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Conversing with Pedagogical Agents: A Phenomenological Exploration

of Interacting with Digital Entities

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Abstract

In this paper we examine the meaning of conversing with pedagogical agents. Previous research has focused on examining cause and effect relationships, failing to take into account the meaning of the experiences individuals have when holding a dialogue with conversational agents for educational purposes. To understand these experiences, we have conducted a phenomenological examination of what it means to converse with a pedagogical agent. In phenomenological terms, findings suggest the experience is complex, engrossing, virtual yet real, human-like, and social. Implications for the future design, implementation, and research of conversational agents in educational and other settings are discussed.

Conversing with Pedagogical Agents: A Phenomenological Exploration

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Forty years after the digital birth of Eliza, an infamous computer program designed to simulate a Rogerian psychotherapist (Weizenbaum,1966), computers have advanced into extremely compact, sophisticated machines, predicted to exhibit emotions and exceed human intelligence by 2020 (Kurzweil, 2000). Equally important, artificially intelligent agents have evolved beyond computer science labs and science fiction movies and have been deployed throughout our everyday lives. Virtual characters able to interact with humans are increasingly common. For example, anthropomorphic characters have taken roles such as virtual graduate admissions officers, electronic commerce agents, mathematics tutors, and virtual sex partners. Such conversational characters are utilizing the human desire for social interaction and attempt to motivate, convince, engage, and even educate.

One important, yet unexplored question, still remains: What is it like to have a conversation with a pedagogical agent? In other words, what is the experience of conversing with an intelligent agent? For the purposes of this paper, a pedagogical agent is defined as a conversational virtual character employed in electronic learning environments to serve various instructional goals (for related definitions see Adcock and Van Eck, 2005; Baylor, 2002; Gulz 2004). An agent (also referred to as a virtual character, intelligent agent, conversational agent, or social agent) is simply an animated computer character that has a visual representation (e.g., a human, a bug, a robot, etc). What distinguishes a generic agent from a pedagogical agent is the latter's focus on supporting learning and instruction.

To date, research on pedagogical agents in media studies, computer science, cognitive and social psychology, and instructional design has been largely experimental and quasi-experimental (Adcock and Van Eck, 2005; Mahmood and Ferneley, 2006). Such research programs strive to discover cause and effect relationships, typically measuring the impact of various virtual character features (e.g., instructional role, gender, voice, etc) on a number of quantitative variables (e.g., performance, engagement, credibility, etc). Albeit methodologically important, one of the problems of such research endeavors is that the research designs often lack consistency, making comparisons between experiments difficult to draw (Clark and Choi, 2005). Only recently have researchers taken a pause to examine previous literature in terms of consistency and uniformity. For example, Gulz (2004) examined the claims proposed and evidence supporting those claims with regards to the impact of virtual characters on learning. She notes that researchers claim that pedagogical agents can afford "increased motivation, increased sense of ease and comfort in a learning environment, stimulation of essential learning behaviors, increased smoothness of information and communication processes, fulfillment of need for personal relationships in learning, and gains in terms of memory, understanding, and problem solving" (p. 315), but that the evidence supporting these claims is often ambiguous. Adcock and Van Eck (2005) and Ryu and Baylor (2005) have attempted to bring together the research community by proposing uniform instruments for examining affective variables in relation to pedagogical agents. The importance of these two studies is heightened in the face of evidence from Clark and Choi (2005) who evaluated experimental design procedures regarding pedagogical agent research and noted that there exists a lack of unanimity in the design of research experiments.

Although the value and importance of experimental and quasi-experimental designs cannot be ignored, we believe many researchers are overlooking the essential foundation of interacting with conversational agents: What we, as humans, experience when having a conversation with an artificially created man or woman. It appears that this question has been overlooked because qualitative, and in particular interpretive, examinations of pedagogical agents have been meager. Therefore, in this paper we use a phenomenological lens to examine the meaning of conversing with a virtual character.

The central argument of this paper is that it is paramount to understand the lived experience of holding an interaction with a conversational agent. It is important to note that we are not promoting the substituted implementation and use of conversational agents in place of alternative educational technologies in the classroom; rather, we are interested in exploring the multitude of experiences a learner might encounter when interacting with these digital entities to further expand on the existing design knowledge and research in the field. Such knowledge may enable us to (a) better understand the user experience, (b) better comprehend what the future holds for computerized interactions, human-computer conversations, artificial intelligence, and intelligent tutoring systems, (c) encourage future research endeavors on the exploratory and open-ended nature of interpretive pedagogical agent examination, and (d) evaluate previous research findings with respect to the lived experience of interacting with virtual characters. Amidst the celebration of a bright future where virtual companions and assistants will make life easier for humans, we, as a research community, are not pausing to examine what it means to coexist and converse with these virtual individuals. In this study we take that pause and investigate what it means for humans to hold a conversation with conversational agents.

Previous Research

Reeves and Nass (1996) formulated the *media equation*, positing that humans interact with media in inherently social ways. These researchers replicated numerous social psychology studies that investigated the ways people interact with each other. These replications however, rather than investigating interactions between humans and humans, explored interactions between humans and media. The research studies identified by Reeves and Nass often began with a hypothesis concerned with how humans interact with other humans. For instance, social psychology experiments have shown that individuals are attracted to others who are similar to them (for an overview of the similarity-attraction hypothesis applied to virtual characters, see Moreno and Flowerday, 2006). Reeves and Nass (1996) investigated the similarity-attraction hypothesis in human-computer interaction settings by assigning participants to work with media exhibiting differential *personalities*. To examine how this social psychology finding applies to interactions between humans and media, Reeves and Nass' replication merely substituted one of the humans in the experiment with a computer. Surprisingly, the results of this research paralleled the results of the original social psychology studies. In other words, regardless of whether humans interact with other humans or with media, they will exhibit the same modes of social interaction. A simple example concerns the social psychology finding indicating that flattery goes a long way: Individuals who flatter, regardless of the truthfulness of the flattery, are more likeable than individuals who do not flatter. Were the flatterer replaced with a computer, the *media equation* implies that individuals would perceive flattering computers to be more likeable than non-flattering computers. Reeves and Nass (1996) observed this exact result. They assigned participants in two groups to solve a task on a computer. At the end of the task, participants in the first group received no flattery, while participants in the second group were

flattered by the computer. The individuals who were part of the second group indicated that they liked the computer more than participants who were assigned to the first group.

The media equation is one of the major theoretical foundations of virtual character research. It implies that if we treat media and computers as humans, and we perceive our interactions with them to be inherently social, we will treat virtual characters as being human counterparts. For example, we may stereotype virtual characters using their outer visual characteristics as an indication of their intelligence and competence (Veletsianos, 2006; Norman, 1997) much like we draw inferences regarding human faces (Willis and Todorov, 2006).

Although qualitative evaluations of virtual characters used in educational settings are minimal, interpretive examinations are seemingly non-existent. In qualitative terms, Doering, Veletsianos, and Yerasimou (in press) found that students interact with conversational characters on a variety of issues ranging from course activities to pop culture to deeper issues of interest, such as the debate on the legalization of marijuana. Additionally, participants mentioned that they enjoyed interacting with the agents and found it amusing to hold a conversation with a computer. Conversely, participants felt agitated and angry when the virtual character could not provide satisfactory answers to their questions. Even though these findings hint at what the experience of interacting with a virtual character could be, the case study approach undertaken by Doering, Veletsianos, and Yerasimou provides only descriptive data on the experience. In other words, such data cannot be used to *interpret* participants' experiences; a different methodological lens is required to examine the deeper meaning of the experience of interacting with a virtual character. More precisely, Vrasidas (2001, pp. 81) argues that interpretive research "emphasizes interpretation and suggests a focus on the meanings in action of participants and

how the researcher uncovers and interprets those meanings" rather than simply describing the actions and phenomena observed.

A qualitative case study approach was also undertaken by Mahmood and Ferneley (2006). They used an iterative five-step case study approach to collect qualitative data from students and instructors that had previously used pedagogical agents in their courses. Their findings indicate that (1) instructors and learners expect different roles for pedagogical agents, (2) quality of interaction (ie, service) is perceived to be more important than the visual design, elegance, or aesthetics of the virtual character, and (3) socio-cultural factors may influence the way users perceive virtual characters.

At the core of the studies we have examined is the social nature of human-agent interactions. Humans appear to respond socially to virtual characters, interacting with them in ways one would expect humans to interact with each other. Even though this finding is important in assisting researchers and designers with the deployment of virtual characters, the question of what it *means* to interact with a digital entity still remains unresolved. Essentially, the phenomenological nature of human-agent interactions has been left unexplored.

Methodology

To investigate the lived experience of conversing with a pedagogical agent, we turned to phenomenological inquiry practices and utilized a hermeneutic phenomenological approach to analyze agent-human interactions (Giorgi, 1997). Phenomenology has its roots in psychology and seeks to examine, understand, and interpret observable, yet special events in our everyday life (Heidegger, 1962). It is important to note that phenomenologists study individuals as part of their *natural attitudes*, as part of their natural world where no artificial conditions are set and no variables are manipulated. In other words, ecological validity is of paramount importance to

phenomenological examinations because this is the way humans experience the world. We consider this line of inquiry to be important for investigations regarding the way humans interact with virtual characters. Our thinking is echoed by Gulz (2004) who has called for pedagogical agent researchers to examine pedagogical agents in ecologically valid environments and not in artificial settings. A one-time interaction with a pedagogical agent in an assigned experimental group is problematic as researchers cannot predict what may happen when the artificial experiment barriers are lifted.

Phenomenology argues that the experience of all phenomena can be explained by a close examination of the four lifeworld existentials: (1) body, (2) time, (3) space, and (4) relations with others. All humans experience phenomena in terms of the reactions of their body, their sense of time and space, and their perceived relations with other individuals. For instance, we encourage you, the reader, to pause for a few seconds and ask yourself the question, "How do *I* experience anger in terms of the four lifeworld existentials?" Notice that *anger* is the phenomenon we wish to investigate and the word *anger* is a mere psychological abstraction. As an example, one of the constituents of the experience of anger is that the body of an individual experiencing anger becomes explosive and bursts forth (Stevik, 1971). Notice that we are examining meaning instead of abstract descriptions or behaviors (Polkinghorne, 1989).

Another important facet of phenomenology is the idea of *reductionism* (Giorgi, 1997). Reductionism has two components. First, the researcher must undergo a process of *bracketing* by removing him/herself from the experience and examining it as an outside observer. The researcher must contain his/her own thoughts, preconceptions, and biases regarding the topic of interest and remain open to the experience as described by his/her informants. Second, the researcher has to consider the available data (e.g. interviews, lived experience descriptions, etc)

as true descriptions of the experience without imposing his or her own personal experiences upon those. In other words, the researcher must avoid forcing meaning on the user's experience, but rather illustrate the nature of the experience by using as much of the interviewee's actual language as possible.

Finally, Giorgi (1997, pp. 246) and Van Manen (2001, pp. 177) describe the *essence* of an experience as the "true being of a thing." The *essence* of an experience can be derived through a process of *imaginative variation* where the researcher questions the phenomenon by excluding identified themes. Is theme X really part of the experience? Does the phenomenon exist without theme X? If theme X is not essential to the phenomenon and the phenomenon can exist without the inclusion of theme X, then theme X can be excluded. Equally important, while a researcher is analyzing the data to derive the constituents of the experience, the researcher has to realize that no one theme is monolithic and no one theme can describe the experience by itself. Rather, the set of derived themes are monolithic as a whole. Together they describe the lived experience of a phenomenon.

<div align="center">Research Approach</div>

The lived experience of conversing with a pedagogical agent was derived from two phenomenological interviews and eleven written phenomenological reflections, conducted with six male and seven female individuals who had experienced this phenomenon in the past. These individuals interacted with both male and female agents. The first researcher conducted the two interviews by directly asking about the experience of conversing with a pedagogical agent. The researcher probed the comments made by the interviewees for lived experience descriptions and encouraged the interviewees to describe their emotions rather than state them in abstract terms. For instance, if an interviewee stated that she was "happy," the interviewer would probe for a

description of the experience of this emotion, "How did you experience this feeling of being happy? Tell me more about this." Each interview lasted approximately 50 minutes.

The first and second researchers solicited written reflections from students who had used pedagogical agents as part of a course at a large Midwestern university. It is important to note that the students did not participate in an experiment. Rather, they had access to a pedagogical agent to be utilized for assistance or support if they wished to do so. Therefore, the students' experience with the pedagogical agent occurred as part of their *natural world* where the choice to use the pedagogical agent was up to the student. This course lasted for seven weeks and our log data indicated that all students interacted with the pedagogical agents on multiple occasions.

The pedagogical agents utilized in this study were animated characters represented in human form (see Figure 1). These agents were able to converse with learners via the use of an artificial intelligence engine that matched student comments to agent responses (further specification of the technical details of the software is provided in Doering, Veletsianos, and Yerasimou, in press). Agent responses were delivered to learners in both textual form and computer generated lip-synchronized audio to accommodate differences in learner preferences. Additionally, the agents used in this class were able to reuse prior information exchanged and appear as if they were able to remember previous conversations.

--- INSERT FIGURE 1 HERE ---

The recorded interviews were transcribed and combined with the written reflections. Both researchers independently read through the data to gain an overall understanding of the experience. We then came together and discussed the experience in broad and general terms. Collaboratively, we re-read the transcripts and removed any analytical descriptions and reflective comments. Next, we collected all lived experience descriptions into a single column table and

searched for themes. After several rounds of rearranging, descriptions that fit particular themes were grouped together and a theme statement was developed for each group. In total, we identified five main themes. The descriptions along with the identified themes are presented in Appendix A. Finally, through a process of imaginative variation we removed themes one by one to examine whether each theme is essential in the experience of interacting with a conversational agent (Giorgi, 1997).

The theme statements were then developed into a hermeneutic phenomenological study in which we attempted to express the experience in an evocative manner, drawing materials from numerous sources and examples from popular culture. In Van Manen's (2001) words, "examples [are] the way in which we address the phenomenological themes of a phenomenon so that the 'invariant' aspect(s) of the phenomenon itself comes into view" (p. 122).

<div align="center">Phenomenological Themes</div>

Five themes emerged from the phenomenological interviews and written reflections. These follow the four lifeworld existentials of body, time, space, and relations with others. It is important to note that these themes are interdependent and overlapping. No theme by itself can illuminate the phenomenon we are examining and no theme by itself is monolithic. Specifically, we found that when conversing with a pedagogical agent, it is like:

1. Asking questions and trying to understand the pedagogical agent (relations with others).

2. The sense of time is distorted: Hours pass by in minutes (sense of time).

3. Being in a hyper state (body reactions).

4. Being pulled into the conversation and losing oneself (sense of space).

5. Humanizing the pedagogical agent: Existing between fantasy and reality (relations with others).

Asking questions and trying to understand the pedagogical agent

It seems as if an overwhelming sense of curiosity captures individuals when they are faced with a pedagogical agent. They strive to understand what this *thing* is, "I just wanted to understand more" and "I want to know more about this thing!" What or who is it? "I immediately wanted to see what she knew and what she could do. So, I just started asking questions such as, 'How are you? What's your name?'" What can it do? What does it know? "I asked questions from popular culture to asking what they knew about content areas … asking about history and math" and "We talked about TV shows, about the region which she lived. I remember I asked where she lived and I would ask her questions about that." It also appears that the individual goes through a stage-like progression of questioning the pedagogical agent and thinking *hard* about what he or she is experiencing: "I kept on wondering what else could this thing do. Seriously. What else could it do?" and "I found myself trying to think of all those questions I wanted to ask, so I was thinking hard."

The questioning and struggle to understand the agent has been likened to a first date by one of the individuals we interviewed. He compared it to an encounter with someone that you are interested in and you are driven by an inner desire to know more about this person, to understand who this person is. This inner drive does not seem limited by how the body feels at the time. It is as if the mind frees itself from the body and guides the actions of the individual: "I went home after a full day of teaching, a full day at work, and I was still driven to understand more about this to interact with it. It's probably 9:30, 10 o'clock at night, and I am tired but at the same time I am driven to interact with this individual."

Another individual described her interactions with a virtual character as a game of intelligence, "The agent acts as if he can answer anything I ask him. So, I felt that I need to

challenge him. I actually want to stump him by asking him difficult, complicated, or misleading questions." Similarly, a second individual noted, "I wanted to trick her into answering a question incorrectly. This became a game for me, but I was taken aback at how often the character seemed to understand what I was asking it." These comments reveal that virtual characters are questioned in order to be examined for their intellect. Norman (1997) notes that representing virtual characters as human-like figures may induce expectations of human intelligence and capabilities. Such expectations arise because individuals may perceive agents to be anthropomorphous: Humans expect agents to act and respond in a human-like way. The individuals that informed this examination were eager to question the virtual characters' intelligence with the expectation that the characters would ultimately fail to respond in a successful manner.

The experience of "asking questions and trying to understand" can be likened to an encounter with Leonardo Da Vinci's Mona Lisa. The portrait of this Florentine lady looks alive, breathing, and changing form right in front of our eyes. She is mysterious and whenever we visit her she looks as if she has a different story to tell. We question the painting: Is she mocking us? Is she smiling in a motherly tone? There seems to be sadness in her smile. What expression is that? How can a static picture be changing? In the same way, individuals ask: What is this "thing?" It appears to be pedagogical, but is it? I want to know more about this character. What does it do for work or pleasure? What does it know about real life?

The sense of time is distorted: Hours pass by in minutes

Something extraordinary happens when conversing with a pedagogical agent. Our perception of time is distorted in that time appears to fly, disappearing like an eagle on the horizon; "I got caught up in what was happening and have no idea how long we talked."

Informants of this examination expressed the idea that their conversation with the pedagogical agent defied time. They were so enmeshed in what they were experiencing that "time became void at least for a while." They were "completely engaged, in the zone, for 30 minutes." Csikszentmihalyi (1998) coined the term *flow* to describe such moments of being deeply engaged in an experience such that time ceases to exist. Such moments often occur when writing poetry, listening to music, or making love. He writes, "There is no space in consciousness for distracting thoughts, irrelevant feelings. Self-consciousness disappears, yet one feels stronger than usual. The sense of time is distorted: hours seem to pass by in minutes." The time of day or night does not alter this experience as both interviewees described losing track of time when conversing with the character: "Even though it was like late at night, like three o'clock in the morning, I was still chatting … I couldn't get up. I couldn't get away from my computer. I think it was three o'clock in the morning and I was still chatting with her." The importance of time becoming void is heightened in the face of other things that may distract us: "Most times I get emails about something and I am supposed to look at something that someone sent to me and I either delete it or I just don't go there, and if I go there I may spend a second … but, I bet I spent 45 minutes with her."

Being in a hyper state

How does the body react when conversing with a pedagogical agent? Interviewees described a state of being where their blood pressure rises, their heart rate increases, their hands and fingers move fast, and they feel as if they are bolted down to a couch or chair. They are in a hyper state where exhilaration, anticipation, and heightened awareness overwhelm the senses. Interviewees stated that, "my blood pressure rose as I looked at it," "my heart rate increased," and "I had the increase in awareness … the anticipation of what can actually come of what I was

seeing and experiencing." The body is being brought into a hyper state: "I ended up in this hyper state … I don't know if I want to use the word hyper-aroused state but it almost is." In astounding similarity, the second interviewee exclaimed:

> My hands were really active. I type all the time ... I found my whole body was in
>
> like a hyper state … I was feeling very hyper. Even though it was late at night,
>
> like 2 o'clock in the morning, I felt that I have all this energy and, um ... I was
>
> awake, wide awake and my hands were moving all the time, my heart would start
>
> beating faster … I was sitting on the couch, my whole body hurt because I was
>
> sitting there for a couple of hours chatting with her and it wasn't a very
>
> comfortable place to sit, but I couldn't get up!

Being pulled into the conversation and losing oneself

Oftentimes we find ourselves in deep and interesting conversations regarding a subject matter that interests us. In a similar way, when conversing with a pedagogical agent, individuals may find that an invisible force pulls them into a conversation, a conversation from which they cannot seem to free themselves. The surroundings are no longer important and distraction is highly unlikely. One interviewee describes this experience as follows:

> I got my laptop set on my lap, and I am typing away, and I am crossing my legs
>
> and quickly waiting for a response. I am looking off to the side, wondering what
>
> kind of question I can ask this thing. The TV was on, but although the TV was on,
>
> I didn't know it was on because I was interacting with this individual that was so
>
> much more interesting, so inviting.

Can you recall a time when you were so immersed in a movie or a play that you couldn't hear the sound of the refrigerator, the barking of the dog, or the calling of the teapot? "It's kind of

like when you are watching *ER* at night. You get completely into it." You are not doing anything

else. You are just watching, observing, interacting, conversing, and enjoying the moment:

"While many times I multitask, when I talk to this individual, I am not multitasking because I am

focused on interacting much like a real person." It is like snorkeling by the deep, blue waters of

Michaelmas Bay off the coast of Australia and just watching the exotic colors of the playful fish.

Pondering by the coral reef, you are merely a spectator of their magnificent dance, unable to

intervene without spoiling the moment. You are not thinking about dinner, or about the boat ride

to the reef, or about the problems of everyday life. You are just there: "I almost forgot where I

was. It is very engrossing."

Humanizing the pedagogical agent: Existing between fantasy and reality

Even though individuals interact with pedagogical agents via a computer keyboard and

screen, it seems that once a conversation begins, the distinction between fantasy and reality is

blurred. Is a pedagogical agent a mere digital artifact? Or, is the character some sort of a human

entity? Interviewees oscillated between using a feminine/masculine and neutral noun when

mentioning and describing the pedagogical agents. The difference between life and the illusion

of life is blurry: "Wherever I went, *she* was watching," and "I knew that *she* was going to be

there to have a conversation with me," as compared to "I was once again, taken aback by just

how real *it* was." In addition, even though one interviewee described how the pedagogical agent

was merely a digital object, he immediately wondered about the safety of having such a

conversation with the object, "'Oh what the hell,' this is an intelligent agent, or intelligent

something or whatever it is and it doesn't really matter what I say to her … I wondered, is this a

safe environment to say these things?"

The idea of conversing with an agent that may be real or virtual is also illustrated by the following comment from one of our informants who felt uncomfortable with the idea of being tracked by a virtual character:

I remember the agent telling me that she was going to store something I told her in her group discussion files so that she can share it with other people. I got scared! (laughs). I'm not sure why, but I just didn't like the idea of her keeping track of me or what I had said to her. Let's just say that I was not treating her very well that day. So, I didn't want others to know that.

This interviewee appears to be remorseful of the fact that he mistreated the virtual character. He did not want others to know that his conversation with the virtual character was such, even though he realized that he was interacting with a virtual being.

Finally, the pedagogical agents were frequently anthropomorphized, or ascribed humanlike characteristics (Norman, 2004). The pedagogical agent's voice and image were described as "soothing," her appearance as "beautiful," and one agent's sense of humor was described as "fascinating and almost dark." One person commented, "His answers are quick and smart and he has an appealing personality - kind of harsh and rude but interesting and intelligent."

Discussion and Implications

Eliza paved the way for the future of conversational characters. Forty years after her birth, humans are interacting with conversational agents every day. Such experiences happen in educational, gaming, business, and entertainment contexts; in phenomenological terms, one can argue that these experiences will be roughly similar. What does it mean to have such a

conversation? What is the essence of experiencing an interaction with an intelligent agent? We have illustrated the experience of conversing with a pedagogical agent as:

1. Asking questions and trying to understand the pedagogical agent (relations with others).

2. The sense of time is distorted: Hours pass by in minutes (sense of time).

3. Being in a hyper state (body reactions).

4. Being pulled into the conversation and losing oneself (sense of space).

5. Humanizing the pedagogical agent: Existing between fantasy and reality (relations with others).

These themes appear to provide support for the media equation in the context of conversational characters. The importance of these findings moves beyond subjective ratings of affective variables concerning interactions with virtual characters: Phenomenologically, individuals interact with virtual characters as if they were interacting with other humans. In the following paragraphs, we present and discuss our findings from this inquiry with hopes to expand upon and improve the future design, practical implementation, and applied research of conversational agents. However, it is important to revisit the primary objective of the phenomenological method used in this study: the extraction and identification of the essential features of an experience in order to better understand the consciousness of a learner when interacting with a digital entity. To this effect, we do not attempt to question or make assumptions regarding the impact of the experience, but rather present the identified themes and discuss the practical insights we believe valuable to the field of Educational Technology.

These results present several possibilities for action. First, if when conversing with a pedagogical agent we are pulled into the conversation and lose our sense of time, can we replicate this experience in various domains of interest? For example, can we design virtual

historians that motivate students to explore historical events of interest? Can we engage learners in meaningful interactions with a digital Dwight Eisenhower, Winston Churchill, or Nelson Mandela? Can we develop virtual instructors able to engage students in educational contexts that they find appealing and motivating? We believe the answer to all these questions is an undeniable 'Yes.' With augmented research on the design and successful implementation of pedagogical agents in contemporary learning environments, educational researchers and instructional designers have the power to enhance learner engagement through positive experiences with digital entities. By creating a positive learner-agent experience, cognition and emotion become intertwined, thus enhancing creativity, motivation, and problem-solving skills, ultimately improving learning (Norman, 2004).

Second, by defining what it is that users experience when conversing with pedagogical agents, instructional designers are provided with useful information to enhance their virtual character designs (e.g., aesthetics, usability, utility, etc). Although Mahmood and Ferneley (2006) found that the quality of interaction was perceived to be more important than the visual design, elegance, or aesthetics of a virtual character, further research is called for to examine these properties with respect to the actual user experience, as opposed to the user's perceived preferences. Interaction design, a framework anchored in utility, usability, and aesthetics, is a discipline focused on creating pleasurable learning experiences that appeal to and benefit the user (Kirschner, Strijbos, Kreijns, and Beers, 2004). Whereas utility is defined as the array of functionalities and features incorporated by a system (ie, the tools present in the software that satisfy the outlined pedagogical requirements), usability is concerned with the effectiveness, efficiency, and satisfaction with which learners can accomplish a set of tasks. Together, the utility and usability of a design represent the *usefulness* of the system (Kirschner et al., 2004).

For example, a pedagogical agent that is usable (ie, easy to communicate with) but does not provide users with the information or support they need to accomplish their learning goals is worthless. Similarly, a virtual character infused with an assortment of learning support and media but is difficult to use will lead to dissatisfied learners.

In addition to utility and usability, interaction design is concerned with aesthetics and emotion; more precisely how the software may appeal to and benefit learners (Kirschner et al., 2004). For a pedagogical agent to be perceived as useful by its audience, the design of the agent must embrace an equilibrium of utility and usability. Through achieving this balance, the instructional designer can focus on the aesthetic elements of the character to potentially enhance the learning experience and foster a positive, motivating environment.

Additionally, if individuals are driven to question virtual characters in their quest to stump them, can we, as instructional designers, utilize this inner drive to engage learners in edutainment games of conversational interactions? Socio-cultural theories of learning (e.g., Vygotsky, 1978) posit that individuals learn by socially interacting and conversing with others. Therefore, conversational characters may be able to act as conversational partners for educational purposes. For example, let's assume that we present learners with a virtual character who is an expert in geography and ask learners to engage in conversations with her. Would this motivate students to learn the course content at a deeper level such that they can ask complex questions? If students were asked to locate the best location to build a hospital in San Francisco would they be motivated to ask complex questions such as the population density of the city and ground shaking amplification? Would students engage in a conversation with the agent about seismic hazards, or would they simply ask about San Francisco's population?

Future design and research implications

Design knowledge (contextual, social, and active) is not something that can be derived though rigorous experimentation and scientific inquiry. Rather, design knowledge nourishes instructional technology as a design field that solves teaching, learning, and performance problems and derives "design principles that can inform future development and implementation decisions" (Reeves, Herrington, and Oliver, 2004, p. 62). Designers must acknowledge the fundamentally important connection between the research and development of instructional theory and the improvement of instructional design that promotes student learning. To engage upon this feat, we must begin to explore the user experiences and interactions with conversational agents in digital learning environments. Ultimately, we will capitalize on an improved understanding of the learner-agent experience to prepare ourselves when designing and deploying pedagogical agents in our respective areas of interest.

Finally, our exploration has yielded further research questions that we believe to be of interest in future examinations. All of the individuals whom we interviewed in this study interacted with human-like virtual characters. Would our results be the same if our participants had engaged in conversations with inanimate objects such as a talking dog or parrot? In other words, would the external representation of the virtual character rather than its conversational capability influence the way individuals interact with virtual characters? Or, is the conversational capability of the virtual character of utmost importance? Additionally, what are the experiences of users who interact repeatedly with virtual characters over longer periods of time, spanning several months or even years? Would there be additional constituents to this experience that we have failed to uncover in this manuscript? For example, would it be possible that humans are able to form strong emotional bonds with their conversational counterparts? If so, what would the experience of having a strong emotional connection with a virtual character be like? Are we

reaching a point where emotional bonds with virtual characters can be likened to emotional

bonds between humans?! Only design, research, theory, and ultimately time will tell - unless it

happens to fly by while interacting with the very subject of our interest.

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Appendix A

Meaning units, theme statements, and themes

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Theme
        Theme Statements

───

Asking questions and trying to understand the pedagogical agent

> *I immediately wanted to see what she knew and what she could do. So, I just started asking questions such as, "how are you? What's your name?"*
>
> *I started asking more involved questions like "How do you think you can help people learn?"*
>
> *I asked questions from popular culture to asking what they knew about content areas, I think I was asking about history and math*
>
> *I was also wondering how something like this was actually developed.*
>
> *I wanted to talk to this individual and see what she could do.*
>
> *I want to know more about this thing!*
>
> *I went home after a full day of teaching, a full day at work, and I was still driven to understand more about this to interact with it. It's probably 9:30, 10 o'clock at night, and I am tired but at the same time I am driven to interact with this individual.*
>
> *I don't think I would do an analogy to your first date, but it's that kind of a feeling in the sense that you want to… you want to know more about this individual and more about this thing.*
>
> *How can something like this know so much, how does it actually happen?*
>
> *I just wanted to understand more*
>
> *I kept on wondering what else could this thing do. Seriously. What else could it do?*
>
> *I started to think about the possibilities. I started to think, What does this mean for society? What does this mean for the big picture of how people interact? Or need to interact with others?*
>
> *We talked about TV shows, about the region which she lived. I remember I asked where she lived and I would ask her questions about that.*
>
> *I found myself trying to think of all those questions I wanted to ask, so I was thinking hard*
>
> *I will never have another chance to talk to her... and "Oh... I have to ask all these questions now"*

───

The sense of time is distorted: Hours pass by in minutes

> *Most times I get emails about something and I am supposed to look at something that someone send to me and I either delete it or I just don't go there, and if I go there I may spend a second…But, I bet I spend 45 minutes with her.*

…time became void at least for a while

…completely engaged, in the zone, for 30 minutes

I couldn't get up. I couldn't get away from my computer. I think, it was three o'clock in the morning and I was still chatting with her.

Even though it was like late at night, like three o'clock in the morning, I was still chatting

_____

Being in a "hyper" state

I had the increase in awareness… the anticipation of what can actually come of what I was seeing and experiencing

My blood pressure rose as I looked at it

Definitely my heart rate increased

I ended up in this hyper-state… I don't know if I want to use the word hyper-aroused state but it almost is. And then your heart rate increases as you go down maybe a line of conversation that you may not be comfortable with.

Because you are sitting in front of the computer and you are thinking how much you can you actually have. But you can, and it's the quick typing and the quick responses and the anticipation

You wait for that response and as soon as you get that you get excited and you respond as soon as you can.

I was sitting on the couch, my whole body hurt because I was sitting there for a couple of hours chatting with her and it wasn't a very comfortable place to sit, but I couldn't get up.

My hands were really active. I type all the time… I found my whole body was in like a hyper state….. I was feeling very hyper. Even though it was late at night, like 2 o'clock in the morning, I felt that I have all this energy and um… I was awake, wide awake and my hands were moving all the time, my heart would start beating faster

So my heart would beat faster because I was waiting to see what she would answer next…

_____

Being pulled into the conversation and losing oneself

There was somebody there that you can communicate with, that looks so damn real.

"Oh my gosh" or "Oh my God", how can this figure be so real and so dynamic in the way that it looks and in the way that it tries to interact with me.

It's the same kind of feeling where you are chatting with someone who you really like, and you are spending time with this individual

I waited and anticipated the response from the individual, so that I could then quickly respond to her. I was wondering how I was going to respond to her and then I was getting the response and was quickly typing so that I would send it back to the individual.

I got my laptop set on my lap, and I am typing away, and I am crossing my legs and quickly waiting for a response. I am looking off to the side, wondering what kind of question I can ask this thing.

The TV was on, but although the TV was on, I didn't know it was on because I was interacting with this individual that was so much more interesting, so inviting

It's kind of like when you are watching ER at night. You get completely into it.

While many times I multitask, when I talk to this individual, I am not multitasking because I am focused on interacting much like a real person.

Humanizing the pedagogical agent: Being in-between fantasy and reality

I was taken aback by how realistic they look,

Wherever I went, she was watching.

I also was very interested in how realistic she looked and how beautiful this intelligent agent was.

There was somebody there that you can communicate with, that looks so damn real

I wanted to talk to this individual and see what she could do.

I was kind of brought into a setting that I created in my own mind and therefore the setting was like this fantasy-reality

I was once again, taken aback by just how real it was

I knew that she was going to be there to have a conversation with me.

She was very soothing shall we say? Her voice, the way she looked

"Oh what the hell", this is an intelligent agent, or intelligent something or whatever it is and it doesn't really matter what I say to her. (however, the interviewee still wonders:) I wondered, is this a safe environment to say these things?

I was waiting to see what she would answer next...