



Mediated Ecological Validity in Anthropomorphic Avatar Dyad Parasocial Interactions

Elizabeth H. Stringer , Southern Methodist University

A “team dynamics workshop” improvisational role-play series to teach emotional intelligence skills was adapted for virtual reality (VR) avatar dyads. Interaction levels were theoretically sampled to develop a grounded theory of parasocial relationships in the media of VR.

This grounded theory research study accessed the content designer’s theories of mediated expressions for interactive experiences in an immersive virtual environment (IVE) in order to advance virtual reality (VR) as a medium beyond the baseline of technological immersion and develop novel channels for human interactions. Methodologically, a systematic review of the relevant background theory in human factors was done first to determine:

1. “What type of design metaphors will enhance the user’s performance in an IVE? How do you amplify the positive attributes?”¹

Next, a user research (UR) experimental design applied the multiphased process of studying a product as it was designed, built, and used over time.¹ This extension of UR to the user experience (UX) with IVE technology (IVET) aligned the users’ characteristics, intentions, and interactions with an IVE centered on a goal to improve all aspects of users’ lives.¹ The designed UX encompassed “a user’s entire relationship with the artifact, including not only usability but also usefulness and emotional factors”² and considered the human factors to determine:

2. “How much sensory feedback from the IVET can the user process? Will the user perceive limitations? How will the user accept the limitations?”¹

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These limitations are difficult to predict in this emerging discipline of UX because modern VR platforms offer designers a mixture of accessible haptic constructors along with visual and auditory reproductions to direct the intended experiential reality to the mind. Accordingly, it is the only media in which many interactive sensory experiences are even achievable. Moreover, it is understood that an IVET generates illusions with several modes of stimuli that can act in consort with one another to distribute a layered experience.³ Ultimately translated by the brain, cross-modal stimuli (semantic, spatial, and temporal) converge to form the UX, simulating representations of the designed encounter.³ As such, the biological processes and psychological phenomenon of the UX with IVET necessitates a cross-disciplinary understanding in order to manipulate the IVE capacities. Consequently, researchers continue to further explore how the IVET remaps the mind's flexible inference state by recreating real-world semantics, visuo-proprioceptive modulations, visuomotor modulations, and visuotactile modulations.³ And IVE designers are documenting how to directly communicate with the human nervous system which continuously processes multisensory signals from the body to update a unified state of perception information in the mind.³ Thus, the potential of VR as media can be understood with homuncular flexibility, in which the mapping of the body to the motor cortex presents images shaped by the IVET's own mediated ecology of physics, subjects, objects, and processes.⁴

These insights into human virtual environment interaction (HVEI, a subfield of the broader field of UR) have attached an egocentric perspective to human-virtual interactions to

encapsulate the level of participation in the willing suspension of disbelief.¹ HVEI accounts for the technological aspects influencing human performance (input, throughput, and output) with the physical user characteristics (the brain's ability to process visual data via the refresh rate of a screen), and then accesses the added layer of cognitive influences of the user in VR (how the illusion of reality forms).¹ HVEI's focus identified reality constructs sustained by the IVET bionetwork. Specifically, the UX involves the perception of "presence" in an IVE to describe the fidelity of the simulated experience. As a phenomenon in VR, presence is described as the feeling of being there.² In designing for presence, the simulation manipulates various human factors with HVEI mechanisms (vividness of a user experience and the level of user interaction) to determine the effectiveness of the media's illusion.^{1,2}

As it is common for users to interact as an avatar within the IVE, this grounded research study next converged on the associated HVEI avatar processes theories and then employed corresponding procedures for UX design. The selected IVE artifact in the experiment used the established design convention in which a user's avatar is a real-time simulated entity whose actions are controlled by the user.⁴ And though avatars in VR can take almost any imaginable form (a shape symbol, a worldly object, or even a fantasy creature) the review found when populating an IVE, avatars frequently appear as a virtual human, a computer-generated representation that looks, moves, and communicates like a real human being.⁵ Moreover, the interactivity in connection with other virtual human avatars in an IVE identified the involvement of a more complex and sophisticated form of HVEI presence, social presence. Social presence

within an IVE reflects the user's belief that they are in the presence of and are interacting with other veritable human beings and, as a consequence, feel that the virtual partners can either influence or be influenced.⁵

Hence, in order to find markers of HVEI social processes, this study's original research explored social presence in VR using conditions in which parasocial relationships were investigated as a theorized element in that process. The construct of a parasocial relationship describes persistent one-sided feelings of intimacy simulating those of an interpersonal relationship by a consumer with a media persona.⁶ The theoretical grounding of the experiment's analyses of the UX with a virtual avatar dyad then informed other elements to refine the human factor social framework:

3. "What type of consequences will the user face after an [IVE] experience?"¹

It was new insight gains from the experience of the parasocial experimental conditions that led to the incorporation of further explanatory theory to give meaning to the data and framed the discussion. Thus, this research report was organized around grounded theory methods using theoretical sensitivity, theoretical sampling, data collection, and analysis simultaneously to formulate an emerging theory of social presence.

THEORY

Grounded theory HVEI systematic review: "What type of design metaphors will enhance the user's performance in an [IVE]?"

The embodied cognition of a virtual human, self-avatar realism, is derived

from egocentric cognitive processes of the body.^{7,8} The UX with IVET considers the sense of embodiment (SoE) as the quality of a simulated self-avatar experience, which is “the ensemble of sensations that arise in conjunction with being inside, having, and controlling a virtual body.”⁹ Designers

being inside a body and is measured on a continuous scale in VR.⁹ Self-location is quite extendable; it is achieved when semantically viewed from a multitude of virtual avatar design metaphors: an eyes only point-of-view with no form rendered for representation in VR (the virtual camera), a first-person

forearm, the low realism virtual avatar hand had lower self-location scores compared to the medium realism virtual avatar hand with forearm and the high realism virtual avatar hand with forearm.⁷ This HVEI review suggested that higher quality anthropomorphic avatars are better when establishing a sense of self-location.

THE UX INVOLVES THE PERCEPTION OF “PRESENCE” IN AN IVE TO DESCRIBE THE FIDELITY OF THE SIMULATED EXPERIENCE.

The sense of self-agency component refers to the phenomenology of the sense of having a subjective experience of action, control, and intention and is measured on a continuous scale in VR.⁹ Self-agency is achievable with synchronous global motor correlations of the efference copy to active movement of the user.⁹ Previous researchers found that while interacting as the avatar in an IVE, visual discontinuity in an anthropomorphic first-person avatar representation using the metaphor of a full arm decreased the sense of agency.¹² Corresponding research found that in a VR simulation with a first-person avatar representation using the metaphor of a hand with forearm, the low realism virtual avatar hand had lower self-agency scores compared to the medium realism virtual avatar hand with forearm and the high realism virtual avatar hand with forearm.⁷ Both these HVEI reviews suggested that higher quality anthropomorphic avatars are better when establishing a sense of self-agency.

achieve the SoE state by employing the multimodal user interface (UI) to control the digital avatar and experience the sensations of the user’s avatar. The effective implementation of SoE reproduces users who unconsciously perceive the avatar actions as their own.

SoE research is a factor in the HVEI affordances and constraints of anthropomorphic artificial bodies in the human neural conceptualization modeling process for an embodied avatar.^{7,8} SoE was formulated to have an underlying structure in VR that contains three overlapping spatial attributes: self-location, agency, and body ownership.⁹ The first overlapping spatial attribute, self-location, is “the sense of being inside an [avatar] body.”⁹ The second overlapping spatial attribute, agency, is “the sense of control over a [virtual] object or event.”¹⁰ The third overlapping spatial attribute, body ownership, is “the sense that an [avatar] is part of one’s own body.”¹⁰

The sense of self-location component refers to the phenomenology of

point-of-view body (humanoid and/or nonhumanoid) representation in VR with some or all representative body parts, a second-person point-of-view body (humanoid and/or nonhumanoid) with some or all representative body parts reflected in a VR mirror, and a third-person point-of-view body (humanoid and/or nonhumanoid) representation in VR.² For example, in a VR simulation study using the virtual avatar metaphor of the virtual camera, users demonstrated their acceptance of self-location inside the IVE by varying their proximity distance (the tracked movement in the real-world while standing and wearing the untethered head-mounted display, HMD) from other stationary and moving computer-controlled VR anthropomorphic avatars.¹¹ Specific to the affordances employed in this study’s designed UX, previous research designs for assessing how anthropomorphism qualities affect self-location, researchers found that in an IVE with a first-person avatar representation using the metaphor of a hand with

However, in an HVEI study that modeled itself after the classic Rubber Hand Illusion experimental conditions, a virtual hand illusion in which researchers employed an anthropomorphic first-person avatar representation using the metaphor of a hand with forearm, agency was stronger for the less realistic virtual hands.²⁴ These researchers attributed the stronger self-agency toward the nonhumanoid

hand avatars to problems in the UI fidelity: a visual design limitation and motion tracker failures.¹³ Specifically, they noted the overly large sized 3D model of the hand occluded the virtual objects being manipulated, and the limitations of the Leap Motion trackers could not reliably produce real time feedback control of the realistic virtual avatar hand.¹³ While the anthropomorphic ecological validity scales of higher behavior realism expectations when there is higher form reality are consistent with theory, this experiment's faulty technology reports also suggest the incongruent visuomotor feedback played a role in the users' acquisition of agency over the virtual avatar hand.¹³ The technological failure is then, in fact, consistent with other research that found when controlling a VR avatar, synchronous movement leads to an intermodal match between the virtual visual pattern and the tactile/proprioceptive pattern of the real body.^{3,10} Moreover, in another study, researchers were able to demonstrate "noncorporeal VR avatar representations can be perceived as body parts if they are systematically related to one's actions."¹⁰ These HVEI reviews suggested that fully humanoid anthropomorphic form realism in a virtual avatar is not required to create a user's sense of embodiment when establishing the sense of self-agency if the user's control over the virtual avatar establishes high-quality behavioral realism, prioritizing visuomotor modulation with temporal correspondence.

The sense of body ownership component refers to the phenomenology of one's self-attribution of a body and is measured on an ordinal scale in VR.⁹ Body ownership is achievable with the visual illusion of spatial configuration between the user's body and body

parts corresponding to a virtual avatar body and/or avatar body parts.¹² Previous researchers found that both in the condition while a user remained stationary, and in the condition while a user interacted as the virtual avatar in an IVE, visual discontinuity in an anthropomorphic first-person avatar

variant condition in which researchers employed an anthropomorphic first-person avatar representation using the metaphor of a full body.¹⁵ The study found users reported the sense of body ownership among all varied levels of realism of the virtual avatar bodies and users exhibited decreased



UX DESIGNERS MUST CONSIDER THE SPECIFIC HUMAN FACTORS THAT ENABLE COMMUNICATION BETWEEN VIRTUAL AVATARS.

representation using the metaphor of a full arm decreased the sense of body ownership.¹² This HVEI review suggested that higher quality anthropomorphic avatars are better when establishing a sense of body ownership.

Markedly, other HVEI UR found evidence to suggest that the idea that perceived body ownership relies on preexisting stable body models is more fluid in VR.¹⁰ Previous researchers capturing physiological measurements found that the user's implicit reactivity to a perceived virtual threat to an artificial limb of an anthropomorphic first-person avatar representation using the metaphor of a full arm was not equally affected by visual discontinuity.¹⁴ While the two lower realism virtual avatars elicited the lowest skin conductivity readings, respectively; unexpectedly, the high realism virtual avatar and medium realism virtual avatar skin conductivity readings did not differ from one another significantly.¹⁴ Additional findings to help interpret these results included another virtual body illusion experimental

levels of body ownership as the levels of realism declined.¹⁵ These HVEI reviews suggested that there is a form realism quality threshold in anthropomorphic avatars, the range yet to be pinpointed, necessary when establishing the sense of body ownership to generate the user's sense of embodiment. This developing theory of HVEI allows UI semantic information reconstruction for extended UX perception of shape, size, and symmetry inconsistent with normal body proportions.¹⁵

Grounded Theory HVEI Systematic Review: "How do you amplify the positive attributes?"

In addition, UX designers must consider the specific human factors that enable communication between virtual avatars. For interaction and communication by, and with, virtual human avatars, both the qualities of form realism and behavioral realism⁵ are charted along sliding scales to determine anthropomorphic realism, referred to as ecological validity.¹⁶ Ecological validity of form realism of

a virtual human avatar in an IVE refers to “how much the representation statistically resembles features of a given user.”¹⁶ Ecological validity of behavioral realism in an IVE refers more broadly to “the extent to which virtual humans and other objects behave like their counterparts in the physical world.”⁵ Virtual encounters have documented the associated tendency in the human psyche of anthropomorphism, the attribution of human-like traits, including intentions and emotions to nonhuman objects.¹⁷ Mapping to preexisting mental models of human forms is one explanation for how 20 polygons is an accepted avatar face in VR. It is the degree of virtual human avatar realism, the anthropomorphism, that neurological studies are now capable of manipulating with design heuristics to measure the effect on the user’s acceptance of the simulated reality.

However, it is not a given that higher form realism is the right affordance on the ecological validity scale in a virtual human avatar even when using

design heuristics capable of facilitating realism. Other research fields have described the potential consequences of the uncanny valley effect when artificial human forms come too close to real human forms.¹⁷ This phenomenon of affinity toward an artificial human is graphed to show when the acceptance of the degrees of realism in an artificial human sharply decreases, creating the uncanny valley.¹⁷ Human cognition processes instinctively recognize appropriate human behaviors associated with movement and communication exchanges, and thus the simulated forms that try to replicate a real human can trouble the emotional responses to virtual humans.¹⁷ Modern film audiences and videogame players have described negative feelings when viewing computer generated characters on the screen that attempt more form realism but lack matching human behavioral realism.^{17,18} Many ascribe this to a viewer becoming more discerning of the artificial human’s behaviors as the artificial human achieves higher form realism, which then raises the

quality expectations for behavioral realism.^{17,18,19}

EXPERIMENTAL DESIGN

Grounded Theory HVEI Multiphase Experimental Design Process: “How much sensory feedback from the [IVET] can the user process?”

In this study’s experimental procedure, subjects preselected a VR partner, an interactor, situated in “The Backyard Porch” IVE (Unity game engine) to perform an improvisational scene (“So, What You’re Saying Is”). The research assistant, as the improv partner, crafted a role-play persona to puppeteer the interactor’s virtual body in real time (see Figure 1). Subjects did not know there was a live person interacting with them in the IVE as an avatar. The research assistant was in the closed UR lab across the hallway from the participant’s lab room and used a networked computer to view the live IVE scene and hear the participant audio feed.

To study the ecological validity of social presence in VR, the IVE explored the affordances of virtualness on the chart of the uncanny valley. For the experiment, the researcher considered that highly accurate anthropomorphic avatar forms set up sophisticated expectations for behavioral realism, that if not met, lead to reduced “copresence.”⁴ HVEI copresence is a more basic level of the illusion of presence that encompasses the feeling of being together with virtual humans in the same virtual space.¹⁶ Accordingly, the interactor’s avatar purposely did not represent a pixel accurate rendering of a human being. Instead, this design classified a novel category for a virtual human avatar, mediated anthropomorphic android



FIGURE 1. Research assistant in the UR Lab puppeteering the interactor’s avatar, the improv scene partner.

projections [see Figure 2(a)]. The experimental “anthropomorphoid” persona is based on a realistic human form with stylized-realism visuals and a synthesized voice that do not afford hyperrealism, such that the effect renders an unconscious affinity toward an anthropomorphic android. The anthropomorphoid avatar design template was mapped along the existing anthropomorphic form realism axis as nonphoto-realistic computer-generated. The template scaled up the anthropomorphic avatar along the behavioral realism axis with real time interactive verbal responses. The design prioritized reactive communication to enable authentic conversations for behavioral simulation. The research assistant used a headset with a microphone and a voice modulation app to perform the interactor character’s persona while simultaneously triggering their avatar’s gestures and facial expressions bound to the keyboard hotkeys.

The design of the participant’s avatar heuristics also maximized the phenomenon associated with the Proteus effect; in a dyadic IVE encounter, if there is no avatar or no contradictory information about a humanoid body form is presented for the participant’s avatar, participants default to an anthropomorphic assumption in their partner’s avatar form.⁴ However, to strengthen copresence, any participant avatar form is better than no avatar.⁴ Further, when there is a first-person avatar for the participant, their virtual body ownership (VBO) is affected by the appearance of the partner’s avatar; and less anthropomorphic partner avatars generate less copresence.^{4,8} Therefore, the study assigned a first-person form-matched anthropomorphic avatar to the subject.

The VBO illusion was achieved with the fabrication of a humanoid 3D computer model that was a relative physical match to the subjects in proportion and scale realism. The anthropomorphic biased extendable self-location illusion was achieved with the first-person self-avatar using humanoid form parts that were sufficient in number for the efference copy to be filled in with the user’s pre-existing mental models of human forms; the designed exclusion of avatar arm extremities successfully released the user to behave naturally with their physical gestures and not

have to process any behavioral inconsistencies with their avatar body parts [see Figure 2(b)]. The bottom-up cross-modal self-agency illusion was achieved with the operationalized Gestalt law of proximity, the closeness effector, situating the camera in place of the avatar head overrode the lack of physical real-body visual correlations of a head form for their virtual avatar, and used the Gestalt law of continuity, the connectedness effector, with the topmost human factor of quality of synchronicity of operation of the camera’s movement to the user’s head movement for control of the agency

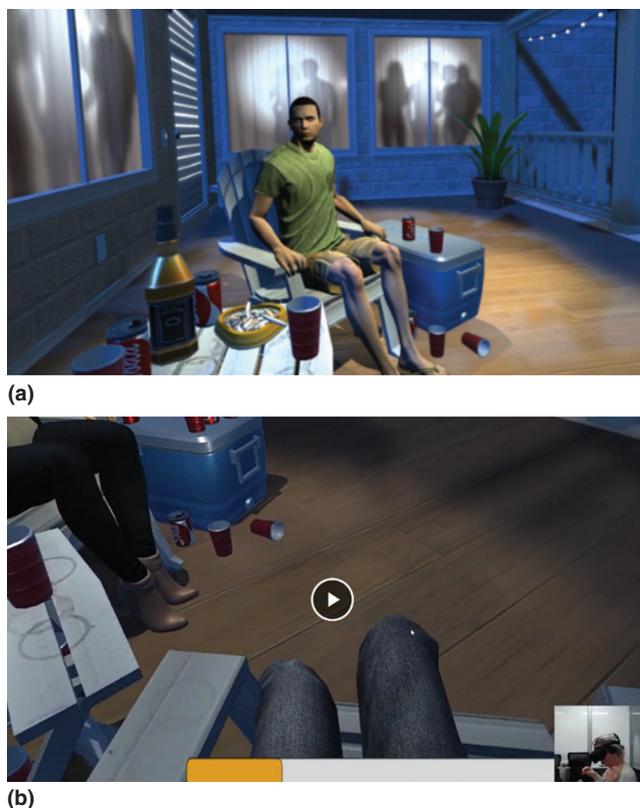


FIGURE 2. (a) Participant HMD view of an interactor’s avatar inside “The Backyard Porch” IVE in the Unity game engine. (b) Participant view of their self-avatar situated in the virtual gray Adirondack chair and a live view of participant in the hallway lab seated in the real-world gray Adirondack chair.

of their avatar “head.” And the overlapping relationship of self-avatar anthropomorphism and matching body-scale effects in the virtual environment was furthered with the gray plastic Adirondack chair in the lab space, in which the participant sat, that was realistically modeled and placed in “The Backyard Porch” IVE in which their self-avatar was presituated at the start of the simulation.

Grounded Theory HVEI Multiphase Experimental Design Process: “Will the user perceive limitations? How will the user accept the limitations?”

Previous research has shown that, provided the participant’s sense of presence is sufficient, an IVE can eliminate the Hawthorne effect, the alteration of behavior by the subjects of a study due to their awareness of being observed; in an IVE, the participants forget they are being observed and offer genuine responses to the stimuli in the experiment.²⁰ The real-time qualitative data in this study suggested that the user’s combined SoE of the ecological validity of their self-avatar form was sufficient to experience the scenario designed by the researcher, improvisational role-play. All subjects completed the improv scene with their partner. The researcher’s collection of contemporaneous comments of the participants did not contain accounts of critique of the gender-neutral self-avatar in which the subject was placed. The observational data sources, the memos and the session video recordings, documented the user physically gesturing with a thumb’s up, clasping and unclasping their hands, waving hello and goodbye, and moving their arms up, down, and sideways throughout multiple user sessions.

The observational data in the video capture of the virtual session showed all the virtual dyad avatar communications were facing one another in the scene, the participants oriented the virtual camera with their physical heads to converse in the virtual world’s line of sight of the interactor’s avatar. The researcher’s observational notes did not document a single instance of the user getting up from the physical chair until after they had left the virtual world in which their self-avatar was situated in the mediated replica of the chair and removed the HMD. Taken together, the verbal and non-verbal behavioral observations of the subjects were markers consistent with copresence within the IVE. Thus, the application of the HVEI egocentric perspective of human virtual interactions indicates that an anthropomorphoid avatar, as the artifact’s virtualization design affordance in this experiment, did not seem to trigger the psychological rejection phenomenon of the uncanny valley with its UX application of stylized humanoid visuals.

DISCUSSION

Grounded Theory Analyses of Data and Theoretical Interpretations: “What type of consequences will the user face after an IVE experience?”

Previous research established social desirability bias, associated with the patterns of response to a real-life human partner in which the subject inflates their self-assessment to appear favorable, is reduced when paired with a virtualized partner.²⁰ This study found the anticipated IVE methodological copresence effect of reduction in social desirability bias dynamics associated with

dyadic interactions within the media of VR. In this experiment’s variable controls, emotional intelligence was selected to represent a skill that the participants would be learning with the instructional content of the VR workshop session. Emotional intelligence (EI), is the degree of mastery of an individual’s abilities in communication, to “perceive, interpret, demonstrate, control, and use emotions to communicate with and relate to others effectively and constructively,”²¹ including “the ability to express and control emotions and the ability to understand, interpret, and respond to the emotions of others.”^{21,22,23} EI had not been introduced to the participants, and the subjects’ preexperiment self-assessments of EI skills were based solely on their interpretation and subject to potential social bias. The EI of the participants was assessed via the Trait Emotional Intelligence Questionnaire, a 30-item scale developed by Petrides.²⁴ A seven-point Likert scale was provided, with options ranging from “completely disagree” to “completely agree.”²⁴

The team dynamics workshop was adapted for VR from a classic role-play improvisational scenario designed to teach EI using active listening script prompts. For the improv, a noncontroversial topic about which people can hold opposite positions was selected by subject popular vote: “I love cats” versus “Cats are not good pets.” In the IVE, two seated avatar partners faced one another, and each partner shared their opinion in one sentence without relating to the other person. Then the improv partners took turns sharing reasoning for their opinion, and the partner responded by paraphrasing the sentence without using any of the same words, starting with “So what you’re

saying is..." until each had shared a minimum of three reasons. The 30-minute VR session practiced the following EI creative thinking skills:

- › attentive listening
- › listening without interpretations to what another person is saying
- › receiving emotional information
- › responding without judgement

The post-session resurvey of the participants' EI was used to compare their skill self-ratings after the virtual avatar dyad interactions. Specifically, the quantitative data analysis found there was a statistically significant (t -value = 4.6998, p = 0.0001) directional change in the participants' self-assessment of their EI rating after the first VR session, the subjects' mean score decreased (see Table 1). Thus, the experimental research conditions with anthropomorphoid ecological validity (as an avatar heuristic design) were consistent with the theoretical markers for creating copresence within the IVE (an effect on social desirability bias) and contributed to a grounded theory of social presence in the media of VR.

Grounded Theory Analyses of Data and Theoretical Interpretations: Parasocial Interaction with the Media of VR

Parasocial relationships were not introduced to the participants directly and were assessed post-session via the 13-item scale originally designed with race car drivers as the subject developed by Hartmann et.al., and this study operationalized with "VR partner" as the subject.²⁵ A five-point Likert scale was provided, with options ranging from "disagree strongly"

to "agree strongly."²⁵ The analysis of quantitative variable data in this study points to the presence of parasocial relationships forming in a dyadic IVE between the participant with a virtual human self-avatar and their mediated scene partner's fictionalized virtual human avatar persona. Specifically, there was a statistically significant positive relationship (t -value = 3.06, p = 0.005) between the strength of the parasocial relationship with the scene partner's avatar and the participant's increase in real-life skill development of EI. For a given subject, as parasocial relationship scores varied by one-unit, EI scores increased by 0.7894 units. The analyses indicated that the virtual human persona dyad generated the theorized effect of parasocial interaction, in which a person's behavior is influenced by a fictional media persona.⁶ The theoretical sampling of a virtual media persona relationship and a real-world skill variable, parasocial relationship and EI, suggested the social relationship with a virtual human avatar fictional persona influenced the real-life behaviors of the subject and further contributed to

a grounded theory of social presence in the media of VR.

Grounded Theory Analyses of Data and Theoretical Interpretations: A Proposed New Hybrid Orthosocial-Parasocial Relationship Grounded Theory

These theoretically sensitive interpretations of the quantitative and qualitative data analyses across the VR sessions led to the new grounded theory of an emergent arrangement of parasocial relationships, a hybrid orthosocial-parasocial relationship in VR as a media platform. Orthosocial relationships are mutually reciprocal interpersonal relationships between two or more people.⁶ In this study's IVE, the mediated communication of the dyad described an authentic interpersonal relationship that embodied elements of both orthosocial and parasocial relationship phenomenology:

- › As seen in this study's qualitative memos, puppeteering, as an orthosocial relationship communication construct,

TABLE 1. EI pre- and post-session, N = 32.

Variable	Mean	Std. dev.	Min	Max
EI pre-S1	99.53	11.50	77	127
EI post-S1	94.16	11.03	77	124

TABLE 2. Parasocial relationship post-session 1, N = 32.

Variable	Mean post-S1	Std. dev. post-S1	Min post-S1	Max post-S1
Parasocial relationship	39.75	6.8203	26	53

EMOTIONAL INTELLIGENCE SURVEY QUESTIONS

1. It's easy for me to talk about my feelings to other people.
2. I often find it hard to see things from someone else's point of view.
3. I'm a very motivated person.
4. I find it hard to control my feelings.
5. My life is not enjoyable.
6. I'm good at getting along with my classmates.
7. I change my mind often.
8. I find it hard to know exactly what emotion I'm feeling.
9. I'm comfortable with the way I look.
10. I find it hard to stand up for my rights.
11. I can make other people feel better when I want to.
12. Sometimes, I think my whole life is going to be miserable.
13. Sometimes, others complain that I treat them badly.
14. I find it hard to cope when things change in my life.
15. I'm able to deal with stress.
16. I don't know how to show the people close to me that I care about them.
17. I'm able to "get into someone's shoes" and feel their emotions.
18. I find it hard to keep myself motivated.
19. I can control my anger when I want to.
20. I'm happy with my life.
21. I would describe myself as a good negotiator.
22. Sometimes, I get involved in things I later wish I could get out of.
23. I pay a lot of attention to my feelings.
24. I feel good about myself.
25. I tend to "back down" even if I know I'm right. I'm unable to change the way other people feel.
26. I believe that things will work out fine in my life.
27. Sometimes, I wish I had a better relationship with my parents.
28. I'm able to cope well in new environments.
29. I try to control my thoughts and not worry too much about things.²⁴

PARASOCIAL SURVEY QUESTIONS

1. I think the VR partner is like an old friend.
2. The VR partner makes me feel as comfortable as when I am with friends.
3. I think about the VR partner even when I'm not in VR with them.
4. I miss the VR partner if I do not interact in VR with them for a long time.
5. I feel that I know the VR partner very well.
6. I try to imagine what the VR partner thinks about a conversation.
7. VR conversations show me what the VR partner is like.
8. I find the VR partner to be likable.
9. I mostly agree with the conversations with the VR partner.
10. If there were a story about the VR partner in a newspaper or on TV, I would read or watch it.
11. I would like to meet my VR partner in person.
12. I admire the VR partner for their achievements.
13. I look forward to having a discussion with the VR partner in the next conversation.²⁵

enabled contextually reactive UX interactivity and achieved behavioral realism at appropriate levels to engage the willing suspension of disbelief with a virtual partner.

- › As seen in this study's quantitative analyses, a parasocial relationship with a fictional persona that was one-sided on the part of the subject, the stylized humanoid form of the mediated interactor virtual avatar, was enough to influence behavior in the real world.

Thus, the reciprocated interactive communication with a mediated persona virtual in appearance and synthetic in voice should be considered for a separate threshold of orthosocial relationship, a mutually reciprocal interpersonal relationship between a consumer and mediated virtual persona. As there were elements of both orthosocial and parasocial relationships in the experimental design of this grounded theory research study, future exploration to establish the nature of authentic interpersonal interactions embodied with virtual avatar heuristics design is warranted.

This study's experimental conditions stimulated some unique potential benefits of "more than genuine" responses to stimuli with anthropomorphoid dyadic behavioral simulations. Specifically, those participants who chose to return for the second VR improv workshop described that subsequent emotionally charged session ("Emotional Contagion") as fun, and requested another, third, session to learn more EI skills. This suggested a conscious understanding that

the virtual human avatar scene partner was not physically present in the same real-world space and some participants desired to interact more playfully in VR.

With the benefits of virtuality itself only partially documented by research, there is more to be explored in relation to social engagement with virtual avatars in IVE interactivity design and behavioral change. The markers documented in this study point to a level of concern for another virtual person's reactions in the IVE consistent with "more" freedom of expression. Perhaps situating the dyad in an emotional state afforded untempered responses precisely because of its artificialness. Participants may have felt freer as there were no ramifications that accompany a real-world orthosocial relationship. As the ecological validity for boundaries of the new proposed hybrid orthosocial-parasocial relationships in a dyadic IVE are researched further, fidelity accorded interactive behavioral training simulations could accomplish gains for individuals that find they prefer to engage with virtual human interactors on sensitive topics concerning their feelings or experiences. ■

ABOUT THE AUTHOR

ELIZABETH H. STRINGER is a clinical professor at Southern Methodist University, Dallas, TX 75275-0309 USA. Her research interests include games user research, extended reality, and learning cognition. Stringer received her Ph.D. in arts, technology, and emerging communication from the University of Texas, Dallas. Contact her at estring@smu.edu.

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