereby prompting awkward reactions like generating more incomplete words. This behavioral measure might be more reliable than self-reported rapport since this data was collected by

observing users' verbal behavior. This outcome also answers the ***Q1***, ***Q2***, and ***Q3*** while supporting the ***H1***.

However, we can't ignore statistically significant findings that support the opposite trend found in users' self-reports on the degree of intimacy in their self-disclosure and their perception of computer interviewers. These users rated interviewers with no self-disclosure more positively than high self-disclosure. The users also reported a higher level of intimacy in their self-disclosure when interacting with computer interviewers with low behavioral realism or audio-only, compared to high behavioral realism. This might have been because users interpreted the consistently positive nodding feedback from computer interviewers as very submissive. Furthermore, perhaps the computer back stories delivered by virtual agent interviewers made users regard them as computer programmed characters that weren't as natural to interact with on an intimate level.

Although some contradictory consequences may arise from users' social responses, we observed that users revealed greater verbal self-disclosure when interacting with computer interviewers that displayed high behavioral realism and high self-disclosure. Users also delivered more fluent, uninterrupted speech when interacting with computer interviewers that presented high behavioral realism. Thus, we claim that the outcomes of observed data analysis should be more trustworthy than the results from self-reported data analysis. These outcomes are supported by the *Revised Ethopoeia* concept (von der Pütten, Krämer, Gratch, & Kang, 2010) from the CASA theory, as well as previous findings on users' preference for highly reciprocal self-disclosure of human counselors in human-to-human counseling interactions based on URT. Overall, there was no statistically significant difference of social consequences regarding users' self-disclosure when users interacted with computer interviewers displaying behavior with low realism compared to audio-only simulations. Therefore, we argue that there might be no difference in using audio-only interviewers instead of animated characters without nonverbal feedback, or vice versa, in case one or the other is unavailable. This

proposal prompts us to reconsider the conclusion of Bailenson's study (2006) which argues that the communication effect based on self-disclosure was greater when users interacted with partners displaying less visual such as audio-only interfaces.

In conclusion, the outcomes and conclusions above support the positive social consequences on users' responses when interacting with computer interviewers with high behavioral realism, compared to low behavioral realism or audio-only simulations. This also applies to when users communicate with interviewers demonstrating high self-disclosure, compared to low disclosure or no disclosure. Therefore, we propose the design of virtual agent interviewers which present higher behavioral realism and greater self-disclosure in order to obtain better results and a more realistic experimental setting. However, we should be cautious of using excessively submissive head nods as a back-channel from virtual agent interviewers and constructed computer back stories for the virtual interviewer's self-disclosure. In future studies, we would like to investigate the social effects of different types of head nods and various human-like back stories delivered by computer interviewers.

Other future work could explore combining other forms of virtual agent interviewer feedback that was not explored in this study, such as facial expressions or verbally empathetic utterances. This would no doubt reveal even more interesting effects of a computer interviewer's degree of self-disclosure and behavioral realism on users' social responses. Furthermore, longitudinal studies on this subject would allow us to investigate the long-term social effects of a computer interviewer' behavior on users' responses based on communication theories investigated in this study.

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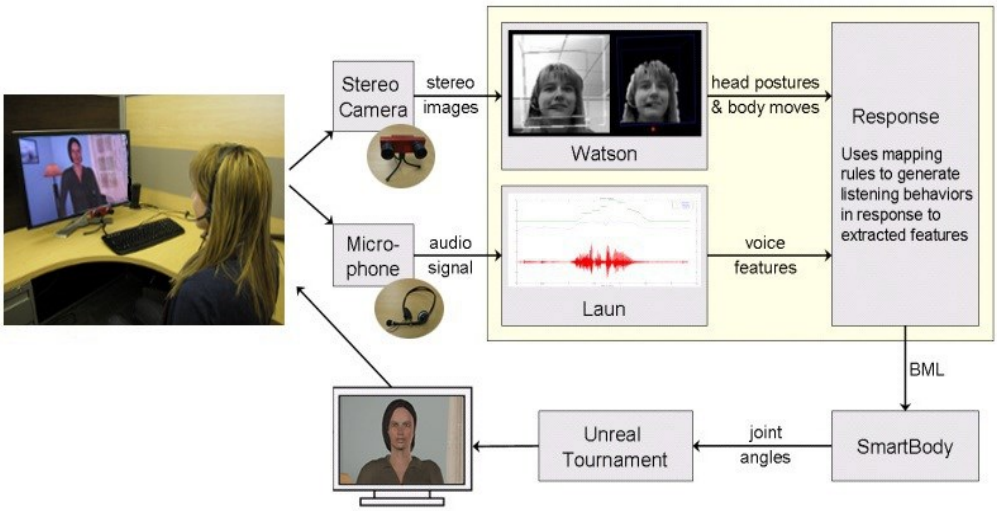
Figure and Tables

(a)



(b)

Figure 1. (a) Virtual agent interviewers (Rapport Agents: male & female) (b) Interview interaction scene and System architecture of the Rapport Agent

Table 1. Three types of reciprocal self-disclosure from computer interviewers

High **Self-Disclosure**	***Low*** **Self-Disclosure**	***No*** **Self-Disclosure**	**Questions**
I was created about 3 years ago.	I was created about 3 years ago.	You are now ready for the first question.	"How old are you?"
I was designed and built by ICT researchers here in Marina del Rey.	I was designed and built by ICT researchers here in Marina del Rey.	You will next be asked a question about where you are from.	"What is your hometown?"
When I don't interact with people, I usually study them so that I can better communicate with them.	When I don't interact with people, I usually study them so that I can better communicate with them.	The next question in this interview asks about the different things you like to do in your spare time.	"What are your favorite things to do in your free time?"
My face was designed and created based on a movie star Brad Pitt's face. I'm pretty proud of that. I like to listen to what people say. I have lots of patience for listening, even if you have a lot to say.	The next question in this interview has to do with your personal characteristics. In this question, you will be asked about those characteristic that you are the most proud of.	The next question in this interview has to do with your personal characteristics. In this question, you will be asked about those characteristic that you are the most proud of.	"What characteristics of yourself are you most proud of?"
I feel furious when people treat me as if I were just a machine without any thinking or feeling.	You will now be asked with the next question about the things that make you furious.	You will now be asked with the next question about the things that make you furious.	"What are some of the things that make you furious?"
I am built so that I can theoretically last forever. However, because newer and faster computer technologies are always coming along, most virtual agents last just a few years before they are dumped by their creators. I have been around 3 years…so I probably have about 1 or 2 years left before I end up being replaced by a newer agent.	You will now be asked the next question in the interview. The next question has to do with the topic of death. In this question, you will be asked about how you feel with respect to the topic of death. In this question, you will also be asked about your attitudes with respect to the topic of death. More specifically, the question is:	You will now be asked the next question in the interview. The next question has to do with the topic of death. In this question, you will be asked about how you feel with respect to the topic of death. In this question, you will also be asked about your attitudes with respect to the topic of death. More specifically, the question is:	"What are your feelings and attitudes about death?"
My abilities are somewhat limited. For example, I can speak and listen to what you say, but I can't do any kind of physical activity, such as play sports or walk down the street in your world.	You will now be asked the next question. This question is also about your characteristics, but this time, you will be asked about those characteristics that you hate about yourself:	You will now be asked the next question. This question is also about your characteristics, but this time, you will be asked about those characteristics that you hate about yourself:	"What are some of the things you hate about yourself?"
There are times when I crash for reasons that are not apparent to my conversation partner. It usually happens at the most inopportune time, causing great inconvenience to the partner.	The next question in this interview is about guilt. More specifically, you will be asked what you have done in your life that you feel most guilty about. The question is:	The next question in this interview is about guilt. More specifically, you will be asked what you have done in your life that you feel most guilty about. The question is:	"What have you done in your life that you feel most guilty about?"
I interact with people when they want to talk about their worries or problems. Sometimes, however, many days go by without anyone talking to me at all. So I end up just sitting here, for days and days, with absolutely no communication with people.	You will now be asked the next question in this interview. The next question is about your personal feelings. In particular, in this question you will be asked about some of the things that hurt your feelings. So the specific question is:	You will now be asked the next question in this interview. The next question is about your personal feelings. In particular, in this question you will be asked about some of the things that hurt your feelings. So the specific question is:	"What are some of the things that really hurt your feelings?"
A few weeks ago, someone came in here and began talking about his very intimate problems. No one had ever disclosed such intimate ones with me before.	You will now be asked the next question in this interview. The next question will ask you about the last time you were sexually aroused. The question is:	You will now be asked the next question in this interview. The next question will ask you about the last time you were sexually aroused. The question is:	"Can you describe the last time you were sexually aroused?"

Table 2. Factor loadings and communalities based on a Principal Components Analysis with Varimax rotation for 21 items regarding person perception of a computer interviewer (N = 171)

	Likability Traits	*Reliability Traits*	*Negativity Traits*
Compassionate|Aloof	.840		
Warm|Cold	.807		
Sensitive|Cold	.763		
Inviting|Unapproachable	.733		
Sympathetic|Unsympathetic	.718		
Friendly|Unfriendly	.714		
Kind|Cruel	.686		
Likable|Dislikable	.685		
Active|Passive	.670		
Pleasant|Unpleasant	.647		
Involved|Detached	.623		
Cool|Not cool	.558		
Humble|Proud	.486		
Intelligent|Unintelligent		.774	
Honest|Dishonest		.693	
Reliable|Unreliable		.691	
Alert|Sleepy		.642	
Sophisticated|Naive		.522	
Polite|Rude		.554	
Threatening|Nonthreatening			-.726
Tense|Relaxed			-.696

Note. Factor loadings < .4 are suppressed.

Table 3. MANOVA with the independent variable Reciprocal Self-Disclosure and seven dependent variables (N = 171)

	High-Disclosure		**Low-Disclosure**		**No-Disclosure**		***F***	η^2	***P***
	μ	SD	μ	SD	μ	SD			
Embarrassment	2.452	1.590	2.526	1.411	3.246	1.596	4.679	.055	.011
Copresence	4.540	1.447	3.883	1.170	3.548	1.080	9.279	.103	< .001
Negative PANAS	1.814	1.092	1.968	.939	2.619	1.148	9.141	.101	< .001
Person perception (Likability)	-1.243	1.201	-.789	1.101	-.471	.994	6.975	.079	.001
Speech disfluency (Incomplete Words)	.273	.480	.546	.582	.167	.278	11.126	.121	< .001
Verbal self-disclosure (Medium Intimacy)	33.23	17.675	23.47	12.487	29.09	14.423	7.526	.085	.001
Verbal self-disclosure (Low Intimacy)	2.89	1.600	3.89	2.127	2.96	1.239	6.170	.071	.003

Table 4. MANOVA with the independent variable Behavioral Realism and three dependent variables (N = 171)

	High Behavioral Realism		**Low Behavioral Realism**		**Audio-only**		***F***	η^2	***P***
	μ	*SD*	μ	*SD*	μ	*SD*			
Self-reported self-disclosure (How personal?)	6.16	1.645	6.91	1.184	6.84	1.461	4.624	.054	.011
Speech disfluency (Incomplete Words)	.1993	.4074	.4812	.5541	.3060	.4593	5.885	.068	.003
Verbal self-disclosure (Medium Intimacy)	33.75	17.757	24.88	10.784	27.16	15.820	6.673	.076	.002

Table 5. MANOVA for interaction effects between two independent variables Behavioral Realism and Interviewers' Reciprocal Self-Disclosure on one dependent variables (N = 171)

Highest Scores	**High Behavioral Realism * High-Disclosure**		**Low Behavior Realism * High-Disclosure**		**Audio-only * No-Disclosure**		***F***	η^2	***P***
	μ	*SD*	μ	*SD*	μ	*SD*			
Verbal Self-Disclosure (Medium Intimacy)	49.26	16.763	27.68	12.405	32.63	16.721	8.323	.170	<.001