

Understanding and Supporting Interactions with Virtual Agents

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Abstract

Virtual agents, computer-generated entities that simulate human-like social behaviours, are increasingly important as mediators between users and virtual environments. Beyond functional roles, these agents also serve important social purposes — as users interact with virtual agents, they inevitably form emotional bonds. To better understand such dynamics and the consequences of such interactions, my thesis investigates how users engage with, form connections with, and reflect on their experiences with virtual agents. Through a series of interconnected projects, I explore the nature of virtual social interactions and the extent to which they mirror real-world social behaviour. I consider how the malleable dimensions of virtual worlds shape how users perceive and engage in virtual social interactions, draw insights toward broader human motivation, and develop guidelines for designing virtual agents. My future plans involve refining virtual agents through generative models and exploring interactions with an agentive self mediated through a virtual environment.

CCS Concepts

• **Human-centered computing** → **Empirical studies in HCI**;
Empirical studies in interaction design.

Keywords

Social Interactions, Social Virtual Reality, NPC Interaction, Reflection

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1 Introduction

In a virtual world, the environment, interactions, and actions that a person can take are limited solely by the imagination of the designer. These spaces allow individuals to embody different characters, explore novel environments, and interact with virtual agents that may help or hinder them. Although such virtual worlds, such as games and virtual reality environments, are often lauded for their entertainment purposes, they have been increasingly studied for their potential to affect human emotions and motivations through

the existence of these agents [5, 16, 24, 28]. Consequently, such environments have increasingly been used in serious contexts such as education or healthcare [6, 19, 27], with virtual agents acting in social roles such as conversation partners, mentors, or teammates. In such virtual environments, social interactions with virtual others can foster connections that can evoke a wide range of emotions, such as joy, sadness, or deep contemplation [16].

Given the malleable nature of virtual worlds, interactions with agents can be specifically shaped by a designer. Although the use of virtual agents is broad in context, my research has primarily focussed on agents in entertainment domains; these agents enhance a user's subjective feelings of fun and enjoyment within the virtual world. For example, these agents often take the form of non-playable characters (NPCs) in games. NPCs are pivotal — they give players a reason to care about the game and are critical to the game's success [2, 9]. Users often interact with NPCs functionally; NPCs help the user progress, provide information, and so forth. However, users also foster emotional connections through interaction [15]. These emotional connections, and their subsequent impacts on empathy, appreciation, and perceived meaning [16], extend beyond the virtual realm — both games and virtual reality applications have been studied for their potential to establish prosocial outcomes that users take into the real world [14, 16, 23].

Focussing on this, how do players perceive themselves within virtual worlds, and how do their actions and decisions within such worlds reflect and influence their real-world personalities and choices? Furthermore, how do specific design decisions within these worlds, including the behaviour of the virtual agents, shape the connections that players form with them? Through understanding these dynamics, we can make guidelines for the future to create experiences that are increasingly engaging and meaningful; experiences that can potentially help promote empathetical thinking.

Thus, the main research objectives that my thesis aims to address are:

- Understanding how people perceive and their positionality in the virtual world, and examining the extent to which their social behaviour in the virtual world mimics or affects their social behaviour in the real world.
- Investigating how the flexible dimensions of virtual social interactions affect the connections people form with virtual agents, and exploring the implications these dynamics have on future design.
- Interpreting people's social behaviour in virtual worlds as a mirror into a broader understanding of social motivation, providing insights into how virtual interactions inform our understanding of human nature.

My work takes a comprehensive look at social interactions in virtual worlds, from examining people's present experiences with such interactions to building systems that explore specific dimensions

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of interaction. It bridges the gap between activities that are often seen as leisurely (such as playing narrative-driven games) using these activities as a lens for understanding human social behaviour. Through my research, I aim to highlight guiding implications towards the design of virtual interactions, to create more engaging, impactful, and meaningful interactions in the future.

2 Results and Contributions

2.1 Social Interactions with Virtual Agents

The majority of my existing corpus of work has focussed on social interactions with virtual agents (NPCs in game contexts). NPCs are important in enhancing the game experience and making players care [2]. Through interactions with the NPCs during gameplay, players can develop emotional relationships with NPCs which can induce feelings tied towards appreciation and perceived meaningfulness [10, 16, 26]. NPCs that act realistically are therefore imperative for emotionally compelling social experiences that feel consequential [15].

2.1.1 Player Positionality and the Importance of Choice. Isbister describes how the emotional power of games lies in the fact that games are ‘comprised of choices with consequences’ [15]. We extended upon this statement in our work on understanding the impact of choice in narrative-rich games [33], with part of our findings tying into how choice mediates the relationship between the player and the NPCs. In this work, we interviewed both video game developers and players to better understand how and why choice is used in narrative-rich games. Our findings first establish player positionality within the game — whereas the player themselves (in the real world) and the player character (their representation in the game) are separate entities, the existence of choice synchronizes their intention. Player choices both inform and affect the virtual world and the NPCs that inhabit the world, thus, player choice inevitably connects the player and the NPCs. Through making decisions in-game, players consciously affect the lives and the future of these NPCs, and form emotional relationships with them; these relationships later feed back into decision-making as players consider the consequences of their actions and begin to empathize with these virtual agents.

This is supported by additional work on decision-making in moral dilemmas from various visual perspectives [35]. The primary focus of this work was on understanding how moral decision-making variables might be affected by visual point-of-view for a modified trolley problem. However, one auxiliary finding we made was that moral decision-making was mediated by participants forming relationships with virtual agents within the virtual environment of the experiment. Even within a short period of time, participants were able to establish empathetic relationships and bonds with the virtual agents and consider the consequences of their decisions on these agents. Altogether, our findings suggest that the weight of decision-making in virtual worlds extends beyond mechanics, and helps foster a deeper relationship between players and the virtual agents in such worlds.

2.1.2 Interactions with Virtual Agents. Although our work on choice took a broad look at its impact across games as a whole, we wanted

to take a deeper dive into the specific nature of interactions that people have with virtual agents in games. We evaluate how the context of interaction shapes player experience in two independent studies. We developed systems to support demonstrative interactions, allowed participants to engage with these systems, and interviewed them to better understand their experiences.

In the first study, we explored the concepts of lying and deception, which are important and common facets of social communication [8] but had been an underexplored area in games. We developed a game in which players would interact with NPCs who would make a variety of false statements, some intentional and some not [32]. Through interviews after playing the game, we learned that players generate a mental model of the virtual agents based on their interactions with them, including their level of trust towards them. Players often defaulted to trusting NPCs, yet several factors such as ambience and context may mediate this trust. Overall, we found that characters that make false statements can serve diverse purposes, such as crafting antagonism and conflict or adding a level of realism and humanization. Yet, false statements can also make the game challenging and frustrating for players if players perceive them to be made without a ‘meaning’ or ‘purpose’. This underscores a key difference between NPC interactions versus interactions with others in real life — NPCs are still perceived to be rational beings whose actions serve a role in the broader narrative.

In the second study, we explored the immersive nature of VR and its impact on expected NPC interactions [36]. VR offers the opportunity for players to be transported into an embodied, immersive world [29], with potential for new possibilities in terms of interaction design drawn from physical motion and direct input. Yet many existing VR games often simply directly port interactions from traditional displays, relying on button presses or story points. In this work, we performed interviews in VR with players to better understand their expectations for interactions in VR. Participants expressed a strong preference for physical motion as input, being much more realistic and in line with real-world interactions. At the same time, participants also expressed the limitations of VR environments in granting player agency and noted the trade-offs that come with direct input mechanisms. Overall, this work highlighted that, even though NPCs in VR are not always expected to behave with complete realism, the methods of interaction were often expected to reflect real-world paradigms. This positions VR environments and the social interactions within them as an extension or simulacra of real-world experiences, borrowing familiar interaction patterns.

2.2 Social Interactions with Virtual Human Avatars

In addition to interactions with virtual non-human agents, I am also deeply interested in social interactions with human avatars mediated through virtual worlds. I have explored such interactions in the realm of social VR — which refers to the virtual environments that support the gathering of users in VR that allows people across the world to interact freely in a digital world through their head-mounted displays [21]. Maloney et al. highlighted the motivation and experience of virtual activities in VR [20], and we extended their work focussing specifically on the activity of sleeping [34].

Through interviews with people who sleep in VR, we found that the motivations for sleeping in VR were twofold — partly due to the experience of being in a novel environment, but partly of wanting to share in a social experience for an activity typically not thought of as such. Participants described the intimacy of keeping company during sleep and the comfort and fulfilment that came with it. This work reveals that part of the appeal of social virtual worlds comes from their transformative nature regarding mundane daily activities. Social VR was able to satisfy people’s desires in ways that might not be possible in real life, offering connectedness even during the inherently solitary act of sleeping.

2.3 Takeaways and Implications

Studying social interactions with virtual agents is important for several reasons, particularly in understanding the relationship between technology and human behaviour and feelings. An essential part of my prior work is in understanding how our often empirical findings can inform future design and facilitate meaningful outcomes. Although much of my work has focussed on entertainment contexts, the proliferation of virtual agents in serious domains underscores the extensibility of my research — fundamental insights into human-agent interactions can be adapted and applied to a wide range of applications. In this section, I outline three key areas in which this research has value.

2.3.1 Immersivity and Engagement. Realistic virtual agents are crucial in making experiences feel immersive and consequential, and thereby more engaging and fun [15]. To this end, realistic behaviour has been extensively studied in ludological research [11, 22, 26]. My work highlights various guidelines for how virtual agents (and the broader virtual world) might be designed to facilitate social engagement and immersion. For example, in our studies regarding NPCs in story-driven games [32, 33], we highlight how deceptive behaviour can facilitate realism and social immersion in games, making the characters feel more believable and complex, and the game overall feel more challenging and engaging. Additionally, we highlight how the existence of choice in games allows players to connect more closely with their representation in-game, further strengthening immersion and engagement.

In the context of VR, we considered how interactions that borrow cues from the physical world would help leverage the unique affordances of VR to create more immersive and engaging social interactions [36]. However, we also recognize that immersivity is not always the goal depending on the aim of the system [35], and point-of-view (PoV) could be an influential factor in shaping a person’s engagement and emotional investment. Future applications should leverage our findings to control the desired level of engagement and attachment a user has with virtual agents and with the virtual environment themselves.

2.3.2 Prosocial Outcomes. One important academic implication for both games and VR is their potential for prosocial outcomes [14, 16, 23]. For the former, games have been explored as mediums for inducing empathy. My work builds on this idea, guiding designers through understanding how prosocial outcomes can be promoted through design. For example, in our study on choice in narrative-rich games [33], we find that choice offers a way for players to

consider the consequences of their actions and their effect on virtual agents. Making difficult decisions required players to consider the broad-reaching effects of their decision in-game, and required them to empathize with the plight of the NPCs.

Extending similar prosocial outcomes, VR has been called an ‘empathy machine’ [13] that can deeply immerse users into the perspective of others. When VR increases immersion and presence to a degree that choices feel real, we consider what factors people consider when making moral decisions in VR [35]. We find that people consider factors related to sociality, consequences, and so forth when making moral decisions and that the meaningfulness that a person feels with a moral scenario is mediated by the perspective they are in. Overall, both games and VR offer unique opportunities to foster empathy and prosocial behaviour; designers can use our findings to design more empathy-inducing and meaningful agent interactions for contexts outside of games.

2.3.3 Understanding Human Behaviour and Wants. Lastly, understanding behaviour in virtual worlds, which are malleable and limited solely by imagination, can hint towards a broader understanding of human desires in the real world. Throughout my work, I tie the implications of human social behaviour to their deeper underlying motivations. In this context, my focus on entertainment contexts strengthens these takeaways, as entertainment mediums are often pursued out of self-motivated contexts. For instance, one common overarching theme in my work is that of ‘the search for meaning’ and ‘meaningful experiences’ [32, 33, 35], and how player desire for meaning manifests in their interactions within and perception of virtual experiences. Even in entertainment contexts, people yearn for their actions, decisions, and experiences to be meaningful for them. One facet of a meaningful experience, according to Maloney and Freeman, is that of experiencing mundane activities in transformative new ways, particularly through social engagement [20]. Building on this idea, our exploration of sleeping in VR not only offered novel design opportunities to extend this practice but also underscored the significant human longing for sociality, connectedness, and intimacy — even for activities typically seen as isolated [34].

3 Future Plans

3.1 Believable Virtual Agents

One future direction I plan to focus on is the development of believable and real virtual agents (NPCs), building upon the importance of such agents for both entertainment and academic purposes. In particular, the rise of AI models, especially in generative pre-trained transformers (GPTs) and large language models (LLMs) offers a promising direction in approaching NPC development. Park et al. have used such technologies in simulating not only actions — such as waking up, interacting with others, and conversing with other agents — but also complex facets of human identity such as memory, self-reflection, and coordination [25]. These traits imbue such agents with human-like qualities such as personality and memory, which have long-standing goals in prior research [1, 18, 31]. However, the 2D sandbox simulation in their work offers limited methods of expression outside of dialogue. Thus, my work aims

to extend upon this gap — how can virtual agents learn to express themselves given their emotions and intentions?

This proposed idea stems from viewing virtual agents as akin to actors in theatre. Taking this perspective, presently, the animator and designer of the virtual experience must micromanage every single motion and behaviour of the agent — from changes in facial expression to subtle movements to express emotion. However, with the hastened transition towards realistic agents, we aim to provide agents with the capacity to learn how to "act" given a script. Beyond reciting lines, the lifeblood of an actor comes in terms of their nonverbal communication and emotional delivery — our approach essentially aims to teach precisely this. Virtual agents are already able to encapsulate a character — understanding their motivations and emotions holistically [25]; we want them to learn how to use these traits to dynamically express themselves and captivate an audience. Our proposed methods revolve around character learning, scene understanding, and emotional delivery based on generative AI approaches. We plan to use a layered pipeline of GPTs for each of these tasks, inspired by prior work in generative creation [7].

3.2 Personal Reflection in Virtual Worlds

Although much of my prior work has explored social interactions with virtual 'others', either agents or avatars, I am increasingly interested in using virtual avatars as a conduit to interact with one's past self, especially in a therapeutic context. Interactions with one's past self, either through self-talk [12] or through journalling [4, 30], have been shown to be correlated with positive outcomes of mindfulness and self-compassion. I aim to represent one's past self as a virtual agent that can be interacted with and conversed with in a virtual experience, and study how various interactions and designs of such an agent might facilitate positive well-being. Extending beyond simply talking and writing, the idea of immersively engaging with such a virtual agent that represents 'you' extends upon the prosocial outcomes discussed prior — of establishing empathy towards your past self and being kinder towards yourself.

My proposed idea centres around creating an evolving model of one's behaviour, motivations, and actions that users will regularly update over an extended period through journalling. Entries in the journal would be used as a basis for a virtual agent (e.g. through using generative AI methods) that would comprehensively capture the emotions, actions, and lived experiences of the individual. This agent would allow users to revisit specific moments in their personal histories by simulating their past selves. Users would be able to interact with this agent through conversation and non-verbal communication. In a therapeutic context, I plan to use this agent as a mediator for users to handle self-blame regret [3, 17]. For example, if someone regrets an action they have taken, they may blame their past self for their decision, leading to a spiral of self-blame that can have negative mental consequences. By interacting with their past self, users might ask questions about why they made certain decisions and come to an understanding — learning from mistakes and offering growth for the future [17]. Overall, I aim to evaluate how such a practice may help resolve unresolved emotions, absolve regrets, and help people pursue self-empathy and growth.

4 Positionality

I am a Ph.D. candidate at the University of British Columbia, supervised by Dr. Robert Xiao (who also supervised me during my Master's degree). I am currently in my third year of full-time study in this program. I have never attended any doctoral consortium. Regarding future aspirations, I plan to continue in academia post-graduation, aiming to obtain a tenure-track position at a research-focused university.

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