COLAB: Social Context and User Experience in Collaborative Multiplayer Games

MSc Dissertation

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September 2017

Acknowledgements

I would like to give thanks, first and foremost, to my supervisor Professor Edwin Blake, whose guidance, insight, and commitment to the project have gotten me to the finish line. Edwin helped me refine and shape my ideas into a workable and interesting Master's project. Over the last two years, he has made himself available during regular supervision meetings, and his detailed feedback on my writing and research has made both more rigorous. This research project would simply not have come to fruition were it not for him. My deepest thanks also go to my fellow Master's students in the field of user experience in games: Bryan Davies, who took me under his wing and provided me with invaluable resources, reading material and ideas along the way, and Jacob Clarkson, who helped me navigate the statistical analysis required for this thesis and reminded me of the importance of the ambiguity-slaying Oxford comma. Bryan and Jacob, your constant camaraderie and support have enriched this project. Finally, to my partner and editor Daniela Joffe: thank you.

Abstract

Recent studies have shown that the social context in which people play digital multiplayer games has an effect on their experience. Whether co-players are in the same location ("co-located") or in different locations ("mediated") changes how they interact with the game and with one another. We set out to explore how these complex psychological dynamics played out in a collaborative multiplayer game, since most of the research to date has been focused on competitive gameplay scenarios. To this end, we designed a two-player puzzle-based gaming apparatus called *COLAB*, implementing specific features that have been proven to foster collaboration and preclude competition between players. The independent variable was player location; the dependent variable was game experience, as measured by the Social Presence in Gaming Questionnaire and the Game Experience Questionnaire, two comprehensive self-report instruments. We found a significant difference in the game experiences of players collaborating in the same location versus players collaborating in different locations. Specifically, co-located players of the collaborative game experienced significantly higher scores for negative experience than mediated players did, while mediated players experienced significantly higher levels of three key game-experience measures: positive affect, immersion, and flow.

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1 Introduction

In recent years, digital gaming has become a hugely popular leisure activity for millions of people around the world. More and more people are spending their time playing digital games (henceforth referred to as *games*) (Lenhart, Madden & Hitlin, 2005). As a result of this burgeoning consumer appetite, the games industry has grown rapidly, and game developers continue to innovate new experiences for gamers. One early development involved multiplayer games that allowed for collaborative, co-operative, and/or competitive play. Multiplayer games introduced a new social aspect to gaming. Initially, people could only play multiplayer games in a co-located context: players had to be physically present in the same room. More recently, with the development of online games and the widespread adoption of the Internet, it has become common for multiplayer games to be played in a mediated (i.e., non-co-located) context. In a mediated context, players use virtual avatars to interact and communicate in virtual environments, without having to be physically present in the same room (Weibel et al., 2008).

For many gamers, socialising is the primary motivation for playing games (Jansz & Martens, 2005). The rise in popularity of Massively Multiplayer Online Games (MMOGs) and their associated virtual communities makes multiplayer gaming an increasingly relevant social activity, and highlights the importance of the social experience underlying multiplayer gameplay (de Kort, IJsselsteijn & Poels, 2007). Although historically overlooked in the literature, the social aspects of gaming are now gaining traction as an area of research. Yet the existing research on social gameplay tends to focus on user experience in a *competitive* social context (see, for example, Weibel et al., 2008; Gajadhar, de Kort & IJsselsteijn, 2008; Ravaja et al., 2006; Martin, 2010). User experience in a *collaborative* social context has received far less attention. In a collaborative game, players are required to work as a team towards a shared outcome, whereas in a competitive game the goals and objectives of players are diametrically opposed (Zagal, Rick & Hsi, 2006). Naturally, the social interaction resulting from these vastly different contexts varies significantly. Competing players barely need to communicate with one another in order to achieve victory over their opponent. On the other hand, collaborative players rely on social interaction and communication in order to succeed.

Ranging from extremely competitive Multiplayer Online Battle Arenas (MOBAs) like *League of Legends* (Riot Games, 2009) to independent collaborative puzzle games like *LittleBigPlanet* (Media Molecule, 2008), games offer a multitude of experiences for players (Ivory, 2015). The social context in which these games are played also has a significant influence on players' game experience (de Kort et al., 2007). The study presented here aimed to contribute to the literature by investigating how *collaborative* game experience in particular differs in co-located versus mediated social contexts.

1.1. Research Questions and Hypotheses

While multiple studies have addressed social context and game experience under competitive circumstances (Weibel et al., 2008; Gajadhar, de Kort & IJsselsteijn, 2008; Ravaja et al., 2006; Martin, 2010), little work has been done to empirically investigate other types of games. We aimed to fill this research gap by investigating how different social contexts influence social interaction, communication and associated game experience in a purely collaborative multiplayer setting. Thus, we asked:

> RQ1: Do variations in social context (i.e., co-located play versus mediated play) influence players' experience of collaborative multiplayer games?

The specific social contexts we investigated took the form of two common multiplayer gameplay configurations. In the first configuration, users collaborated with co-located others: players in the same physical location socialised directly via face-to-face interaction. In the second configuration, users collaborated with mediated others: non-co-located players socialised over long distances via a computer network. In order to highlight the social aspects of gaming and advance our understanding of how common variations in social contexts affect user experience during collaborative multiplayer gameplay, we approached games as a *social presence* (see Section 2.1.1) technology, which led us to pose the question:

> RQ2: Do variations in social context during collaborative play result in changes in co-players' subjective feelings of social presence?

We therefore focused on the social aspects of the collaborative gaming experience, using a similar approach to that of de Kort et al. (2007), who developed the Social Presence in Gaming Questionnaire (SPGQ) (see Section 2.1.2) to measure social presence between co-players during multiplayer gameplay. In order to address RQ1 and RQ2, we took a multi-disciplinary, psychologically structured approach to game experience. Specifically, we investigated the effects of changes in social context and social presence on psychological indicators of experience, both during and after collaborative play. Building on work by IJsselsteijn, Poels and de Kort (2008), who developed the Game Experience Questionnaire (GEQ) (see Section 2.1.8), we analysed players' experience of the following factors during gameplay: flow (Section 2.1.5); immersion (Section 2.1.6); positive and negative affect (Section 2.1.7); challenge; competence; and tension/annoyance. In addition, players' positive and negative experience, tiredness, and difficulty in returning to reality were self-reported after they had stopped playing. This multi-layered approach allowed for an in-depth investigation of the differences between co-located and mediated collaborative gameplay experience. We were furthermore interested in determining whether there were correlations between any of the factors of experience measured by the GEQ and SPGQ under the co-located or mediated conditions. We therefore asked:

RQ3: Do correlations exist between any of the experience factors measured by the GEQ and SPGQ during collaborative gameplay in the co-located and/or mediated social contexts?

Various studies have shown that the type of social context in place will significantly influence players' game experience (Bracken et al., 2005; Ravaja et al., 2006; de Kort et al., 2007; Gajadhar et al., 2008). Owing to the differences in social affordances and communication channels offered by co-located technology compared to mediated social-gameplay technology, we predicted:

H1: Collaborative players' game experience (as measured by the GEQ) will differ with variations in social context.

Gajadhar et al. (2008) found that, during competitive multiplayer gameplay, social presence was higher during co-located compared to mediated play. We therefore predicted:

H2: Co-located players will experience higher levels of social presence during collaborative gameplay than mediated players.

The presence of co-located players or bystanders during gameplay has been shown to interrupt players' focus and attention, breaking their engagement with the virtual environment of the game (Sweetser & Wyeth, 2005). These kinds of interruptions can have a negative impact on flow (Csikszentmihalyi, 1991; Chen, 2007) and immersion (Sweetser & Wyeth, 2005; Jennett et al., 2008), which led us to predict:

H3: Mediated players will experience higher levels of flow and immersion during collaborative gameplay than co-located players.

To address our hypotheses we designed and developed a collaborative game, entitled *COLAB*. In order to determine the collaborative gameplay mechanisms that would encourage social interaction and preclude competition between co-players, we posed the question:

RQ4: Which gameplay mechanisms facilitate collaboration and social interaction between co-players while precluding any form of competition?

In this paper we document the empirical investigation undertaken to answer our research questions. In Chapter Two, we conduct a review of the literature related to social gameplay experience, collaborative gameplay mechanisms, and communication channels in multiplayer games. Next, Chapter Three describes the methodology, experimental design, and measures employed in this study. In Chapter Four we present our results and analyse the data gained from our experiments. Chapter Five offers a discussion of our results in relation to our research questions and hypotheses. Finally, our conclusions and the implications of our research are presented in Chapter Six.

2 Literature Review

The following chapter is divided into two distinct sub-sections. Section 2.1 explores the discourse surrounding the social aspects of games and user experience in relation to games. We outline key findings and identify the gaps within the literature that this study aims to address. The information gathered in Section 2.1 assisted in the design and development of an appropriate methodology for investigating our research questions.

In Section 2.2, we review the current body of literature in relation to collaborative and co-operative gameplay mechanisms. We present an overview on communication channels in multiplayer games, and investigate player-avatar relationship dynamics. Section 2.2 aids our understanding of how players interact and communicate during collaborative gameplay and informed the design and development of the collaborative multiplayer game, *COLAB*, employed as the apparatus in this study.

2.1. Social Gaming

Digital gaming has been a social activity since its introduction into the mainstream in the 1970s. One of the earliest commercially successful digital games, *Pong* (Atari, 1972), was a multiplayer game (Ivory, 2015). *Pong* is a rudimentary tennis simulator where two players compete for the highest score by knocking a ball (represented by a dot) past their opponent's bat (represented by a rectangle). While *Pong* was mostly enjoyed by players in a co-located context, it did not take long for game developers to introduce networked (or mediated) multiplayer gaming. Multi-user text-based games, commonly referred to as Multi-User Dungeons (MUDs), were originally played over TelNet and date back to 1979 (Bartle, 2004). Players of early MUDs interacted with one another in text-based virtual worlds where they would participate in quests and go on fantasy-themed adventures together (Sanchez, 2009). More recent Massively Multiplayer Online Games (MMOGs) like *World of Warcraft* (Blizzard, 2004) and *League of Legends* (Riot Games, 2009) boast millions of active players who socialise with each other over the Internet on a daily basis.

Crucially, people who play games are often typecast by the media as isolated, introverted individuals, possessing negligible social ability (Bryce & Rutter, 2003). While the belief in the association between online gameplay, social ineptitude and social isolation remains widespread (Cole & Griffiths, 2007), a recent wave of research argues that multiplayer games provide ideal spaces for social learning and offer easily accessible social outlets for players (Ducheneaut & Moore, 2005; Kowert et al., 2014; Kowert & Oldmeadow, 2015). Durkin and Barber (2002) describe how co-located multiplayer gaming is an activity that encourages social interaction between friends and family, and liken this kind of social interaction to playing traditional board games. Studies of gamers in their home environment have shown that, even while playing games designed specifically for solo play, players often participate in co-operative play and social interaction (de Kort et al., 2007). Outside of the home environment, early research illustrated how arcade gaming functioned as a popular pastime among youth, providing a space where friendships were formed and developed (Selnow, 1984). More recently, research into the effects of gaming on the social lives of children has shown that children who play games spend more time socialising with friends outside of school hours (Colwell, Grady & Rhaiti, 1995) and have more social contact with other children (Bonnafont, 1992) compared to non-gamers.

The ubiquity of modern computers and mobile devices, coupled with affordable and accessible Internet connectivity, has changed the way games are being played (Kowert & Quandt, 2015). Strangers and friends play together via the Internet, socialising through games over long distances. This kind of mediated social interaction between people has given rise to a class of meaningful relationships that exist exclusively online, in the virtual world of the gamer (de Kort et al., 2007). Indeed, the social aspect of gameplay is often the most popular feature of online games among adolescents and adults (Griffiths et al., 2004), and online gaming has facilitated new kinds of relationships and online friendships (Bryce & Rutter, 2003). Naturally, these online relationships may translate into face-to-face social interaction. Players who meet online often meet up in the so-called real world, playing games face-to-face at local area network (LAN) events. Jansz and Martens (2005) found that, for most gamers, the primary motivation for attending LAN events was for social interaction with other gamers. Current market research also confirms that gaming has become an increasingly social experience. A recent report by consumer researchers at Nielsen Interactive Entertainment (Nielsen, 2005), commissioned by the Interactive Software Federation of Europe (ISFE), shows that two-thirds of gamers (N = 2000, equally sampled from Germany, Spain, the UK, Italy and France) play games with other people for at least one hour per week. In addition, 60% of the gamers interviewed stated that their primary motivation for playing games was "being able to play with friends".

Despite these various indicators, the social aspect of digital gaming is often absent from researchers' models and theories of player experience, and digital gaming is not adequately acknowledged as a social platform that brings people together (Ermi & Mäyrä, 2005; Klimmt, 2003). A handful of researchers are attempting to address this gap in the research. Weibel et al. (2008) conducted a study that examined whether playing a competitive game against other mediated (i.e., non-co-located) people was different from playing against computer-controlled opponents, in terms of user experience. They found that people who played against a mediated human-controlled opponent experienced higher levels of presence (see Section 2.1.3) and flow (see Section 2.1.5) than those who played against a computer-controlled opponent. Ravaja et al. (2006) found that playing against another human, be it a friend or a stranger, resulted in higher engagement and spatial presence and more positive emotional responses when compared to playing against the computer. Furthermore, they found that these factors were amplified when participants played against a friend instead of a stranger.

In a similar study, Lazzaro (2004) investigated people's reasons for playing computer games.

Focusing on the emotional aspects of game experience, Lazzaro found that an increase in players' emotional intensity resulted in a higher level of involvement in the game. Lazzaro also explains that the social aspect of gameplay, or "the people factor", is a key element of player motivation and player enjoyment of games. Through teamwork, rivalry and competition, social gaming influences player emotions like amusement and *schadenfreude* (malicious delight) immensely, and is thus central to shaping the gaming experience (Lazzaro, 2004).

While the above-mentioned studies focused primarily on competition between co-players, Mandryk and Inkpen (2004) sought to investigate co-located collaborative player experience, and employed physiological measures of emotions to do so. They found that, when collaborating with a co-located friend rather than a computer, players experienced higher levels of physiological arousal in the form of galvanic skin responses, respiratory measures and electromyography. While there has been a long history of researchers using physiological data to identify emotional states, theoretical difficulties arise when it comes to classifying emotions (Cacioppo & Tassinary, 1990) and inferring significance (Picard & Picard, 1997). Gajadhar (2010) took a more psychologically structured approach to player experience. He used the Game Experience Questionnaire (GEQ) and the Social Presence in Gaming Questionnaire (SPGQ) to measure the influence of social cues on player experience during networked multiplayer gameplay. By systematically varying the availability of social cues, such as audio and video communication between co-players, Gajadhar (2010) found that the ability to use vocal sounds significantly increased player engagement and enjoyment during collaborative gameplay. Interestingly, the addition of video communication had no significant impact on collaborative or competitive gameplay, while the addition of audio communication—that is, the ability for mediated players to speak, laugh and cheer—had no significant impact on competitive gameplay. While Mandryk and Inkpen (2004) and Gajadhar (2010) have investigated the influence of social factors on physiological and psychological measures of collaborative player experience, little work has been done to investigate the influence of co-located versus mediated social interaction on psychological indicators of player experience, in collaborative gameplay specifically.

2.1.1. Social Presence

While the relevance of the social factors of gaming has been acknowledged by scholars (Ravaja et al., 2006; Weibel et al., 2008; Mandryk & Inkpen, 2004), few researchers explicitly incorporate social processes into their psychological theories and models of player experience. De Kort, IJsselsteijn and Poels (2007, p. 2) argue that games researchers need to include a larger situational perspective, "tapping in on [*sic*] the social-contextual contingencies that powerfully influence game interactions and associated experiences". Consequently, the diverse interactive experiences linked to playing games can only be fully understood when games are conceptualised as more than just the software or hardware tools that players interact with. To emphasise the significance of social interaction in games, Gajadhar, de Kort and IJsselsteijn (2008) approach digital games as a *social-presence* technology. For the purpose of this study, social presence is referred to as the sense of involvement with, and awareness of, the co-presence of another human being or intelligence (Biocca & Nowak, 2001).

There are three common configurations of social gameplay, in which co-players experience social presence to varying degrees. In the first configuration, users interact with co-located others: players are in the same physical location. In the second configuration, users interact with mediated others: non-co-located players socialise over long distances via a computer network. The third configuration is a single-player game: players interact with non-player (computer-controlled) characters, or play completely solo (Gajadhar et al., 2008). Gajadhar et al. (2008) tested social presence as a determinant of player experience in these three social contexts. By manipulating the level of co-presence between players in each social gameplay configuration, they found that subjective feelings of social presence had a significant effect on player experience. It is important to emphasise that the three forms of gameplay interaction tested by Gajadhar et al. (2008) were competitive: participants played *against* one another or *against* the computer.

In the case of both mediated and co-located interaction, social presence is more than simply the sense of being present with another person. The following social factors provoke subtle differences in how players experience social presence: sensory awareness of how the body is represented (both in the real world and in the virtual environment); behavioural engagement through interaction between co-players; and psychological involvement with another intelligence (Biocca, Harms & Burgoon, 2003). De Kort and IJsselsteijn (2008) build on work from Biocca et al. (2003), arguing that the role of *sociality characteristics* (Figure 1) beyond the direct realm of a game have a significant influence on co-located as well as mediated game experience. Sociality characteristics are contextual factors that shape the way in which players interact and communicate during play. In addition to the social affordances offered by the virtual world of the game itself (e.g., personalised avatars), de Kort and IJsselsteijn (2008) outline different sociality characteristics that result from the degree of co-presence between players. During mediated play, players experience *mediated co-presence*. In this scenario, available communication channels largely shape the social affordances between players. These communication channels can take the form of text, emoticons, voice chat, and the social richness of in-game animations during interaction among co-players' avatars. During co-located play, players experience *local co-presence*. In addition to the sociality characteristics that come with mediated play, co-located social interaction is also influenced by the characteristics of the physical play environment. Interpersonal distance, seating positions and viewing arrangements all affect co-located communication, even though a player's attention will naturally be focused on the game, the controller and co-player(s). Moreover, face-to-face communication involves gestures, body language, gaze direction and social cues (Argyle & Dean, 1965; Hall, 1959), factors not present in the mediated context. Single-player games also offer a sense of social presence through *virtual co-presence*, which results from the interactions between the player and non-player characters. In this way, social context significantly influences a player's sense of social presence, and shapes the psychological impact that social presence will have on that player's game experience (de Kort & IJsselsteijn, 2008).

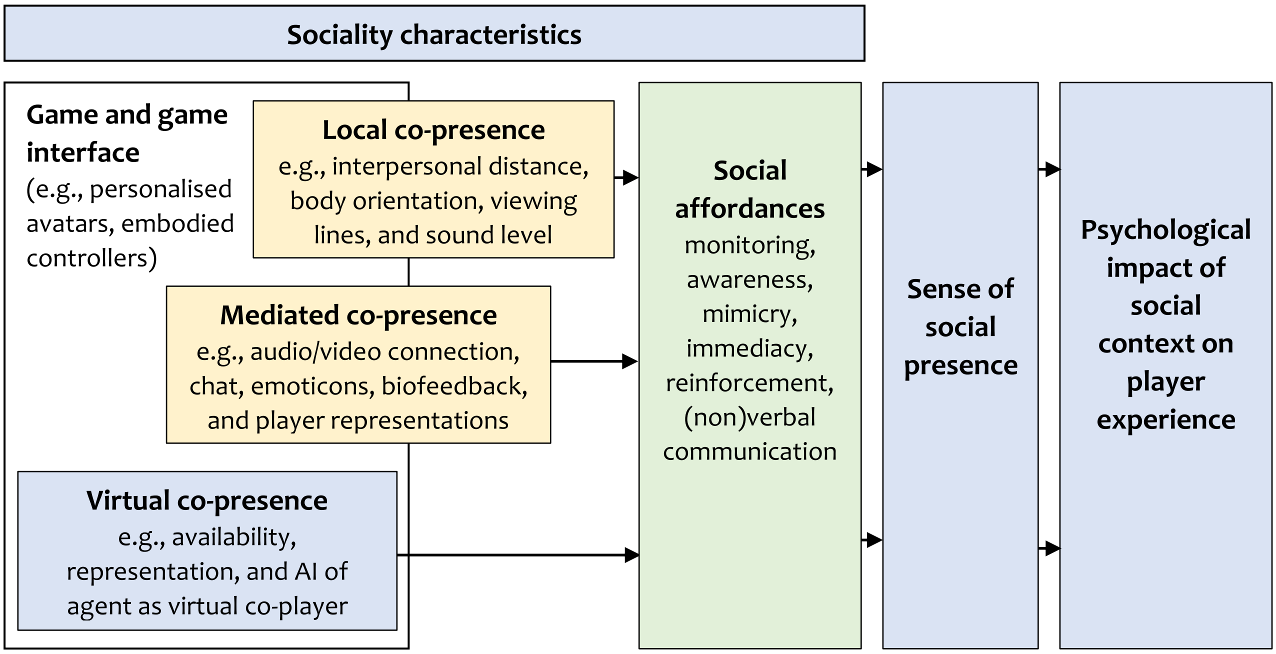

Figure 1: The sociality characteristics of the play environment shape co-players' social affordances and can alter their sense of co-presence and social presence. Co-located players experience *local co-presence*, while mediated players experience *mediated co-presence* (de Kort & IJsselsteijn, 2008).

2.1.2. Social Presence in Gaming Questionnaire (SPGQ)

In order to better understand the relationship between social interaction and the game experience, de Kort, IJsselsteijn and Poels (2007) developed and validated a self-report measure named the Social Presence in Gaming Questionnaire (SPGQ). The SPGQ was developed to probe gamers' involvement with, and awareness of, their co-players and was inspired by the Networked Minds Measure of Social Presence (NMMSP) (Biocca, Harms & Gregg, 2001). The NMMSP was developed for measuring experiences in social-presence technologies such as mobile and wireless telecommunication, collaborative work environments, and teleconferencing interfaces (Biocca et al., 2003). Due to significant differences between these communication technologies and digital games, de Kort et al. (2007) adapted the content of the NMMSP for use in games, conducting focus-group interviews with both casual and avid gamers to facilitate the process. The resulting SPGQ investigates the psychological and behavioural involvement of the player with other social entities in the game: co-located players, mediated players, or virtual (i.e., non-player) characters. Furthermore, the SPGQ measures social presence on three subscales: psychological involvement—empathy (PI—empathy), psychological involvement—negative feelings (PI—negative feelings), and behavioural involvement. The PI—empathy scale measures players' ability to understand and share feelings with each other. The PI—negative feelings scale measures players' negative emotions towards each other (e.g., guilt, anger, loneliness, jealousy, envy). The behavioural engagement scale measures players' interdependency and attention towards each other. See *Appendix A* for the full version of the SPGQ, which forms one of the modules of the Game Experience Questionnaire (see Section 2.1.8).

Various questionnaires have been developed to measure the psychological impact of player experience. For example, Witmer and Singer (1998) developed a questionnaire for measuring players' presence and immersion in virtual environments, while Brockmyer et al. (2009) developed a questionnaire to measure players' levels of engagement with a virtual environment during gameplay. However, the SPGQ is the only self-report measure that explicitly measures players' subjective feelings of social presence. The development and validation of the SPGQ as a consistent measure of social presence is therefore unique. It allows for the study of the impact of social context on other psychological impacts of game experience: for example, flow (see Section 2.1.5), immersion (see Section 2.1.6), and positive and negative affect (see Section 2.1.7). As discussed in Section 3.3.2, the SPGQ was particularly useful in our study since it allowed for us to observe whether manipulations in the levels of co-presence between players were sufficient for producing significant differences in participants' subjective feelings of social presence.

2.1.3. Presence and Co-presence

It is important to note that, although related, presence and social presence are two separate concepts. While social presence refers to the sense of being with another (Biocca et al., 2003), presence stems from the idea of *telepresence*. Introduced by Minsky (1980), the term telepresence describes a state of consciousness rooted in the impression of being physically present in a virtual environment. Steuer (1992), describes (tele)presence as the extent to which one feels present in the virtual environment as opposed to one's immediate physical surroundings. Similarly, Slater and Wilbur (1997, p. 4) define presence as a "state of consciousness, the (psychological) sense of being in the virtual environment", while Sadowski and Stanney (2002, p. 791) describe presence as "a sense of belief that one has left the real world and is now 'present' in the virtual environment". Lombard and Ditton (1997, p. 9) explain that presence is a "perceptual illusion of non-mediation". This concept of illusion has been further explored by IJsselsteijn, Freeman and de Ridder (2001), who subdivided presence into three components:

- **Spatial presence:** the illusion of being present in a virtual environment.
- **Social presence:** the sense of being present with another person.
- **Co-presence:** the combination of both spatial and social presence.

For the purposes of this study, we took the approach outlined by IJsselsteijn et al. (2001), whereby the traditional definition of *presence* is more clearly defined as *spatial presence*. *Co-presence* refers to the combination of both spatial and social presence, whereby co-players experience the illusion of being spatially present in the virtual world of the game and feel socially present with one another. Co-presence also implies a mutual awareness between co-players (Wolbert et al., 2014), whether they are co-located or mediated.

2.1.4. User Experience in Games

Various approaches to describing, measuring and evaluating user experience in games have been adopted. Some scholars focus on the physiological measures of emotion as a way to understand user experience in games (Mandryk & Inkpen, 2004; Ravaja, 2009; Mandryk & Atkins, 2007). As mentioned, physiological measures, in the form of galvanic skin responses, respiratory measures and electromyography, can indicate various levels of arousal in players, but do little to explain the psychological implications related to the experience of games. Physiological measures need to be interpreted via a careful understanding of both the context and situation in which they are taken. Simply stated, there is "no simple relation to physiological measures and emotional or evaluative states" (Bernhaupt, 2010, p. xi).

Other scholars focus on psychological indicators of user experience in games (de Kort et al., 2007; Chen, 2007; Weibel et al., 2008). Researchers and gamers agree that enjoyment is one of the core experience-dimensions of playing games (Vorderer et al., 2004, 2006). However, game enjoyment is not an easy term to define. Klimmt (2003) presents the notion that game enjoyment is based on three experiential factors: the experience of *effectance* (i.e., immediate feedback to the player as a causal agent); cyclic feelings of *suspense* and *relief*; and the fascination of being drawn into a virtual environment or *alternative reality*. Subsequent studies have demonstrated the following: the experience of *effectance* is an important factor of game enjoyment (Klimmt at al., 2007); *suspense* is a driver of game enjoyment (Klimmt et al., 2009); and the quest for *control* is a big part of the challenge of a game, which can make playing it enjoyable (Klimmt et al., 2009). The phenomenon of being drawn into a virtual environment or an alternative reality is often referred to as immersion (Calleja, 2011). Although immersion plays a vital role in game experience, its presence does not necessarily imply that players have fulfilling or optimal experiences (Jennett et al., 2008). By contrast, a psychological construct that does indicate an optimal experience is flow (Csikszentmihalyi, 1988). Stemming from the field of positive psychology, flow has been widely applied to the experience of games (Keller & Bless, 2008; Sherry, 2004), because games, by their nature, match closely with the activities that Csikszentmihalyi (1988) identified as being typically conducive to a state of flow. Other psychological constructs—for example, tension, challenge, competence, positive affect and negative affect—have also been applied to the field of user experience in games, to better understand the emotional responses of players (IJsselsteijn, Poels & de Kort, 2008).

This study implemented a multi-dimensional, psychologically structured approach to studying game experience. In an attempt to integrate gamers' descriptions of their social, collaborative gaming experience with theoretical constructs regarding human experience, we investigated the following psychological constructs in relation to game experience: flow, immersion, tension, challenge, competence, positive affect, and negative affect.

2.1.5. Flow

Flow represents the feeling of "complete and energised focus in an activity" (Debold, 2002). It is characterised by an intense level of intrinsically motivated engagement that maximises performance, fulfilment and enjoyment in an activity. Accordingly, flow is frequently described as the "optimal experience" or as being "in the zone", and is often associated with professional athletes and artists. Introduced by Csikszentmihalyi in the 1970s, the concept of flow has become fundamental to the field of positive psychology (Chen, 2007, p. 31). Csikszentmihalyi defines flow as an operative mental state in which one is completely immersed in an activity and links it to intrinsically rewarding experiences, feelings of total involvement, energised focus and success in the process of the activity (Csikszentmihalyi, 1988). Csikszentmihalyi identifies eight major components of the flow experience:

- A challenging activity requiring skill;
- A merging of action and awareness;
- Clear goals;
- Direct, immediate feedback;
- Concentration on the task at hand;
- A sense of control;
- A loss of self-consciousness; and
- An altered sense of time.

However, not all eight components are required simultaneously for an activity or technology to give users the experience of flow (Csikszentmihalyi, 1991). Furthermore, flow can emerge from any kind of activity, and has naturally been applied to research in human–computer interaction, user experience, and more specifically user experience in games. Descriptions of flow experience tend to converge with players' reported experience when they are deeply engaged in a game: for example, an altered sense of time, a loss of self-consciousness, and a sense of control and concentration on the task at hand. As a result, almost all modern video games deliberately include and capitalise on Csikszentmihalyi's eight components of flow (Chen, 2007).

Whether or not a player is transported to the flow "zone" in digital games (and other forms of interactive experience) depends on the duration of the flow experience (Chen, 2007). In order to sustain a player's flow experience, the activity must balance its challenge with the player's ability to overcome that challenge (Figure 2). If the challenge is beyond the ability of the player, the activity becomes overwhelming and generates anxiety in the player. Conversely, if the challenge is too easy to accomplish, player engagement drops rapidly and interest in the activity is lost (Chen, 2007).

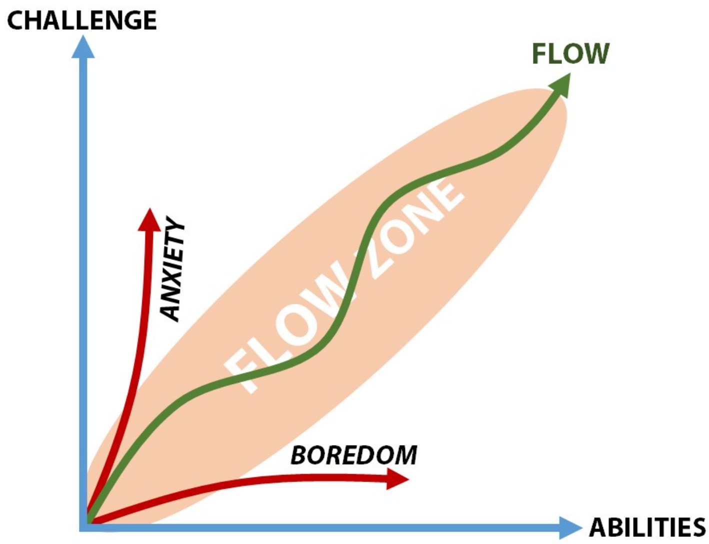

Figure 2: People enter the flow "zone" when their abilities are in balance with the challenge presented by an activity. If the activity is too challenging, people become overwhelmed and increasingly anxious. On the other hand, if an activity is not challenging enough, people become bored and lose interest (Chen, 2007).

Due to the inherent relationship between challenge and ability, any interactive experience (especially gaming) involves keeping people in the flow (Chen, 2007). But no two people experience the same thing in exactly the same way. For example, gamers of different experience and skill level expect different challenges, and therefore experience different flow zones. In order for an interactive experience to appeal to a broader audience, the experience cannot be the same for all people. Any such experience must offer multiple choices that adapt to different users' personal flow zones. Too many choices can overwhelm players, however. If people can't decide what to choose, they feel at a loss; being required to make frequent choices can be frustrating and can break a player's concentration and sense of control, further interrupting flow. To avoid these counterproductive situations, while still offering adaptive choices that allow players to enjoy flow in their own way, Chen (2007) argues that players' choices should be embedded in the core activities of the interactive experience.

Another important factor that has been shown to impede the experience of flow in a game is the presence of other people, both as observers and as co-players (Sweetser & Wyeth, 2005). The presence of other people has also been shown to impede immersion in games (Sweetser & Wyeth, 2005). For these reasons, flow and immersion were of particular interest to this study, since we expected mediated co-players to experience higher levels of both flow and immersion compared to co-located players, during collaborative gameplay.

2.1.6. Immersion

Researchers, developers and players commonly use the term "immersion" to describe the experience of being deeply involved or "lost" in a game (Martin, 2010). Although players consider immersion to be fundamental to a good gaming experience, immersion is a complex phenomenon, and there is a lack of consistency within the academic community regarding what being "immersed" in a game actually denotes (Jennett, et al., 2008). Due to this lack of consistency, Brown and Cairns (2004) carried out a qualitative study regarding players' use of the term immersion. They found that the term was typically used to "describe the degree of involvement with a game", with involvement experienced at three increasing levels: engagement, engrossment, and total immersion (Brown & Cairns, 2004, p. 1298). Players had to enter the first level of involvement (engagement) before they could progress to higher levels, and each level of involvement could only be experienced if the "barriers" to that level were removed.

According to Brown and Cairns (2004), the first barrier to the engagement level of immersion is player *access*. Access entails personal preference as well as gameplay controls. If a player does not like a certain genre or style of game, he or she will not even attempt to engage with it. Similarly, the control system and feedback of a game need to cohere in such a way that the player is able to become easily comfortable with the game's mechanics. The second barrier to engagement is *investment*. Players must invest concentration, effort and time into a game and become familiar with the control scheme in order to become engaged. Once players are engaged, they are able to move to the second level of involvement: *engrossment*. The main barrier to engrossment is the construction of the game itself. The design of the game and its features need to combine in such a way that players' emotions become affected by the game. When players are emotionally invested in the game, they are motivated to keep playing: all their attention is directed at the game; they become less self-aware and feel detached from their physical surroundings. "Everything else is irrelevant, you know it's there but it's irrelevant", as one participant put it (Brown & Cairns, 2004, p. 1299).

After reaching the engrossment level, players who traverse the barriers of atmosphere and empathy are able to reach the highest level of immersion: *total immersion*. If a player is able to empathise with the game, and believe in the game's atmospheric credibility, he or she can become so far detached from reality that the game is the only thing that impacts the player's thoughts and feelings. "You feel like you're there", was how one player described this state (Brown & Cairns, 2004, p. 1299). Brown and Cairns (2004) describe *total immersion* as a fleeting experience, whereas *engagement* and *engrossment* are much more commonly achieved during digital gameplay. Furthermore, the authors conflate the feeling of total immersion with the feeling of presence, arguing that the two are different sides of the same experiential coin.

We disagree with Brown and Cairn's (2004) assertion that the terms *total immersion* and *presence* are analogous. Instead, we view immersion and presence as distinct concepts. Slater (2003, p. 2) argues that presence is a "human reaction to immersion". Given the same immersive system, then, different people might experience different levels of presence. Similarly, different immersive systems might give rise to the same levels of presence in different people. Presence and immersion are therefore logically separable and should not be conflated (Slater, 2003). Similarly, Jennett et al. (2008, p. 643) argue that presence is only a small factor in gaming experience, and that immersion differs from presence in that immersion is an "experience in time" whereas presence is a "state of mind".

Although Brown and Cairns' (2004) model of immersion is useful in pointing out how involvement in a gaming activity can fluctuate, their approach fails to adequately address the qualitative differences between various modes of involvement (Ermi & Mäyrä, 2005). Ermi and Mäyrä (2005) emphasise the fact that immersion is a multi-faceted phenomenon with distinct aspects that can manifest differently, depending on the specific combination of players and games. In an attempt to illuminate the complex dynamics that are involved in the interaction between a player and a game, Ermi and Mäyrä (2005) developed the SCI model of immersion (Figure 3). The SCI model identifies the three key dimensions of immersion that play a role in the formation of game experience. The first dimension is *sensory immersion*, which relates to the audio-visual impact of digital games. Digital games have grown into visually sophisticated, often highly realistic three-dimensional worlds with formidable sound production. As a result, sensory information coming from the real world is easily overpowered, and players become entirely focused on the stimuli of the game world. Given the fundamentally interactive quality of games, the second dimension is *challenge-based immersion*. This is the aspect of immersion that comes into effect when the player is able to achieve a gratifying balance of challenge and ability. Challenges usually involve a combination of motor skills and mental skills, such as logical problem-solving or strategic thinking. In this way, players frequently encounter physical and mental challenges that keep them playing. Story elements, characters and the visual aesthetic have become central to contemporary games, too, and the third dimension consequently involves players' *imaginative immersion*. This is the aspect of games that offers players the opportunity to use their imagination, become absorbed in the story, empathise with in-game characters, and simply enjoy the fantasy experience of the game.

These three dimensions of immersion usually overlap in various ways, and social context plays a decisive role in influencing immersion (Ermi & Mäyrä, 2005). In this study, we adopted the approach taken by IJsselsteijn et al. (2008), de Kort et al. (2007), Gajadhar et al. (2008) and Gajadhar (2010), who used the Game Experience Questionnaire (GEQ) to measure players' experience of sensory and imaginative immersion (Ermi & Mäyrä, 2005) during gameplay. Specifically, we were interested in how changes in social context influenced players' experience of sensory and imaginative immersion during collaborative multiplayer gameplay.

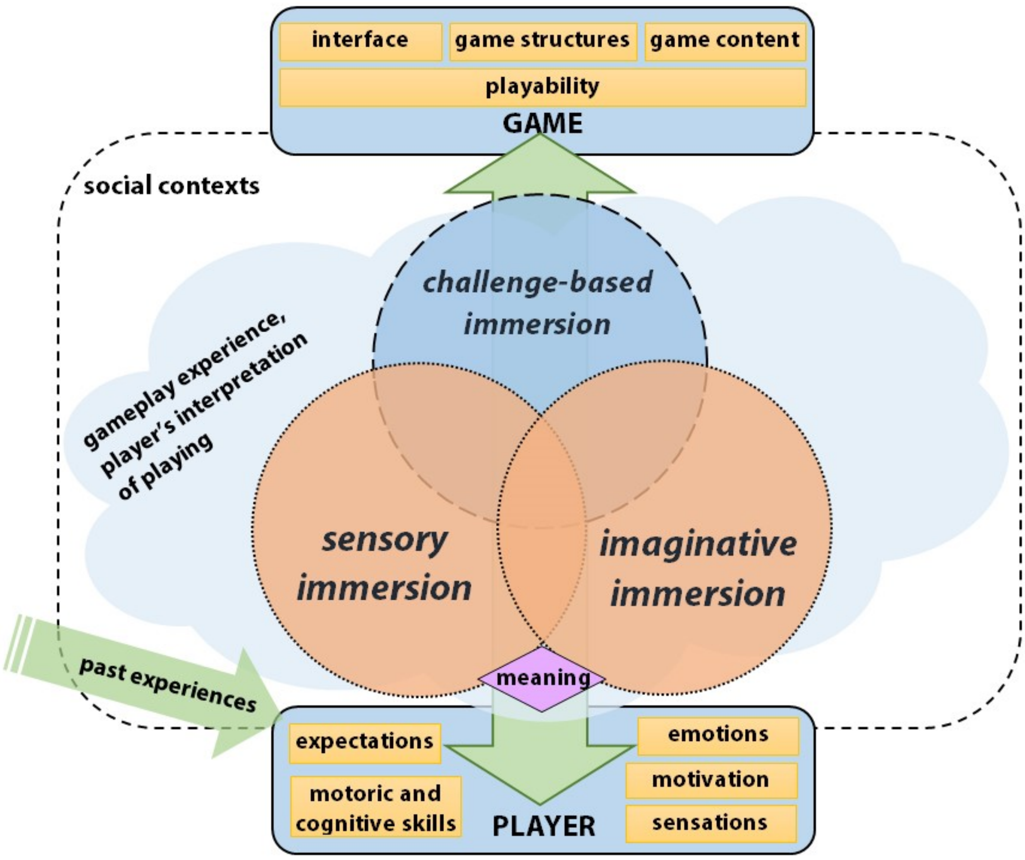

Figure 3: The SCI model identifies the three key dimensions of immersion: sensory immersion, challenge-based immersion, and imaginative immersion (Ermi & Mäyrä, 2005). These three dimensions of immersion overlap in various ways, and social context plays a decisive role influencing immersion. Adopting the approach taken by IJsselsteijn et al. (2008), we focus on sensory immersion (related to the audio-visual impact of games) and imaginative immersion (related to the story elements, characters, and visual aesthetics of games).

2.1.7. Affect

Affect is often described by psychologists as the experience and expression of feeling or emotion (Russell, 1980). Many researchers argue that affective states—for example, excitement, anger, elation, sadness and distress—fluctuate independently of each other (Borgatta, 1961; Clyde, 1963; Nowlis, 1965) and that each affective state should be treated as a separate dimension. However, other researchers argue that affective states are related to each other in a highly systematic fashion. Schlosberg (1952) illustrates this notion by proposing that emotions are cognitively organised in a circular arrangement and that each affective state can therefore be adequately represented by two bipolar dimensions. Similarly, Russell (1980, p. 1162) stipulates that “affective states are, in fact, best represented as a circle in a two-dimensional bipolar space”, and presents the circumplex model of affect (Figure 4) as a set of interrelated, bipolar cognitive categories for interpreting and expressing emotional experience.

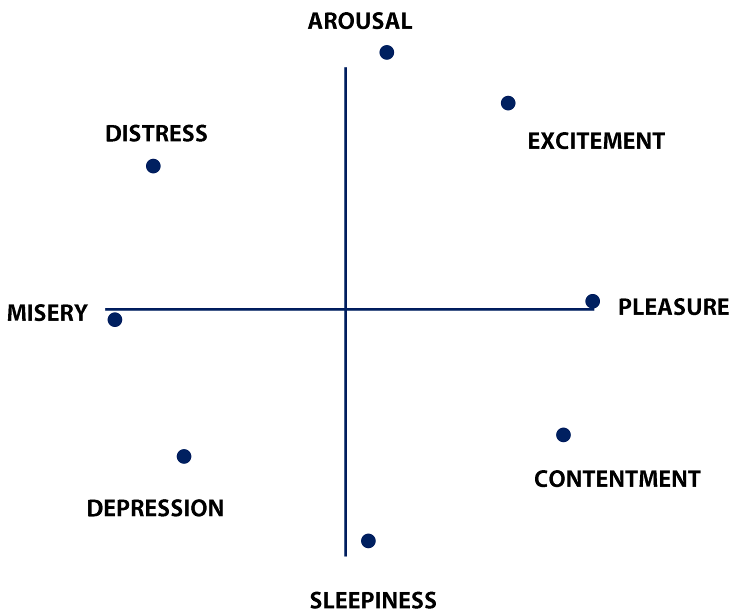

Figure 4: Russell's (1980) circumplex model summarises the properties of the cognitive representation of affect. Eight affective states are arranged in a circular order in two-dimensional bipolar space. Each variable has a polar opposite: for example, arousal's polar opposite is sleepiness (north–south) and excitement's polar opposite is depression (northeast–southwest).

The circumplex model of affect is analogous to a compass, with eight variables falling on a circle in two-dimensional space. Each variable has a polar opposite, and together these polar opposites represent the positive and negative dimensions of an affective state. The vertical (north–south) dimension in Russell's (1980) circumplex model is the arousal–sleep dimension. The horizontal (east–west) dimension is the pleasure–displeasure dimension. The remaining four variables help to define quadrants in space and form bipolar dimensions of their own. For example, excitement (northeast) is a combination of high pleasure and high arousal. Excitement's bipolar opposite is depression (southeast), while distress (northwest) forms a bipolar dimension with contentment (southeast). These bipolar dimensions of affect form the basis for an established cross-cultural affect structure that broadly divides into negative affect (NA) and positive affect (PA) (Russell, 1983; Almagor & Ben-Porath, 1989).

Although NA and PA are often perceived as opposite poles in a continuum, empirical evidence suggests that NA and PA are uncorrelated and can be conceptualised as relatively discrete dimensions of affect (Thompson, 2007). Whether PA and NA are correlated or orthogonal is, to this day, a contentious topic of scholarly debate (Schmukle, Egloff & Burns, 2002). In this study, we adopted the approach presented by Watson et al. (1988), viewing PA and NA as broadly independent dimensions of affect. Watson et al. (1988) found that PA and NA are highly distinctive, orthogonal dimensions of affect. They define PA as "the extent to which a person feels enthusiastic, active and alert", with high PA associated with a state of "high energy, full concentration, and pleasurable engagement" (Watson et al., 1988). Conversely, NA is defined as "a general dimension of subjective distress and unpleasurable engagement that subsumes a variety of aversive mood states, including anger, contempt, disgust, guilt, fear, and nervousness" (Watson et al., 1988). The intensity of positive and negative dimensions of affect can vary dramatically, with low PA "characterised by sadness and lethargy" (Watson et al., 1988) and low NA characterised by "calmness and serenity" (Watson et al., 1988).

Cognitive categorisation of the positive and negative dimensions of affective states allows people to interpret and anticipate the moods of others, and even to influence others' emotional responses. Not only does this complex cognitive structure help in decoding both verbal and non-verbal signs of emotion—for example, tone of voice, facial expressions and blushing—but it also plays a major role in conceptualising and conveying one's own emotional state (Russell, 1980). In our research, we were particularly interested in the interplay between the conceptualisation of one's own emotional states and the conceptualisation of the emotional states of others during collaborative multiplayer gameplay, under different social contexts. Social activity has been shown to be related to PA (Beiser, 1974; Watson, 1988), and it is generally agreed that PA is related to enjoyment of games (de Kort et al., 2007). Similarly, negative emotions and experiences undeniably contribute to the challenge of a game (Gilleade & Dix, 2004), and NA has been shown to be related to stress and poor coping (Wills, 1986; Clark & Watson, 1986). We expected that the ways in which people were able to convey their mood, feelings and emotions under different social contexts would influence collaborative players' experience of both the positive and negative dimensions of affect. For example, we expected that co-located players' ability to convey subtle non-verbal signals of emotion, such as body language and facial expressions, would result in differences in self-reported affective states, as compared to mediated players, who would be limited to verbal and in-game signals of emotion only.

2.1.8. Game Experience Questionnaire (GEQ)

Measuring and describing game experience is extremely important for designing, evaluating and testing games. The process is by no means straightforward, though. The application of user-testing and user-centred design approaches to traditional software tools—for example, word processors and spread sheets—focuses primarily on user experience in terms of productivity, user satisfaction, the time taken to perform tasks, ease of use, and error reduction (Norman, 2013). Measuring game experience, on the other hand, presents a vastly different challenge. Games thrive on variety and the element of surprise, while work applications are designed to be predictable and consistent. Furthermore, the motivation for playing a game is intrinsic; it is not linked to material gain, vocational duty, or other external influences. In order to accurately measure and describe player experience, then, a broad spectrum of psychological and subjective feelings on the part of the player must be considered and assessed (IJsselsteijn et al., 2008). Accordingly, a number of psychometric instruments have been developed to measure various aspects of players' experience, engagement and skills during gameplay, on the one hand, and of games' playability and attractiveness to players, on the other (Norman, 2013).

One such instrument, the Game Engagement Questionnaire, was developed as a measure of engagement for particularly violent games (Brockmyer et al., 2009). Brockmyer et al. (2009) focus on the issue of violence in games, and point out that violent games are increasingly popular among children (Funk, 2008). They argue that playing violent games can result in desensitisation to violence (Carnagey, Anderson & Bushman, 2007) and increased aggression in players (Anderson, Gentile & Buckley, 2007). Rather than an assessment of the game itself, the Game Engagement Questionnaire probes children's tendency to become involved in, and engaged with, a violent video game. Although the Game Engagement Questionnaire measures numerous factors of game experience, including flow, immersion, and presence, Brockmyer et al. (2009) focus on a one-dimensional continuum, which they aptly describe as "engagement". They imply that increasing levels of engagement are associated with different experiential constructs, with immersion representing the lowest level of engagement, presence low to medium engagement, flow medium to high engagement, and absorption the highest level of engagement. However, these associations are tenuous at best, and Brockmyer et al. (2009) provide no empirical evidence to support the relationship between engagement and the psychological dimensions of experience (Norman, 2013).

Unlike Brockmyer et al. (2009), IJsselsteijn et al. (2008) underscore the value of a multi-faceted approach when measuring a broad spectrum of player experience. To assess the multi-dimensional psychological impact of games, IJsselsteijn et al. (2008) developed the Game Experience Questionnaire (GEQ). The GEQ enables game researchers to empirically test and explore a wide range of experiential constructs, and a variety of games, in a comprehensive and quantitative manner. The recently validated GEQ was based on focus-group investigations (Poels, de Kort & IJsselsteijn, 2007) and two subsequent large-scale survey investigations among frequent gamers (IJsselsteijn et al., 2008). The GEQ is divided into three parts: the core module; the Social Presence in Gaming Questionnaire (SPGQ) (see Section 2.1.2); and the post-game module. The GEQ's core questionnaire is used to assess game experience during game play and measures experience via scores for the following seven psychological components: sensory and imaginative immersion, flow, tension, challenge, competence, positive affect, and negative affect. For a more robust measurement, six items per component are included in the questionnaire.

The GEQ's post-game module is used to assess how players feel after they have stopped playing. The post-game module consists of the following four components: positive experience, negative experience, tiredness, and returning to reality. Assessment of positive and negative *affect* in the GEQ's core module should not be confused with the post-game module's assessment of positive and negative *experience.* Positive and negative affect as measured by the core module refers to the extent to which people feel positive or negative emotions during gameplay (see Section 2.1.7). By contrast, positive and negative experience as measured by the post-game module refers to the extent to which players feel they had a positive or negative experience, looking back on the gameplay session as a whole. For example, positive *experience* is measured by items like "I felt proud", "I felt energised”, and “I felt satisfied”. Similarly, negative *experience* is measured by items like “I felt bad”, “I felt guilty”, and “I found it a waste of time”. It should be noted that the post-game module’s *returning to reality* scale refers to players’ difficulty in returning to reality after having stopped playing, which is measured by items like “I found it hard to get back to reality” and “I had a sense that I had returned from a journey”.

Due to the highly social, collaborative, non-violent and anti-competitive nature of our study and our apparatus, the GEQ was chosen as the ideal tool for measuring participants’ experience of collaborative gameplay. The GEQ was pivotal for the validity of our study, enabling analysis of the influence of changes in social context (i.e., co-located play versus mediated play) on players’ subjective feelings of social presence, as well as a wide range of associated game experiences, including flow, immersion, positive affect, and negative affect. See *Appendix A* for the full version of the GEQ, consisting of the core, SPGQ, and post-game modules.

In order to deepen our understanding of how people interact and socialise during collaborative games, the following section (2.2) presents a review of the current body of literature surrounding collaborative and co-operative games and gameplay mechanisms. We investigate communication channels in multiplayer games, and explore player-avatar relationship dynamics. These collaborative concepts and mechanisms helped inform the design of our study and our apparatus, entitled *COLAB*.

2.2. Collaboration and Co-operation in Games

Collaborative and co-operative mechanisms have become an important feature of many modern computer games. The gaming industry realises this, and some of the most popular AAA titles today include collaborative and co-operative gameplay. Games like *World of Warcraft* (Blizzard Entertainment, 2001), *League of Legends* (Riot Games, 2009), *Portal 2* (Valve, 2011), *Diablo 3* (Blizzard Entertainment, 2012), *Destiny* (Bungie, 2014) and *Overwatch* (Blizzard Entertainment, 2016) continue to boast active player communities years after release and stand out as some of the most lucrative games ever developed. These kinds of games offer social spaces where players can connect and communicate with friends from the comfort of their own home. Most importantly, they encourage players to work together and collaborate as they progress towards common goals.

Kim (2013) describes the increasing success of collaborative games as the “co-op revolution”. In particular, she describes three disruptive trends that are re-shaping the gaming industry and influencing the broader digital landscape. Firstly, ubiquitous connected devices are disrupting the dominance of consoles in the games industry. In 2014, PC games revenue surpassed that of console games, and growth in the video games sector is predicted to be concentrated in the mobile and online gaming markets (Figure 5).

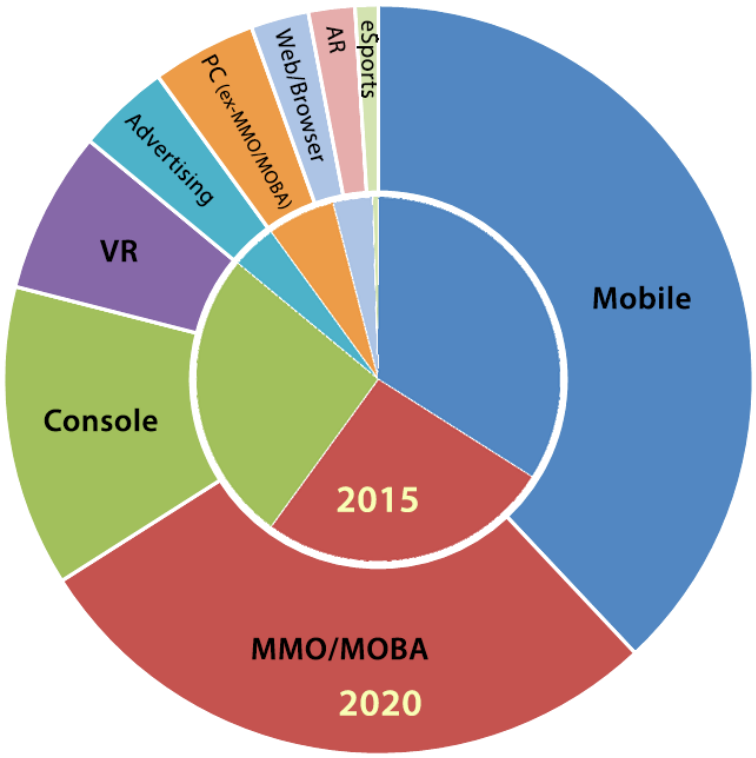

Figure 5: Games revenue share and predicted growth by sector (Digi-Capital, 2016). The mobile and Mass Multiplayer Online (MMO)/Mass Online Battle Arena (MOBA) gaming markets are predicted to continue growing year-on-year, and make up the most lucrative sectors of the market. The console gaming market is shrinking rapidly, while the popularity of Virtual Reality (VR) games and Augmented Reality (AR) games is expected to grow significantly by the year 2020.

Secondly, gaming has gone mainstream and is appealing to a much wider audience of all ages, genders and cultures. Gaming is no longer a "boys club", and has become an increasingly social experience. According to a recent survey, 93% of children ages 8–13 play games online in the USA (M2 Research, 2014). Thirdly, user-generated content is disrupting the way game developers approach gameplay. *Minecraft* (Mojang, 2011), one of the most successful games in recent history, focuses on allowing players to collaboratively build virtual spaces together, one building block at a time. *Minecraft* players generate their own content, and in doing so they entertain, inspire and communicate through an active and thriving social community centred on collaboration and co-operation.

2.2.1. Designing Games for Collaboration

Due to an uptick in games that provide co-operative mechanisms without necessarily fostering collaboration between players, Zagal, Rick and Hsi (2006) investigated those co-operative mechanisms that encourage collaboration among players. They posed the question: "How can electronic games be designed so that collaboration is a worthwhile, interesting, and attractive option?" (Zagal et al., 2006, p. 25). The authors argue that, owing to the complexity of existing collaborative electronic games, it is difficult to extract design principles from them. Consequently, they focus on collaborative board games, which are simpler and easier to understand. In traditional (i.e., non-digital) game research, games are considered innately multiplayer activities that can be divided into two basic categories: *co-operative* or *competitive*. In a competitive game, players are required to form strategies that conflict directly with other players in the game. The goals and objectives of competing players are diametrically opposed (Zagal et al., 2006). Many popular traditional board games like chess, checkers and go fall into the competitive category (Jones, 2000). On the other hand, a co-operative game presents a scenario where two or more people have interests that are “neither completely opposed nor completely coincident” (Nash, 2002). In a co-operative game, players have the opportunity to work together to obtain a win–win condition. The word “opportunity” is important here, since it is not guaranteed that co-operating players will benefit equally or even at all. Although it was not originally recognised by game theorists, a third category of game exists: *collaborative* (Zagal et al., 2006). In a collaborative game, players are required to work as a team towards a shared outcome. If the team wins, everyone wins. If the team loses, everyone loses. Marschak and Radner (1972) define a team as an organisation in which the interests and beliefs of each individual are the same, while the type of information each person possesses can differ. Co-operation among individuals differs from collaboration as a team in that collaborative players have only one objective and share the consequences or rewards of their decisions. “The challenge for players in a collaborative game”, write Zagal et al. (2006, p. 26), “is working together to maximise a team’s *utility.*” Conversely, co-operative players can have different goals and may reap rewards individually.

In short, competitive games exclude collaboration. Collaborative games require collaboration between players. Co-operative games lie between competitive and collaborative games by allowing co-operating players to participate in anti-collaborative practices. Behaving competitively in a co-operative environment precludes collaboration, but might guarantee a player’s success. Thus, one of the key components in designing collaborative games is that of navigating the “competitiveness that players bring to the table” (Zagal et al., 2006, p. 26). Collaborative games require mechanisms that force collaboration while inhibiting competitive or anti-collaborative practices.

More recent work by Rocha, Mascarenhas and Prada (2008) overlaps significantly with the findings presented by Zagal et al. (2006). Based on an analysis of popular collaborative and cooperative electronic games, Rocha et al. (2008) investigated the cooperative game mechanics that promote collaboration while precluding competition. A game mechanism refers to a “physical artefact, rule or type of interaction that implements an action in the game” (Zagal et al., 2006, p. 27). Based on their findings, Rocha et al. (2008) describe six design patterns for developing collaborative game mechanics:

- **Complementarity:** Players have unique character roles or information that complement each other’s activities within the game.
- **Synergies between abilities:** Players have different abilities (often based on their unique character roles) that can assist or change another character’s abilities.

- **Abilities that can only be used on another player:** Players have abilities that are only usable on team members. For example, a medic in *Team Fortress 2* (Valve Corporation, 2007) has a weapon that can only be used to heal fellow team members.
- **Shared goals:** A group of players have one non-exclusive goal that can only be accomplished by working together as a team. All players in the team depend on one another, and they either win together or lose together.
- **Synergies between goals:** When players have different tasks to accomplish, some sort of synergy or dependency between each of the player's tasks encourages collaboration.
- **Special rules for players of the same team:** Rules are used to enforce collaboration between players in the same team; for example, preventing team members from being able to damage each other while allowing them to damage players on the opposing team.

Rocha et al. (2008) further explored how the in-game challenges defined by Rollings and Adams (2003) are used to encourage collaboration among players in current cooperative games. They found that challenges can be divided into two primary categories: *pure challenges* and *applied challenges.* Pure challenges involve real-life physical effort, coordination, reflexes and spatial-awareness. Physical effort can be used to promote collaborative play if the effort required to accomplish a task is configured in such a way that it is too much for a single player handle. Collaboration is also encouraged in a team of players who have to coordinate movements and strategies, be spatially aware of their surroundings, and use their reflexes to react to challenges that arise during the attainment of shared goals.

Applied challenges are different to pure challenges in that they apply directly to the content and mechanics of the game in question. Examples of applied challenges that encourage collaboration include race conditions, exploration, and economics. Race conditions (or timed events) force players to complete certain tasks in unison before a timer expires, and the additional time pressure causes players to focus better and work more cohesively. Exploration requires players to collaborate so they can progress to other areas by, for example, opening locked doors via simultaneous switches or working together to disable or avoid traps and dangerous objects. In games centred on resource management, economic necessity can be used to encourage players to collaborate closely, with players having to trade with each other and manage and allocate their shared resources in order to succeed.

Seif El-Nasr et al. (2010) continued the work begun by Zagal et al. (2006) and Rocha et al. (2008). Based on an in-depth analysis of fourteen popular and current cooperative games, Seif El-Nasr et al. (2010) extended the findings of Rocha et al. (2008) and proposed an additional seven design patterns for developing collaborative game mechanics:

- **Camera settings:** Camera setup emerged as an important design component in collaborative games, especially in situations where people play together on a shared screen. The following camera setups were identified: screen split horizontally or vertically; one character in focus or all characters in focus.

- **Interacting with the same object:** Players interact with objects that can be manipulated by multiple team members simultaneously. For example, players sharing a ball or both players push/pull one object at the same time.
- **Shared puzzles:** Similar to Rocha, Mascarenhas and Prada's (2008) *Shared goals*, players encounter shared challenges or obstacles.
- **Shared characters:** There is a shared non-player character (NPC) equipped with unique abilities that can be taken control of by one player at a time. Shared characters encourage collaboration by enabling discussions among players concerning how to share the NPC.
- **Special characters targeting lone wolf:** Special NPCs that target players working alone or indulging in anti-collaborative practices are designed and implemented.
- **Vocalisation:** Player characters have automatic vocal expressions that alert team members of strategic decisions, challenging events or imminent danger. Vocal expressions encourage players to support each other and play close together.
- **Limited resources:** Players have a limited amount of resources, which encourages players to exchange or share resources to complete shared goals.

After having reviewed, identified and validated the collaborative patterns described above, Seif El-Nasr et al. (2010) ran a study to investigate how players experience multiplayer games that embed these patterns. Through an iterative process involving expert and team reviews, Seif El-Nasr et al. (2010) defined a set of performance metrics for analysing the collaborative nature of the games played. The performance metrics included the following components: players laughing and being excited together, players communicating to work out collaborative strategies, one player helping another player, players taking different roles that complement each other's responsibilities and abilities, players waiting for each other, and players getting in each other's way. The authors video-recorded a total of 25 three-hour gameplay sessions, with groups of two–to four participants playing collaborative games throughout each session. They then annotated the video recordings and determined the causes of the performance metrics in each session. Consequently, the authors were able to identify the collaborative game mechanics that had the most significant impact on players' performance metrics:

- **Complementarity** was identified as the most common component impacting players' performance metrics. Complementarity was noted as an important factor in players laughing and being excited together, players communicating to work out collaborative strategies, and players taking different roles that complemented each other's responsibilities and abilities.

- **Shared goals and shared puzzles** were identified as the primary causes behind players communicating as a team to work out collaborative strategies.
- **Interacting with the same object** was identified as a common cause for players laughing and being excited together, players helping each other, and players having to work out collaborative strategies together.
- **Camera setting** was identified as the primary cause for players having to wait for each other and players getting in each other's way. Games employing a split screen or a camera led by the first player had a negative impact on player experience because they caused players to wait for each other and get in each other's way relatively often. On the other hand, games where all characters are always in the camera's focus had far fewer cases of players having to wait for each other or players getting in each other's way.
- **Difficulty** was identified as one of the primary drivers of players helping each other. Although difficulty is not necessarily a game mechanism by itself, it is worth noting that players helped each other more frequently when the game was difficult for players.

2.2.2. Communication in Collaborative Games

Although the above-mentioned game mechanisms do well to facilitate a very hands-on approach to collaborative gameplay, Rocha et al. (2008) and Seif El-Nasr et al. (2010) do little to describe how best to facilitate communication between players in team-work environments. Communication channels and awareness cues are essential to keeping players actively engaged in collaborative gameplay. Communication in multiplayer games is most commonly facilitated by synchronous verbal communication via voice or text chat (Toups et al., 2014; Kowert, 2015). Although video chat can also be used to communicate in games, it is rarely implemented in games, and there is very little evidence of its use by players during multiplayer gameplay. Furthermore, researchers have found that the addition of the visual representation of co-players only marginally improves social presence (Gajadhar et al., 2008).

However, rich alternative channels for communication through in-game systems enable players to provide information and direct attention in ways that can be difficult or impossible to convey verbally (Toups et al., 2014). Cheung, Chang and Scott (2012) found that players collaborate not only through explicit communication channels but also through an implicit awareness of each other. A key communication channel that both Cheung et al. (2012) and Kujanpää and Manninen (2003) identify involves *virtual gestures*. Virtual gestures allow players to use avatar movement to convey information to other players. In addition to synchronous verbal communication, teams use alternative communication channels (like virtual gestures) as collaborative tools to accomplish shared goals and convey information (Toups et al., 2014). Using a grounded theory approach on a range of 40 popular and recent collaborative and/or co-operative games, Toups et al. (2014) developed a framework of game mechanics for communication. In addition to synchronous verbal communication, the primary communication mechanics identified were as follows:

- **Environment-modifying** mechanics are used by players to alter the game environment in order to convey information to other players
- **Automated-communication** mechanics simplify communication among teammates by reducing the burden on the communicator to provide detail or context. For example, predefined in-game announcements or responses can make communication more efficient during intense gameplay.
- **Immersive** mechanics enrich the user experience by expanding the player's involvement in the game's world or story.
- **Expressive** mechanics support players by allowing them to convey information about themselves during gameplay, including their ideas and emotions. For example, cosmetic items can be used to express players' personalities.
- **Emergent** mechanics allow players to assign their own meanings to in-game actions that were not initially designed to be used for communication: for example, jumping to gain another player's attention.
- **Attention-focusing** mechanics allow players to provide directives to one another or point out important components of the game environment to others.

Communication is a core mechanism of collaborative games (Toups et al., 2014). Accordingly, synchronous verbal communication and alternative forms of in-game communication should not be overlooked when designing games for collaborative play.

2.2.3. Player–Avatar Relationships

While communication between players is crucial in shaping their collaborative gameplay, human behaviour and interaction during multiplayer gameplay is equally shaped by the in-game social representations of players (more commonly known as their "avatars"). Although specific researchers' perspectives on the nature of the relationship between players and their avatars vary, the connection between player and avatar is generally understood to influence a variety of behavioural and cognitive play phenomena (Banks & Bowman, 2013). Various attempts at understanding this relationship have been undertaken, with researchers defining it in a number of different ways: as a feature of social presence (de Kort, IJsselsteijn, & Poels, 2007), as a function of perceived agency and emotional intimacy (Banks, 2013), as a merging of player and avatar psyches (Lewis, Weber, & Bowman, 2008), and as an identification with avatar personae (Yee, Bailenson, & Ducheneaut, 2009).

Banks and Bowman (2013) argue that, while these approaches are beneficial in investigating specific manifestations of the player–avatar relationship, they tend to be so qualitatively diverse that their ability to inform our understanding of a generally applicable player–avatar experience is limited.

The player–avatar relationship can be described as the “interaction between a corporeal person and a digital body” (Banks & Bowman, 2013). In an attempt to combat the lack of generality/applicability in the literature on player–avatar relationships, Banks and Bowman (2013) demonstrated how player–avatar relationship archetypes can be reanalysed to fit the dimensions of character attachment. Their findings highlight the intersections between players’ feelings of intimacy and agency, and suggest the usefulness of such an approach when attempting to understand the larger multiplayer gaming experience (Banks and Bowman, 2013).

In Massively Multiplayer Online Games (MMOGs), an avatar is taken up by a player over a period of time and “cared for” as it develops and advances in the game world. This relationship results in some level of emotional intimacy, defined here as “the perception of closeness resulting from feelings of mutual care and understanding” (Sinclair & Dowdy, 2005, quoted in Banks & Bowman, 2013, p. 1). Related to the notion of emotional intimacy is the notion of perceived agency. Perceived agency is defined as “the degree to which the player sees herself or the avatar as being ‘in charge’ of gameplay experiences” (Banks & Bowman, 2013, p. 1). Banks (2013) proposes that emotional intimacy and perceived agency in players tend to coalesce, with higher levels of emotional intimacy associated with higher avatar agency, and lower levels of emotional intimacy associated with higher player agency. Specifically, Banks and Bowman (2013) identified four player–avatar relationship archetypes along the Intimacy/Agency (I/A) continuum:

- **Avatar-as-object:** Players emphasise competition and combat. Involves high player agency and low emotional intimacy.
- **Avatar-as-me:** Players focus on social interaction. Involves high player agency and moderate emotional intimacy.
- **Avatar-as-symbiote:** Players concentrate on negotiating identities between their real-world identity and their avatar identity. Involves mixed agency and moderate to high emotional intimacy.
- **Avatar-as-other:** Players are motivated by escapism and the separation of the physical world and the digital world. Involves high avatar agency and high emotional intimacy.

Related to the notion of player–avatar relationships, the theory of character attachment argues that, in contrast to the majority of mediated forms of entertainment, digital games and immersive virtual environments are highly interactive spaces requiring players to communicate via virtual embodiments, and become attached to those embodiments (Lewis, Weber & Bowman, 2008). Character attachment is defined here as the “psychological merging of a player’s and [avatar’s] mind” (Lewis et al., 2008, p. 515). Character attachment can be broken down into four factors:

- **A sense of identification** with one’s avatar;

- **A suspension of disbelief** when it comes to accepting the avatar's in-game environment as a real space;
- **A sense of control** over an avatar's in-game actions; and
- **A sense of responsibility** for an avatar's needs.

Bowman et al. (2016) found that players inclined to feel a great sense of control over their avatars reported enjoyable video game experiences (i.e., gaming experiences that resulted in feelings of arousal, excitement, and hedonic-rooted positive affect), while players inclined to feel a strong sense of responsibility for their avatars reported meaningful video game experiences (i.e., gaming experiences that promoted a sense of introspection, appreciation and self-reflection).

For Banks and Bowman (2013), the level of interactivity offered by digital games means that the player–avatar relationship can be mapped according to different degrees of character attachment. The authors developed a conceptual framework of player–avatar archetypes that aligns the player–avatar relationship with character-attachment approaches (Figure 6).

	Avatar-as-object	**Avatar-as-me**	**Avatar-as-symbiote**	**Avatar-as-other**
Identification (I am the avatar)	**Low** My avatar is a digital form.	**High** My avatar is *me* in digital form.	**Mid** My avatar is a part of me.	**Low** My avatar is its own being.
Suspension of Disbelief (Accepts digital world as real one)	**Low** The environment is a space of competition	**Mid** I appropriate the world to fit my own view of it.	**Mid** I am able to visit my avatar's world.	**High** My avatar lives in a digital world with its own norms.
Sense of Control (Physical)	**High** My avatar is a tool for mastery of in-game challenges.	**Mid** My avatar is my social surrogate to accomplish my social play goals.	**Mid** My avatar and I use each other to accomplish negotiated goals.	**Low** I am a tool for my avatar; it tells me how to control it to accomplish its goals.
Sense of Care & Responsibility (Affective)	**Low** My avatar has no needs.	**Mid** My avatar is *me*—it needs what I need.	**Mid** My avatar and I know each other's needs.	**High** I help my avatar get the things it needs in his/her world.

Figure 6: Conceptual classification of Banks' (2013) player–avatar archetypes (avatar-as-object, avatar-as-me, avatar-as-symbiote, and avatar-as-other) mapped onto Lewis et al.'s (2008) dimensions of character attachment (identification, suspension of disbelief, sense of control, sense of care and responsibility) (Banks & Bowman, 2013).

As seen in Figure 6, the character-attachment dimensions of suspension of disbelief and sense of care and responsibility align with player–avatar archetypes, with avatar-as-other players expressing the highest degree and player-as-object players expressing the lowest. However, Banks and Bowman (2013) found that, for sense of control, there is an inverse relationship between character attachment dimensions and player–avatar archetypes. Avatar-as-other players expressed the lowest control, while avatar-as-object players expressed the highest control. Finally, the character-attachment dimension of identification deviated from the player–avatar relationship archetypes, with avatar-as-me players expressing the highest levels of identification.

Banks and Bowman's (2013) integrative approach holds implications for our understanding of player–avatar relationships' influence on game experience and the associated gratifications for players. For example, avatar-as-object players are more likely to concentrate on in-game challenges and mechanics, resulting in gratifying experiences linked to the "pleasure of control" (Bowman et al., 2016). On the other hand, avatar-as-other players are more inclined to focus on relationships and the social aspects of the game and its virtual environment, resulting in an appreciative experience linked to the "pleasures of cognition" (Bowman et al., 2016). Player–avatar relationships are particularly relevant to our study because of the ways in which collaborative players interact and communicate, either face-to-face when co-located, or via their avatars when mediated. Conceptualising these different modes of communication, alongside differences in the way players interact with each other's avatars and relate to their own avatars, allowed for an informed investigation into how changes in social context influence player experience during collaborative gameplay.

2.3. Summary

In Section 2.1 we outlined the social aspects of games and introduced the multidisciplinary, psychologically structured approach to user experience in games. The work presented in Section 2.1 was necessary in deepening our understanding of the psychology-based approach to game experience, allowing us to clearly define, and begin to explore, the research questions and hypotheses presented in Section 1.1. Although various aspects of game experience have been investigated, most of the literature surrounding the psychological impact that changes in social context (i.e., co-located play versus mediated play) have on game experience focuses on *competition* between co-players (see, for example, Ravaja et al., 2006; Weibel et al., 2008; Gajadhar et al., 2008). Where collaborative gameplay experience was studied, social context was not investigated (Gajadhar, 2010), or only physiological measures of emotional responses in players were analysed (Mandryk & Inkpen, 2004). Using the Game Experience Questionnaire (Section 2.1.8) in combination with the Social Presence in Gaming Questionnaire (Section 2.1.2), we aimed to contribute to this gap in the research and investigate the influence of social context on collaborative gameplay experience from a psychologically structured standpoint.

In Section 2.2 we reviewed the current body of literature surrounding the following key research areas: collaborative and co-operative gameplay mechanisms; communication channels in multiplayer games; and player–avatar relationship dynamics. One of the fundamental aspects of designing collaborative games involves dealing with the "competitiveness that players bring to the table" (Zagal, Rick & Hsi, 2006). Collaborative games require mechanisms that cultivate teamwork while discouraging any competitive or anti-collaborative behaviour in players. In order to address

RQ4 ("Which gameplay mechanisms facilitate collaboration and social interaction between co-players while precluding any form of competition?"), Section 2.2 outlined a number of successful collaborative and co-operative game mechanics. The game mechanics that were found to have the most significant impact on necessitating collaboration between players were: *complementarity*; *shared goals*; *shared puzzles*; *interacting with the same object*; and *difficulty* (Seif El-Nasr et al., 2010). Communication channels are pivotal to players' success during collaborative gameplay, and verbal communication is most commonly facilitated by via voice or text chat (Toups et al., 2014; Kowert, 2015). Additionally, alternative forms of in-game communication, like *virtual gestures* and *environment-modifying* mechanics, allow players to share information in ways that can be difficult or impossible to convey verbally (Toups et al., 2014). Through in-game social representations of players (i.e., avatars), player–avatar relationships also influence the way players experience games, and are helpful in understanding how players socialise during multiplayer games (Banks & Bowman, 2013). Section 2.2 not only investigated RQ4 in more detail and increased our understanding of how players interact and communicate during collaborative gameplay; it also informed the design and development of our experimental apparatus, a collaborative multiplayer game entitled *COLAB*.

3 Method

The aim of our research was to investigate how changes in social context (i.e., co-located versus mediated gameplay) impact players' psychological experience of collaborative multiplayer games. In the following chapter we outline the methods used to empirically investigate our research questions:

> RQ1: Do variations in social context (i.e., co-located play versus mediated play) influence players' experience of collaborative multiplayer games?
>
> RQ2: Do variations in social context during collaborative play result in changes in co-players' subjective feelings of social presence?
>
> RQ3: Do correlations exist between any of the experience factors measured by the GEQ and SPGQ during collaborative gameplay in the co-located and/or mediated social contexts?
>
> RQ4: Which gameplay mechanisms facilitate collaboration and encourage social interaction between co-players while precluding any form of competition?

and confirm or reject our hypotheses:

> H1: Collaborative players' game experience (as measured by the GEQ) will differ with variations in social context.
>
> H2: Co-located players will experience higher levels of social presence during collaborative gameplay than mediated players.
>
> H3: Mediated players will experience higher levels of flow and immersion during collaborative gameplay than co-located players.

To this end, we describe the processes involved in developing an appropriate apparatus for the study, recruiting participants, and measuring psychological indicators of experience. Furthermore, we explain the experimental design, procedures, and manipulations employed in this study.

3.1. Apparatus

To investigate our research questions and address our hypotheses, we developed a purely collaborative, anti-competitive, non-violent multiplayer puzzle game centred on communication and social interaction. The game, entitled *COLAB*, is similar to games like *Portal 2* (Valve Corporation, 2011) and *LittleBigPlanet* (Media Molecule, 2008) in that its gameplay involves two players working together to solve interactive puzzles. To minimise the complexity of the study and avoid any confounding variables that might be introduced by the presence of more players, the number of players in *COLAB* was limited to two. The aim of *COLAB* is for two players to socialise, communicate and, most importantly, collaborate in order to escape from a maze made up of a series of rooms. If players do not work together and interact with each other as a cohesive unit, they are unable to progress through the collaborative puzzles presented by *COLAB*. In this way, competition is precluded from *COLAB's* gameplay, with players forced to communicate with each other, co-ordinate their actions and work as a team throughout *COLAB's* puzzle-solving process. In *COLAB*, each player controls a colour-coded avatar in an isometric 3D environment (Figure 7). Using their respective avatars, the players can manipulate objects in the game world that are the same colour as their avatars. In other words, the blue avatar can interact with blue objects, while the red avatar can interact with red objects. A third category of object exists that requires input from both the red avatar and the blue avatar simultaneously. This kind of object is shaded purple, the colour that results from the combination of blue and red.

Figure 7: *COLAB* screenshot. Each player's avatar is represented by a colour-coded disk. The blue player can interact with blue objects and the red player can interact with red objects. Both players are able to interact with purple objects. By manipulating colour-coded objects in the game world, players work together and communicate to solve collaborative puzzles in order to escape from a series of rooms.

The collaborative mechanics underlying the design of *COLAB's* gameplay were based on the gameplay mechanics outlined in Section 2.2.1 and the communication channels outlined in Section 2.2.2. In addition to synchronised voice chat, players are able to use environment-modifying mechanics in *COLAB* to communicate with each other in-game. Players can draw attention to their avatar's location by kicking up a ring of dust around their avatar (Figure 8). In addition to this visual cue, an audio cue in the form of a bell sound is triggered whenever a player takes this action.

Figure 8: In-game communication channels. Players can draw the attention of their co-player by triggering an animation of dust around their avatar. The visual animation is accompanied by an audio cue of a bell sound to further grab the attention of the co-player.

Specific examples of the implementation of the collaborative gameplay mechanics outlined in Section 2.2.1 include:

- **Complementarity and synergies between abilities:** By manipulating objects of the same colour as their avatar, players have designated roles to perform at each stage of the puzzle-solving process. Furthermore, each player has a unique special ability that enhances his or her role while complementing the co-player's role at each stage of the puzzle. The red player's special ability is the power to move more quickly, while the blue player's special ability is the power to grow in size. Players have a finite amount of special power, represented by a meter around their avatar (Figure 9) that depletes as they use their special ability. If the meter becomes empty, players are unable to use their special ability. In order to refill their special-ability meter, the avatars must come together and touch. Once the meter is refilled, players can continue using their special powers and supporting each other. In this way, players have unique character roles and special abilities that complement each other's activities throughout *COLAB's* gameplay.

Figure 9: Player avatars surrounded by their special-ability meter. The red player's special ability is to boost its speed for a finite amount of time, and the blue player's special ability is to grow in size for a finite amount of time. The meter depletes as players use their special ability, and players are unable to use their special ability if their special ability meter is empty. When touching each other, both players' special-ability meter refills.

- **Shared goals and shared puzzles:** In *COLAB*, players have the single non-exclusive goal of escaping the maze they find themselves trapped in at the start of the game. The only way players can escape is by working together as a team to solve the collaborative puzzles presented by each room in the maze until they are both free, at which point players have won the game. Both players depend heavily on each other, and they either win together or lose together.
- **Timed events and interacting with the same object:** In *COLAB*, large purple objects (Figure 10) are too big for one player to manipulate alone, and can only be manipulated by both players acting simultaneously. Smaller purple objects are shared by both players, and, depending on a player's role in a specific part of the puzzle, players can use these smaller objects to help each other traverse the virtual landscape. Similarly, timed events in the game force players to perform the actions that are specific to their roles and special abilities in unison before a timer expires. Timed events and shared objects force players to focus, work more cohesively, and work out collaborative strategies to accomplish their shared goals.

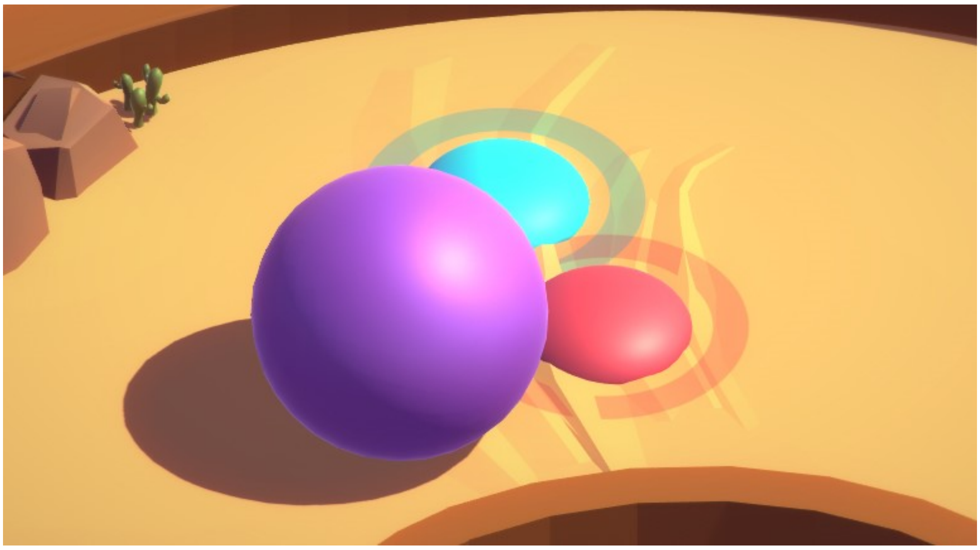

Figure 10: Shared objects. In *COLAB*, large purple spheres can only be moved if both players exert force onto the sphere simultaneously.

- **Camera setting and difficulty:** To ensure that all visual information on-screen is always shared by both players, the camera in *COLAB* zooms in and out, showing both players and their surroundings at all times. In this way, neither player can be abandoned by the other or have access to less information about each puzzle than the other. Furthermore, puzzles in *COLAB* were specifically designed to be too difficult for one player to solve alone, and can only be solved if both players help each other and collaborate.

COLAB was developed using the *Unity3D* game engine. *Unity3D* was chosen as the optimal platform for the development of *COLAB* because it provides tools, models, extensive documentation and boiler-plate code that speed up the game-development process substantially. 3D models, environment textures, particle effects, shadows, sounds, music and animations were implemented to simulate the experience of playing a contemporary multiplayer game. Furthermore, we tested *COLAB* with volunteers throughout the game's development life-cycle, in order to identify and fix bugs, improve gameplay, finetune difficulty, and provide as seamless of an experience as possible for participants during the final experiments. See *Appendix B* for *COLAB's* full game-design document, including details on: level design; gameplay mechanics; controls; models; textures; sound effects; technical specifications; and software licensing. A fully playable executable (.exe) of the final version of *COLAB* can be downloaded at: https://people.cs.uct.ac.za/~mterblanche/. For more information on the source code, class structure, and software architecture underlying *COLAB*, the entire *COLAB* project is open-source and available at: https://github.com/phatphrog/colab.

3.2. Participants

Prior to recruitment, ethics clearance was granted by the Faculty of Science at the University of Cape Town for the use of student volunteers from the University as participants in this study (*Appendix E*). Pilot tests, consisting of eight participants (four co-located and four mediated) were carried out for the purpose of determining the adequate sample size required to validate our study. Based on the pilot data, power analysis was conducted with a minimum effect size d of 0.5, a power of 80% ($1-\beta = 0.8$) and an error probability of 5% ($\alpha = 0.05$). The results of the power analysis indicated that a total of thirty-four participants were required to produce statistically significant results and confirm or reject our hypotheses. To ensure that we had enough data in the case of outliers, problematic data, or confounds, we increased the number of participants to forty.

Therefore, a total of forty participants were recruited, either face-to-face or via email, from the student population at the University of Cape Town. Thirteen (32.5%) participants were female and twenty-seven (67.5%) participants were male. Participants were eighteen to twenty-six years of age, with a mean age of 21.05 years (SD = 2.1). Participants were specifically recruited in friendship pairs (i.e., participants within pairs were friends prior to taking part in this experiment), to avoid any confounding variables that might arise from differences in the way in which strangers and friends interact. Various studies have found that playing with or against strangers elicits different psychological, psychophysiological, and physiological responses in players compared to playing with or against friends (Mandryk & Atkins, 2007; Ravaja et al., 2006; Ravaja, 2009). Participant pairs were randomly split into two independent populations, with twenty participants (six female, fourteen male) assigned to the co-located condition, and twenty participants (seven female, thirteen male) assigned to the mediated (i.e., non-co-located) condition. Friendship pairs remained constant throughout this split to ensure that participants played with their friends regardless of whether they were co-located or mediated. All participants had experience playing digital games and had played games with others, either in a co-located and/or a mediated setting, prior to taking part in this experiment. Individual differences in the amount of time spent playing games in the past, game preferences and overall gaming experience were not controlled for in this study. Where images of participants were used in this document, permission was obtained from the relevant participants.

3.3. Self-report Measures

A combination of self-report measures were employed in this study to obtain quantitative data regarding participants' subjective experience of collaborative multiplayer gameplay under different social contexts (i.e. co-located versus mediated). These self-report measures took the form of two psychologically validated questionnaires: The Game Experience Questionnaire (GEQ) (see Section 2.1.8), which measures a multitude of psychological indicators of game experience, and the Social Presence in Gaming Questionnaire (SPGQ) (see Section 2.1.2), which measures players' subjective feelings of social presence during gameplay. See *Appendix A* for the full GEQ, in combination with the SPGQ. In addition to the GEQ and SPGQ, participants completed a consent form that included a brief record of their demographic information (*Appendix C*).

3.3.1. Game Experience Questionnaire (GEQ)

The levels of flow, sensory and imaginative immersion, competence, tension/annoyance, challenge, negative affect, and positive affect experienced by participants during play were measured through the use of the GEQ's core module. The GEQ's post-game module measured participants' feelings of positive experience, negative experience, tiredness, and difficulty in returning to reality after they had stopped playing. The combination of the GEQ's core module and post-game module allowed for a robust, psychologically structured investigation into collaborative multiplayer gameplay experience.

3.3.2. Social Presence in Gaming Questionnaire (SPGQ)

The SPGQ was used in combination with the GEQ and measured social presence on three subscales: psychological involvement—empathy; psychological involvement—negative feelings; and behavioural engagement. The SPGQ allowed us to determine whether the changes made in this study to social context and associated levels of co-presence (since co-located players have a higher level of co-presence than mediated players) were sufficient in producing significant differences in participants' subjective feelings of social presence. We were therefore able to attribute differences in game experience to experimental manipulation, making the SPGQ an indispensable tool for adding validity to the construct of this study.

3.4. Experimental Design

The study used a between-group design. Participant pairs were divided into two separate groups and the independent variable—the co-player's location—was systematically varied across the two groups to produce two levels of co-presence in players.

In the first group, co-located participants sat next to each other and played together in the same room (Figure 11). They were able to interact face-to-face via direct verbal communication, body language, and social cues. In this way, co-located players were co-present in their physical space as well as in the virtual environment of the game.

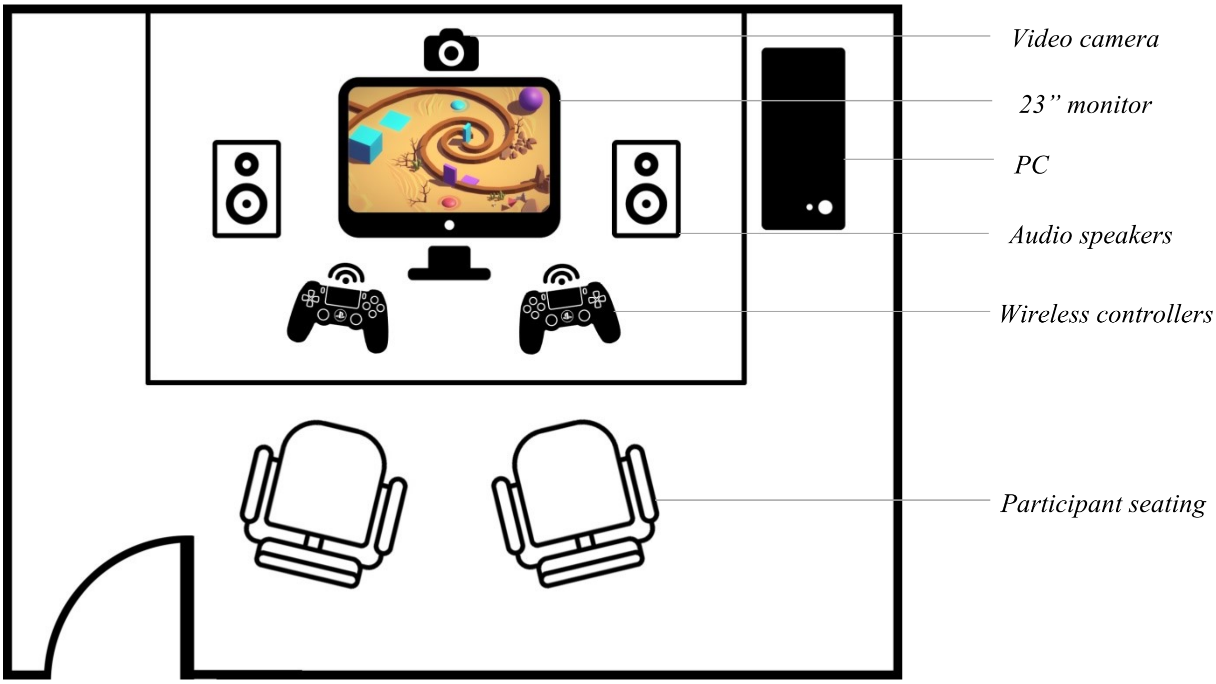

Figure 11: Co-located setup, consisting of a single room equipped with a 23" monitor, audio speakers, video camera, and two wireless controllers.

In the second group, mediated participants were non-co-located. They were in separate rooms and were able to communicate using voice chat via a headset and microphone, as well as via in-game animations and environment-modifying mechanics (Figure 12). The opportunity to communicate vocally during mediated collaborative gameplay has been shown to significantly add to player experience in terms of engagement and enjoyment, while the ability for mediated players to see each other while talking has been found to have hardly any impact on experience (Gajadhar, 2010). Consequently, video chat software was not included in this study. Instead, *TeamSpeak* (https://www.teamspeak.com/), a popular voiceover IP software tool, was used to facilitate uninterrupted, synchronised voice chat between mediated co-players. Communication between non-co-located players was therefore mediated by the technology, and players were co-present only in the virtual environment of the game.

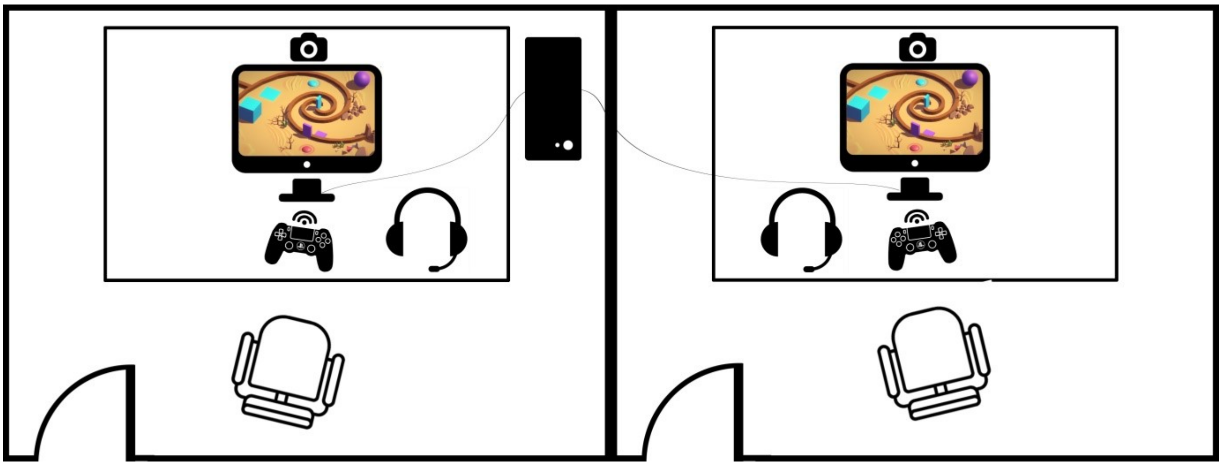

Figure 12: Mediated setup, consisting of two separate rooms. Each room was equipped with its own 23" monitor (duplicated display), video camera, and wireless controller. In place of audio speakers, participants were provided with a headset and microphone.

The dependent variables of interest were as follows: subjective feelings of social presence in co-players, as measured by the SPGQ; levels of flow, immersion, competence, tension/annoyance, challenge, negative affect, and positive affect, as measured by the GEQ's core module; and feelings of positive experience, negative experience, tiredness, and difficulty in returning to reality after the game had ended, as measured by the GEQ's post-game module.

Observational data was collected via video and audio recordings of each session. Once play had commenced, participants were not interrupted or disturbed until they had stopped playing. Interruptions have been shown to have a negative impact on flow (Csikszentmihalyi, 1991) and immersion (Jennett et al., 2008). This control was therefore necessary for avoiding confounded results.

3.5. Procedure

The study was carried out under laboratory conditions in the Computer Science Department at the University of Cape Town. The laboratory consisted of two adjacent rooms. Only one of the rooms was needed during the co-located play condition. Both rooms were used during the mediated condition, wherein each participant required his or her own separate room. Each room contained a computer with a 23" monitor, a mouse, a keyboard, a headset, *PlayStation 4 DualShock 4* controllers (see *Appendix B)*, speakers, and a video camera.

To avoid biased responses, participants were misled about the true aim of the experiment. Participants were told that they were simply play-testing a new game that the researcher was developing, and were brought into the lab to play *COLAB* one pair at a time. The researcher explained to participants what was expected of them and stressed that they were free to leave or stop playing at any time. Participants were then asked to fill out a consent form (*Appendix C*) containing their demographic information. Participants in the co-located condition were seated next to each other in the same room, playing *COLAB* together on the same 23” monitor; all audio from the game was played through speakers (Figure 13).

Figure 13: Co-located participants playing *COLAB* together in the same room.

Participants in the mediated condition were seated in their respective rooms and provided with a headset through which both in-game audio and the co-player’s voice audio were heard. In the mediated condition, participants each had their own 23” monitors that duplicated the display of the game in each room, and their headsets also contained a microphone for voice chat (Figure 14).

Figure 14: Mediated participants playing *COLAB* together in separate rooms.

Participants were then informed of the aim of the game, how the controls worked, and how long (on average) the game would last. Verbal instructions were kept to a minimum and, to avoid confounding effects, strictly standardised for all participants (*Appendix D*). In-game instructions were added to *COLAB* so that participants could refer to these instructions at any time (see *Appendix B*). After being introduced to the basic premise and controls of *COLAB*, players were left alone to complete a forty- to sixty-minute period of gameplay, during which they socialised and worked together to complete the interactive, collaborative puzzles that make up *COLAB*.

After having completed the game, each participant filled out his or her own GEQ (core module), as well as both the post-game and the SPGQ modules. After each gameplay session was complete, and each participant had filled out a questionnaire, a short interview was carried out with the pair, during which the co-players were invited to provide any feedback on their experience of playing *COLAB* together. Participants were then fully debriefed about the true aims of the experiment. Finally, participants were deservedly thanked and dismissed.

4 Results

The aim of this study was to investigate whether the systematic variation of co-presence between players, by way of the variation of co-players' location, resulted in changes in user experience of a collaborative multiplayer game, as measured by the Game Experience Questionnaire (GEQ) (see Section 2.1.8) and the Social Presence in Gaming Questionnaire (SPGQ) (see Section 2.1.2). Specifically, we examined whether the two co-presence settings used in this study (i.e., co-located play versus mediated play) resulted in significant differences in players' feelings of:

a) competence, sensory and imaginative immersion, flow, tension/annoyance, challenge, negative affect, and positive affect, as measured by the GEQ's core module;
b) positive experience, negative experience, tiredness, and difficulty in returning to reality, as measured by the GEQ's post-game module; and
c) social presence, as measured by the SPGQ;

On completion of the laboratory experiments, we collated the data and subjected it to statistical analysis, in order to assess our research questions. The results obtained from the GEQ's core and post-game modules were analysed to address our first research question:

> RQ1: Do variations in social context (i.e., co-located play versus mediated play) influence players' experience of collaborative multiplayer games?

Meanwhile, the results gained from the SPGQ were analysed to address our second research question:

> RQ2: Do variations in social context during collaborative play result in changes in co-players' subjective feelings of social presence?

Finally, we explored the possibility of correlations between the experience factors measured by the GEQ and SPGQ, as part of our third research question:

> RQ3: Do correlations exist between any of the experience factors measured by the GEQ and SPGQ during collaborative gameplay in the co-located and/or mediated social contexts?

Statistical analysis of our results, driven by RQ1, RQ2, and RQ3, allowed us to accept or reject our hypotheses:

> H1: Collaborative players' game experience (as measured by the GEQ) will differ with variations in social context.

> H2: Co-located players will experience higher levels of social presence during collaborative gameplay than mediated players.

> H3: Mediated players will experience higher levels of flow and immersion during collaborative gameplay than co-located players.

The relevant descriptive statistics for all the factors measured by the GEQ and SPGQ are presented in Table 1 (co-located pairs) and Table 2 (mediated pairs). All the scores for each component making up each experience factor were measured on a Likert-type five-point scale (0 = totally disagree, 4 = totally agree) and averaged to produce a single score between zero and four for each experience factor (see *Appendix A: Scoring guidelines*).

Table 1:

Co-located Descriptive Statistics	*M*	*Mdn*	*Var*	*SD*	*N*
GEQ: Core Module					
Competence	2.670	2.800	0.549	0.722	20
Sensory and Imaginative Immersion	2.967	2.833	0.294	0.529	20
Flow	3.030	3.100	0.393	0.611	20
Tension/Annoyance	0.800	0.667	0.613	0.763	20
Challenge	1.900	2.000	0.267	0.504	20
Negative Affect	0.463	0.250	0.166	0.397	20
Positive Affect	3.380	3.600	0.336	0.565	20
SPGQ Module					
Psychological Involvement—Empathy	3.346	3.333	0.228	0.466	20
Psychological Involvement—Negative Feelings	1.510	1.600	0.596	0.752	20
Behavioural Involvement	3.722	3.833	0.101	0.309	18
GEQ: Post-Game Module					
Positive Experience	2.750	2.917	0.648	0.784	20
Negative Experience	0.292	0.167	0.117	0.333	20
Tiredness	0.700	0.500	0.800	0.872	20
Returning to Reality	1.283	1.167	0.623	0.769	20

Table 2:

Mediated Descriptive Statistics	*M*	*Mdn*	*Var*	*SD*	*N*
GEQ: Core Module					
Competence	2.770	3.000	0.266	0.503	20
Sensory and Imaginative Immersion	3.450	3.583	0.258	0.495	20
Flow	3.540	3.600	0.123	0.341	20
Tension/Annoyance	0.833	0.667	0.965	0.957	20
Challenge	2.200	2.200	0.316	0.548	20
Negative Affect	0.413	0.250	0.245	0.483	20
Positive Affect	3.570	3.900	0.494	0.685	20
SPGQ Module					
Psychological Involvement—Empathy	3.475	3.583	0.311	0.543	20
Psychological Involvement—Negative Feelings	1.440	1.500	0.310	0.543	20
Behavioural Involvement	3.425	3.583	0.253	0.490	20
GEQ: Post-game Module					
Positive Experience	2.983	3.250	0.637	0.778	20
Negative Experience	0.217	0.000	0.231	0.469	20
Tiredness	0.525	0.250	0.486	0.680	20
Returning to Reality	1.783	1.667	0.682	0.805	20

4.1. GEQ: Core Module Scores

The GEQ's core module probes players' thoughts and feelings during gameplay and consists of seven components: competence, sensory and imaginative immersion, flow, tension/annoyance, challenge, negative affect, and positive affect. Each of the seven components was calculated for each participant from the self-report data received via the GEQ's core module, and the resulting scores were compared across the conditions (i.e., co-located play versus mediated play). This analysis aimed to identify whether the systematic manipulation of co-presence made in this study resulted in significant differences in any of the seven components measured by the GEQ's core module. We were especially interested in analysing whether mediated (i.e., non-co-located) players experienced significantly higher levels of flow and sensory and imaginative immersion compared to co-located players, as hypothesised in Section 1.1 (H3).

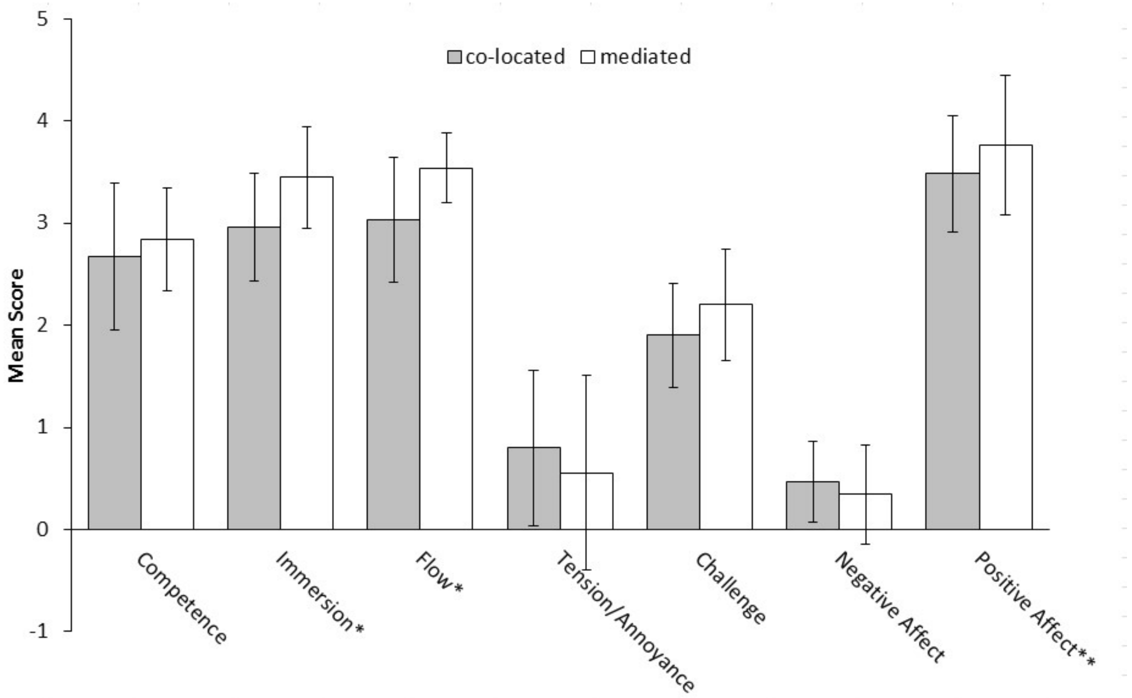

Figure 15: Mean participant scores on each factor of the GEQ's Core Module under each condition. * indicates significance at the $p < 0.01$ level. ** indicates significance at the $p < 0.05$ level.

Figure 15 represents the difference in mean scores, as self-reported by the GEQ's core module under each condition. Comparing the co-located results to the mediated results reveals that participants reported on average higher scores for feelings of competence, sensory and imaginative immersion, flow, challenge, and positive affect in the mediated condition. On the other hand, participants reported higher levels of tension/annoyance and negative affect in the co-located condition.

An independent-samples t-test revealed that changes in the level of co-presence between players had a statistically significant effect on sensory and imaginative immersion, with a significant increase in sensory and imaginative immersion in the mediated condition compared to the co-located condition ($t(39) = -2.91$, $p = 0.006$). Further, Cohen's effect size value ($d = 0.92$) suggested high practical significance. Due to unequal variances in the flow data across conditions, we opted to use Welch's t-test to compare differences in flow scores. The Welch's t-test (Welch, 1947) showed a highly significant increase in flow scores self-reported in the mediated condition compared to the co-located condition (*t(39)* = -3.177, *p* = 0.003). Moreover, Cohen's effect size value (*d* = 1.005) indicated very high practical significance. We therefore confirm our hypothesis that mediated players experience higher levels of flow and immersion during collaborative gameplay than co-located players (H3). The data for positive affect was not normally distributed, leading us to use Mann-Whitney's U test to compare positive affect across conditions. The Mann–Whitney U test (Mann & Whitney, 1947) indicated that positive affect was significantly greater in the mediated condition than in the co-located condition (*U(39)* = 118, *p* = 0.025, *z* = -2.218). Additionally, Cohen's effect size value (*d* = -0.75) indicated medium-to-high practical significance. Although challenge scores were not statistically significant at the p < 0.05 level (*t(39)* = 1.757, *p* = 0.087), Cohen's effect size value (*d* = 0.556) indicated medium practical significance. The findings presented in section 4.1 directly address RQ1 and indicate that variations in social context (i.e., co-located play versus mediated play) significantly influence players' experience of collaborative multiplayer games. Inferential statistics for the GEQ's core module are represented in Table 3.

Table 3:
Inferential Statistics

GEQ: Core Module	*parametric*	*statistical test*	*statistic*	*p*	*z*	*Cohen's d*	*r*
Competence	FALSE	Mann-Whitney U test	183.5	0.661	-0.446	-0.142	-0.071
S and I Immersion*	TRUE	Independent t-test	-2.91	0.006		0.92	
Flow*	TRUE	Welch's t-test	-3.177	0.003		1.005	
Tension/Annoyance	FALSE	Mann-Whitney U test	208	0.837	0.216	0.068	0.034
Challenge	TRUE	Independent t-test	-1.757	0.087		0.556	
Negative Affect	FALSE	Mann-Whitney U test	227.5	0.447	0.744	0.237	0.118
Positive Affect**	FALSE	Mann-Whitney U test	118	0.025	-2.218	-0.75	-0.351

* indicates significance at the p < 0.01 level. ** indicates significance at the p < 0.05 level.

4.2. SPGQ Module Scores

The social presence module investigates the psychological and behavioural involvement of the player with other social entities, whether they are virtual (i.e., in-game characters), mediated, or co-located. Social presence scores, as self-reported by participants via the SPGQ, made it possible to gauge whether a relationship existed between the experimental manipulation of co-presence between players and players' feelings of social presence, as hypothesised in Section 1.1 (H2).

Social presence is a multidimensional construct measured on three sub-scales, namely: psychological involvement—empathy (PI—empathy), psychological involvement—negative feelings (PI—negative feelings), and behavioural involvement. Participant scores for each of the three sub-scales of the SPGQ were calculated for each of the two experimental conditions (i.e., co-located play and mediated play). Figure 16 denotes the difference in mean SPGQ scores for each of the three sub-scales under each condition. Inspection of the figure indicates that participants reported higher scores for behavioural involvement and slightly higher scores for PI—negative feelings during co-located gameplay. On the other hand, participants reported marginally higher scores for PI—empathy during mediated gameplay.

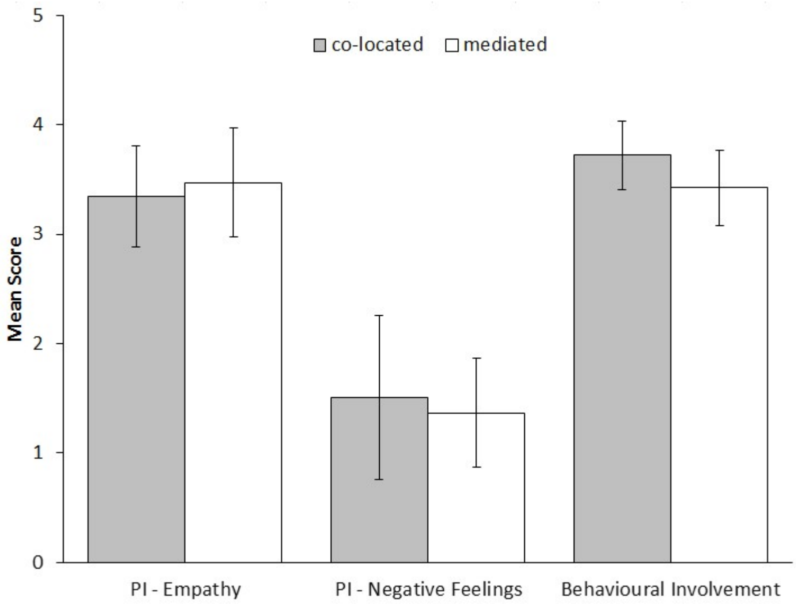

Figure 16: Mean participant scores for each sub-scale of the SPGQ under each condition. * indicates significance at the $p < 0.05$ level. ** indicates significance at the $p < 0.1$ level.

Tukey's test for outlier detection (Tukey, 1977), which is based on the interquartile range of the data, revealed that two data points in the co-located condition's behavioural involvement data fell below the lower fence of the interquartile range, as displayed in Figure 17 below.

Upon investigation of the video recordings made during each session, it was discovered that the two participants who recorded the outlier data points in question were distracted by their mobile phones multiple times during the session. Further video investigation revealed that these were the only two people in the participant pool of this experiment who used their mobile phones during gameplay. Interestingly, these participants did not record abnormalities in any other indicators of experience. For these reasons, we did not deem it necessary to remove their responses from other experience factors, but the two data points below the lower fence were omitted from subsequent statistical analysis as they were considerably anomalous from the rest of the behavioural involvement data self-reported in the co-located condition.

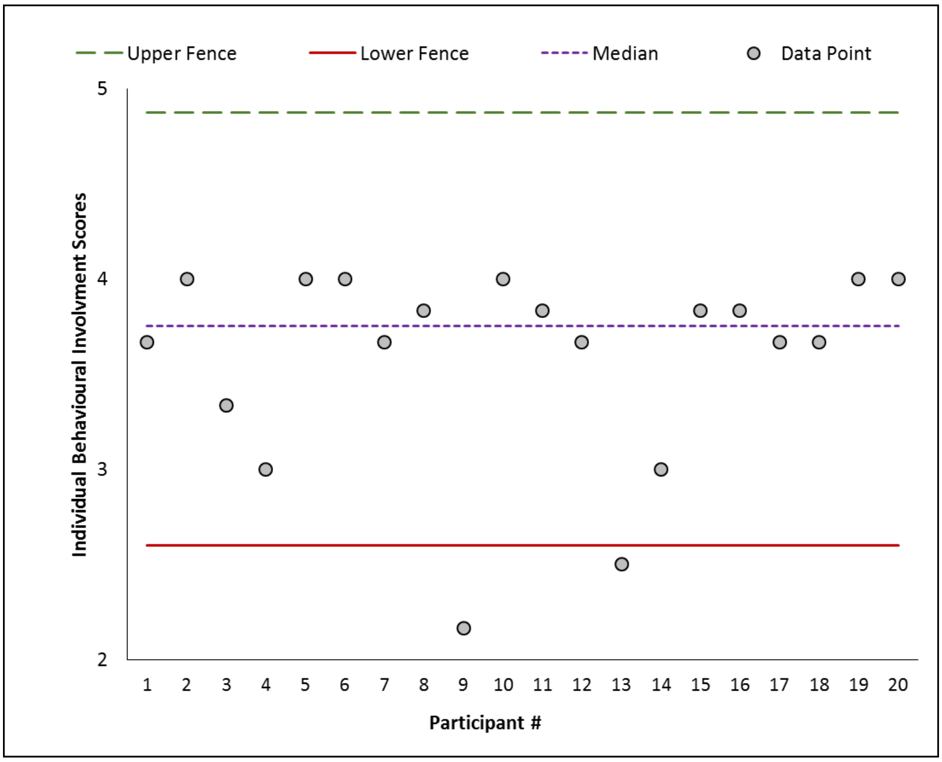

Figure 17: Based on the interquartile range of the data, outliers were detected in the co-located condition's behavioural involvement data.

Due to the nonparametric nature of the data for behavioural involvement, Mann-Whitney's U test was used to compare behavioural involvement across conditions. Although behavioural involvement was not found to be statistically significant at the $p < 0.05$ level, ($U(37) = 241.5$, $p = 0.069$, $z = 1.798$), Cohen's effect size value ($d = 0.62$) indicated medium-to-high practical significance. Given the relatively high effect size found when comparing behavioural involvement between conditions, the results presented here do indicate that variations in social context during collaborative play are likely to result in changes in co-players' subjective feelings of social presence (RQ2). That said, due to the lack of statistical significance found when comparing any of the social presence sub-scales across conditions, we reject our hypotheses that co-located players experience higher levels of social presence during collaborative gameplay than mediated players (H2). Table 4 represents the inferential statistics for the SPGQ module.

Table 4:
Inferential Statistics

SPGQ Module	*parametric*	*statistical test*	*statistic*	*p*	*z*	*Cohen's d*	*r*
PI—Empathy	FALSE	Mann-Whitney U test	160	0.281	-1.082	0.347	-0.171
PI—Negative Feelings	TRUE	Independent t-test	0.329	0.744		0.104	
Behavioural Involvement	FALSE	Mann-Whitney U test	241.5	0.069	1.798	0.629	0.3

* indicates significance at the p < 0.01 level. ** indicates significance at the p < 0.05 level.

4.3. GEQ: Post-game Module Scores

The GEQ's post-game module assesses how players feel after they have stopped playing and consists of the following four components: positive experience, negative experience, tiredness, and difficulty in returning to reality. Each of the four components of the GEQ's post-game module was calculated for each participant under the two conditions. Subsequent statistical analysis aimed to investigate whether the systematic manipulation of co-presence made in this study resulted in significant differences across conditions in any of the four components self-reported by participants via the GEQ's post-game module.

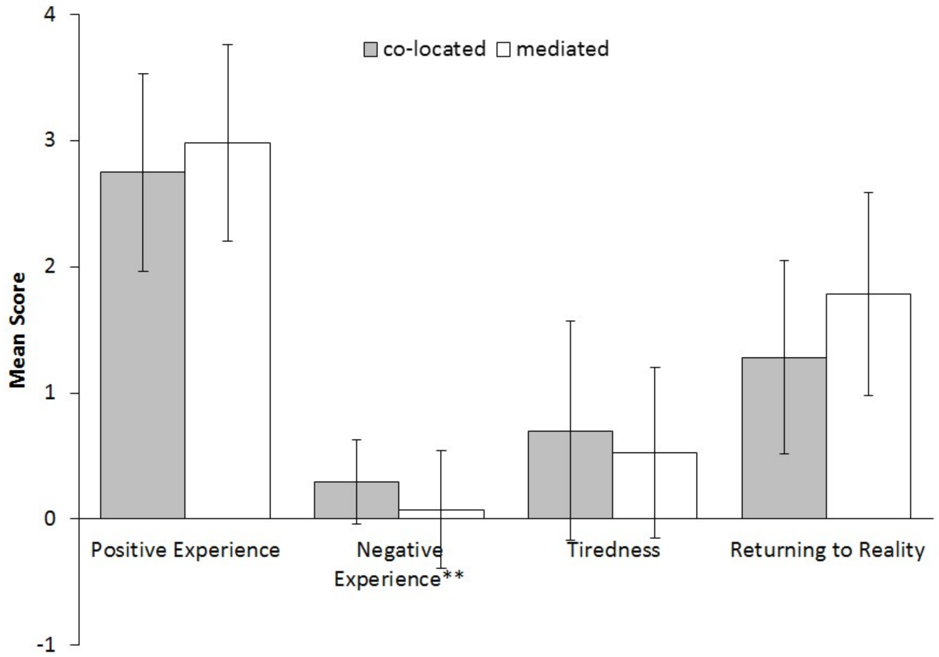

Figure 18: Mean participant scores for each component of the GEQ's post-game module under each condition. * indicates significance at the $p < 0.01$ level. ** indicates significance at the $p < 0.05$ level.

Figure 18 represents the difference in mean GEQ post-game module scores for each component under the two conditions. Inspection of the figure reveals that participants had on average higher scores for positive experience and difficulty in returning to reality in the mediated condition. Conversely, participants reported on average higher scores for negative experience and tiredness in the co-located condition.

The self-report data for negative experience was not normally distributed. We therefore used Mann–Whitney's U test to compare negative experience between the two conditions, which revealed a statistically significant increase in negative experience in the co-located condition compared to the mediated condition ($U(39) = 270.5$, $p = 0.04$, $z = 1.907$). Further, Cohen's effect size value ($d = 0.634$) suggested medium-to-high practical significance. Although an independent-samples t-test revealed that the co-located increase in difficulty returning to reality was not significant at the p <

0.05 ($t(39)$ = -1.958, p = 0.058), Cohen's effect size value (d = 0.62) indicated medium-to-high practical significance. The results presented here, along with the results presented in section 4.1, clearly enable us to confirm our hypothesis that collaborative players' game experience (as measured by the GEQ) will differ with variations in social context (H1). Inferential statistics for the GEQ's post-game module are represented in Table 5.

Table 5:
Inferential Statistics

GEQ Post-game Module	*parametric*	*statistical test*	*statistic*	*p*	*z*	*Cohen's d*	*r*
Positive Experience	TRUE	Independent t-test	0.92	0.363		0.291	
Negative Experience**	FALSE	Mann-Whitney U test	270.5	0.04	1.907	0.634	0.302
Tiredness	FALSE	Mann-Whitney U test	217	0.634	0.46	0.146	0.073
Returning to Reality	TRUE	Independent t-test	-1.958	0.058		0.62	

* indicates significance at the p < 0.01 level. ** indicates significance at the p < 0.05 level.

4.4. Correlations

The different factors measured by the GEQ's three modules (i.e., core module, SPGQ module and post-game module) were tested for correlation against one another. Because each condition represented an independent sample, correlation testing was conducted in each of the two conditions separately (i.e., co-located data was tested for correlations against co-located data only, while mediated data was tested for correlations against mediated data only). This analysis aimed to address RQ3 ("Do correlations exist between any of the experience factors measured by the GEQ and SPGQ during collaborative gameplay in the co-located and/or mediated social contexts?") and verify whether any of the psychological constructs measured by the three questionnaire modules showed a significant relationship with any other construct, in either of the two conditions. Correlation matrixes for each of the two samples (i.e., co-located participants and mediated participants) are presented in Table 6. Intercorrelations for co-located participants are presented above the diagonal, and intercorrelations for mediated participants are presented below the diagonal.

Table 6:

Summary of Intercorrelations for Scores on Competence, Sensory and Imaginative Immersion, Flow, Tension/Annoyance, Challenge, Negative Affect, Positive Affect, Psychological Involvement – Empathy, Psychological Involvement – Negative Feelings, Behavioural Involvement, Positive Experience, Negative Experience, Tiredness, and Returning to Reality as a Function of Co-player Location (i.e., co-located or mediated).

Measure	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*
1. Competence	—	0.08	0.27	0.01	-0.02	-0.30	0.11	-0.03	-0.08	0.24	0.47**	0.02	-0.16	0.12
2. S & I Immersion	0.11	—	0.39	0.34	0.28	-0.02	0.44	0.17	0.39	-0.36	0.07	0.28	-0.32	0.39
3. Flow	-0.001	-0.16	—	0.001	0.32	-0.30	0.35	-0.10	0.15	-0.30	0.25	0.01	-0.01	0.14
4. Tension/Annoyance	0.12	-0.05	0.43	—	0.60*	0.43	-0.09	-0.32	-0.11	-0.11	0.10	-0.16	0.07	-0.21
5. Challenge	0.00	0.09	0.41	0.55**	—	0.26	-0.01	0.01	0.06	0.07	0.20	-0.02	0.17	-0.05
6. Negative Affect	0.15	-0.37	0.07	0.46**	0.23	—	-0.09	0.06	-0.02	0.37	-0.04	-0.17	0.13	-0.10
7. Positive Affect	0.31	0.64*	-0.02	-0.12	-0.07	-0.45**	—	0.05	0.38	0.38	0.08	-0.07	-0.58*	0.51**
8. PI - Empathy	0.13	0.69*	0.06	-0.05	-0.14	-0.51**	0.74*	—	0.62*	0.38	0.43	0.36	0.03	0.22
9. PI - Negative Feelings	-0.16	0.41	0.23	0.03	-0.07	-0.28	0.41	0.60*	—	0.25	0.52**	0.23	-0.15	0.56*
10. Behavioural Involvement	0.05	0.32	0.27	-0.08	-0.20	-0.53**	0.56*	0.72*	0.37	—	0.21	0.00	0.57*	0.01
11. Positive Experience	0.17	0.30	0.23	0.05	-0.16	-0.57*	0.67*	0.86*	0.51**	0.87*	—	0.13	-0.05	0.45
12. Negative Experience	-0.40	-0.22	0.18	0.12	0.11	0.02	-0.01	0.03	0.47**	-0.13	0.07	—	-0.05	0.50
13. Tiredness	-0.62*	-0.19	-0.25	-0.17	0.03	-0.08	-0.32	-0.13	-0.12	-0.30	-0.22	0.32	—	0.03
14. Returning to Reality	-0.29	0.24	-0.02	-0.18	-0.05	0.03	0.23	0.24	0.39	0.13	0.21	0.23	0.47**	—

Note. Intercorrelations for co-located participants (n = 20) are presented above the diagonal, and intercorrelations for mediated participants (n = 20) are presented below the diagonal. * indicates significance at the $p < 0.01$ level. ** indicates significance at the $p < 0.05$ level.

4.4.1. Co-located Correlations

Upon inspection of the data above the diagonal line in Table 6 (p. 53), it is evident that a number of significant correlations among co-located experience measures were detected.

A Pearson product-moment correlation coefficient was computed to assess the relationship between competence and positive experience. There was a weak-to-moderate positive correlation between the two variables ($r(20)$ = 0.47, p = 0.035). The co-located data for tension/annoyance was not normally distributed and consequently a Spearman's rank-order correlation coefficient was computed to assess the relationship between tension/annoyance and challenge. Spearman's r_s revealed a moderate positive correlation between tension/annoyance and challenge ($r_s(20)$ = 0.60, p = 0.006).

Similarly, the co-located data for positive affect was also not normally distributed, and we therefore computed the Spearman's rank-order correlation coefficient to assess the relationship between positive affect and tiredness. There was a moderate negative relationship between the two variables ($r_s(20)$ = -0.58, p = 0.007). Again, due to the nonparametric nature of the co-located data for positive affect, Spearman's rank-order correlation coefficient was computed to assess the relationship between positive affect and returning to reality. There was a moderate positive relationship between positive affect and returning to reality ($r_s(20)$ = 0.51, p = 0.022).

A Pearson product–moment correlation coefficient was computed to assess the relationship between PI—empathy and PI—negative feelings. The Pearson's r revealed a moderate positive correlation between PI—empathy and PI—negative feelings ($r(20)$ = 0.62, p = 0.003). Similarly, a Pearson product-moment correlation coefficient was computed to assess the relationship between PI—negative feelings and positive experience, revealing a moderate positive correlation between the two variables ($r(20)$ = 0.52, p = 0.018). A Pearson product-moment correlation coefficient was also computed to assess the relationship between PI—negative feelings and returning to reality, revealing a moderate positive correlation between the two variables ($r(20)$ = 0.56, p = 0.0098). Finally, due to the nonparametric nature of the data in question, the Spearman's rank-order correlation coefficient was computed to assess the relationship between behavioural involvement and tiredness. There was a moderate positive correlation between behavioural involvement and tiredness ($r_s(20)$ = 0.57, p = 0.009).

Although various weaker correlations were detected between some of the other variables in the co-located sample (e.g., tension and annoyance and negative affect had a weak positive correlation ($r_s(20)$ = 0.43, p = 0.06)), none of these weaker correlations were found to be statistically significant and should therefore be taken with a pinch of salt.

4.4.2. Mediated Correlations

Correlation testing revealed multiple significant correlations between experience factors self-reported by participants in the mediated condition, as displayed below the diagonal line in Table 6 (p. 53).

The mediated data for tension/annoyance was not normally distributed and consequently a Spearman's rank-order correlation coefficient was computed to assess the relationship between tension/annoyance and challenge. There was a moderate positive correlation between tension/annoyance and challenge ($r_s(20)$ = 0.55, p = 0.012). This result is directly in line with that of the co-located condition's correlation between tension/annoyance and challenge. Again, due to the nonparametric nature of the mediated data for tension/annoyance, a Spearman's rank-order correlation coefficient was also computed to assess the relationship between tension/annoyance and negative affect. There was a weak-to-moderate correlation between the two variables ($r_s(20)$ = 0.46, p = 0.043). Again, this result was very similar to that of the co-located condition's correlation between tension/annoyance and negative affect. Negative affect was also found to have a moderate negative correlation with behavioural involvement ($r_s(20)$ = -0.53, p = 0.016). On the other hand, positive affect and behavioural involvement were found to have a moderate positive correlation ($r_s(20)$ = 0.56, p = 0.009).

The mediated data for positive affect was not normally distributed and for that reason a Spearman's rank-order correlation coefficient was computed to assess the relationship between sensory and imaginative immersion and positive affect. There was a moderate positive correlation between the two variables ($r_s(20)$ = 0.64, p = 0.002). Due to the nonparametric nature of the mediated data for negative and positive affect, a Spearman's rank-order correlation coefficient was computed to assess the relationship between negative affect and positive affect. There was a weak-to-moderate negative correlation between the two variables ($r_s(20)$ = -0.45, p = 0.044).

The mediated data for PI—empathy was not normally distributed, and consequently a Spearman's rank-order correlation coefficient was computed to assess the relationship between sensory and imaginative immersion and PI—empathy. There was a moderate positive correlation between the two variables ($r_s(20)$ = 0.69, p < 0.001). A Spearman's rank-order correlation coefficient was also computed to assess the relationship between negative affect and PI—empathy, revealing a moderate negative correlation between the two variables ($r_s(20)$ = -0.51, p = 0.02). Again, a Spearman's rank-order correlation coefficient was computed to assess the relationship between positive affect and PI—empathy, revealing a moderate-to-strong positive correlation between the two variables ($r_s(20)$ = 0.74, p = 0.0002). A Spearman's rank-order correlation coefficient was computed to assess the relationship between PI—empathy and PI—negative feelings, revealing a moderate positive correlation between the two variables ($r_s(20)$ = 0.60, p = 0.005). Similarly, a Spearman's rank-order correlation coefficient was computed to assess the relationship between PI—empathy and behavioural involvement, revealing a moderate-to-strong positive correlation between the two variables ($r_s(20)$ = 0.71, p < 0.001). Again, a Spearman's rank-order correlation coefficient was computed to assess the relationship between PI—empathy and positive experience, revealing a strong positive correlation between the two variables ($r_s(20)$ = 0.86, p < 0.001). Due to the nonparametric nature of the mediated data for negative affect, a Spearman's rank-order correlation coefficient was computed to assess the relationship between negative affect and positive experience. There was a weak-to-moderate negative correlation between the two variables ($r_s(20)$ = -0.57, p = 0.009). Conversely, a Spearman's rank-order correlation coefficient revealed a moderate positive correlation between positive affect and positive experience ($r_s(20)$ = 67, p = 0.001).

A Pearson product moment correlation coefficient was computed to assess the relationship between PI—negative feelings and positive experience. There was a week-to-moderate positive correlation between the two variables ($r(20)$ = 0.51, p = 0.02). A Pearson product moment correlation coefficient was also computed to assess the relationship between behavioural engagement and positive experience. Interestingly, unlike the co-located sample, there was a strong positive correlation between the two variables ($r(20)$ = 0.87, p < 0.001). Due to the fact that the data for negative experience in the mediated sample was found to be nonparametric, a Spearman's rank-order correlation coefficient was computed to assess the relationship between PI—negative feelings and negative experience. There was a weak positive correlation between the two variables ($r_s(20)$ = 0.47, p = *0.034*). The mediated data for tiredness was also found to be nonparametric, and therefore a Spearman's rank-order correlation coefficient was computed to assess the relationship between competence and tiredness. A moderate negative correlation was found between the two variables ($r_s(20)$ = -0.63, p = *0.003*). Finally, a Spearman's rank-order correlation coefficient was computed to assess the relationship between tiredness and returning to reality. A weak-to-moderate correlation was found between the two variables ($r_s(20)$ = 0.47, p = *0.035*).

The results of the correlation testing enable us to confidently answer RQ3 ("Do correlations exist between any of the experience factors measured by the GEQ and SPGQ during collaborative gameplay in the co-located and/or mediated social contexts?"). The results presented in Section 4.4 and summarised in Table 6 (p. 53) indicate that a number of significant correlations exist between experience factors measured by the GEQ and SPGQ during both co-located and mediated collaborative multiplayer gameplay. Strong and significant correlations were found between numerous factors of experience, with some results duplicated in both samples (e.g., a moderate correlation between tension/annoyance and challenge was found in both the mediated and co-located samples), while others were unique to one of the two samples (e.g., a strong correlation between behavioural involvement and positive experience was only found in the mediated condition).

4.5. Observational Excerpts

In addition to the self-report data collected through the GEQ and SPGQ, sessions were video recorded, and participants were asked to provide verbal feedback regarding their gameplay experience after each gameplay session. Excerpts of the reactions and responses of participants both during and after gameplay sessions are presented here, in support of the quantitative results presented in Sections 4.1 to 4.4. Furthermore, these excerpts, in combination with our quantitative results, indicate that the collaborative game mechanics set forth in Section 2.2.2 effectively and reliably answer RQ4 ("Which gameplay mechanisms facilitate collaboration and social interaction between co-players while precluding any form of competition?”). Overall, participants responded very positively to the gameplay experience delivered by *COLAB*. The successful implementation of non-violent collaborative gameplay mechanics, as outlined in Section 2.2.2, was highlighted by a number of participant comments, both during and after gameplay. See, for example:

> “The teamwork aspect of this game is way more intense than I thought it would be.” Participant A (co-located)
>
> “I should play this with my girl. This would really improve our relationship.” Participant B (co-located)
>
> “I love this game. It’s not violent; it’s co-operative.” Participant C (mediated)

Even though all the participant-pairs were friends prior to taking part in this study, many participants felt that playing *COLAB* together had taught them new things about each other. Interestingly, co-located players were more vocal, compared to mediated players, about the learning and bonding experience gained from socially interacting with each other during *COLAB’s* collaborative gameplay:

> “This game teaches us so much about each other.” Participant D (co-located)
>
> “This game is going to illuminate things [about each other]. This is going to be a serious learning experience [about each other] in so many ways.” Participant E (co-located)

While these observations are not significant in and of themselves, they do corroborate the study’s quantitative results. Co-located players in our study often used gestures—for example, pointing to locations on the screen—to communicate ideas and information to each other. In two of the sessions, co-located players swapped controllers when one player was struggling with his or her assigned role during a particularly challenging part of the game. Mediated players were unable to swap controllers and therefore had to stick with their designated roles throughout the puzzle-solving process presented by *COLAB*. They were also unable to use gestures, body language and social cues to convey information and had to do so verbally or through in-game environment-modifying mechanics:

> “I keep pointing to the screen as if you can see me.” Participant F (mediated)

Consistent with their significantly higher scores for flow and sensory and imaginative immersion (see Figure 15, Section 4.1), mediated players also verbally expressed heightened levels of flow and immersion both during and after gameplay:

> “This is a full-on meditation. I totally lost track of time.” Participant C (mediated)
>
> “I feel so energised.” Participant G (mediated)

“That was a trip.” Participant H (mediated)

In addition to flow and immersion, positive affect is often used by researchers as an indicator of fun and enjoyment during gameplay (Poels, de Kort & IJsselsteijn, 2012; Bowman et al., 2016). Specifically, Bowman et al. (2016) define enjoyable gameplay experiences as gaming experiences that result in feelings of arousal, excitement and hedonic-type positive affect. While mediated participants self-reported significantly higher levels of positive affect than co-located participants, both groups scored very high on the positive affect scale (see Figure 15, Section 4.1). Consistent with the generally high scores for positive affect, sensory and imaginative immersion, flow and positive experience in both conditions, participants expressed that they had fun and enjoyed the experience of playing *COLAB* with their friends tremendously:

“That was mad, dude! I want to do that again.” Participant I (mediated)

“This is the most fun I’ve had in a while.” Participant J (co-located)

“This is a nice little world. I want to be in here forever. It’s so relaxing.” Participant K (co-located)

“Euphoria! That was the best game I’ve ever played.” Participant G (mediated)

The qualitative observations surveyed in this section are consistent with the scores we collected for experience factors through the GEQ and SPGQ. Although these observations by no means constitute a qualitative analysis of the gameplay sessions, the consistency between the quantitative results and the qualitative excerpts presented here provides further confidence that the GEQ and SPGQ are valid tools for measuring psychological indicators of experience. Furthermore, the collaborative gameplay mechanics presented in Section 2.2.2, on which *COLAB* as an apparatus was based, can be recommended as proven drivers of team-based collaborative gameplay that evoke high scores for quantitative psychological indicators of game experience (e.g., positive affect, flow, sensory and imaginative immersion) as well as positive qualitative responses from players.

4.6. Summary

In summary, results within and across the two co-presence settings were consistent. Players experienced significantly higher levels of sensory and imaginative immersion, flow, and positive affect in the mediated condition than in the co-located condition, as self-reported by the GEQ’s core module (Table 3). We therefore accept our hypothesis that mediated players experience higher levels of flow and immersion during collaborative gameplay than co-located players (H3). Furthermore, the GEQ’s post-game module revealed that players experienced significantly higher levels of negative experience in the co-located condition than in the mediated condition (Table 5). The significant results gained from the GEQ’s core and post-game modules also allowed us to verify and accept our hypothesis that collaborative players' game experience (as measured by the GEQ) will differ with variations in social context (H1). By verifying and accepting H1 and H3, we are able to safely state that variations in social context (i.e., co-located play versus mediated play) do influence players' experience of collaborative multiplayer game, thereby answering RQ1.

Unexpectedly, we did not find any significant differences between the two conditions with regard to the data self-reported by the SPGQ module (Table 4). We therefore reject our hypothesis that co-located players experience higher levels of social presence during collaborative gameplay than mediated players (H2). The rejection of H2 leads us to suggest that variations in social context during collaborative play do not result in changes to co-players' subjective feelings of social presence, thereby answering RQ2. That said, although the behavioural involvement subscale of the SPGQ was not found to be statistically significant at the $p < 0.05$ level, Cohen's effect size value ($d = 0.62$) indicated medium-to-high practical significance, suggesting that a larger sample size would be required to further validate our rejection of H2.

Correlation testing revealed numerous statistically significant correlations between player-experience factors measured by the GEQ and SPGQ during collaborative gameplay in both the co-located and mediated social contexts (Table 6), thereby answering RQ3. While our relatively small sample size for each condition may indicate that our correlation testing would need to be confirmed on a larger scale, the results obtained point toward a number of strong and significant intercorrelations between experience measures in both the co-located and mediated conditions. Interestingly, only a small number of significant correlations were duplicated across conditions (e.g., the relationship between tension/annoyance and challenge was consistent across both conditions) while numerous correlations where found to be unique to either the co-located or mediated condition respectively (e.g., the relationship between behavioural involvement and positive experience was unique to the mediated condition; and the relationship between behavioural involvement and tiredness was unique to the co-located condition).

Finally, observational excerpts of the video recordings of the gameplay sessions, as well as excerpts of the verbal feedback provided by participants after the sessions, corroborated the quantitative results gathered via the GEQ and SPGQ. While by no means intended as a thorough qualitative analysis of the gameplay sessions, the observational excerpts indicated that the collaborative gameplay mechanics set forth in Section 2.2.2 successfully address RQ4 ("Which gameplay mechanisms facilitate collaboration and social interaction between co-players while precluding any form of competition?").

5 Discussion

In this study we investigated how changes to social context influence collaborative multiplayer gameplay experience. To this end, we conducted a systematic enquiry into collaborative player experience across two common multiplayer gameplay configurations: namely, co-located play versus mediated play.

In response to RQ1 ("Do variations to social context [i.e., co-located play versus mediated play] influence players' experience of collaborative multiplayer games?"), we found that changes in social context had a significant effect on various aspects of collaborative multiplayer gameplay experience. Specifically, mediated collaborators experienced significantly higher levels of flow, sensory and imaginative immersion, and positive affect than co-located collaborators. Mediated collaborators also reported significantly lower levels of negative experience after they had stopped playing. These results enabled us to accept H1 ("Collaborative players' game experience [as measured by the GEQ] will differ with variations in social context") and H3 ("Mediated players will experience higher levels of flow and immersion during collaborative gameplay than co-located players").

In response to RQ2 ("Do variations in social context during collaborative play result in changes in co-players' subjective feelings of social presence?"), we were surprised to discover that statistical analysis did not reveal any significant differences in social presence self-reported by participants in the co-located compared to mediated conditions. Although comparing the *behavioural engagement* subscale between conditions did indicate a relatively high effect size, we were unable to statistically validate its significance, and therefore we reject H2 ("Co-located players will experience higher levels of social presence during collaborative gameplay than mediated players").

In response to RQ3 ("Do correlations exist between any of the experience factors measured by the GEQ and SPGQ during collaborative gameplay in the co-located and/or mediated social contexts?"), we found that a number of significant correlations exist between experience factors during both co-located and mediated play. Some correlations were revealed to be significantly related across both conditions (i.e., the relationship between tension/annoyance and challenge; the relationship between PI—empathy and PI—negative feelings), while others were far more strongly correlated in either the mediated condition (i.e., the relationship between behavioural involvement and positive experience; the relationship between positive affect and sensory and imaginative immersion) or the co-located condition (i.e., the relationship between behavioural involvement and tiredness).

In this discussion, we position our findings among two independent, but related, schools of thought. Firstly, we explore the results of our analysis through the lens of existing work in the field of social gaming and multiplayer gameplay experience. Secondly, we situate our findings about the differences between co-located versus mediated collaborative gameplay experience in the context of an on-going discourse surrounding computer-mediated communication (CMC) compared to face-to-face (FtF) social interaction.

5.1. The Inherent Sociality of Gaming

Digital gaming is an inherently social activity (Whitson, 2013). Even while playing single-player games, people engage in a form of collaborative gameplay that has been dubbed *tandem play*. Tandem play is described by Consalvo et al. (2016, p. 1) as "when two or more players engage with a single-player game together". From tandem play to multi-million dollar eSports competitions (Hamari & Sjöblom, 2017), gaming offers a multitude of opportunities for people to socialise and play games together. Voida and Greenberg (2009, p. 10) describe games technology as a "computational meeting place [. . .] around which individuals with varied interests and experiences are willing to converge for the sake of social interaction". The ways in which people engage with each other in these "computational meeting places" can vary dramatically, and researchers have responded by investigating the myriad social gaming experiences with equally as diverse approaches (Kowert & Quandt, 2015; Voida & Greenberg, 2009; Ravaja, 2009; Weibel et al., 2008; de Kort at al., 2007; Lazarro, 2004; Mandryk & Inkpen, 2004).

One such avenue of research positions digital gaming as a *social presence* (see Section 2.1.1) technology (Gajadhar et al., 2008; de Kort et al., 2007). Gajadhar et al. (2008) manipulated co-presence between players in order to induce changes to players' psychological indicators of experience (e.g., social presence, flow, positive affect, and immersion) during multiplayer gameplay. Our study adopted a similar approach to that of Gajadhar et al. (2008). We implemented two common social gameplay contexts: namely, mediated (i.e., non-co-located) human co-players, and co-located human co-players. By varying the location of the co-player (i.e., whether co-located or non-co-located), we were able to elicit significant differences in players' psychological indicators of experience during collaborative multiplayer gameplay. The primary differences between the approach implemented by Gajadhar et al. (2008) and our own are threefold: firstly, our study implemented a between groups design as opposed to the within groups design implemented by Gajadhar et al. (2008); secondly, the multiplayer game used in our study was purely collaborative as opposed to the competitive game employed by Gajadhar et al. (2008); and thirdly, mediated players in our study were able to communicate via synchronous voice chat as opposed to mediated players having no form of verbal communication (no voice or text chat) in the study by Gajadhar et al. (2008).

Our findings directly contradict the findings presented by Gajadhar et al. (2008), who found that positive affect, tension, and social presence, as measured by the GEQ, were significantly higher when competing players were co-located as opposed to mediated. In contrast to the findings by Gajadhar et al. (2008), we found that sensory and imaginative immersion, flow, and positive affect were all significantly higher when collaborating players were mediated as opposed to co-located. We also found that negative experience, as measured by the GEQ's post-game module, was significantly higher in the co-located condition compared to the mediated condition. To our surprise, we found no significant difference between the levels of social presence self-reported by participants between the two conditions (i.e., co-located play compared to mediated play).

There are a number of reasons that the results presented in this study differ so dramatically from those presented by Gajadhar et al. (2008). Firstly, and in relation to RQ2, let us examine why variations in social context (i.e., whether players were co-located or mediated) during collaborative play did not result in significant changes to co-players' subjective feelings of social presence. In both our study and the study conducted by Gajadhar et al. (2008), co-located players communicated directly with each other via face-to-face social interaction. In additional to verbal communication, direct face-to-face social interaction is characterised by subtle changes in facial expressions, gestures, body language, proximity, and social cues (Argyle & Dean, 1965; Hall, 1959), and as a result, co-located co-players are able to engage in a *high-bandwidth* mode of communication. Here, bandwidth refers to the "number of communicative cue systems a technology can convey" (Walther & Parks, 2002). One of the primary differences between the design of our study compared to that of Gajadhar et al.'s (2008) is that mediated players in our study were able to communicate via synchronous voice chat, while players in the study by Gajadhar et al. (2008) were not able to communicate verbally at all (i.e., no voice or text chat). By the addition of synchronous voice chat, mediated players in our study were offered a higher bandwidth mode of communication compared to the mediated players in the study carried out by Gajadhar et al. (2008). In a more recent study Gajadhar (2010) found that the availability of audio cues between co-players had a significant influence on social presence and associated player experience. Specifically, Gajadhar (2010) found that having the opportunity to use vocal sounds during both competitive and collaborative gameplay (i.e., the ability to speak, cheer, and laugh) significantly increased social presence between players, and led to significantly more positive player experiences in terms of enjoyment and engagement. Interestingly, the addition of being able to see a co-player (i.e., via a synchronised video stream) during mediated play had no significant impact on social presence (Gajadhar, 2010). The work presented by Gajadhar (2010), along with the findings presented in Section 4.2 and our ensuing rejection of H2, leads us to suggest that, during collaborative multiplayer gameplay, the availability of synchronous voice chat between co-players can induce similar levels of social presence in players to those experienced by co-players during direct face-to-face (i.e., co-located) communication.

In relation to RQ1, H1, and H3, we examine the reasons for mediated players experiencing significantly higher levels of flow, sensory and imaginative immersion, and positive affect than their co-located counterparts. In addition to mediated players being able to communicate via voice chat, our study exhibits another key difference from the study carried out by Gajadhar et al. (2008). In our study, participants played a collaborative game together, compared to playing a competitive game against each other in the study by Gajadhar et al. (2008). The type of game being played has been shown to have significant effects on player experience (Poels, de Kort & IJsselsteijn, 2007), and different kinds of game mechanics solicit diverse kinds of social interactions among co-players (Zagal et al., 2006). In a collaborative game, all players either win together or lose together. Players have to work together as a team to achieve a common goal, and their success relies on cohesion and communication between them (Zagal et al., 2006). Collaborating co-players' gameplay experience relies heavily on their ability to interact and communicate effectively (Rollings & Adams, 2003). Consequently, in order for us to understand how changes to social context influence collaborative multiplayer gameplay experience, it is crucial that we understand how communication during collaborative multiplayer gameplay shapes player experience. de Kort and IJsselsteijn (2008) argue that *sociality characteristics* beyond the direct realm of the game have a significant influence on both co-located and mediated gameplay experience. Sociality characteristics are defined here as contextual factors that shape the way players interact and communicate during play (de Kort & IJsselsteijn, 2008). During mediated play, sociality characteristics take the form of text, emoticons, voice chat, and the social richness of in-game animations during interaction between co-players' avatars (de Kort & IJsselsteijn, 2008). During co-located play, players are afforded all the sociality characteristics available during mediated play, as well as an extra layer of direct face-to-face social information. Direct face-to-face communication is characterised by subtle changes to seating and viewing arrangements (de Kort & IJsselsteijn, 2008), gestures, body language, and gaze direction (Argyle & Dean, 1965; Hall, 1959). In the case of our study, the differences in sociality characteristics, and the associated social affordances available to players, during co-located compared to mediated multiplayer gameplay hinged on the availability (or unavailability) of the social cues that characterise direct face-to-face social interaction. In answering RQ1 and validating H3, our findings indicate that when collaborating players engage in mediated gameplay, and are only able to interact with each other through the virtual environment of the game and via synchronous voice chat, they experience significantly higher levels of positive affect, flow, and sensory and imaginative immersion than co-located players. These findings, along with the fact that co-located players experienced significantly higher levels of negative experience than mediated players, suggest that the addition of face-to-face social interaction can disrupt or override in-game tasks and interactions, resulting in a negative impact on player experience.

5.2. Enter the Correlation Matrix

In investigating RQ3, correlation testing revealed results consistent with our contrast analysis. We found that in the mediated condition, behavioural involvement was significantly correlated with positive affect. On the other hand, during co-located play, behavioural involvement was revealed to have a significant correlation with tiredness. These correlations are interesting because they indicate that face-to-face communication can lead to fatigue between collaborators, while a lower bandwidth mode of mediated communication correlates not with tiredness but rather with higher levels of positive affect in players. These results further substantiate our finding that mediated communication can in fact be beneficial to collaborative game experience. Another interesting correlation that was only present in the mediated condition was the relationship between positive affect and sensory and imaginative immersion. Due to our finding that mediated players experienced significantly higher levels of positive affect and sensory and imaginative immersion than co-located players, the correlation between the same two factors of experience during mediated play is not surprising. Furthermore, these findings echo the work of Ermi and Mäyrä (2005), who describe how social context plays a decisive role in influencing immersion, and explain that heightened levels of immersion can lead to increased engagement and enjoyment in players.

One correlation that was consistent between both conditions was the relationship between tension/annoyance and challenge. Regardless of being co-located or mediated, the more challenging players found the experience, the higher the level of tension/annoyance they experienced. This result indicates that the collaborative game employed in this study (*COLAB)* was successful in challenging players' collaborative problem-solving abilities consistently across both conditions. Another interesting set of correlations turned out to be present only in the mediated condition. Specifically, during exclusively mediated collaborative, empathy was found to be correlated with: positive affect; positive experience; sensory and imaginative immersion; and behavioural involvement. In the mediated condition, players interacted via voice chat and with each other's avatars in the virtual environment of the game, instead of communicating face-to-face like co-located players did. Based on the work of Banks and Bowman (2013), who argue that player–avatar relationships have an impact on player experience during mediated gameplay, it is logical to assume that mediated co-players feelings of empathy were influenced by their avatars and the accompanying virtual interactions within the game, instead of solely being shaped by the physical human being on the other side of the mediated social interaction. Accordingly, we argue that these feelings of "mediated" empathy were critical to keeping players engaged in the virtual environment of the game and contributed to players' heightened sense of sensory and imaginative immersion, flow, and positive affect during mediated collaboration.

5.3. Computer-Mediated Collaboration

Outside of digital games, the study of the social nature of the Internet is to a large extent based on the study of interpersonal constructs, such as: self-presentation; socio-emotional orientation; hierarchical role awareness; impression formation; intimacy; cooperation; attraction; and relational development (Walther & Parks, 2002). Walther and Parks (2002, p. 530) apply these general theories of communication and social interaction to the interpersonal dynamics of computer-mediated communication (CMC), and argue that these interpersonal dynamics, "in one way or another, all deal with how the communication cues available in on-line settings affect the ensuing interaction". The work of Walther and Parks (2002) is particularly relevant to our research as it helps to explain how changes to the communication cues available during mediated compared to co-located collaborative gameplay influenced social interaction and the resulting player experience.

Early investigations into online social behaviour drew on theories that were originally focused on other types of media. For example, Short, Williams, and Christie's (1976) social presence theory considers the *bandwidth* of a particular kind of media as a primary factor in its ability to convey a sense of social presence. In addition to describing the set of communicative cues embedded in a particular technology, bandwidth refers to the "incremental addition of verbiage of voice, kinesics, and proxemics" (Walther & Parks, 2002, p. 531). Short et al. (1976) argue that face-to-face (FtF) nonverbal cues enhance the warmth and friendliness of communicators, making their presence more salient to one another. They therefore conclude that the greater bandwidth a system affords, the greater the social presence of communicators (Short et al., 1976). Similarly, CMC was thought to lack the nonverbal cues typically available in FtF settings, resulting in communicators' inability to "alter the mood of a message, communicate a sense of individuality, or exercise dominance or charisma" (Kiesler, 1986, p. 48). As a result, Kiesler (1986) argued that, without FtF social cues, communicators would become disinhibited and hostile towards each other. Along this line of reasoning, researchers believed that, if no other social cues can perform the social function that co-presence, physical appearance, and nonverbal behaviour can, then CMC must always be impersonal (Culnan & Markus, 1987).

Our study contrasts with the work by Short et al., (1976), Kiesler (1986), and Culnan and Markus (1987). We found that, although FtF nonverbal social cues were absent during computer-mediated collaborative gameplay, the availability of voice chat and in-game virtual social interaction led to mediated players experiencing similar levels of social presence to co-located players. In line with our findings, it was not long before the work by Short et al. (1976), Kiesler (1986), and Culnan and Markus (1987) came under intense criticism from a broad spectrum of researchers studying communication under different kinds of offline and online social settings (Walther & Parks, 2002). Specifically, researchers found that complex factors outside of the exclusive domain of FtF spatial and nonverbal cues (e.g., group identity and attitude) can have an influence on the way people interact (Lea & Spears, 1995). As a result, the idea that FtF communication is more beneficial to social interaction than CMC—championed by researchers like Short et al., (1976), Kiesler (1986), and Culnan and Markus (1987)—has fallen out of favour in more recent decades (Walther and Parks, 2002).

One theory that helps to explain why FtF communication is not necessarily more efficient than CMC (with efficiency defined here as the measure of success with regard to social interaction) is *media richness theory*. Media richness theory is based upon the seemingly common-sense proposition that some types of messages can be conveyed more efficiently in one medium than another (Daft & Lengel, 1984, 1986). The core argument of media richness theory is that "there is an optimal match between the equivocality of communication tasks and the communication media among which one may choose" (Walther & Parks, 2002, p. 533). The richness of a particular medium is shaped by four characteristics: multiplicity of cue systems (i.e., communication bandwidth); availability of immediate feedback (i.e., whether a medium offers delayed social interaction or real-time interruptability);

message personalisation; and language variety (e.g., conversational language versus formal language). CMC has been incorporated into the media richness model as a relatively lean medium compared to FtF communication (Daft, Lengel, & Trevino, 1987), and especially when the equivocality of a communication task is low, a leaner medium like CMC can be more efficient. Our findings echo the work presented by Daft & Lengel (1985, 1986) and Daft et al. (1987). The equivocality of collaborative and communicative tasks presented by our game (*COLAB)* was relatively low. Players had to work within clearly defined constraints and gameplay mechanics to solve each collaborative puzzle in *COLAB*. We argue that the relatively lean medium of communication offered by CMC, coupled with the low equivocality of communicative tasks presented by *COLAB*, resulted in mediated players being more efficient than co-located players in their social interaction during collaborative gameplay, leading in turn to increased levels of positive affect, sensory and imaginative immersion, and flow.

Furthermore, Tidwell and Walther (2002) argue that CMC users adapt to the social cues available to them in order to perform interpersonal functions. They found that, compared to CMC partners, FtF partners employ proportionally more superficial forms of interrogations while collaborating (Tidwell & Walther, 2002). During FtF social interaction, partners draw on numerous verbal, visual, spatial, and auditory cues at their disposal, while CMC users avail themselves of the remaining strategies for interpersonal information acquisition (Walther & Parks, 2002). These findings help to explain our own finding that behavioural involvement was correlated with tiredness in the co-located setting. We argue that during FtF interaction increased superficial communication, combined with the addition of nonverbal and spatial cues, can result in social interaction, causing fatigue in co-located players during collaborative gameplay.

Another theory that helps to explain why CMC can be more effective than FtF social interaction is the *hyperpersonal model* of CMC (Walther, 1996). The hyperpersonal model of CMC "posits that users exploit the technological aspects of CMC in order to enhance the messages they construct to manage impressions and facilitate desired relationships" (Walther, 2007, p. 1). According to the hyperpersonal perspective, partners that interact via CMC are able to ultimately exceed parallel FtF partnerships in intimacy and social interaction. Furthermore, the hyperpersonal model proposes that CMC users reallocate cognitive resources from the typical environment scanning they do in FtF settings towards communicative activities in CMC settings (Walther, 2007). This kind of CMC can create *hyperpersonal communication* that goes beyond the interpersonal levels typically achieved during FtF interaction (Walther & Parks, 2002). In line with Walther's (1996, 2007) hyperpersonal model of CMC, we found that player experience was enhanced during mediated collaboration. Specifically, we found that mediated players experienced significantly higher levels of positive affect, flow, and sensory and imaginative immersion than co-located players, and that only mediated players exhibited a correlation between behavioural engagement and positive affect. These findings echo the work by Walther (1997, 2007), Walther & Parks (2002), and Tidwell and Walther (2002) and demonstrate that co-players can experience more engaging and enjoyable gameplay when collaborating in a mediated, as opposed to co-located, social context.

5.4. Limitations and Possible Confounds

Individual variances in gaming experience and preference were not controlled for in this study. Some players had previous experience of playing collaborative games and were more comfortable using a gamepad than others. Less experienced gamers took longer to become comfortable with *COLAB* and its controls, which could have been a cause of frustration in novice users. Although differences in the levels of gaming experience existed, all participants were able to complete the entire puzzle presented by *COLAB*. Furthermore, the experience scores self-reported by participants varied minimally for avid versus novice gamers.

The game used in this study (*COLAB*) was substantially more complex than the game used in a previous study by Gajadhar et al. (2008), who used a much simpler game by the name of *WoodPong* (Figure 21). The theoretical thinking behind using a simpler game like *WoodPong* is that its simplicity can aid in focusing the outcome of the experiment on the social context of the gaming experience, rather than on the complex graphics of the game and its controls. Although *COLAB* is considerably more complex than a game like *WoodPong*, it was designed with as simple a control system as possible, such that even novice users were able to learn the controls and mechanics of *COLAB* within minutes (see *Appendix B*). Furthermore, *COLAB* is not nearly as complex or difficult for new players as some of the leading multiplayer games in the industry. For example, games like *Dota 2* (Valve, 2013) can take months, or even years, to master.

Without making the experience too complex or overwhelming for novice gamers, the incorporation of slightly more sophisticated visuals, sound effects, background music and voice chat allowed *COLAB* to be representative of a modern collaborative multiplayer game. A game devoid of these features would not yield as full of an experience for players, and the results obtained would not be as representative of modern collaborative multiplayer gameplay experience.

Participants' awareness of being video recorded was also a factor that could have had an influence on the outcome of the experiments. Unfortunately, this awareness was unavoidable because participants had to consent to being video recorded prior to taking part in the experiment. The effects of being video recorded were mitigated for as much as possible by the use of small, unobtrusive cameras in both the mediated and co-located conditions.

Although it could be argued that our study was conducted with a relatively small sample (n = 40), the effect size was consistently large for all of our significant findings, leading us to feel confident in inferring significance throughout our statistical analysis. Finally, we would like to point out that psychological factors of experience (e.g., flow, positive affect, immersion, social presence) were not directly or physiologically measured, but rather inferred by measuring their indicators and "symptoms".

6 Conclusions

The influence of social context on specifically *collaborative* gameplay has been largely neglected in the literature. To fill this gap in the research, we set out to explore the complex dynamics of collaborative gameplay experience. We formulated the following research questions:

> RQ1: Do variations in social context (i.e., co-located play versus mediated play) influence players' experience of collaborative multiplayer games?
>
> RQ2: Do variations in social context during collaborative play result in changes in co-players' subjective feelings of social presence?
>
> RQ3: Do correlations exist between any of the experience factors measured by the GEQ and SPGQ during collaborative gameplay in the co-located and/or mediated social contexts?
>
> RQ4: Which gameplay mechanisms facilitate collaboration and social interaction between co-players while precluding any form of competition?

Based on our research questions, we conducted an extensive literature review and formulated the following hypotheses:

> H1: Collaborative players' game experience (as measured by the GEQ) will differ with variations in social context.
>
> H2: Co-located players will experience higher levels of social presence during collaborative gameplay than mediated players.
>
> H3: Mediated players will experience higher levels of flow and immersion during collaborative gameplay than co-located players.

Driven by our research questions and hypotheses, we empirically investigated the influence of two common social contexts (i.e., whether players were co-located or mediated) on collaborative game experience. In answering RQ1 and RQ2, we conducted contrast analysis to explore the differences in co-located compared to mediated collaborative gameplay experience. Whether co-players were co-located or mediated significantly influenced their collaborative game experience, confirming our first hypothesis (H1). Surprisingly, co-located players did not report significantly higher levels of social presence than mediated players, and we therefore reject our second hypothesis (H2). However, mediated players did experience significantly higher levels of flow and sensory and imaginative immersion than co-located players, confirming our third hypothesis (H3). Interestingly, we also found that mediated players experienced significantly higher levels of positive affect, and significantly lower levels of negative experience, than co-located players.

In response to RQ3, we found a number of significant correlations between experience measures during collaborative gameplay. In line with the results of our hypotheses testing, mediated players' sense of sensory and imaginative immersion was found to correlate with positive affect. Furthermore, behavioural involvement was found to be correlated with positive affect during mediated play, and with tiredness during co-located play. Another interesting set of correlations emerged surrounding player's feelings of empathy toward each other during mediated play. Specifically, during exclusively mediated collaboration, empathy was found to be correlated with: positive affect; positive experience; sensory and imaginative immersion; and behavioural involvement.

In response to RQ4, our apparatus *COLAB* (see Appendix B) represents a successful implementation of game mechanics that preclude competition and rely on collaboration (see Section 2.2.1). The results of our analysis indicate that *COLAB* evokes immersive, challenging, fun, and socially engaging collaborative gameplay experiences for both co-located and mediated players.

In response to literature that examines psychological indicators of specifically *social* gameplay experience, our findings directly contrast with the work of Gajhadar al. (2008), who found that positive affect, tension, and social presence, as measured by the GEQ, were significantly higher when players of a *competitive* game were co-located as opposed to mediated. In response to RQ2, and our rejection of H2, we argue that the addition of synchronous voice chat during mediated communication led to mediated players experiencing similar levels of social presence to those of co-located players. Interestingly, these finding echo more recent work by Gajadhar (2010), who found that having the opportunity use vocal sounds during both competitive and collaborative gameplay (i.e., the ability to speak, cheer, and laugh with your co-player) led to significantly increased feelings of social presence in co-players, while the addition of the video communication had hardly any impact on social presence.

In response to RQ1, and our validation of both H1 and H3, we argue that collaborating co-players' gameplay experience relies heavily on their ability to interact and communicate effectively (Toups et al., 2014; Cheung et al., 2012; Poels et al., 2007; Zagal et al., 2006; Rollings & Adams, 2003). Consequently, it is crucial that we understand how communication during collaborative multiplayer gameplay shapes player experience. Our findings indicate that, during collaborative gameplay, computer-mediated communication (CMC) can result in more positive emotions, an increased sense of immersion, and higher levels of flow than direct face-to-face (FtF) social interaction. Furthermore, we argue that FtF social interaction disrupts players' game experience, especially in a collaborative setting, where communication and interaction are pivotal to players' success in the tasks at hand. We propose that direct FtF interaction can override in-game collaborative tasks and social interaction. Instead of interacting via their avatars in the virtual world of the game, co-located players in our study interacted primarily with their real world co-player, distracting their attention away from their game experience. Conversely, mediated players could only interact with each other using voice chat and their in-game avatars, contributing to increased focus and attention on the virtual environment of the game. This shift in focus, we suggest, contributed to the significantly higher levels of flow, sensory and imaginative immersion, and positive affect found in mediated players as compared to co-located players.

These findings are in line with the work of Sweetser and Wyeth (2005), who concluded that the presence of co-located players during gameplay interrupts players' focus and attention, breaking their engagement with the virtual environment of the game. These kinds of interruptions have been found to have a detrimental effect on flow (Csikszentmihalyi, 1991; Chen, 2007) and immersion (Sweetser & Wyeth, 2005; Jennett et al., 2008), which further supports the results presented in this study.

In relation to RQ3, we found that increased levels of immersion during computer-mediated collaboration were correlated with increased levels of positive affect, further substantiating the benefits of CMC during collaborative gameplay. Furthermore, we found that empathy was correlated with various factors of experience during mediated collaboration, including: positive affect; positive experience; sensory and imaginative immersion; and behavioural involvement Based on the research on player–avatar relationships carried out by Banks and Bowman (2013), we argue that mediated players identified more strongly with their virtual avatars and, and instead of directing their feelings of empathy at their real-world co-player, CMC players experienced a mediated form of empathy that was critical to keeping players engaged in the virtual environment of the game, resulting in increased positive emotions in players. An interesting correlation revealed itself in the co-located condition: that is, the relationship between behavioural involvement and tiredness. We argue that during FtF interaction, increased superficial communication, combined with the addition of nonverbal and spatial cues, can result in social interaction causing fatigue during co-located collaborative gameplay.

Echoing Walther's (1996, 2007) hyperpersonal model of CMC, we argue that collaboration via CMC can ultimately exceed parallel FtF collaborative player experience, in terms of psychological indicators of experience such as positive affect, immersion, and flow. Players adapt to the social cues available to them (Tidwell and Walther, 2002). We argue that CMC users are able to capitalise on their ability to manage each other's impressions, and are also able to reallocate cognitive resources that would otherwise have been spent on FtF interaction towards in-game social interaction, resulting in enhanced collaborative gameplay experience.

6.1. Implications

One of the most important conclusions that can be drawn from the results of this study is that mediated players experience significantly higher levels of positive affect, sensory and imaginative immersion, and flow, than co-located players when they are collaborating on a multiplayer game. We therefore recommend that developers and producers of multiplayer games design and incorporate mechanisms that allow for and encourage computer-mediated collaborative gameplay between friends. These finding leads us to suggest that direct face-to-face social interaction can in fact have a negative impact on game experience during collaboration between co-players. Game designers, developers and producers should take this suggestion into consideration when creating collaborative multiplayer games, shifting the focus away from co-located gameplay environments. In addition, collaborative game design should focus on providing players, whether co-located or not, with clear communication channels that allow for in-game social interaction as well as voice chat via a headset and microphone. The collaborative gameplay mechanics described in Section 2.2.1 of this report provide a viable foundation for producing a fun and engaging collaborative multiplayer experience for players.

As de Kort et al. (2007) have argued, the social context in which digital gameplay takes place is not explicitly considered or even mentioned in most theoretical models of player experience. The findings presented in this study demonstrate that social context (i.e., whether players are co-located or mediated) during collaborative multiplayer gameplay has a significant influence on game experience. Changes to the social conditions of collaborative multiplayer gameplay result in changes in communication, social interaction and game experience among players. It is therefore crucial that researchers and game designers take into account the social aspects of gameplay when constructing models, theories and evaluations of game experience.

Furthermore, the type of game being played has a considerable effect on the way players socialise, communicate, and experience gameplay. Researchers need to be careful when drawing assumptions that are in fact based on very specific gameplay mechanisms. Different kinds of games (i.e., competitive, co-operative, collaborative, or any variation or combination thereof) should be understood to evoke their own unique game experiences in players, and should not be conflated.

6.2. Further Research

The present study focused on player experience during collaborative multiplayer gameplay, while previous studies by Lazzaro (2004), Ravaja et al. (2006), Gajadhar et al. (2008) and Martin (2010) focused on competitive multiplayer gameplay. Most popular multiplayer games, such as *World of Warcraft* (Blizzard Entertainment, 2004), *Dota 2* (Valve, 2013), *Counter Strike: Global Offensive* (Valve, 2012), *Overwatch* (Blizzard Entertainment, 2016), and *PlayerUnknown's Battlegrounds (PUBG Corp., 2017)* offer a combination of competitive and collaborative team-based gameplay. Further research could examine the combined effects of collaboration as a team and competition against other teams (e.g., eSports) on gamers' levels of social presence and on their associated game experience.

Strikingly, co-located, compared to mediated, collaborators in this study reported higher levels of the following experience factors: tension/annoyance and negative affect, as measured by the GEQ's core module; psychological involvement—negative feelings, as measured by the SPGQ module; and negative experience and tiredness, as measured by the GEQ's post-game module. Although statistical analysis revealed that only negative experience, as measured by the GEQ's post-game module, was significantly higher in the co-located condition, this trend towards an increase in negative feelings in a co-located social setting could be an interesting avenue for further research.

Popular multiplayer games often result in strangers playing with or against each other, and players who meet online often become friends in the world of the game in question (Ravaja et al., 2006). While this study only focused on collaboration between friends, further research could investigate the effect of playing with strangers on collaborative and/or competitive gameplay experience. Ravaja et al. (2006) explored some of the psychophysiological differences between playing a competitive game against a friend and playing the same game against a stranger, but they did little to address purely psychological indicators of experience such as flow, immersion, and positive and negative affect. Further studies could also explore how the experience of playing with or against online friends is different to playing with or against real-life friends, in various social contexts.

When carrying out studies on digital gaming, it is important to consider the social consequences of online (i.e., mediated) gameplay. Players of online multiplayer games often sacrifice other areas of their lives in order to spend more time playing online (Griffiths et al., 2004; Kowert & Oldmeadow, 2015). As a result, excessive online social gameplay may have negative social outcomes and can lead to addiction (Kowert, 2015). The findings presented in this study support the notion that mediated multiplayer gameplay experience can be more engaging than the gameplay experience offered by co-located social interaction, especially in collaborative circumstances. While there is a lack of empirical evidence for the potential of in-game friendships to replace real-world friends (Steinkuehler & Williams, 2006; Colwell & Kato, 2003), a considerable percentage of online gamers report that in-game friends are equivalent or superior to their real-world friends (Yee, 2006). Perhaps as a result, online gameplay has been associated with a variety of negative social consequences for long-time players, including difficulties in players' abilities to develop effective emotional and social skills (Kowert & Oldmeadow, 2015; Ratan et al., 2010). On the other hand, a recent wave of research argues that online multiplayer games can have positive social consequences by providing ideal spaces for social learning and offering easily accessible social outlets for players (Ducheneaut & Moore, 2005; Kowert, Domahidi & Quandt, 2014; Kowert & Oldmeadow, 2015). However, the causal links between online gaming and these kinds of social consequences have not yet been firmly established (Kowert, 2015). Based on the findings of our study, we suggest that the empirical investigation of both the positive and negative social consequences of multiplayer gaming (across various social contexts and game genres) constitutes an important area for further research.

A final avenue for further research might involve examining the relationship between social context and collaborative experiences outside of the digital gameplay space. It would be interesting to expand on the work of Walther (1997, 2007), Walther & Parks (2002), and Tidwell and Walther (2002), and examine whether other forms of collaborative software and associated user experience produce comparable results to those found in this study. Does real-world collaboration (among workers, athletes, partners, and so on) under different social conditions lead to similar effects on experience? Or do the findings presented in this study apply solely to collaborative experience in games?

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Appendix A: Questionnaires (GEQ & SPGQ)

GAME EXPERIENCE QUESTIONNAIRE

IJsselsteijn, W.A., de Kort, Y.A.W. & Poels, K.

Introduction

The Game Experience Questionnaire has a modular structure and consists of :

1. The core questionnaire
2. The Social Presence Module
3. The Post-game module.

In addition to these modules, a concise in-game version of the GEQ was developed.

All three modules are meant to be administered immediately after the game-session has finished, in the order given above. Part one and two probe the players' feelings and thoughts while playing the game; Part 3, the post-game module, assesses how players felt after they had stopped playing.

Part 1 is the core part of the GEQ. It assesses game experience as scores on seven components: Immersion, Flow, Competence, Positive and Negative Affect, Tension, and Challenge. For a robust measure, we need five items per component. As translation of questionnaire items, no matter how carefully performed, sometimes results in suboptimal scoring patterns, we have added a spare item to all components. After the first use of the translated GEQs, scale analyses will be performed to check whether any item should be discarded or replaced.

Part 2, the social presence module, investigates psychological and behavioural involvement of the player with other social entities, be they virtual (i.e., in-game characters), mediated (e.g., others playing online), or co-located. This module should only be administered when at least one of these types of co-players were involved in the game.

Part 3, the post-game module, assesses how players felt after they had stopped playing. This is a relevant module for assessing naturalistic gaming (i.e., when gamers have voluntarily decided to play), but may also be relevant in experimental research.

Game Experience Questionnaire – Core Module

Please indicate how you felt while playing the game for each of the items,

on the following scale:

not at all	slightly	moderately	fairly	extremely
0	1	2	3	4
< >	< >	< >	< >	< >

1 I felt content

2 I felt skilful

3 I was interested in the game's story

4 I thought it was fun

5 I was fully occupied with the game

6 I felt happy

7 It gave me a bad mood

8 I thought about other things

9 I found it tiresome

10 I felt competent

11 I thought it was hard

12 It was aesthetically pleasing

13 I forgot everything around me

14 I felt good

15 I was good at it

16 I felt bored

17 I felt successful

18 I felt imaginative

19 I felt that I could explore things

20 I enjoyed it

21 I was fast at reaching the game's targets

22 I felt annoyed

23 I felt pressured

24 I felt irritable

25 I lost track of time

26 I felt challenged

27 I found it impressive

28 I was deeply concentrated in the game

29 I felt frustrated

30 It felt like a rich experience

31 I lost connection with the outside world

32 I felt time pressure

33 I had to put a lot of effort into it

GEQ - Social Presence Module

Please indicate how you felt while playing the game for each of the items,

on the following scale:

not at all	slightly	moderately	fairly	extremely
0	1	2	3	4
< >	< >	< >	< >	< >

1 I empathized with the other(s)

2 My actions depended on the other(s) actions

3 The other's actions were dependent on my actions

4 I felt connected to the other(s)

5 The other(s) paid close attention to me

6 I paid close attention to the other(s)

7 I felt jealous about the other(s)

8 I found it enjoyable to be with the other(s)

9 When I was happy, the other(s) was(were) happy

10 When the other(s) was(were) happy, I was happy

11 I influenced the mood of the other(s)

12 I was influenced by the other(s) moods

13 I admired the other(s)

14 What the other(s) did affected what I did

15 What I did affected what the other(s) did

16 I felt revengeful

17 I felt schadenfreude (malicious delight)

GEQ – post-game module

Please indicate how you felt after you finished playing the game for each of the items, on the following scale:

not at all	slightly	moderately	fairly	Extremely
0	1	2	3	4
< >	< >	< >	< >	< >

1 I felt revived

2 I felt bad

3 I found it hard to get back to reality

4 I felt guilty

5 It felt like a victory

6 I found it a waste of time

7 I felt energised

8 I felt satisfied

9 I felt disoriented

10 I felt exhausted

11 I felt that I could have done more useful things

12 I felt powerful

13 I felt weary

14 I felt regret

15 I felt ashamed

16 I felt proud

17 I had a sense that I had returned from a journey

Scoring guidelines GEQ Core Module

The Core GEQ Module consists of seven components; the items for each are listed below.

Component scores are computed as the average value of its items.

Competence: Items 2, 10, 15, 17, and 21.

Sensory and Imaginative Immersion: Items 3, 12, 18, 19, 27, and 30.

Flow: Items 5, 13, 25, 28, and 31.

Tension/Annoyance: Items 22, 24, and 29.

Challenge: Items 11, 23, 26, 32, and 33.

Negative affect: Items 7, 8, 9, and 16.

Positive affect: Items 1, 4, 6, 14, and 20.

Scoring guidelines GEQ Social Presence Module

The Social Presence Module consists of three components; the items for each are listed below.

Component scores are computed as the average value of its items.

Psychological Involvement – Empathy: Items 1, 4, 8, 9, 10, and 13.

Psychological Involvement – Negative Feelings: Items 7, 11, 12, 16, and 17.

Behavioural Involvement: Items 2, 3, 5, 6, 14, and 15.

Scoring guidelines GEQ Post-game Module

The post-game Module consists of four components; the items for each are listed below.

Component scores are computed as the average value of its items.

Positive Experience: Items 1, 5, 7, 8, 12, 16.

Negative experience: Items 2, 4, 6, 11, 14, 15.

Tiredness: Items 10, 13.

Returning to Reality: Items 3, 9, and 17.

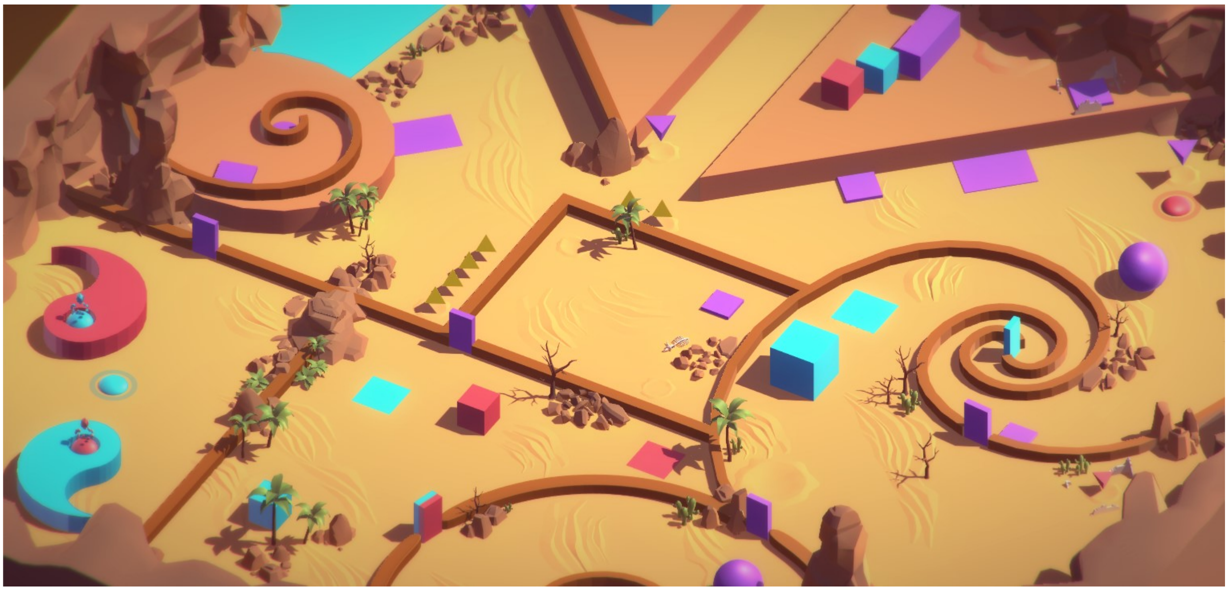
Appendix B: *COLAB* Game Design Document

Game Design Document

By Marcel Terblanche

12 April 2016

"The secret is to gang up on the problem, rather than each other". —Thomas Stallkamp



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1. Summary

Focusing on providing players with a collaborative social experience, *COLAB* is a non-competitive, non-violent, multiplayer puzzle game. *COLAB* requires two players to work together as a team and communicate in order to complete shared puzzles and work towards a common goal. *COLAB* employs collaborative gameplay mechanics made popular by multiplayer puzzle games like *Portal 2* (Valve Corporation, 2011), *Lego Star Wars* (LucasArts, 2007) and *Little Big Planet* (Sony, 2008). To download *COLAB* visit: https://people.cs.uct.ac.za/~mterblanche/

2. Motivation

COLAB is designed as a tool to assist the study of collaborative game experience. The research that *COLAB* forms a part of is specifically concerned with how different social contexts influence social interaction, communication and associated game experience in a purely collaborative multiplayer setting. Specifically, the social contexts of interest take the form of two common multiplayer gameplay configurations. In the first configuration, users play *COLAB* with co-located others: players in the same physical location socialised directly via face-to-face interaction. In the second configuration, users play *COLAB* with mediated others: non-co-located players socialised via voice chat and in-game communication channels. With these motivations in mind, *COLAB* is designed to encourage communication, social interaction and collaboration between players under both mediated and co-located settings. Furthermore, *COLAB* is designed to be representative of a modern collaborative game employing modern technologies including, 3D models, animations, sounds, and music. For a full description of the research see the thesis these documents forms an appendix of or visit: https://people.cs.uct.ac.za/~mterblanche/

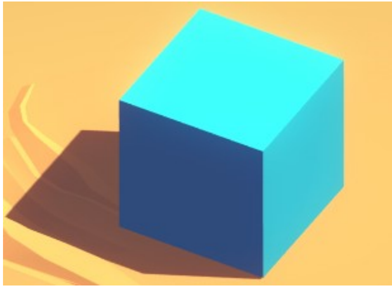
3. Core concept

At the start of *COLAB* two player avatars find themselves trapped in a maze situated in a desert landscape. The maze is made up of a series of interconnected rooms, and players must escape from each room until they find their way out of the maze and to freedom. Each room in *COLAB* is made up of an interactive, collaborative puzzle. Players must communicate with each other, explore their surroundings, interact with objects in the environment, and experiment with collaborative strategies to solve each puzzle and progress to the next room in the maze. As players progress through *COLAB* each puzzle becomes more complex than the previous puzzle, requiring players to build upon the lessons learned from the previous room. New interactive objects are introduced as the puzzles become more complex, and players have special powers that help each other through the more challenging aspects of each puzzle. Most importantly, if players do not collaborate they are unable escape from the maze. Teamwork is the only viable option for solving *COLAB's* puzzles. There is no room for competition in *COLAB* and both players either win together or lose together.

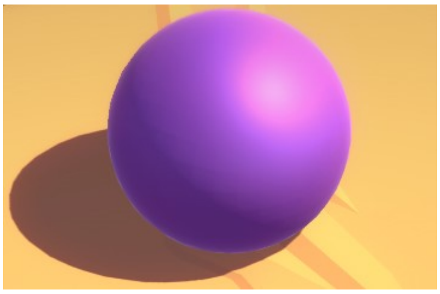
4. Gameplay overview

COLAB is a top-down, two player collaborative puzzle game. Each player controls a disk shaped avatar: one red, one blue. Interactive objects in the game world are colour coded. The red player can interact with red objects in the game environment, while the blue player can interact with blue objects. Both players are able to interact with purple objects.

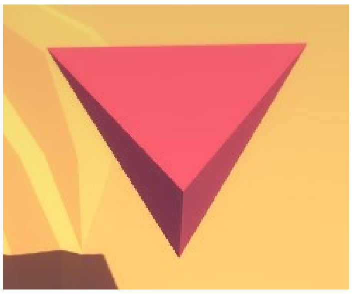
Examples of colour coded objects



Blue Cube



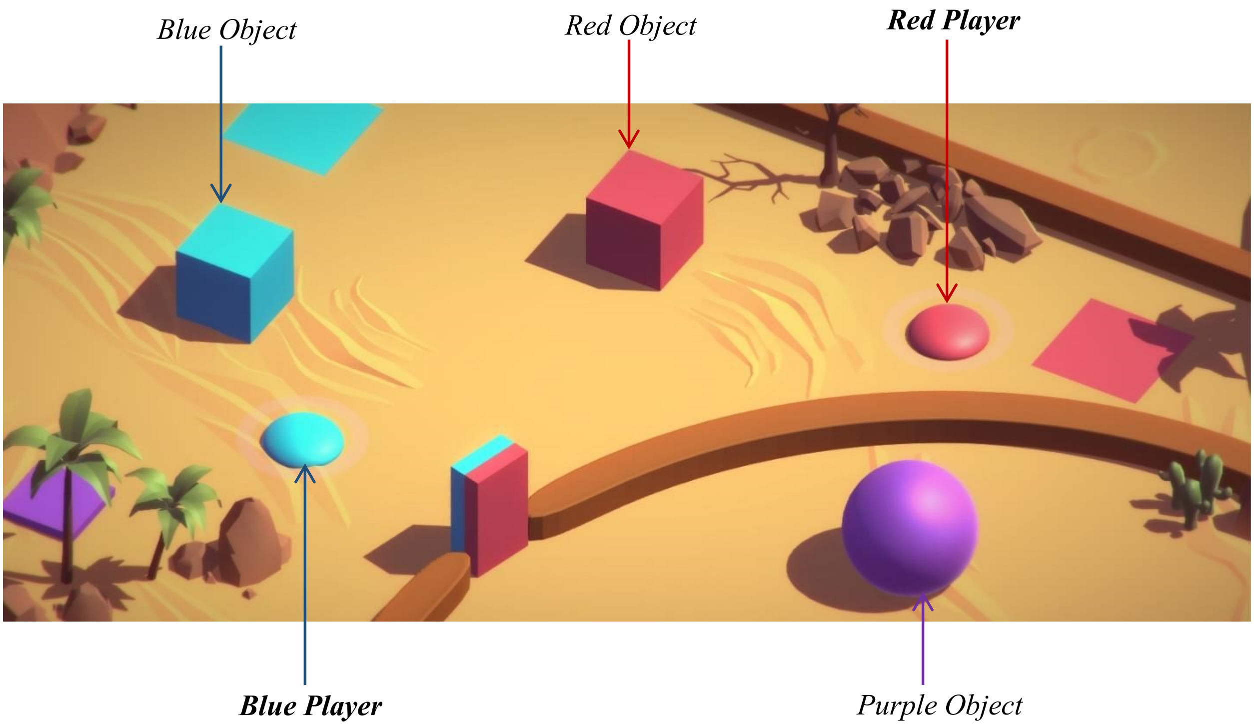
Purple Sphere



Red Tetrahedron

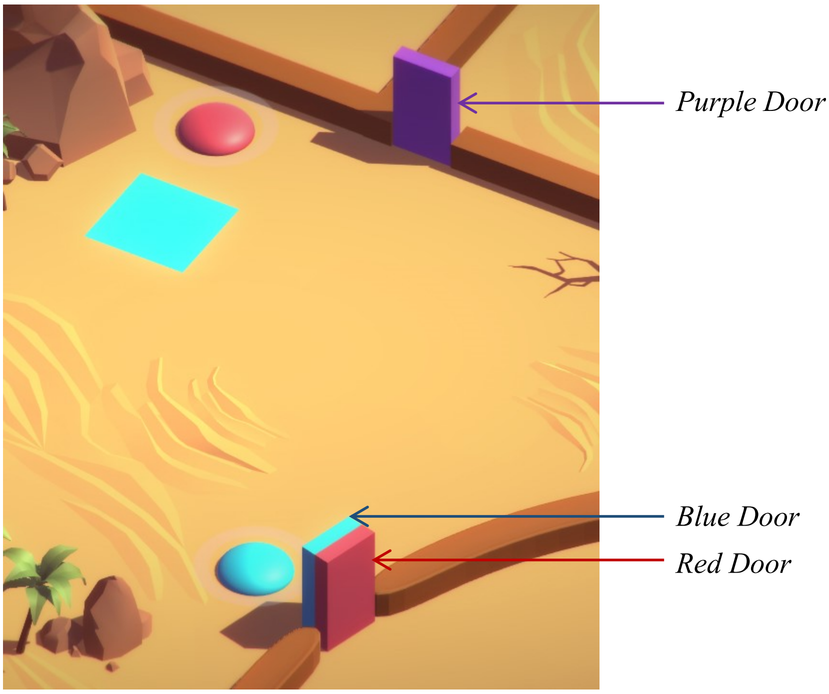
Based on this simple premise, the game puts players in the centre of a maze of rooms where both players have to work together to make their way out of the maze one room at a time. In each room players need to work as a cohesive unit in order progress to the next room. As players move through each room puzzles become progressively more difficult and require increasing levels of teamwork and coordination between co-players.

A room in *COLAB*



Rooms in *COLAB* are connected by one or more doors. To progress through the game players need to manipulate colour coded objects to solve collaborative puzzles in each room. By solving the puzzle in each room players open the door(s) to the next available room. Along with all objects in the game, doors are colour coded: red, blue or purple. Red doors require some kind of interaction from the red player to open, while blue doors require some kind of interaction from the blue player to open. Purple doors require interaction by either player or both players simultaneously to open.

Colour coded doors



5. Core mechanics

Based on the academic literature concerning the design of collaborative multiplayer games (see the thesis this document forms an appendix of, Section 2.2.2) this section outlines the mechanics that have been identified to facilitate collaboration between players. These collaborative mechanics form core gameplay mechanics implemented in the design of *COLAB*.

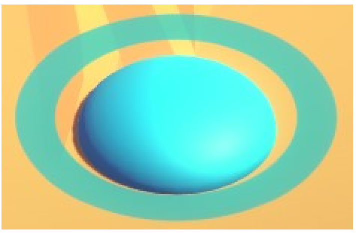
5.1. Complementarity

The following mechanics provide players with unique character roles, abilities, and information that complement each other's activities within the game, encouraging collaboration, social interaction, and communication:

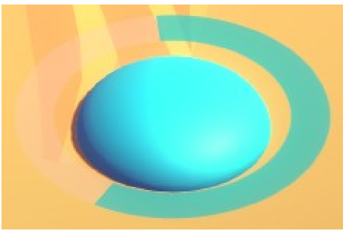
Roles: Each puzzle requires players to perform actions that complement each other's responsibilities for solving the puzzle in each room, thereby providing each player with interdependent roles at each stage of the maze. Roles encourage team work, communication, and strategizing because each player has an independent responsibility that contributes to the greater good of the team in their quest to complete shared goals. By ensuring each player has their own independent responsibilities; separate roles ensure that players do not engage in competitive or anti-cooperative practices.

Special abilities*:* Each player has a special ability that supports each other's role in each puzzle. The blue player is able to grow double in size, while the red player is able to boost its speed. Each player has a meter that represents how much special ability they can use at any given point in time. While using their special ability, a player's special ability meter gradually depletes until empty, at which point they can no longer use their special ability. To refill their special abilities, players must touch each other. While touching, each players special ability meter gradually replenishes until full. Each player's special ability meter is depicted by a circle around the player. When the special ability is full the circle is entirely blue or red, depending on the colour of the player. As the player uses his or her special ability the circle depletes its colour and decreases leaving behind a grey circle to represent an empty special ability meter.

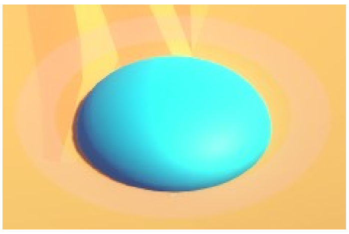
Special ability meter



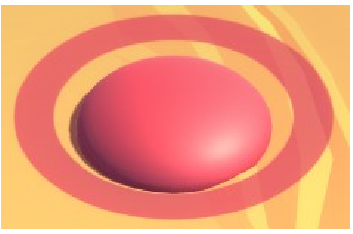
Blue Special Meter Full



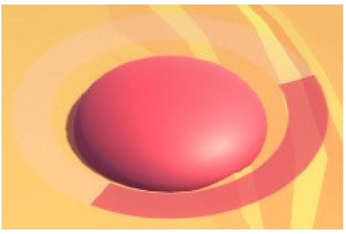
Blue Special Meter at 60%



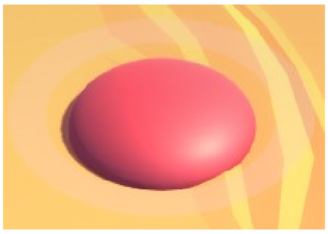
Blue Special Meter Empty



Red Special Meter Full



Red Special Meter at 30%



Red Special Meter Empty

Timed events**:** Timed events force players to communicate and work cohesively to perform separate interdependent role based actions simultaneously within a specific timeframe.

Timed puzzle

Players have to strategise and use their special abilities simultaneously to make it through the centre of the spiral before a timer runs out.

5.2 Shared goals and shared puzzles

COLAB does not allow for any competitive or anti-cooperative practices by ensuring players are only able to progress through each part of the puzzle by working as a team to open the door(s) to the next room. In this way, players have a single common goal, and share their ideas, abilities, and information as a team to accomplish this goal. If a player tries to play alone, both players will not succeed and a ***loose-loose*** condition will ensue. The only way players are able to complete the game is by collaborating, communicating, and working together as a team to ultimately obtain a ***win-win*** condition. In this way both players will always lose together or win together. There is no possibility for a *win-lose* condition. Furthermore there is no individual score for each player. All rewards and benefits of completing the game are shared amongst both players as a single unit.

5.3 Interacting with the same object

Purple objects in the game can be manipulated by both players. Smaller purple objects can be interacted with by any of the two players independently. These smaller objects require players to communicate and strategise depending on their roles. Larger purple objects require input from both players simultaneously, and require careful coordination to manipulate at the same time. For example, a large purple sphere can only be moved when both players push it at the same time.

5.4 Camera setting

The camera is designed so that both players are in focus at all times. This prevents players from having to wait for each other or get in each other's way as a result of camera related mechanics. In order to ensure both players are in focus, the camera is fixed on the centre point between both avatars at all times, and zooms in and out depending on how far away the players are from each other. In this way, both players share all the visual information on-screen at all times, encouraging collaboration as they explore each room to solve their shared puzzles.

Camera zooms in when players are closer together

When players are closer together the camera zooms in and is always fixed at a centre point between both the red and blue player avatars.

Camera zooms out when players are further apart

As players move further apart the camera zooms out, remaining fixed on a centre point between both player avatars. In this way players can explore the world collaboratively, sharing all information about the map at all times without getting in each other's way or having to wait for each other.

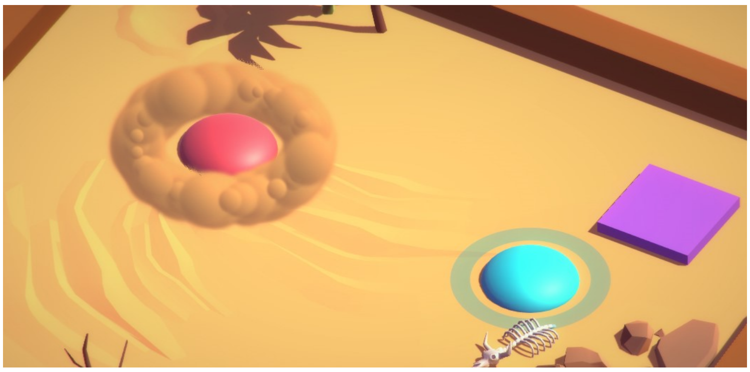
5.5 Difficulty

As players progress through the game the puzzles gradually become more difficult. Starting with simpler, easier puzzles, players are taught the basic mechanics of the game. As they become familiar with the game mechanics and controls, the puzzles become increasingly more difficult encouraging players to communicate, help each other, share ideas and leverage each other's strengths as a team to solve the puzzles as a single unit.

5.6 Communication channels

Communication is core in solving *COLAB's* puzzles. Synchronised voice chat allows players to communicate verbally with a microphone and headset. In addition to synchronised verbal communication, in-game communication channels offer alternative ways of conveying information. To provide players with the ability to draw each other's attention via in-game mechanics, players are able to trigger an animation to disperse a circle of sand around their avatar. This animation is accompanied by an audio cue of a bell ringing to further amplify its effect.

Attention grabbing mechanic



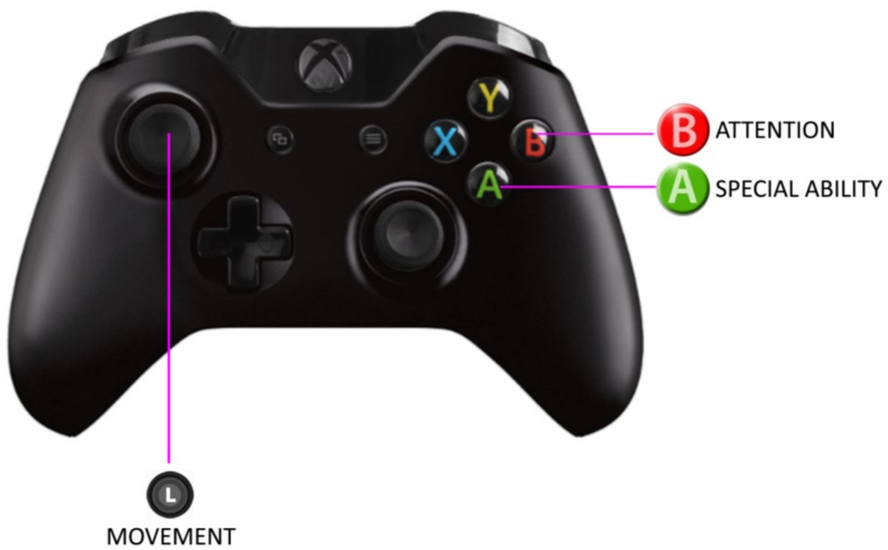
Red player drawing attention to its location by kicking up a circle of dust around its avatar

6. Controls

Controls in *COLAB* are designed to be "pick up and play". Below is a sample of the control map for the *PlayStation 4 DualShock 4* controller. The controls are included in the game to give players an understanding of how to control their avatar and indicate additional mechanics available to them.

- **Movement:** Players move around using the *Left Analog Stick* .
- **Special ability:** To use their special ability, players press and hold the *X Button* . Upon release of the *X Button* players will stop using their special ability.
- **Attention:** To gain each other's attention, or to communicate something of importance in the game environment to each other, players press the *Circle Button* to emit a ring of dust around their avatar and trigger a bell sound.

COLAB also supports the use of *Xbox One* controllers. Buttons are mapped identically to that of the *PlayStation 4 DualShock 4* controller as follows:



7. Level design

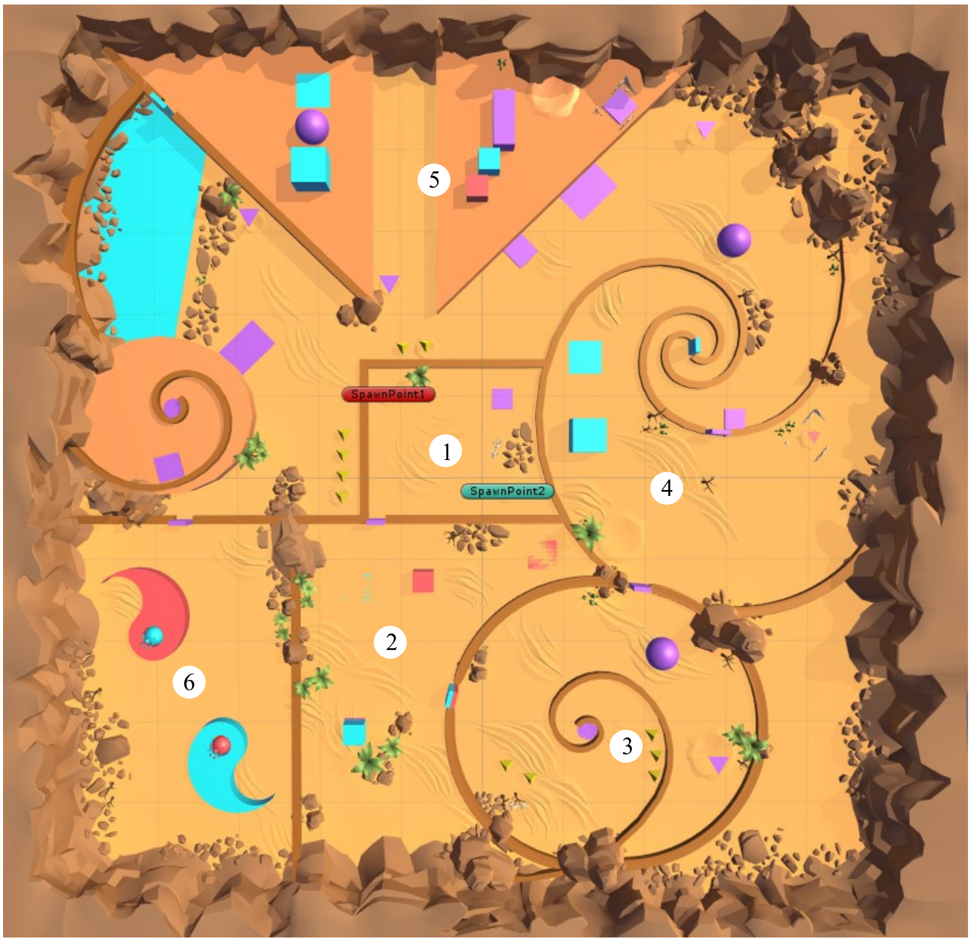
7.1. Theme

In *COLAB,* players are put into a playful yet mysterious desert landscape littered with palm trees, cacti and the occasional animal skeleton. The landscape is divided into rooms and objects that are geometrically inspired to further induce a feeling of mystery and exaggerate a feeling of enigma in players. A playful atmosphere encourages players to experiment and investigate the landscape, search for hidden objects and discover new game mechanics to help them through each step of the puzzle.

7.2. Game flow

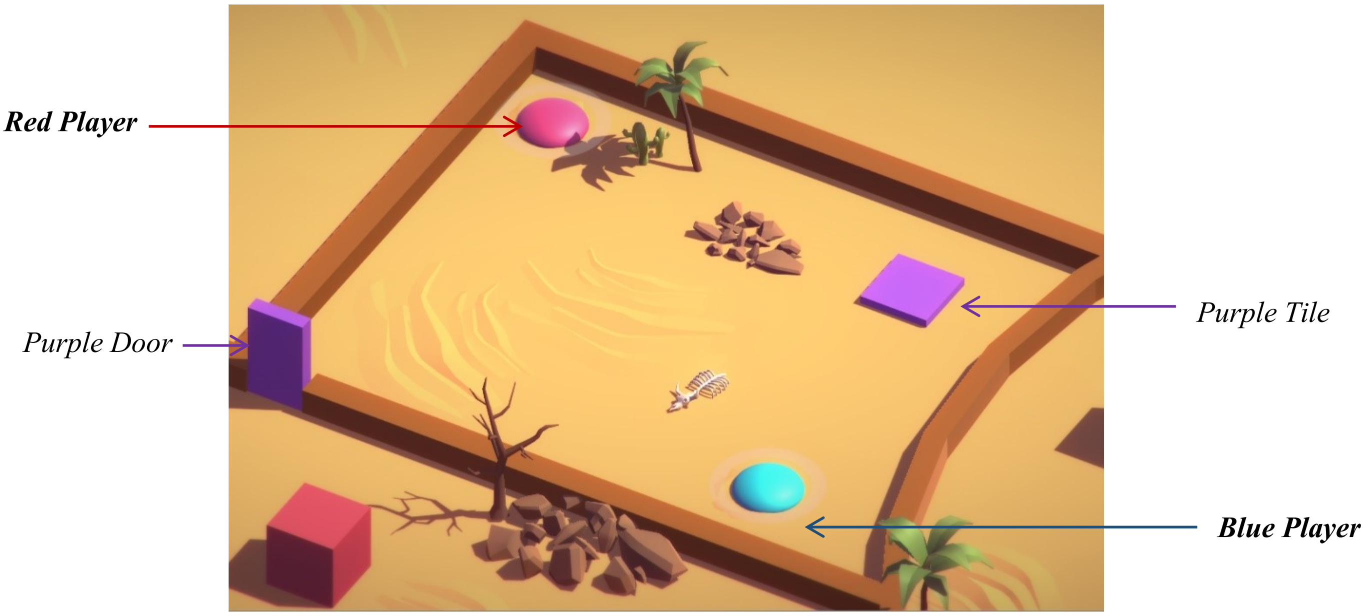
COLAB's level design mantra is "easy to learn, difficult to master". *COLAB* is designed to start fairly simply and becomes progressively more challenging. The below image is a bird's eye view of *COLAB's* level design. Rooms are numbered one to six. Players progress through each room in numerical sequence. Upon finishing room six players have completed *COLAB* and escape the desolate desert landscape to live a life of freedom.

Bird's eye view of *COLAB's* level design



The maze that makes up COLAB's level design. Players start in room one and progress through each room in numerical order. After solving the collaborative puzzle in each of the six rooms players escape from the maze, thereby completing COLAB.

Room 1: The first room acts as the tutorial room, giving players the opportunity to learn the basic controls, gameplay mechanics, and get a feel for moving around in the game world.

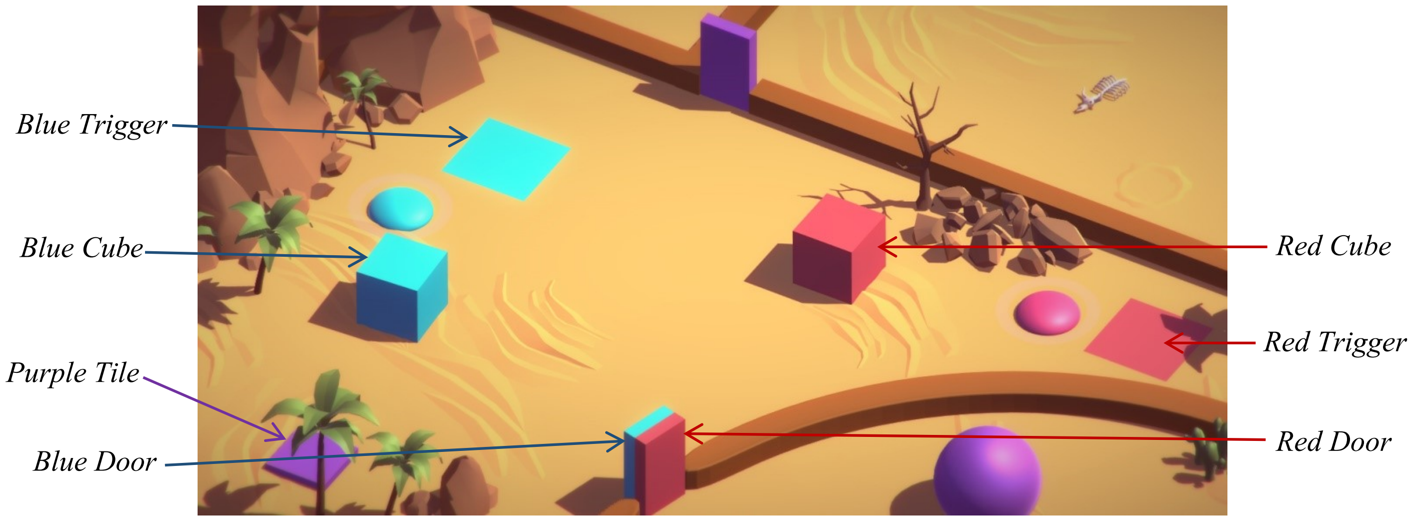


Players learn the basics of COLAB's movement controls and gameplay mechanics in the first room

If either player moves onto the *Purple Tile* in *Room 1* the *Purple Door* opens. As soon as the respective player moves off the *Purple Tile* in *Room 1* the *Purple Door* closes.

<u>Solution to Room 1</u>: The red player must open the *Purple Door* for the blue player, who then proceeds into *Room 2*. In *Room 2*, the blue player must find another *Purple Tile* (hidden underneath a *Blue Cube*) that opens the same *Purple Door* for the red player from the other side.

Room 2: The second room introduces players to colour coded objects and allows players to become familiar with moving colour coded objects around.

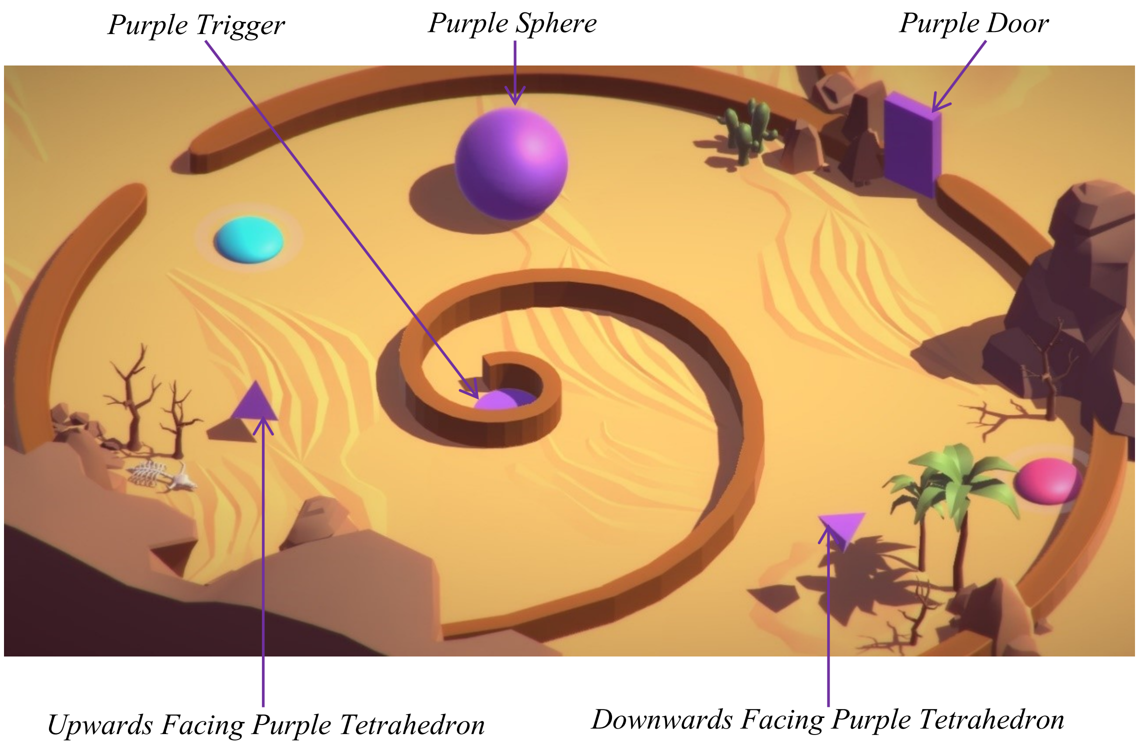


The second room introduces players to colour coded objects and the mechanic of moving these colour coded objects onto switches that open doors of the same colour as the switch.

The blue player can move the *Blue Cube* by pushing it in any direction, while the red player can do the same to the *Red Cube*. The *Purple Tile* in *Room 2* opens the *Purple Door* between *Room 1* and *Room 2*, allowing the red player to proceed from *Room 1* to *Room 2*.

Solution to Room 2: Once both players have made it into *Room 2*, the blue player needs to push the *Blue Cube* onto the *Blue Trigger* to open the *Blue Door*, while the red player need to push the *Red Cube* onto the *Red Trigger* to open the *Red Door*. Once both the blue and red doors have been opened, both players can proceed to *Room 3*.

Room 3: By the third room, players have a better understanding of the basic mechanics of the game and are introduced to shared objects that require simultaneous input from both players.

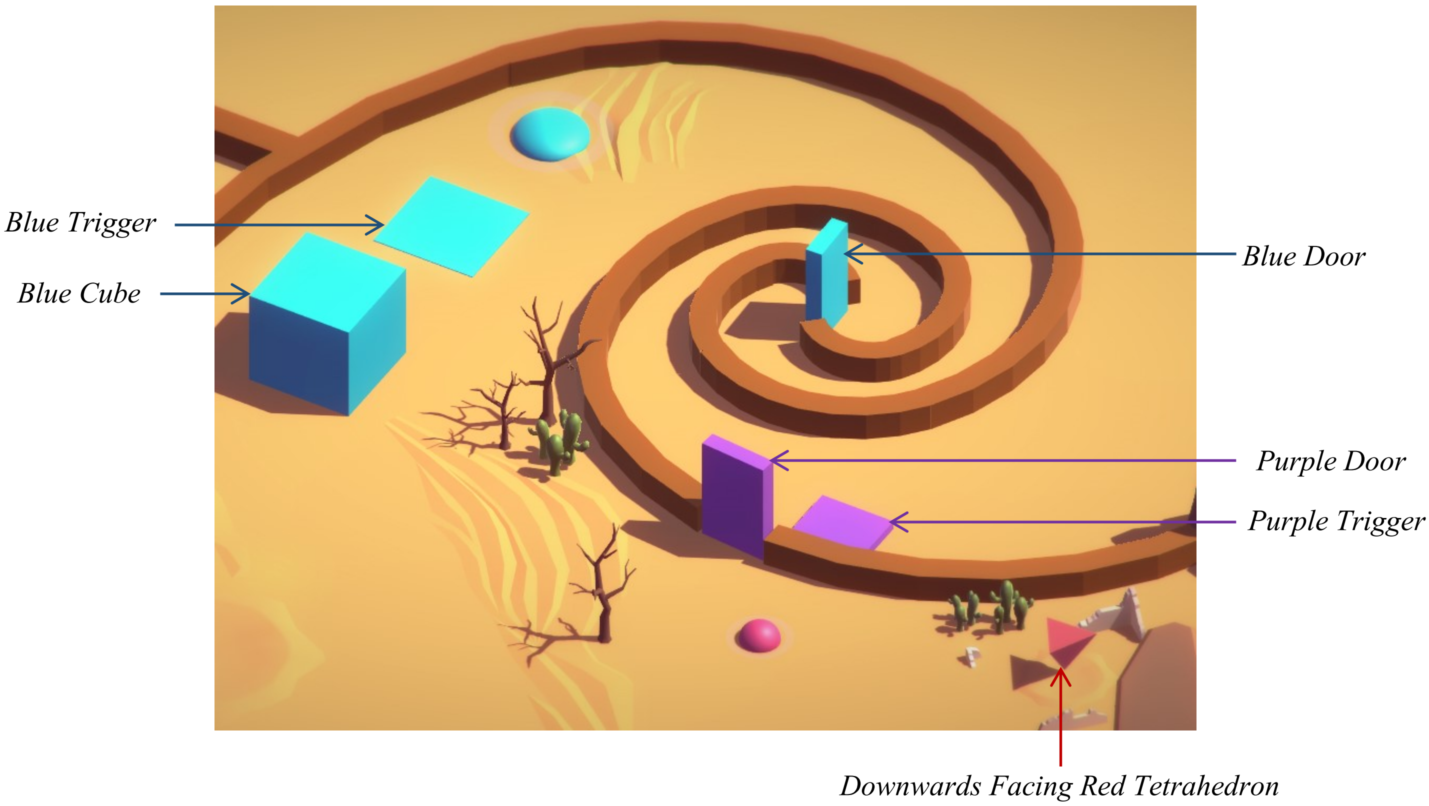


The third room introduces shared objects that require input from both players simultaneously

The large *Purple Sphere* in *Room 3* can only be moved by both players colliding with it simultaneously. If the *Purple Sphere* collides with a *Downwards Facing Purple Tetrahedron* it will decrease in size, while collision with an *Upwards Facing Purple Tetrahedron* will cause the *Purple Sphere* to increase in size.

Solution to Room 3: Both players must push the *Purple Sphere* simultaneously until it collides with the *Downwards Facing Purple Tetrahedron,* at which point it will shrink to a small enough size for a single player to move it. Most importantly, it will be small enough to fit into the centre of the spiral and trigger the opening of the *Purple Door* that leads to *Room 4*. Once shrunk, the *Purple Sphere* must then be moved to the centre of the spiral into the *Purple Trigger* without colliding with the *Upwards Facing Purple Tetrahedron*, otherwise it grows in size and the process must be repeated.

Room 4: By the fourth room players should be fairly comfortable with the game and are introduced to timed events. *Room 4* is also the first room that requires both players to make use of their special abilities in order to proceed to the next room.



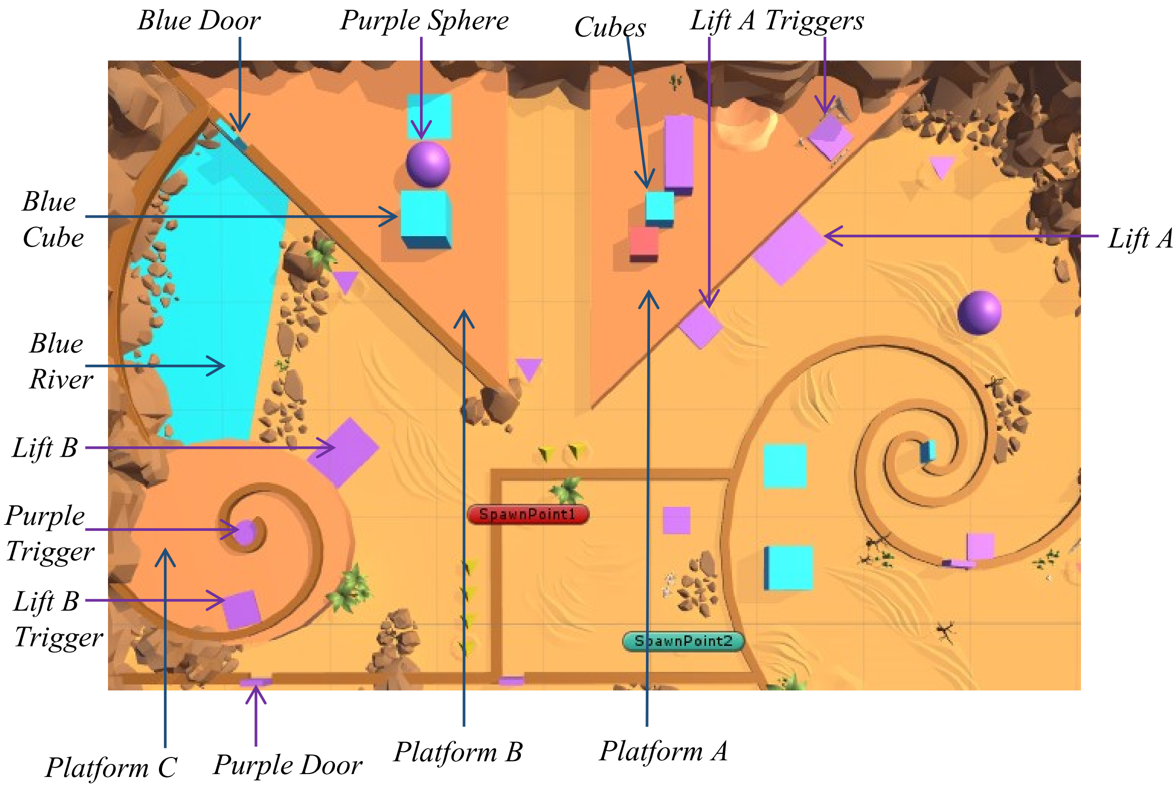
The fourth room introduces timed events to players and requires both players to use their special abilities simultaneously in order to progress to the next room.

The large *Blue Cube* in *Room 4* can only be moved by the blue player when his/her special ability is activated. The blue player's special ability makes him/her double in size and strong enough to push larger objects around. When the red player collides with the *Downwards Facing Red Tetrahedron* he/she shrinks in size for eleven seconds, after which he/she expands to his/her regular size again. Whilst shrunk, the red player is small enough to fit through the centre of the spiral and make it into *Room 5*.

<u>Solution to Room 4:</u> This room requires careful timing and coordination from both players simultaneously. First, the red player must shrink in size by colliding with the *Downwards Facing Tetrahedron.* Once shrunk, the red player has exactly eleven seconds to make it through the blue door in the centre of the spiral and out through the other side. When the red player is almost at the blue door, the blue player must use his/her special ability to push the large *Blue Cube* onto the *Blue Trigger*, which opens the blue door for three seconds. During this time the red player must use his/her

special ability to speed up and make it through the blue door before expanding in size again. Once through to the other side of the *Blue Door,* the red player will expand in size and can open the *Purple Door* for the blue player and both players can continue to *Room 5*.

Room 5: The fifth room expects players to have learnt the gameplay mechanics introduced in the first four rooms and incorporates all of the mechanics introduced in the first four rooms.



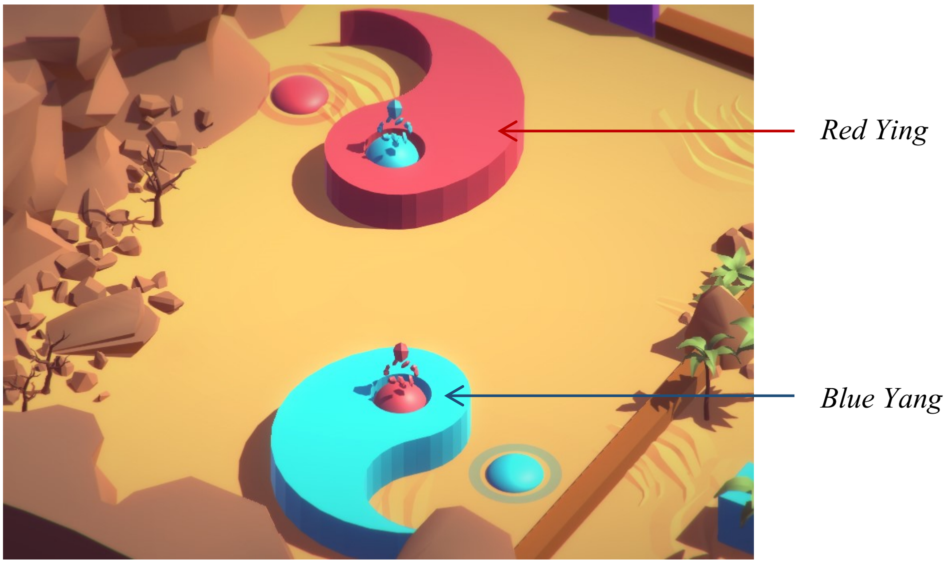
The fifth room is the most complex room and requires players to use all the skills they have learned from the previous four rooms

In addition to containing all the mechanics introduced in the previous four rooms, *Room 5* has lifts that raise players onto elevated platforms (*Lift A* and *Lift B*). To raise a lift one player must stand on the corresponding lift trigger (*Lift A Trigger* and *Lift B Trigger*). In this way players can help each other get onto the raised platforms (*Platform A, Platform B, and Platform C)*. Once on the raised platforms, players must explore the environment and manipulate objects to open the *Purple Door* leading to final room in the maize.

<u>Solution to Room 5:</u> Firstly, one player must stand on *Lift A* while the other player must raise them onto *Platform A* by standing on the *Lift A Trigger* at ground level. The player who is on *Platform A* must then stand on the *Lift A Trigger* on *Platform A* to raise their co-player onto *Platform A* as well. Once both players are *Platform A* they must push the colour coded *Cubes* on *Platform A* into the gap between the *Platform A* and *Platform B* to build a bridge allowing them to both cross over to *Platform B*. Once both players are on *Platform B* they must push the *Purple Sphere* together into the gap

between *Platform A* and *Platform B*. Both players must then drop down into the ditch between *Platform A* and *Platform B* and push the *Purple Sphere* into a purple tetrahedron to make it small. The players must then push the small *Purple Sphere* onto *Lift B* and leave it there. Both players must then get back onto *Platform B* by using *Lift A* to get back onto *Platform A* and cross over their bridge to *Platform B*. Once both players are back on *Platform B*, the blue player must use his/her special ability to push the *Blue Cube* onto its respective blue trigger which opens the *Blue Door* for a short period of time and raises the *Blue River* for a short period of time. While the *Blue Door* is open and the *Blue River* is raised the red player must use his/her special ability to sprint across to *Platform C*. The blue player must then drop down back to ground level and go to *Platform B* where the *Purple Sphere* is still waiting. The red player must then raise *Lift B* using the *Lift B Trigger* on *Platform C*. While *Lift B* is raised the blue player must push the *Purple Sphere* onto the *Purple Trigger* in the centre of the spiral on *Platform C* which opens the *Purple Door* leading to *Room 6*.

Room 6: The sixth room represents the final room in *COLAB*. It is essentially the "home stretch" and is much easier and shorter than *Room 5*.



The sixth room gives players some breathing room. Room six is in essence a victory lap and acts as a reward for players solving of Room 5 (the most difficult puzzle in COLAB).

In Room 6 players are presented with two large objects, one red one blue. Together these objects make the shape of a "Ying Yang" and can be moved around in the same way as any of the other colour coded objects in *COLAB*.

Solution to Room 6: To complete *COLAB* and escape from the maze, the red player must move the *Red Ying* and the blue player must move the *Blue Yang* to make the shape of a Ying Yang. Once the Ying Yang is in place, it sinks into the ground, and blue player must stand in the centre *Red Ying* while the red player must stand in the centre of the *Blue Yang*. At this point the game is complete and both players fly out of the maze to freedom.

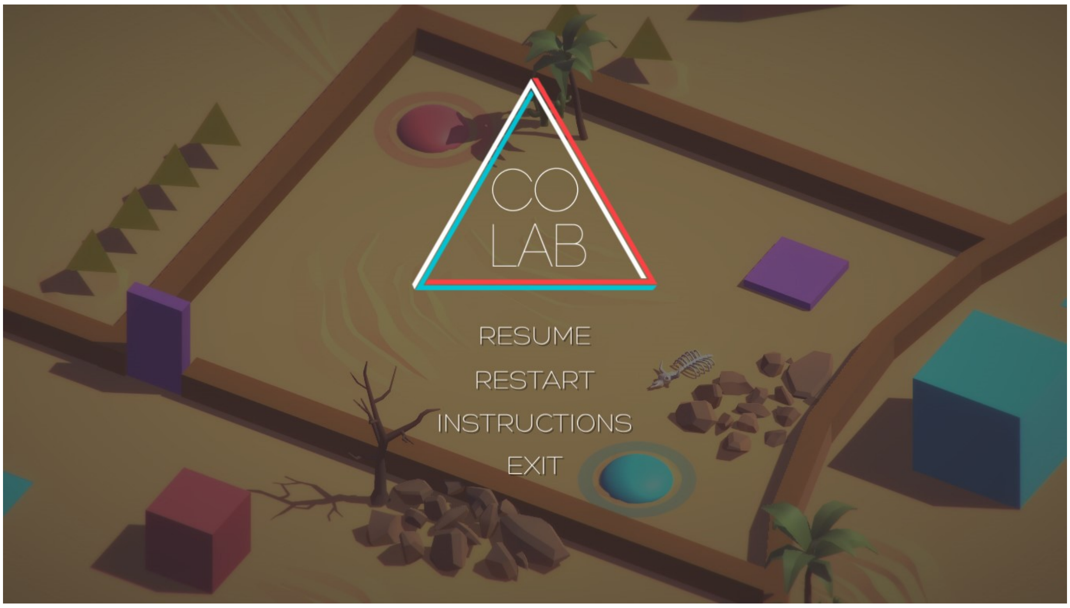
8. User interface

The user interface for *COLAB* is simple and allows players to start a new game, restart the current game, and exit the game at any point in time. Furthermore there are instructions and key mappings available via the pause menu for players to refer to at any time during gameplay.

8.1. Start screen and pause menu

Start screen

Pause menu



8.2. Instructions screens and key mappings

Instructions screen: Gamepad key mappings

Instructions screen: Keyboard key mappings

9. Technical specifications

9.1. Game engine

COLAB was developed using Unity3D Personal Edition. Unity3D Personal Edition is free software that offers all the engine features of Unity3D Professional Edition. Unity3D Personal Edition can only be used under the condition that resulting games are not built for commercial purposes. *COLAB* is for research purposes only and is released as open source software along with the Master's dissertation that it forms a component of. For more information on the source code, class structure, and software architecture underlying *COLAB*, the entire *COLAB* project is open-source and available at: https://github.com/phatphrog/colab.

Unity3D was chosen as the optimal choice for the development of *COLAB* as the tools provided by Unity3D speed up the development process substantially by providing:

- **A unified asset pipeline:** Drag and drop assets into Unity3D's asset folder without the need to implement or develop a resource subsystem.
- **An integrated level editor:** In built level building tools allows for the design and implementation of the game environment quickly and easily without the need creating a level editor from scratch.
- **In-depth debugging support:** Gameplay variables can be tracked, debugged and changed during gameplay. The game can be "paused" at any time, and the debugger allows for code to be stepped through one statement at a time.
- **Comprehensive library of ready-made components and assets:** In combination with the Unity Asset Store, Unity3D provides a comprehensive library of ready-made components, including rendering, collision-detection, physics, input controls, sounds and assets.
- **Multiplatform support:** Unity3D can build and deploy across all major mobile, VR, desktop, console, and TV platforms plus the Web.
- **Extensive Documentation:** Unity3D has an active community of developers, well maintained documentation, extensive tutorials and an in-depth, easy-to-use API.
- **Multiplayer:** Unity3D provides boiler-plate code and extensive libraries for local and networked multiplayer features.

9.2. Scripting language

All scripting in *COLAB* is done in C# as it offers comprehensive, well documented object oriented programming. Most importantly the developer of *COLAB* is an experienced C# developer and Unity3D offers full integration with C#.

9.3. Multiplayer support

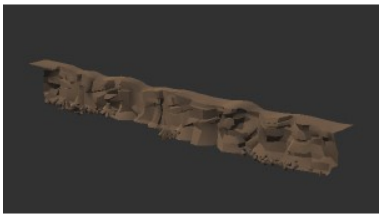
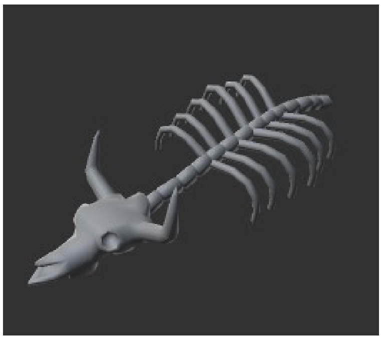
Due to its complexity, networked multiplayer will not be implemented in *COLAB*. Instead, *COLAB* is designed as a local multiplayer experience to be run on a single computer or console with a shared or distributed display and one controller for each player.

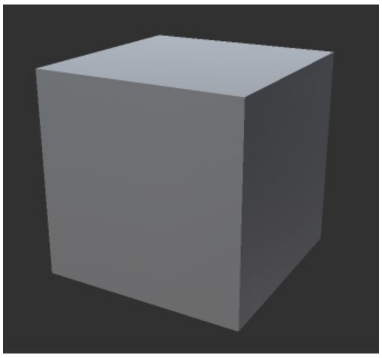
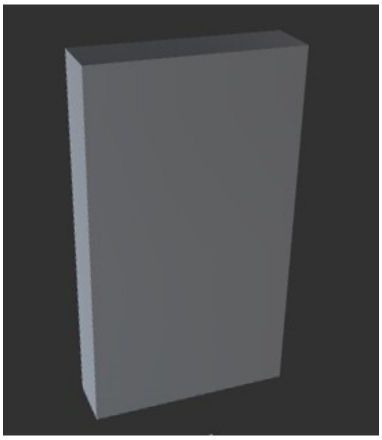
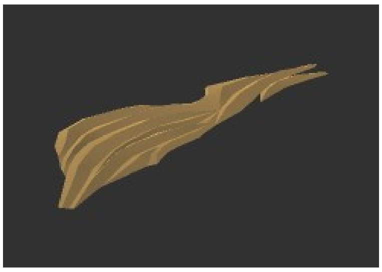
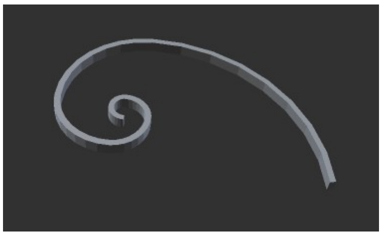
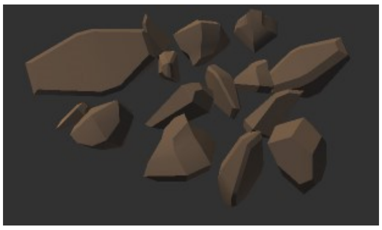
9.4. 3D modelling

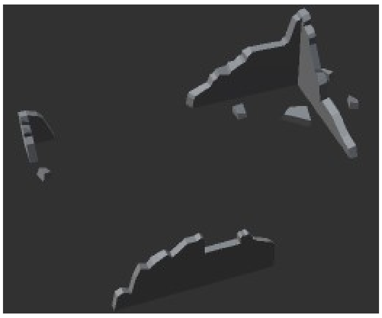
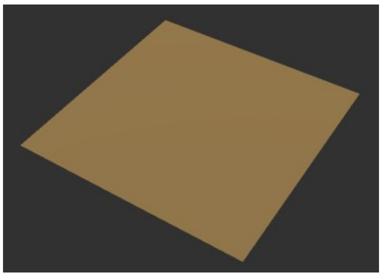
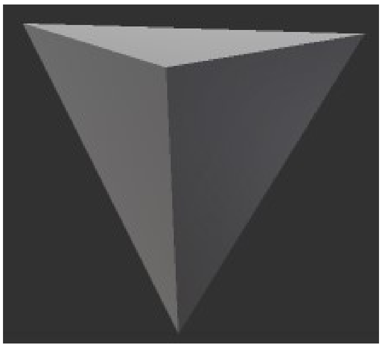
Where models were not freely available on the Unity Asset Store, additional models were created using Blender, a free 3D modelling software toolkit.

10. Assets

10.1. 3D models

Cactus	*Column1*	*Column2*
		
Cliff	*Cow*	*Crater*
		

Cube 	*Door* 	*Double Fibonacci* 
Dunes1 	*Dunes2* 	*Fibonacci Spiral* 
Palm Tree 	*Player* 	*Quarter Circle* 
Rocks1 	*Rocks2* 	*Rocks3* 

Ruins 	*Sphere* 	*Terrain* 
Tetrahedron 	*Tree* 	

10.2. Audio

COLAB includes an original ambient soundtrack that accompanies its theme. The background music of *COLAB* was created by Pierre Terblanche of Eartheart (https://eartheart.bandcamp.com/), and permission has been granted for use within the game.

In addition to background music, the following sounds are included in the game:

- Bell sound for attention grabbing mechanic
- Popping sound for when large objects decreased in size
- Door opening sound
- Door closing sound
- Countdown timer drum roll sound for timed events
- Sound of objects moving in the sand when being pushed by players

10.3. Colour palette

Appendix C: Consent Form

Consent form

You cannot take part in this study without giving us your explicit consent. By signing this consent statement you are indicating that you understand the nature of the research study, your role in that research, and that you agree to participate in the research. Please ensure that you agree with all of the following points before signing:

* I understand that I am participating in gaming research that will be measuring my psychological state as related to gaming.

* I understand that my identity will not be linked with my data, and that all information I provide will remain confidential.

* I understand that I will be provided with an explanation of the research in which I participated and be given the name and telephone number of an individual to contact if I have questions about the research.

* I understand that certain facts about the study might be withheld from me, and the researchers might not, initially, tell me the true or full purpose of the study. However, the complete facts and true purpose of the study will be revealed to me at the completion of the study session.

* I understand the session may be video recorded for research purposes only.

* I understand that participation in research is not required, is voluntary, and that, at any point during the session, I may refuse to participate further without penalty.

By signing this form I am stating that I am 18 years of age or older, and that I understand the above information and consent to participate in this study being conducted at the University of Cape Town.

First Name: ______________________________ Last Name: _______________________________

Age:___________________ Sex: M/F

Signature: _______________________________________ Date: ______________________________

If taking part in this study made you feel distressed in any way and you would like to talk to someone about your thoughts please contact us or the University of Cape Town's Student Wellness at 021 650 1017/ 021 650 1020.

Appendix D: Gameplay Instructions

- *COLAB* is a two player puzzle game.

- You find yourselves stuck in the centre of a maze made up of a series of rooms. Each room has one or more locked doors leading to the next room in the maze. The aim of the game is for you to work together to unlock the doors between each room until you have escaped from the maze.

- Each player controls a colour coded character, one red, one blue. The red character can interact with red objects in the environment and the blue character can interact with blue objects in the environment. Both players can interact with purple objects in the environment.

- Each player has their own unique special power. The red player can boost its speed and the blue player can grow in size. The amount of special power you have is represented by circular meter surrounding your character. While using your special power the meter will gradually deplete. When the special meter is empty you can no longer use your special power. You can refill your special meter and continue using your special power at any time by simply making your characters touch.

- Use the left analog stick on your controller to move around. Press and hold the X button to use your special power. Press the O button to kick up a circle of dust around your avatar to draw attention to the location of your character.

- Explore, experiment, have fun, and good luck!

Appendix E: Ethics Clearance

	RESEARCH ACCESS TO STUDENTS	DSA 100

NOTES

1. This form must be **FULLY** completed by all applicants who want to access UCT students for the purpose of research or surveys.
2. Return the fully completed **(a) DSA 100** application form **by email**, in **the same word format**, together with **your: (b) research proposal inclusive of your survey, (c) copy of your ethics approval letter / proof (d) informed consent letter** to: Moonira.Khan@uct.ac.za. You application will be attended to by the Executive Director, Department of Student Affairs (DSA), UCT.
3. The turnaround time for a reply is **approximately 10 working days.**
4. NB: It is the responsibility of the researcher/s to apply for and to obtain **ethics approval and to comply with amendments that may be requested;** as well as **to obtain** approval to access UCT staff and/or UCT students, from the following, at UCT, respectively: (a) **Ethics**: Chairperson, Faculty Research Ethics Committee' (FREC) for ethics approval, (b) **Staff access:** Executive Director: HR for approval to access UCT staff, and (c) **Student access:** Executive Director: Student Affairs for approval to access UCT students.
5. **Note:** UCT Senate Research Protocols requires compliance to the above, **even if prior approval has been obtained from any other institution/agency. UCT's research protocol requirements applies to *all* persons, institutions and agencies from UCT and external to UCT who want to conduct research on human subjects for academic, marketing or service related reasons at UCT.**
6. **Should approval be granted to access UCT students for this research study, such approval is effective for a period of one year from the date of approval (as stated in Section D of this form), and the approval expires automatically on the last day.**
7. **The approving authority reserves the right to revoke an approval based on reasonable grounds and/or new information.**

SECTION A: RESEARCH APPLICANT/S DETAILS

Position	Staff / Student No	Title and Name	Contact Details (Email / Cell / land line)
A.1 Student Number	TRBMAR009	Mr. Marcel Terblanche	phatphrog@gmail.com / 0762966245
A.2 Academic / PASS Staff No.			
A.3 Visitor/ Researcher ID No.			
A.4 University at which a student or employee	UCT	Address if *not* UCT:	
A.5 Faculty/ Department/School	Science		
A.6 APPLICANTS DETAILS If different from above	Title and Name	Tel.	Email

SECTION B: RESEARCHER/S SUPERVISOR/S DETAILS

Position	Title and Name	Tel.	Email
B.1 Supervisor	Prof. Edwin Blake	+27 21 650 3661	edwin@cs.uct.ac.za

SECTION C: APPLICANT'S RESEARCH STUDY FIELD AND APPROVAL STATUS

C.1 Degree (if a student)	MSc
C.2 Research Project Title	Social Context and User Experience in Collaborative Multiplayer Games
C.3 Research Proposal	Attached: Yes No
C.4 Target population	UCT students. Anyone aged 18 and over
C.5 Lead Researcher details	If different from applicant:
C6. Will use research assistant/s	Yes No If yes- provide a list of names, contact details and ID no.
C.7 Research Methodology and Informed consent:	**Research methodology**: Experimental Design – 45 minute Gameplay Session followed by User Experience Questionnaires **Informed consent: Yes (attached) – voluntary participation.**
C.8 Ethics clearance status from UCT's Faculty Ethics in Research Committee /Chair (EiRC)	Approved by the UCT EiRC: Yes With amendments: Yes No (a) Attach copy of your UCT ethics approval. Attached: Yes No (b) State date / Ref. No / Faculty of your UCT ethics approval: 15 /11/2015 Ref. /Faculty.: SREC 62 – 2015

SECTION D: APPLICANT/S APPROVAL STATUS FOR ACCESS TO STUDENTS FOR RESEARCH PURPOSE
(To be completed by the UCT - ED, DSA or Nominee)

D.1 APPROVAL STATUS	Approved / With Terms / Not	* Conditional approval with terms	Applicant/s Ref. No.:
	(i) Approved (ii) With terms (iii) Not approved	**(a)** Access to students for this research study must only be undertaken <u>after</u> written ethics approval has been obtained. **(b)** In event any ethics conditions are attached, these must be complied with <u>before</u> access to students.	TRBMAR009/ Mr. Marcel Terblanche

D.2 APPROVED BY:	Designation	Name	Signature	Date of Approval
	Executive Director, Department of Student Affairs	*Dr Moonira Khan*		*30 May 2016*