Dynamics of Social Play

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ABSTRACT

Digital games have become a social medium. Players are often socially motivated to play games and actively seek out games that offer social interactions. Early studies on games such as *World of Warcraft* demonstrate that players can form meaningful bonds within the game. Catering to this trend, most game titles now include multiplayer experiences in their gameplay. Despite the growing popularity of social elements within play, we still have little empirically-founded guidance on how to effectively design for social experiences. If we want to design for social play, we have to understand what makes games social. What are the properties of play that are responsible for facilitating social ties between players? We address this question by synthesizing the exiting literature on design recommendations for social play into identify overarching properties of play that we think are the most prolific in literature: cooperation and interdependence. We perform two experimental studies demonstrating how games facilitate trust between players and how cooperation and interdependence are crucial properties of social play. Furthermore, we validate our framework in a field study, investigating the experiences within games that predict in-game social capital. We demonstrate that interdependence and toxicity are strongly linked to the social capital our participants experience in their gaming communities. We also illustrate how in-game social capital is negatively associated with feelings of loneliness and positively associated with need satisfaction of relatedness outside of the context of play. Overall, our findings emphasize how strongly the experiences within the game affect the social ties that emerge from play, suggesting that informed design choices are crucial for the success of social games. This dissertation also contributes to the ongoing debate about the effects that in-game relationships have on the player's mental health—we show a strong positive link between in-game social capital and markers for psychological well-being. It is easy to disregard in-game relationships, as they are fundamentally distinct from the in-person ones we think of as natural. Yet we cannot ignore the emergence of digital games as a social medium. The more we understand the underlying elements of social play, the better we can design games that bring people closer together.

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DEDICATION

This dissertation is dedicated to my parents who I love.

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LIST OF ABBREVIATIONS

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ANOVA	Analysis of Variance
BPNS	Basic Psychological Need Satisfaction
ESA	Entertainment Software Association
HCI	Human Computer Interaction
HIT	Human Intelligence Task
IMI	Intrinsic Motivation Inventory
IRA	Inter-rater Agreement
LAN	Local Area Network
MANOVA	Multivariate Analysis of Variance
MDA	Mechanics, Dynamics, Aesthetics
MMO	Massively Multiplayer Online Game
MMORPG	Massively Multiplayer Online Role Playing Games
MTurk	Amazon's Mechanical Turk
PENS	Player Experience of Needs Satisfaction
RCS	Relational Communication Scale
TIPI	Ten-Item Personality Inventory
WoW	World of Warcraft

1. INTRODUCTION

1.1. Research Question

Why do we play with others? In a pre-digital age, one might argue, people simply needed someone to play against. A game of *Tag* or *Poker* is hardly interesting against an inanimate object, so another person was required to have a suitable opponent. In the age of computers, consoles and smartphones, however, games have evolved. All of these platforms provide the opportunity to play against sophisticated systems with challenging artificial intelligence, making opponents in the form of other people unnecessary. Yet, multiplayer games are still a phenomenon. In fact, they are increasingly popular with gamers [53]. A growing body of literature suggests that we do not play with others simply to have a more interesting opponent, we play with others to interact and to socialize. Frequent gamers spend an average of 6 hours a week playing with others online and 5 hours a week playing with others in person [53]. People play multiplayer games with friends, family members, parents, and spouses [53]. More than half of the most frequent gamers report that they play video games to help them make social connections [53]. Research on the motivations that drive players to engage in play support these reports. Exploratory factor analysis of different player motivations indicate sociability to be a core component of player motivation [67]. Self-determination theory has been successfully applied to game user research, indicating that feelings of relatedness within the game are a relevant part of player experience [167]. The desire to socially interact has been shown to be the biggest predictor for how much players engage in first person shooters online [91] and in gaming conventions [90]. Interviews with *Counter Strike* and *World of Warcraft* players support this claim, suggesting that online gaming is foremost motivated by social reasons that provide gamers with a possibility of cooperation and communication [59]. It is becoming increasingly evident that players regard games as a social medium and wish to interact socially with other players through play.

What we know based on previous research is that games are indeed able to provide these social experiences, satisfying the social needs of players. For example, some *World of Warcraft* players successfully use the game to as a platform to maintain preexisting relationships, form new ones, and even find romantic partners [141,198,200]. Communities that form in games have been described as social hubs similar to bars or cafes [181], and experimental studies have suggested

that games can be used as viable tools for team building [111,117,174]. These findings suggest variation in the depth of these relationships [200]. Nonetheless, in specific conditions, games appear to be able to facilitate social interactions and foster social ties between players. What we don't know, is what these conditions are.

As players increasingly view games as a social medium, the game industry is responding to these trends. The number of multiplayer game titles that are being published has steadily been increasing [120]. Games that were originally designed as single player games (e.g. *The Last of us*) have had multiplayer modes 'attached' to appeal to players' social needs. Even established franchises that have traditionally only been single player experiences, such as *Battlefield* or *Assassins Creed,* are now expanding their play modes to add multiplayer possibilities. These strategies appear to work; of the top 10 best-selling games of 2017, 9 provide multiplayer modes [121].

Catering to the social needs of players by introducing more social play mechanics comes with a set of challenges. For one, digital games lack many of the social aspects we associate with traditional co-located play. Children's games or board games, for example, afford physical proximity, even close physical contact (e.g., *Tag*) and face-to-face communication. Game designers are challenged with finding the social aspects of games that do not require physical or face-to-face interactions. How do we design social games that do not require physical co-presence? Further, many of the games explicitly designed to be multiplayer games also struggle with players behaving antisocially [58,112]. Games such as *League of Legends*, *Dota* or *Hearthstone* are known for 'toxic' players who verbally assault other players [58,112,158]. Simply designing a space that connects people through play appears to also invite abusive behavior. Designers who wish to create pro-social environments need guidance on what properties of the game facilitate pro-social dynamics.

To date, the underlying properties of play that are responsible for social ties are still not yet clearly identified. Game designers who wish to design 'social games' have to rely on common sense solutions and practises that have established themselves through trial and error. What we have is a rich literature using different game mechanics in a social context. Studies designing games for team building purposes implement 'roles' [135] or try to induce a 'need for communication' [52]. However, a systematic approach to identifying and evaluating relevant social experiences within games is still lacking. In my research I therefore want to address the question:

What are the properties of play that are fostering social ties?

‘Social Closeness’

Throughout this dissertation we are investigating interpersonal relationships as our major outcome. As we will demonstrate in the coming chapters the language and methods used to describe and qualify ‘relationships’ is extremely diverse. This diversity will be reflected in the language we use in this dissertation, as we draw form different fields that use different constructs to describe different aspects of ‘social closeness’. The general outcome we are interested in are subjective feelings of *social closeness.* We would argue that the subjective feeling of closeness is an appraisal of existing *social ties*. Throughout this dissertation we will approach these general constructs with more specific language in an effort to describe social closeness. For example, manuscript A and B focus on dyadic relationships between two specific players. In this context we speak of *interpersonal trust* or *social ties*. In manuscript C we investigate communities, therefore our language shifts to words that acknowledge the group and community aspects of social closeness (e.g. *social capitol*, *social fabric*, *social embeddedness*). Each of these terms can be seen as a different tool, a different approach, to describe the general phenomenon of social closeness in games. We are adopting the diversity of language form the existing literature to acknowledge the complexity of the outcome we are investigating in this dissertation. However, we are also trying to add structure by using established and well-defined psychological constructs to operationalize aspects of social closeness in our research: trust and social capital.

1.2. Grounding for the Work Presented in this Dissertation

In the following section we will review the body of work on social play by addressing two questions: Is gaming a social activity? How can we design ‘social games’?

1.2.1. Gaming as a Social Activity?

Social relationships are at the core of human life. Not surprisingly, psychological research has

focused heavily on how these relationships affect our health and emotional state (e.g.[35,165,168]).

The need to form lasting and caring relationships and the feeling of belonging are fundamental human needs [9,36]. As such, a lack of social embeddedness has been identified as a serious threat to well-being [9,176], while meaningful conversations, as well as feeling understood and appreciated, have been identified as essential predictors for well-being [155]. Most prominently, the need to relate to others has been identified by Deci and Ryan, who postulate the psychological need for relatedness as one of the three major basic needs that, 'if satisfied, conduces towards health and well-being but, if not satisfied, contributes to pathology and ill-being' [168]. Subjective loneliness, arguably the inverse of need satisfaction of relatedness, has been linked to serious individual and social problems such as alcoholism [136], physical illness [3], and symptoms of depression [115]. For the purposes of my research, I adopt the term 'psychological well-being', although we focus specifically on the social aspects of psychological well-being. The social aspects of psychological well-being have also been referred to as 'social well-being' in previous research on general health [103,113] and consequences of online behavior [23]. Social well-being has been defined as 'an individual's appraisal of their social relationships, how others react to them, and how they interact with social institutions and communities' [175]. The term social well-being, however, has also been used in other contexts to refer to socioeconomic markers [34]. To avoid ambiguity, we therefore use the term 'psychological well-being', emphasizing that we focus on the social aspects of this area.

Whether or not games can enhance or threaten our psychological well-being is currently still under debate. Given the increasing prevalence of multiplayer digital game play as a leisure activity of choice, we must consider whether there is potential harm or help to psychological well-being in displacing offline relationships with online ones that are enacted through game play.

Besides the generally held cultural stereotypes about the 'antisocial gamers', there are also some serious concerns rooted in academic literature that demonstrates the potential harm games can inflict on players' psychological well-being. Some studies have suggested that online gaming can trigger a number of outcomes associated with negative social behavior. A meta-analytic review suggests that exposure to games is positively associated with heightened levels of aggression and an aggressive cognition in young adults and children [5]. The same study also found a negative

association with exposure to violent games and prosocial behavior. Others emphasized the dangers of excessive playing and gaming addictions, which in turn would affect the social life of gamers [68]. There has also been evidence suggesting that online activity can lead to an erosion of offline friendships and mental health [80,110].

Within the Human Computer Interaction (HCI) literature, a large body of work has identified the social potential games hold. With the rise of Massively Multiplayer Online Role Playing Games (MMORPGs) such as World of Warcraft, online platforms such as Second Life, and Local Area Network (LAN) parties, studies have started to investigate the potential social benefits of gaming. Orleans and Laney [140] broadly investigate computer usage in youth and observe that games provide an opportunity for 'rich, emotional exchanges with promises for more interplay.' Overall, the games the participants played together appeared to facilitate social interactions rather than facilitate social isolation. Huvila and colleagues [80] investigated interactions in the virtual environment Second Life and found that socializing was a major motivation for participating in Second Life. Participants' inclusion into the Second Life community was fostered by the virtual environment, which offered many ways of interaction with others in prosocial ways. Players of the game *World of Warcraft* (WoW) appear to use the game to maintain existing relationships as well as form new ones; Willams et al. [198,201] investigated the social dynamics in WoW guilds and how they facilitate social support. The results indicated that some players use the game as a platform to maintain preexisting relationships while others use it to actively seek out new relationships. The authors also observes variance in how seriously player take the relationships formed in games with some thinking about them as mere acquaintances and other cherishing them as their close friends [198,201]. Similarly, Cole and Griffith [27] demonstrate with a data set of just under a thousand WoW players that many of them have formed relationships that are important to them, provide social support, and even spark romantic interest [141]. In an ethnographic study, Nardi and Harris [132] demonstrate that WoW players undergo a large variety of different social interactions all contributing to the social fabric of the gaming community. WoW [180] as well as Star Wars Galaxies [48], and MMORPG's in general, can be compared to 'third places' [180] – a concept stemming from the urban sociologist Ray Oldenburg [138]. 'Third places' are – in contrast to the home ('first place') and the workplace ('second place') – social environments such as cafes, bars clubs, parks, public libraries, etc. [138,180]. Steinkuehler and Williams [180], as well as

Duchenaut and colleagues [48], go through the different characteristics of third places (eight in total), and demonstrate how MMORPG's can be considered social hubs. They further combine the third place framework with Putnam's [150] concept of social capital (explained below) and argue that third places are facilitators of social capital [180]. They do, however, argue that MMORPG's are far more likely to generate bridging social capital than bonding capital [180]. Additionally, they argue that MMORPG's can lose the attributes that make them third places, as pressure to perform well rises throughout the game [180]. Interestingly, longitudinal analysis of player logs indicated that grouped play increases and play becomes more social as players progress through the game [49], contradicting these notions. Frostling and Henningson [60] interviewed twenty-three online gamers in an attempt to identify general motivations for gameplay and found that gamers are, among other things, predominantly motivated by sociality, cooperation and communication. Similarly, visitors of gaming conventions for co-located local area network (LAN) play also report that social interaction was their major motivation for coming to these kinds of conventions [89].

Are games suited to be a social medium? Can relationships in games satisfy our need to relate to others? The existing literature dealing with these questions is quite heterogeneous. Gaming certainly has been associated with behaviours that could threaten psychological well-being such as aggression [5] and addiction [68]. On the other hand, gaming has also been shown to be strongly socially motivated [59,80,89,92,140], demonstrating the desire on the users' side for games to be social platforms. There also appears to be enough literature on social capital in games to support the claim that for those who seek out social ties, games allow users to form close communities and friendships [27,108,180,198,201] and even romantic relationships [27,141]. It appears that not all players pursue these goals, and for many players, in-game ties are merely acquaintances similar to work colleagues [201]. For those who see games as a social platform, however, the answer is 'yes'; gaming can be a social activity. Given socially motivated players, we can assume *that* games can facilitate social ties. The next interesting question is '*how?'*, the answer to which is especially

relevant to game designers who wish to address the social needs of players.

Social Capital Framework

Research on social ties in online contexts often utilizes the framework of social capital (e.g., [150,180,187,199]), more specifically the differentiation of two kinds of relationships: *bridging ties* and *bonding ties*. Based on Trepte, for example, social capital within games is associated with offline social support [187]. As already mentioned, the characteristics of third places games can have also been linked to social capital [180]. Based on Putnam [150], 'bridging ties' are characterized by tentative relationships that may lack depth but make up for it in breadth. Bridging social capital provides little emotional or social support. However, it can broaden the social horizon of the holder as it exposes one to different world views, opinions and resources [150,199]. In contrast, 'bonding ties' refer to strong relationships in which people feel emotional and social support. Bonding ties are characterized by relationships with less diversity but stronger personal connections. They provide strong, reciprocated, and substantive emotional support [151,199]. As our research aims to understand the social ties between players, we have to be able to describe and quantify the quality of those ties. So far, social capital has been the predominant framework to serve that function.

1.2.2. How can we Design 'Social Games'?

A body of literature has investigated the use of multiplayer games as an intervention for teambuilding and 'jumpstarting' social ties. These studies implemented very different mechanics with different goals and have used different terminologies to describe the games they designed. In the following section we will report the different design recommendations game-based literature has provided for social play. Some studies focus their design recommendation on the interface between users and the games, emphasizing the ease of controls [31,111,135] or the physical embodiment in 3D virtual worlds (e.g.[52,111]). We focus on design recommendations regarding the interactions between players within the game rather than the interaction between the players and the interface of the game. Table 1 is a list of the explicitly-mentioned design recommendations for 'social play' in studies that have investigated the effect of games on the relationships between

players.

Authors	Design Recommendations
Rocha et al. [160]	- ‘Shared goals’ - ‘Synergies between goals’ - ‘Somplementarity’ (specific to roles in the game) - ‘Synergies between abilities’ - ‘Abilities that can only be used on another player’ - ‘Special rules for players of the same team.’
Zagal et al. [208]	- ‘Introduce a tension between group utility and individual utility’ - ‘Allow players to ‘make decisions and take action without the consent of the team’ - ‘Bestow different abilities or responsibilities upon the players’ - ‘Provide a sufficient rationale for cooperation’
Nasir et al. [135]	- ‘Balanced individual participation’ - ‘Uniqueness of roles’ - ‘Need for social interaction’ - ‘Use of cooperative patterns’ - ‘Concurrent play’ (as supposed to asynchronous play)
Ellis et al. [52,117]	- ‘Cooperation’ - ‘Communication’ - ‘Roles’
Beznosyk et al. [14]	- ‘Limited resources’ - ‘Complementarity’ (roles) - ‘Interaction with the same object’ - ‘Shared puzzles’ - ‘Abilities that can be used on other players’ - ‘Shared goals’
Harris et al. [73]	- ‘Asymmetry of ability’ - ‘Asymmetry of challenge’ - ‘Asymmetry of information’

- ‘Asymmetry of investment’ - ‘Asymmetry of goal/responsibility’

Table 1.1: Design Recommendation on social play mechanics by authors.

The diversity in the existing literature makes it difficult to derive knowledge about how to design for social play. Our primary goal in reviewing this literature was therefore to identify the commonalities between all of these implementations so that we could identify the abstract overarching patterns that connect the existing approaches. Upon reading the above-mentioned recommendations, some patterns emerge. An initial synthesis allows us to identify the prominent themes: Cooperation/Goals, Roles, Unique Abilities, Synergy, Communication/Interaction.

Cooperation/Goal sharing is repeatedly mentioned or implied in every set of design recommendations. Some explicitly recommend ‘shared goals’ [14,160], while others explicitly mention cooperation or cooperative patterns [52,135]. ‘Shared puzzles’ describes the process of solving a challenge together [14]. Some researchers focus cooperation/goal sharing by illustrating the tension between following similar or opposing goals (e.g., ‘introduce a tension between group utility and individual utility’ [208], ‘Asymmetry of Goal/Responsibility’ [73]).

The following themes are structurally similar; however, it is important to recognize how they differ as they can result in different design recommendations.

Roles is the second most frequently mentioned recommendation. ‘Roles’ describe the dynamic of players taking on different responsibilities within the group. Roles have been explicitly mentioned by several research teams as a design recommendation [52,135,160]. It is important to note that, within the literature, ‘roles’ are always confounded with different sets of abilities. The two mechanics of play are, however, not identical. It is possible for players to assume roles despite having identical abilities. Many shooter games (e.g., *Counter Strike*) do not assign specific roles within a team. However, players will still specialize on specific responsibilities within the group (e.g., ‘defending strategic locations’, ‘attacking’).

Unique Abilities are special actions a player can perform that other players cannot perform. Implementing different abilities does not always result in players specializing on specific roles. Role-playing games, such as *Diabolo,* implement fundamentally different abilities; for example some players play as fighters and other as spell casters. Within the game, these different abilities

do not affect the responsibilities players assume within the team, but merely change aesthetic and strategic properties of dealing damage to enemies (e.g., while one player swings a sword the other casts a spell). While ‘roles’ don't always mean ‘different abilities’ and vice versa, current recommendations still use these terms interchangeably. What we can learn from the literature is that most authors try to recommend the intersection between roles and different abilities.

Synergies build on the idea of different abilities in many implementations we have seen so far. Synergies describe abilities that are enhanced by other player’s abilities. We name synergies as a separate theme because it is often stated separately as a design recommendation. Roles/different abilities can synergise but do not have to. *Diablo* is a good example for this disparity. The damage a fighter and a spell caster deal do not affect each other but only accumulate. Other role playing games however do implement synergies, where some spells make enemies more prone to attacks of other player s,for example. The recommendations appear to be confounded but distinct.

Communication/Interaction was also mentioned as a design recommendation [14,52,135], although it has been described more as a design goal. Authors stress the importance to induce a need to communicate [52] and to socially interact [135], but do not have specific recommendations on how do to so other than the already mentioned themes. A specific recommendation that can be derived, however, is the explicit need for communication channels so that sufficient interaction can occur.

While ‘Cooperation/Goal sharing’ appears to be an independent theme, the other themes appear to be deeply confounded. Roles, abilities, synergies and a need for communication are all valuable recommendations. However, each recommendation in itself does not appear to be enough. Roles can be implemented in ways that do not require any interactions between players. The same can be said about unique abilities or synergies alone. The core of these design recommendations appears to lie within the intersection of all four themes. What latent variable are all four recommendations describing? In this review of design recommendations, we further synthesize the very similar mechanics Roles, Unique Abilities, Synergies and Communication/interaction into a more abstract theme: *Interdependence*. Interdependence is a way of describing a task. The construct originates from work and organizational psychology describing the degree to which people depend on one another to perform a task. How interdependence applies to the literature on social play is

further described below.

Based on our review of the literature on collaborative game mechanics and their potential to facilitate social bonds, we identified two overarching mechanics [39]: cooperation and interdependence. In the next sections, we summarize literature on social play through the lens of these two design factors. These sections largely stem from the later presented Manuscript B [39].

1.2.2.1. Cooperation

The most prevalent idea in the literature on collaborative play is the notion of players working towards the same goal. This stands in contrast to competitive play in which players have separate or in its most extreme, opposing goals. Rocha et al. [160] identify "shared goals" and "synergy between goals" as essential design pattern in collaborative play. The "synergy between goals" pattern acknowledges that collaboration does not necessarily mean complete cooperation. It is possible for players to simultaneously pursue individual goals (leveling up one's own character) and group goals (making sure the group wins). Zagal et al. [208] describe this phenomenon as the tension between 'individual utility' and 'group utility'. Another way of thinking about cooperation is by examining conflict. Definitions of 'games', as well as design guidelines, emphasize the importance of conflict [61,170]. Competitive and cooperative games differ in where conflict originates. Competitive games pitch players against each other and the conflict lies between the players. In cooperative games, players team up to overcome obstacles and challenges (e.g., limited time or resources) and the conflict originates between the players and the system or other groups.

Social Identity

The argument that working towards the same goal will facilitate social bonds has so far only been justified by Social Identity Theory (e.g., [52]), which argues that a large part of a person's self-concept is based on group membership [1,2,182]. As an individual can potentially identify with many different groups, an important concept within Social Identity Theory is *group saliency* [88]. When a group membership is more salient to the individual, they will likely identify more strongly with that group. Findings suggest that group saliency can be induced by a minimal set of identifiers–even randomly assigning people to a group can elicit group identification, provided the individual is made aware of its group membership [88]. A game that pits the players together against another team or the system could therefore already be enough to create a sense of group membership reinforced by conflict, i.e., 'us vs. them'. Greater identification with a group has been linked to greater trust and cohesion among group members [1,2], greater individual contribution to the goals of the group [1,2], and increased group productivity [88].

The virtue of cooperation in the context of facilitating social bonds seems obvious and a matter of common sense and is often inexplicitly included in design frameworks [12,95]. It is therefore not surprising that every study we reviewed faithfully assumes cooperation to be the superior mechanic for facilitating social bonds. Seif El-Nasr et al. [174] investigated cooperative games like *Little Big Planet* or *Rock Band 2* to identify cooperative performance metrics. A number of cooperative 3D environment puzzle games have been found to effectively promote team building [52,111,117]. In the game Operation Sting, players share the goal of successfully performing a heist together [133,135]. Researchers found the game to have a positive effect on the social fabric of the group [133,135]. Only one study investigating the effect of a collaborative game on the players' perception of each other actually built a competitive version of the game [32]. Unfortunately, a direct comparison between cooperation and competition was not reported. The authors do, however, suggest that competition diminishes the extent to which players relate game outcomes to liking for their partner in a game [32].

The idea that games should be cooperative if they are to facilitate social closeness appears to be an

assumption made by researchers and designers. Unfortunately, there has not been a direct comparison between cooperation and competition regarding their individual effects on the social bonds formed through play. Furthermore, cooperation has almost always been implemented in combination with interdependence. Without an investigation of cooperation separately from interdependence, we can only make assumptions about the effectiveness of either mechanic.

1.2.2.2. Interdependence

The second theme that emerges in the literature on collaborative play is focused on the level of dependence between players. Interdependence is a term from psychological frameworks on social and group interactions and is commonly defined as the 'degree to which group members must rely on one another to perform their task effectively' [169]. In the context of games, the 'task' can be viewed as the goal players want to achieve within the game. Rocha et al. [160] identify six design patterns in their analysis of popular collaborative games. As already discussed, 'shared goals' and 'synergies between goals' are mechanics emphasizing cooperation. The other four design patterns are: 'complementarity' (specific to roles in the game), 'synergies between abilities', 'abilities that can only be used on another player' and 'special rules for players of the same team.' All of these patterns describe game mechanics that induce dependency, i.e., a need to rely on and interact with the other players [160]. Similarly, in their analysis of the collaborative board game Lord of the Rings, Zagal et al. [208] suggest that 'a collaborative game should bestow different abilities or responsibilities upon the players', emphasizing the importance of interdependent play. Beznosyk et al. [14] distinguish 'closely-coupled' from 'loosely-coupled' casual games and find that closely-coupled games rated higher overall in engagement. Unfortunately, they compare different games with each other, making it hard to distinguish what effects are due to the game and what effects are due to interdependence. Their results suggest however, that interdependence has a positive effect on player experience. Duchenaut and colleagues [49] describe World of Warcraft characters in terms of how '*soloable'* they are, meaning how well one can play the game alone without help. What they describe as 'soloability' is essentially the degree of dependence on other players. Extremely 'soloable' characters (e.g., Hunters) would lead to a less interdependent experience while support, or highly specialized characters (e.g., Priests) that can only be played effectively with others would lead to a highly interdependent play experience. What Duchenaut and colleagues find is that different player choose different levels of interdependence depending on how they want

to play [49].

In the game Zoom [111], each player received one picture they had to describe to the others; the group then had to arrange the order to create a coherent story. The game utilized complementary knowledge to induce dependence between the players. Findings suggested that the game was a viable tool for team building [111]. Similarly, Ellis et al. [52,117] designed the games Castle Builder and the Tower of Babble, which each utilized complementary knowledge in a different way. In Castle Builder, only a few players were familiar with the blueprint of the castle that was supposed to be built. In the Tower of Babble, players were required to utilize perspectives of different viewpoints to ensure the tower was being built straight. In all of these games, players were bound to interact because each member had a piece of information that was required to complete the task. All of these games appeared to have positive effects on the social fabric between the players. Nasir et al. [133,135] created a game called Operation Sting to facilitate team building. Players each had the same knowledge, however, the actions they were able to perform were different for each player, giving them complementary roles (e.g., thief, hacker). Also utilizing complementary roles, Harris et al. [71,73] created the game Beam Me 'Round, Scotty!, a game utilizing 'asymmetric' game mechanics inducing interdependence between players. The experimental design does not compare high interdependence to low interdependence; however, the participants' quotes suggest a positive impact of the interdependence that was experienced. Gerling et al. built two interdependent games to explore social play as an opportunity to connect caregiving dyads [63]. They found that dependence between players appeared to foster communication between the players.

Each of these studies used different games, mechanics and contexts to implement interdependence. The findings suggest, however, that a dependence between players and a necessity to interact and communicate could potentially facilitate social closeness. While these results seem promising, we do not know how high interdependence compares to low interdependence or how it affects social closeness when it is not confounded with cooperation.

Although these examples suggest that cooperation and interdependence can promote social closeness, we cannot compare or contrast the advantages of both mechanics. While we have a rich understanding of different methods and contexts in which playing together facilitates social bonds, we have little guidance on the effects of the underlying mechanics. If we want our academic knowledge of collaborative games to effectively inform game design, we need to understand the different elements that make games effective at reinforcing relationships. In previous studies, cooperation and interdependence have been implemented together. How the two mechanics affect relationships individually is yet unclear. Previous studies have also not systematically evaluated how the mechanics affect social bonds. Are the relationships formed through cooperation different from the relationships formed through competition? Finally, we have no knowledge about how the two mechanics interact. Common wisdom might suggest that both mechanics have to occur together in order to facilitate social closeness. Psychological theories on group work would even suggest that interdependence in combination with competition would elicit hostilities and distrust [98,99]. For game designers to be able to make informed design choices based on research, we need to look beyond the blanket term 'collaboration' and systematically disentangle and evaluate

Interdependence

The concept of task interdependence comes from psychological frameworks on group work and is usually described as the 'degree to which group members must rely on one another to perform their task effectively' [169]. Regarding the formation of trust in relationships, psychological research supports the idea that task interdependence is a requirement. Trust towards another person is only required if that person's actions affect the trustor. A person is only vulnerable to a partner if they can be potentially hurt or helped by that person. Therefore, a context of interdependence is believed to be helpful, and perhaps even necessary for two people to build a trusting relationship [98,163]. According to Social Interdependence Theory [99], if a group or dyad performs a task that is high in interdependence, their need to interact and engage with each other increases. This increased interaction and communication between group members is believed to reinforce the formation and maintenance of social relationships. Social Interference Theory proposes that interdependence in competitive settings would diminish social closeness.

the underlying forces of collaborative play.

1.3. Research Goals

In this dissertation, we try to identify the underlying properties of play that are fostering social ties through games. We aim to identify and systematically evaluate game mechanics that show empirical evidence for increasing social ties between players. Providing evidence-based support for social game mechanics, we can inform the design of 'social games'.

The existing literature has so far only descriptively demonstrated that games can lead to social ties. In order to fully understand social play and how we can design for it, we first need to cover some basic pieces of information. For one, we do not actually know if we can attribute social ties in games to the activity of play itself. For example, it might be just as reasonable to assume that the social ties formed in games are just a function of 'time spent together'. Previous literature did not compare game interventions to non-game interventions. Similarly, most mechanics that have been proposed for social games (e.g., 'roles' [174]) have not been compared against control conditions, making it impossible to assess the efficacy of these mechanics. In order to make assessments about social game mechanics, we need comparisons both to non-game settings as well as comparisons between game mechanics in order to form empirically-founded guidelines on design for social play. Furthermore, identifying game mechanics that lead to stronger social ties between players is only valuable if these in-game social ties are actually meaningful to the players. The debate on how strongly online relationships translate into feelings of social embeddedness and well-being is still ongoing. My research goals are therefore:

1. Identify properties of play that are likely responsible for social ties within digital games.
2. Systematically evaluate the efficacy of these identified properties to make informed design recommendations.
3. Provide insight into the links between these identified properties of play, resulting in-game relationships, and general well-being.

1.4. Overview of this Dissertation

In this section we will briefly summarize how we approached these goals. As we have mentioned,

it is unclear how directly we can attribute social ties in games to the activity of play. Before we can investigate what properties of play are facilitating social ties, we first have to investigate whether or not play in itself is actually responsible for in-game ties. We address this question in our first manuscript, in which we compare a social game to a social icebreaker task. The field of distributed team work has an established body of literature on social interactions in online contexts; we therefore ground our first study in this area to address whether or not a game can outperform a social icebreaker designed for teambuilding. We operationalize the quality of the social ties emerging by measuring how much the participants trust each other after the experience. Our findings demonstrate that the activity of play appears to be, on average, more effective at facilitating trust between strangers than a social icebreaker task. As these finding suggest that play can be inherently conducive to the relationship between players, we then proceeded to the more interesting question: What properties of play are responsible for these social benefits? In manuscript B, we build on the synthesis of design recommendations we presented in the previous section. Out hypothesis is that cooperation and interdependence are two properties of play that facilitate social ties. We systematically evaluate both factors by comparing them to their inverse (cooperation vs. competition, interdependence vs. in-dependence) in two-by-two experimental design. The results of our findings confirm our hypotheses. Cooperation and Interdependence appear to be two factors that increase how much players trust each other after a short game session. Manuscripts A and B address the first two research goals of identifying and evaluating properties of play that are facilitating social ties. To further validate this framework, we change our methodological approach from experimental research to a field study in manuscript C. This change to a cross-sectional field study also allows us to investigate the relationship between in-game relationships and psychological well-being. We find that the degree to which players experience interdependence and toxicity within their game community is highly predictive of their in-game social capital. Interestingly, cooperation does appear to be a meaningful predictor for social capital, contradicting our findings from manuscript B. We further find that in-game social capital is highly associated with reduced feelings of loneliness and increased feelings of relatedness outside of the game, indicating a strong link between in-game relationships and psychological well-being. Finally, we discuss major themes that emerged across the studies conducted for this dissertation.

1.4.1. Contribution to Each Manuscript

Each of the Manuscripts presented in this dissertation was a product of multiple authors. To clarify my personal contribution, I will briefly outline the role I played in each of these projects. I am first author on all three manuscripts, as such I was the lead researcher in these projects. The general topic and the more specific research questions were all identified by me under the supervision of my supervisor Dr. Regan Mandryk who provided helpful feedback on the ideas. Similarly, the experimental and study designs, analysis of data, as well as the writing of the manuscripts was predominantly performed by me with feedback from Dr. Regan Mandryk. Jason Bowey and Shelby Thomson helped build the game 'Labyrinth' which was used in Manuscript A and B. Colby Johansson helped set up the online environment in which all studies were performed. All co-authors were part of editing and proofreading the manuscripts.

2. MANUSCRIPT A: Trust Me: Social Games are Better than Social Icebreakers at Building Trust[1]

2.1. Introduction to Manuscript A

Much of the previous work on the design of social games is rooted in a work and organisational setting [31,52,111,117,133,135], exploring the idea that games can be used as team building interventions aimed at fostering trust between group members. We build on this work and address the lack of comparisons of game interventions to non-game interventions. Many studies find that the games they designed were generally accepted as team building exercises (e.g., [111,117]); however, they never compared the interventions to control groups or any other points of comparisons. While the authors attribute the social ties formed between participants on gameplay, these assumptions are not necessarily warranted. An alternative explanation for the findings could be that simply spending time together and interacting through digital communication fosters social ties between participants. This interpretation of the results would mean that the activity of play has nothing to do with social facilitation. Additionally, it would be interesting to assess how effectively games foster social ties compared to non-game interactions that were also designed to facilitate social ties (e.g., social icebreakers). Due to the lack of control groups in previous literature, we cannot make assertions about the cause for the effectiveness of social games. Therefore, our first approach to systematically investigate social ties in games was to investigate whether or not play itself appeared to be beneficial at all for the formation of social ties. In an effort to build on previous literature, we contextualize this research question in the field of team-building interventions.

2.2. Abstract

Interpersonal trust is one of the key components of efficient teamwork. Research suggests two main

[1] The manuscript in this chapter, reproduced with permission form ACM, was published as:

Depping, A. E., Mandryk, R. L., Johanson, C., Bowey, J. T., & Thomson, S. C. (2016, October). Trust me: social games are better than social icebreakers at building trust. In *Proceedings of the 2016 Annual Symposium on Computer-Human Interaction in Play* (pp. 116-129). ACM.

approaches for trust formation: personal information exchange (e.g., social icebreakers), and creating a context of risk and interdependence (e.g., trust falls). However, because these strategies are difficult to implement in an online setting, trust is more difficult to achieve and preserve in distributed teams. In this paper, we argue that games are an optimal environment for trust formation because they can simulate both risk and interdependence. Results of our online experiment show that a social game can be more effective than a social task at fostering interpersonal trust. Furthermore, trust formation through the game is reliable, but trust depends on several contingencies in the social task. Our work suggests that gameplay interactions do not merely promote impoverished versions of the rich ties formed through conversation; but rather engender genuine social bonds.

2.3. Introduction

The performance of project teams depends on many factors; one of the key factors is the interpersonal trust – the "willingness to be vulnerable based on positive expectations about the actions of others" [125] – that exists between team members [45,163]. Low interpersonal trust in project teams can lead to collaboration problems, including poor decision making, hampered information exchange, increased risk of misunderstandings, and higher personal conflict [45,75]. Higher trust on the other hand, leads to organizations that work more efficiently, and adapt more quickly to changing circumstances [45,210]. For project teams that work in a face-to-face context, there are multiple established methods of facilitating trust development; team-building activities such as social icebreaker games, ropes courses, and even trust falls – part of the quintessential team-building movie montage – have been shown to be effective at facilitating trust development within collocated project teams [105].

Literature suggests two underlying strategies for facilitating trust development. First, developing the feeling that another team member is trustworthy assists with trust development [163,213], and can be scaffolded through personal information exchange [214] and feelings of similarity [56]. Second, the situational context can assist with trust development – situations that involve interdependence and mutual risk promote trust building [82,163]. In collocated teams, both strategies can be employed to facilitate trust formation among team members. For example, social icebreakers enable information exchange and a feeling of similarity, while the trust fall represents

the epitome of risk and interdependence.

However, geographically-distributed project teams are becoming increasingly common, as many knowledge workers are able to telecommute and do not have to live in the city in which they work [145]. The rise of distributed project teams raises the question of how trust development is affected by the online virtual interactions that replace face-to-face communication. Research shows that trust is more difficult to achieve in distributed teams, especially in the initial phases of a project [16,93,94]. Trust develops more slowly in distributed teams [82], and once developed, it is also more fragile and easily damaged [214]. These findings call for effective strategies to facilitate trust development in distributed teams. However, traditional strategies that engender trust formation are difficult to transfer to distributed digital communication. From a purely practical perspective, access to team-building activities is limited when team members are distributed in that the activity itself has to be feasible in an online context. As such, current online trust-building approaches use the strategy of promoting trustworthiness, facilitated through personal information exchange [163]. However, current systems fail to employ the second strategy of promoting risk and interdependence – the online equivalent of ropes courses or trust falls are not available to facilitate trust development in distributed teams.

Considering the various social activities that people already participate in online, we argue that there is potential in multiplayer online games to allow players to experience risk and interdependence in a safe and playful environment, addressing the situational context of trust. While the stakes in a game might not have real-world consequences, the vulnerability that is developed, and the need for cooperation with other team members are real. Given their popularity, capacity to help players feel connected [178,203], and ability to simulate risk and interdependence, there is reason to believe that online multiplayer games can be used to facilitate trust building in distributed project teams. Previous literature has already indicated that groups will accept online multiplayer games as a team-building activity [52,117,134], and also provides design guidelines for collaborative games whose purpose is team building [52,134]. However, previous literature has not evaluated the ability of games to enable trust formation.

Previous literature and theoretical frameworks on trust formation suggest that online games can be a viable alternative to current interventions based on personal information exchange. Our goal was

to determine whether or not a game could compete with a social task at building trust. First we developed an online puzzle-based multiplayer game that employs interdependence and creates risk, and we then determined whether it could build trust between distributed strangers. We also created a social task that promotes personal information exchange and similarity development to represent the standard in online team-building. We compared the game to the social icebreaker task in an online experiment with 34 pairs of strangers conducted through the web browser using voice chat. Our results showed that:

- Overall, our game is more effective than a social task at building trust between distributed strangers.
- Our game is as effective as a social task at facilitating interpersonal interaction, including the development of relational depth, affect, and interpersonal involvement.
- Trust formation in the game is reliable, whereas the efficacy of the social task is contingent on several factors:
  - Personality–the game works equally well for everyone, whereas the social task works less well for individuals low in propensity to trust or agreeableness.
  - Enjoyment of the experience–the game works equally well for everyone regardless of whether or not they enjoyed it; however, the social task does not work well for people who did not enjoy it.
- The efficacy of our game for building trust is also not affected by age, gender, or gaming experience, suggesting that it is an option with broad demographic appeal.

Our work shows that our game not only worked better for trust development than a social task in general, but that trust development in the game was robust to individual personality characteristics, task enjoyment, and interpersonal experience, whereas trust development in the social task was sensitive to these factors. As such, online social games should be considered as an approach to foster trust-building in distributed project teams. The relationships built through gameplay are sometimes considered as impoverished versions of the rich bonds that are created through conversation. We contribute to a growing body of work suggesting that games can facilitate deep and meaningful social bonds.

2.4. Related Literature

We propose that games can be used to facilitate trust development in distributed teams. The increasing technological support for telecommuting along with the dearth of skilled workers in certain fields means that more workplace teams are integrating geographically-remote workers or allowing team members to work from home [145]. Ensuring that distributed members of a team are well integrated is essential for the productivity and well-being of the entire team [45,163]. In this section, we present the arguments about the importance of trust development for distributed teamwork, describe how trust is developed, present technologies (including games) that facilitate trust development, and describe how games are used to foster relationship building.

2.4.1. Why Trust is Important

Interpersonal trust is believed to be one of the key factors influencing the performance and efficiency of both face-to-face and distributed teams [11,21,28,42,62,93,94,153,195,196]. Trust is most commonly defined as a "willingness to be vulnerable based on positive expectations about the actions of others" [125]. When trust is low within a work group, collaboration problems may occur. Low trust is associated with poor decision-making [70,75,163], a lack of sharing relevant information with team members [33,163], a tendency to avoid coordination with team members [77,185], increased misunderstandings, and escalating conflicts [70,75,163]. High trust among team members has been shown to have positive effects on team communication [17,44,47], team identification [126,147,159], negotiations among dyads [104,172], conflict resolution [47,149,210], individual performance [157,159], and team performance [44,45,210].

2.4.2. How Trust is Developed

Russman et al. [163] proposed a model of trust development that can be applied to face-to-face and distributed teams. Following Zolin et al. [213], they distinguish between *trust* and *trustworthiness*. Interpersonal *trust* is conceptualized as a state that determines whether the trustor engages in trusting behavior towards the trustee, whereas trustworthiness is conceptualized as the trustor's perception of how trustworthy the trustee is. Interpersonal trust as a state is determined by the perceived trustworthiness of the trustee [213,214], but also by the characteristics of the trustor (e.g., the inherent propensity to be trusting, mood) [125,162,163,205], and the situational context (e.g.,

perceived risk) [82,118,163,213].

The trust state determines whether the trustor engages in trusting behavior for each interaction. If the consequences of an interaction were positive, perceived trustworthiness of the trustee increases, which impacts the trust state in future interactions [163]. Trust is therefore built through repeated feedback loops of trust state, trusting behavior, and positive consequences. Because of these self-enhancing properties, researchers stress the importance of initial trust building right at the formation of work groups [93,94,163,213,215].

2.4.3. *Trust Development in Distributed Teams*

A large body of research has shown that distributed teams face difficulties in building and sustaining trust [16,93,94,202,214]. These challenges and their effects on interpersonal trust can be summarized in three groups:

First, trust formation works differently when teams are not collocated. Distributed teams tend to have less information about trustworthiness available and fewer chances for personal communication, which leads to assessments of trustworthiness based on stereotypes and generalizations [82,102]. These initial assessments of trustworthiness are harder to change (‘sticky’), and heavily impact interpersonal trust, further stressing the importance of initial trust formation in distributed teams [163,213,214]. Second, interpersonal trust that does get built tends to be more fragile and easily damaged in distributed teams than the more robust trust that is based on an extensive history of shared experiences [16,82,163,202,214]. Third, the overall levels of interpersonal trust and trustworthiness appear to be lower in distributed teams, and team members appear to need higher initial trust to engage in collaborative behaviour [163,213].

2.4.4. Current Methods of Building Trust in Distributed Teams

Trustworthiness. In order to engender trust formation in distributed teams, interventions often aim to compensate for the lack of personal and background knowledge in distributed teams [56,139,163,214]. The goal of these interventions is to enhance the initial assessment of trustworthiness. Team members are sometimes encouraged to *exchange personal information* or supply information on trust warranting properties. The sharing of personal information has been shown to increase the perceived trustworthiness of other group members. This in turn facilitates

trust formation and allows for a more robust and stable trust in distributed teams [163]. Zolin et al. [214] found a positive impact of personal information exchange on perceived trustworthiness, and Feng et al. [56] argue that helping group members to find similarities amongst each other promotes interpersonal trust.

Characteristics of the trustor. Other factors that will influence interpersonal trust are characteristics of the trustor, such as personality traits. Research has shown that there is an *inherent propensity to trust* that determines how easily someone trusts people in general [125,162,205]. While personality plays a role in trust formation, it is not something that can be changed easily. Therefore, trust-building interventions don't generally address this aspect of trust formation; however, the role of individual characteristics has to be acknowledged in trust-building interventions.

Context. The other factor that strongly affects interpersonal trust formation is situational context. Research on context properties shows that two concepts are important to facilitate trust formation: *risk* and *interdependence* [82,163]. Risk can be described as an uncertainty about the outcome of an interaction [163]. Interpersonal trust is required when the trustor has a potential gain or loss through the interaction with the trustee. The higher the stakes, the more trust is needed to compensate the uncertainty. An ideal context will therefore provide an appropriate risk/trust ratio that encourages the trustor to risk cooperatively engaging with the trustee. Because new teams often have low initial trust [163] toward each other, starting with low risks might be recommendable. Interdependence is the extent to which a trustor is dependent on the actions of the trustee [56]. If the actions of another person are irrelevant for the personal outcome of the trustor, then trust is neither necessary nor will it form through the interaction [82,163]. If a context involves risk and high interdependence, the trustor is vulnerable to the actions of the trustee. According to current models of trust formation, this vulnerability, in combination with positive experiences, should lead to an increase in perceived trustworthiness and in turn interpersonal trust [163,213].

To our knowledge, current approaches for trust building in virtual teams ignore contextual factors. Current approaches of information exchange (e.g., personal profiles, group chats) don't encourage team members to be vulnerable towards their team members. We believe collaborative games can be an ideal setting for team members to experience risk and interdependence in a safe and playful environment. While the stakes in games might not have real world consequences, the feeling of

vulnerability and the need for cooperation with other team members are real.

2.4.5. Digital Games as Team Building Exercises

Research has started to investigate whether or not games are a viable form of team building for distributed teams. Research has shown that in-game performance and effort influence how team members feel about their partner [32]. The access to online 3D virtual worlds has inspired studies investigating their potential to support collaborative work. Ellis et al. [52] propose the use of playful group activities in the virtual world *Second Life* to increase cohesion in groups. The study doesn't evaluate the effectiveness of these games to enhance group cohesion or trust, but focuses on the design challenges and frameworks that are relevant when designing games for team building. Lewis, Ellis and Kellogg [117] used a game to investigate leadership behavior. Chat interviews with the groups suggested that games should be considered as a viable team-building intervention. Similar results were shown by Bozanta et al. [111], suggesting that playing a game in a 3D virtual world can have positive effects on group identification and team building.

Nasir et al. [134,135] compared the group interaction of three face-to-face groups that played an icebreaking game before a group exercise to three face-to-face groups that did not interact before the group exercise. Their research indicates that playing an icebreaking game has, for the most part, positive effects on group communication in terms of talking activity, and group member participation. Because of the very low sample size, it is difficult to generalize these results to distributed team building. While these results point to the potential benefits of games as icebreakers in subsequent face-to-face collaborations, it is unclear if their results can be transferred to distributed teams. Furthermore, only the first pilot study [135] compared a game condition with a non-game icebreaker condition. The promising initial results were not verified in the actual study [134].

2.4.5.1. Requirements for Games as Trusts-Development Activities

Together all of these results seem to indicate that games are potentially suitable team-building activities for distributed teams. The current literature also suggests that groups accept games as a viable team building exercise, even in a business context [111]. Previous work has provided solid design guidelines for collaborative games [52,134,135]. These guidelines have partially been derived from literature on educational games and partially derived from qualitative analysis of

collaborative game play. Literature is in agreement that the game should be cooperative in the sense that players should be working towards the same goal, they should be required to come up with communication strategies in order to play successfully, and they should fulfill different roles within the game [52,135]. Keeping theories on trust formation in mind, it becomes evident that these are all game mechanics that enhance the interdependence of the game. Literature also suggests to keep the difficulty low and employ easy to use interfaces [52,135].

Following these guidelines, a game should be an interdependent task that rewards or even requires coordination and cooperation. Players should also have the chance to take risks with other players within the safe space of a playful interaction. The risk of winning or losing in a game has no real life consequences. We therefore think it is optimal to encourage players to take risks despite low initial trust. The artificial vulnerability that cooperative games create could be ideal for players to *rehearse trust* in a playful environment that encourages trusting behavior. We therefore think that games can be used specifically to foster trust in distributed teams. This approach does not involve information exchange to increase perceived trustworthiness and is therefore quite different from current trust-building interventions. In the next section, we describe a study that tested our assumptions and investigated whether a game can compete with the trust-building properties of a task designed for personal information exchange.

2.5. Experiment

2.5.1. Conditions

We conducted an online experiment to explore whether games can facilitate trust development in distributed teams. In our experiment, half of the participants played a game to facilitate trust development. To compare our game to a control condition, the remaining participants completed a social icebreaker task used for developing trust.

2.5.1.1. Labyrinth Game

We created *Labyrinth* (see Figure 1), a networked, cooperative 2-player, asymmetric role puzzle game implemented using the Unity3D game Engine. Labyrinth is played on a tiled board where each tile comprises a piece of a maze (a road through a lake of lava).

Players start on fixed positions within the maze as either the *Pusher* or *Collector*. Moving along

the road, the pair's goal is to enable the Collector to collect all of the gems, which appear at fixed locations around the maze. The Pusher can reconfigure the maze by sliding tiles horizontally or vertically, by holding the Shift key and walking towards a wall to "push" the row or column. To foster coordination and communication (over voice chat) between the players, they can only see the other player character's location on the board if they are close to each other; otherwise the other player is invisible. Four rocks are also scattered across the map for players to use as landmarks when communicating locations [191]. The maze's initial configuration was designed such that players would have to work together to effectively move the rows and columns to collect all of the gems. Players completed 4 rounds of 2 minutes, alternating playing as the Pusher or Collector. After each round the participants were given their score with a grade (bronze, silver, gold, or platinum) to give performance feedback.

The mechanics of the game were specifically designed to satisfy the guidelines for developing trust proposed by literature. Players were working together toward the same goal of collecting all of the gems. They were given different but complementary roles. Communication between the players was necessary to coordinate which path to take, to communicate player location, and to strategize. We made the input straightforward, using only arrow keys and shift. The level design

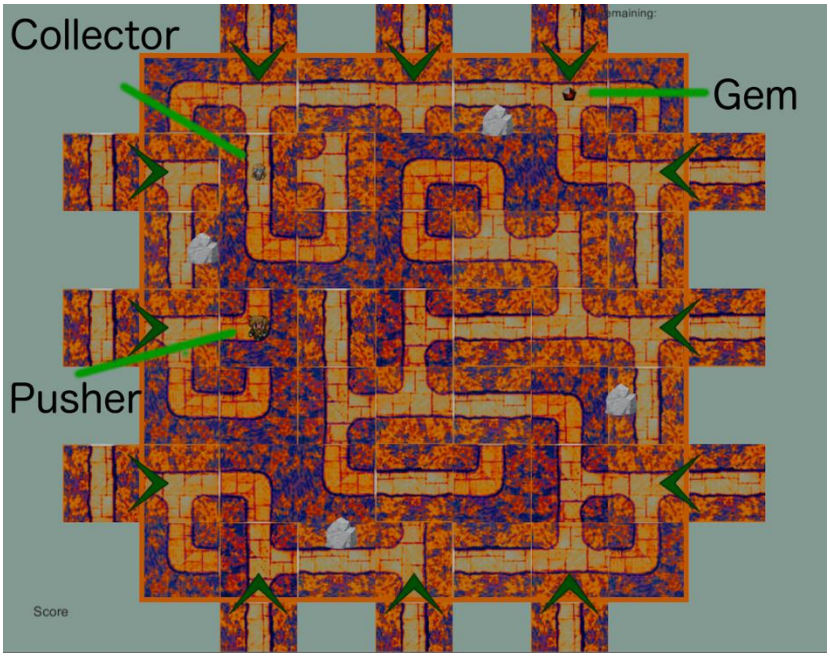


Figure 2.1: Annotated Image of 'Labyrinth'

was simple enough that most gems could be accessed with a single wall push.

2.5.1.2. Social Icebreaker Task

For our non-game control condition, we implemented an online version of a social icebreaker task in Construct 2, using WebRTC for the networking. We designed a set of questions that were presented to both participants and that they were encouraged to ask each other over voice chat. In total, the social task included 30 questions. Participants had to talk for at least 15 seconds after the presentation of a question before they could advance to the next question; this feature was included to ensure that participants did not run out of system-presented content during the duration of the social icebreaker task. They could also dwell on questions for as long as they liked and there were no constraints placed on the content of their conversations.

This social task was designed to stimulate conversation and information exchange. As described in the related literature section, social interaction and exchange of personal information about team members is a current method of developing trust in distributed teams [163]. We created the questions with specific criteria in mind. We did not want participants to feel uncomfortable providing personal information, so we avoided questions that included age, address, or place of work. We also avoided questions about controversial or divisive topics, such as religion or politics.

To support conversational flow, the questions were phrased openly so that participants were encouraged to give longer and more elaborate answers than a simply yes or no answer (e.g., "Where did you grow up?", "If you had a year off with pay, what would you do?", "When you are stressed out, what do you do to relax?"). We tested our icebreaker questions in a pilot study and found that the social task worked well to facilitate communication between distributed strangers online. We also observed reoccurring questions the pilot participants asked and included them in final version. (e.g., "How long have you been working on Mechanical Turk?", "What kind of hits do you usually do?").

2.5.2. Measures

First, we measured interpersonal trust between the participant and their partner as our main outcome measure. Based on literature on interpersonal trust formation, we expected characteristics of the participants to affect trust formation. Therefore, we measured individual propensity to trust and the big five personality dimensions. We were also interested in how the participants perceived the social interaction. We drew from early communication research and distinguished the content of the social interaction from the relational aspects of communication [43,197]: Any given interaction can be analyzed in terms of what it reveals about the relationship between the two participants [43]. Because these are abstract dimensions independent of content, they allow us to compare the two very different tasks in terms of how they impact relational communication. Finally, to understand how trust formation interacts with the experience of the trust development task, we measured how participants experienced the task (game or social task) by including established experience measures from games user research. Unless otherwise mentioned all item responses were measured on a 7-point-Likert scale (full questionnaires can be viewed in the appendix):

Interpersonal Trust: Most scales for interpersonal trust are designed for close romantic relationships [97,114,156]. We selected 5 items from the Rempel trust scale [156] (e.g., *"I could count on my partner to be concerned about my welfare."*), 4 items from the Dyadic Trust scale [114] (e.g., *"I feel that my partner can be counted on to help me."*) and 2 items from the Specific Interpersonal Trust Scale [97] (e.g., *"I could expect my partner to tell the truth."*) to have enough items appropriate for our setting of loose platonic relationships. Our interpersonal trust scale was an internally consistent measurement of trust (Cronbach's α=.922, M=5.46, SD=.93).

Propensity to Trust: We measure general propensity to trust as proposed by Yamagichi [205]. The 6-item questionnaire (Cronbach's α=.859, M=4.94, SD=.93) asks participants to rate statements such as "*Most people are basically honest.".*

Ten-Item Personality Inventory (TIPI): We assessed personality using the TIPI [51]. The questionnaire measures the personality dimensions commonly known as the Big Five [79]: extraversion (M=3.87, SD=1.60), agreeableness (M=5.50, SD=1.20), openness to new experiences (M=5.66, SD=1.19), conscientiousness (M=5.79, SD=1.07) and neuroticism (M=2.52, SD=1.31). As the TIPI uses two-items to measure each subscale Cronbach's α is difficult to interpret. The scale has been shown to be a valid and reliable measurement [51].

Intrinsic Motivation Inventory (IMI): IMI used a 5-point-Likert scale to measures the interest/enjoyment (Cronbach's α=.863, M=4.14, SD=.67), effort/importance (Cronbach's α=714, M=4.44, SD=.48), pressure/tension (Cronbach's α=.857, M=2.43, SD= .93), and perceived competence (Cronbach's α=.926, M=3.42, SD=1.09) felt during a task [127].

Relatedness: We used the relatedness subscale from the Player Experience of Needs Satisfaction (PENS) scale to assess perceived satisfaction of relatedness (Cronbach's α=.649, M=3.71, SD=.68) on a 5-point-Likert scale [167]. The low α can be attributed to the fact that the sub-scale only uses 3 items.

Relational Communication Scale (RCS): We measure relational communication with a selected set of subscales from the RCS [43]. We measure involvement (Cronbach's α=.826, M=5.13, SD=1.26), affect (Cronbach's α=.736, M=48, SD=1.08), similarity/depth (Cronbach's α=.788, M=4.62, SD=1.13), receptivity/trust (Cronbach's α=.79, M=5.70, SD=.87), and formality (two-item scale, M=3.17, SD=1.12).

2.5.3. Participants and Deployment Platform

The study was deployed on Amazon's Mechanical Turk (MTurk) crowdsourcing platform. MTurk connects paid workers to *Human Intelligence Tasks* (HITs) and has been shown to be a reliable research tool [124]. We had 52 pairs of participants in our study; however, one participant left after the task, resulting in 103 participants completing the full study. Participants completed informed consent and were compensated with $2.50 for the 15-20 minute study.

During the deployment of the study, we encountered client-side networking errors that caused technical difficulties for many of our participants (due likely to low-bandwidth connections). We excluded participants from the study if their voice chat did not work or the experimental platform froze. Some of the remaining participants also experienced minor networking issues – particularly in the game condition because it required real-time networking. The debrief comments and the voice chat recordings indicate that these issues clearly impacted the play experience. We will address these shortcomings in the discussion.

2.5.4. Procedure

Participants began with instructions about the expectation that they have a working microphone, they will be recorded, they should be free to interact with a partner for 10 uninterrupted minutes, and that the Unity Web Player plugin was required. Participants completed the trait questionnaires and then proceeded to a matchmaking page that matched people based on the order they arrived. Once participants were matched, the pair was randomly assigned to complete either the icebreaker or labyrinth game task.

The icebreaker started as soon as audio communication was established and both participants pressed a button to indicate they were ready. It lasted 8 minutes. A countdown timer showed for the last 10 seconds of the task before participants were automatically redirected to the remaining questionnaires so that they could say goodbye.

The labyrinth game had a 90-second tutorial video that played before participants were connected to each other. After the video, the audio chat was established and written instructions were also provided. The game began only once it had finished loading for both participants and lasted for 8 minutes. Following the experiment, participants completed the remaining questionnaires and completed a debrief page.

2.6. Data Analyses

We excluded participants for being noncompliant in filling out the questionnaires. We identified non-compliance if participants had zero variance in their answers or spent less than one-second per item on average on our main outcome scale (interpersonal trust). In total, we excluded 36 participants due to the previously-mentioned technical issues and non-compliance, leaving 67

participants: 31 male (age: m = 35.18, SD = 9.65, min = 23, max 64). For more information on the excluded participants see appendix.

To test our hypotheses, we used SPSS to perform multivariate analysis of variance (MANOVA) for comparison of means and multivariate regression analysis to investigate moderating effects. We analyzed our data on the individual level and not dependent on pair membership. For all subsequent analyses, we ran a post-hoc power analysis using G-Power. Given our sample size of 67, an α set to 0.05, and estimated small effect sizes (f = 0.10), our statistical power was above 0.90 thereby allowing us to assume the null hypothesis when no significant differences were found [54]. Assumptions of equality of covariance matrices, normality, and absence of multicollinearity are met (for details see appendix).

2.7. Results

Of 67 remaining participants, 35 experienced the social task and 32 the game. The difficulties experienced while playing the game led to some teams performing rather poorly during the game. Over all four rounds, teams collected on average 15.65 gems (SD = 6.97; min = 7, max = 30). Because poor performance could potentially influence trust formation, we median split teams into high and low performing teams and compared their interpersonal trust scores using ANOVA: there was no effect of performance on trust formation ($F=.965$, $p<.334$, $\eta^2=.03$).

2.7.1. Q1 Does the Game Work Better than the Social Task at Building Interpersonal Trust?

To determine the effects of task on trust development, we conducted a MANOVA with task (social, game) as a between-subjects factor on trust development, on establishing relational communication, and on generating satisfaction of relatedness. The MANOVA revealed an overall significant effect of task ($F1,29=6.76$, $p<.001$, $\eta2=.45$); we investigate each measure in the following sections.

2.7.1.1. Building Trust

The MANOVA revealed a significant effect of task on trust development ($F_{1,65}=13.5$, $p<.001$, $\eta^2=.17$), showing that the game was significantly better at supporting trust development than the

social task (see Figure 2).

2.7.1.2. Relational Communication

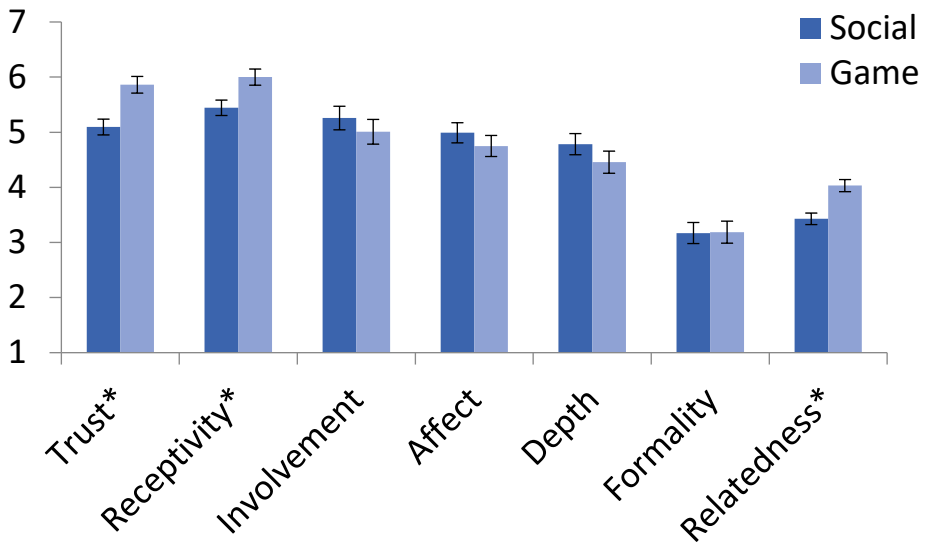
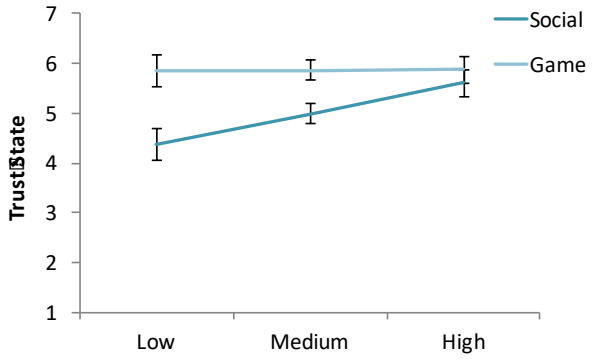


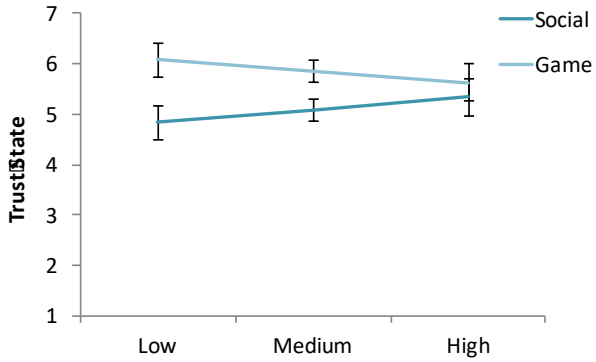
Figure 2.2: Main effects of condition on interpersonal trust, relational communication, and task experience. ('' = $p < .05$)*

The MANOVA revealed a significant effect of task on the receptivity and trust subscale of the relational communication scale ($F_{1,65}$=7.51, p=.008, η^2=.10), showing that the game produced greater receptivity than the social task (see Figure 2). The receptivity subscale measures an individual's perception of the sincerity, honesty, openness, and willingness to listen of their partner.

There was no difference between the game and social task on involvement ($F_{1,65}$=0.65, p=.424) – which measures an individual's perception of the enthusiasm and interest of their partner, affect ($F_{1,65}$=.81, p=.371) – the warmth and closeness of their partner, depth ($F_{1,65}$=1.4, p=.244) – the friendliness, similarity, depth of conversation, and desire for further communication of their partner, or formality ($F_{1,65}$=.003, p=.954) – how casual/formal they perceived their partner to be (Figure 2).

Although the social task was comprised of sharing personal information – whereas the game was comprised of enacting cooperative and interdependent game mechanics – there was no advantage of the social task in any aspects of relational communication.





2.7.1.3. Relatedness and Experience

The MANOVA revealed a significant effect of task on perceived relatedness ($F_{1,65}$=15.6, p<.001,

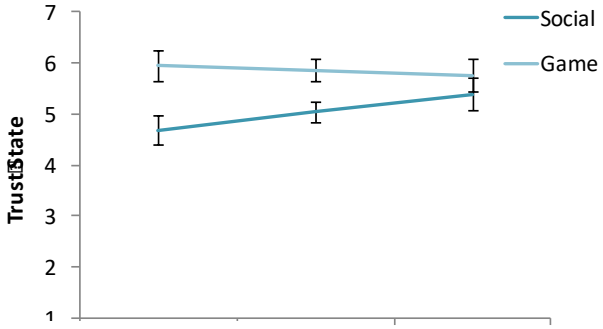


Figure 2.3: Interaction of condition with propensity to trust (Low, Medium, High) on interpersonal trust.

f condition with agreeableness (Low, Medium, High) on interpersonal trust.

η^2=.19), showing that the game was significantly better at satisfying the psychological need for relatedness than the social task (see Figure 2). There were also significant differences for perceived competence ($F_{1,65}$=53.30, p<.000, η^2=.45), and tension ($F_{1,65}$=6.57, p<.01, η^2=.09). Perceived competence was higher in the social task and perceived tension was higher in the game. We partially attribute these results to the technical difficulties during gameplay, but also to the fact that a conversation in our context is a familiar task with low pressure. The other task experience measures showed no differences: interest/enjoyment ($F_{1,65}$=2.56, p<.114, η^2=.04), and effort

Figure 2.5: Interaction of condition with enjoyment (Low, Medium, High) on interpersonal trust.

($F_{1,65}$=2.56, p<.114, η^2=.00).

2.7.2. Q2. Does the Efficacy of the Conditions Depend on Individual Characteristics?

We showed that the game works better than the social task overall at building trust amongst distributed strangers (Q1) We further investigated whether the efficacy of games was dependent on demographic variables (e.g., gamers, women) or particular traits (e.g., extroverts, people who are inherently trusting) as is suggested by literature of trust formation [163]. To investigate the role of the continuous demographic factors, we conducted moderated regressions in which we investigated whether the prediction of trust by task (game, social task) was moderated by the demographic or personality factor of interest (see Data Analyses section).

In each of the regressions, task (game or social) significantly predicts trust; however, the role of the moderating factor varies. To investigate the role of the categorical demographic factors (i.e., gender and gaming experience), we conducted univariate analysis of variance.

2.7.2.1. Age

The moderated regression shows that task (game or social) predicts trust (β=.75, p<.001). However, age does not predict trust (β=.01, p=.284), nor does it moderate the effect of task on trust (p=.265).

2.7.2.2. Gender

To investigate the effect of gender on trust, we conducted a univariate analysis of variance (ANOVA) with gender (male, female) and task (game, social) as two between-subjects factors; because gender was collected as a categorical and not continuous variable, we could not conduct a moderated regression (note that although we provided other options, participants all answered either male or female). The ANOVA shows a significant main effect of task (game or social) on trust ($F_{1,63}$=11.8, p=.001, η^2=.16). Although we also see a significant main effect of gender on trust ($F_{1,63}$=4.84, p=.031, η^2=.07), it does not interact with task ($F_{1,63}$=0.44, p=.511). The main effect of gender shows that women (N=36, mean =5.70, SD=0.74) develop more trust than men (N=31, mean=5.18, SD = 1.06) in our sample.

2.7.2.3. Gaming Experience

Gaming experience was collected using an ordinal scale (from not at all through to every day). We divided participants into two groups – those who played multiple times per week or more (N=45) and those who played once per week or less (N=22). We conducted a univariate ANOVA with

gaming experience and task as two between-subjects factors. As expected, the ANOVA shows a significant main effect of task (game or social) on trust ($F_{1,63}$=15.8, p<.001, η^2=.20). There was no main effect of gaming experience on trust ($F_{1,63}$=0.99, p=.324); however, there was a marginally significant interaction with task ($F_{1,63}$=3.74, p=.057, η^2=.06). The interaction showed that the game was significantly better than the social task at generating trust for people with less gaming experience (p=.001), but only marginally better for people with more experience (p=.078).

2.7.2.4. Propensity to Trust

We conducted a moderated regression with task (game, social) as the predictor of trust state, moderated by an individual's propensity to trust (trait). As expected, task significantly predicted trust development (β=.878, p<.001). General propensity to trust also significantly predicted trust development (β=.348, p=.004). In addition, propensity to trust moderated the effect of task on trust development (p=.009). As Figure 3 shows, for people with low (p<.001) or medium (p<.001) propensity to trust, the social task performed significantly worse than the game; however, for people high in propensity to trust, the social task did not perform worse than the game (p=.294). In other words, the game works equally well for people regardless of their general propensity to trust; however, the efficacy of the social task declines with an individual's propensity to trust.

2.7.2.5. Personality

We conducted five moderated regressions – one for each of the big five personality factors. As expected, in each case, task predicted trust. However, personality was not a significant predictor of trust: Extraversion (β<.001, p=.999), Agreeableness (β=.022, p=.846), Conscientiousness (β=.076, p=.481), Neuroticism (β=-.040, p=.653), and Openness (β=-.076, p=.526). In addition, Extraversion (p=.254), Conscientiousness (p=.433), Neuroticism (p=.653), and Openness (p=.805) did not moderate the prediction of trust. Agreeableness marginally moderated the effect of task on trust development (p=.079). Similar to the effect of propensity to trust, for people with low (p<.001) or medium (p<.001) agreeableness, the social task performed significantly worse than the game; however, for people high in agreeableness, the social task did not perform significantly worse than the game (p=.426) (see Figure 4).

2.7.3. Q3. Does the Efficacy of the Conditions Depend on the Experience During the Task?

In addition to investigating whether the effect of task on trust development was affected by demographic factors, we wondered whether or not trust depended on the participants' experience of the task. To investigate the role of task experience, we conducted moderated regressions in which we investigated whether the prediction of trust by task (game, social task) was moderated by experience as measured by the intrinsic motivation inventory, which measures experienced enjoyment, invested effort, perceived competence, and experienced pressure. In each of the regressions, task (game or social) significantly predicts trust; however, the role of the moderating factor varies.

2.7.3.1. Enjoyment

We conducted a moderated regression with task (game, social) as the predictor of trust state, moderated by an individual's experienced enjoyment of the task. As expected, task significantly predicted trust development (β=.812, $p<.001$). Experienced enjoyment did not directly predict trust development (β=.201, p=.207); however, enjoyment did moderate the effect of task on trust development (p=.040). As Figure 5 shows, for people who experienced low ($p<.001$) or medium ($p<.001$) enjoyment, the social task performed significantly worse than the game; however, for people with high enjoyment, the social task did not perform significantly worse than the game (p=.233). In other words, the game works equally well for people regardless of their experienced enjoyment of it; however, the efficacy of the social task declines with a decline in experienced enjoyment.

2.7.3.2. Invested Effort

The moderated regression shows that task predicts trust (β=.76, $p<.001$), as expected. However, invested effort does not predict trust (β=.243, p=.279), nor does it moderate the effect of task on trust (p=.799).

2.7.3.3. Perceived Competence

Perceived competence does not predict trust (β=.253, p=.076), nor does it moderate the effect of task on trust (p=.187).

2.7.3.4. Experienced Tension

Experienced tension does predict trust (β=-.342, p=.002), showing that increases in experienced tension decrease the development of trust. However, tension does not moderate the effect of task on trust (p=.349).

2.7.4. Q4. Does the Efficacy of the Conditions Depend on the Interpersonal Experience?

The efficacy of the social task was sensitive to task experience, whereas the game was not. We were also interested in whether the efficacy of the tasks might be sensitive to the relationship developed. As such, we conducted moderated regressions of task on trust development with experienced relational communication (i.e., receptivity, involvement, affect, depth, and formality) as moderators.

As expected, task predicted trust development in all cases. In addition, all aspects of relational communication except formality (β=.059, p=.628) also predicted trust development (Receptivity: β=.286, p=.003; Involvement: β=.513, p<.001; Affect: β=.276, p=.012; Depth: β=.335, p<.001). This suggests that relational communication is an important factor for interpersonal trust formation. However, none of the interpersonal relationship factors moderated the effect of the task on trust development (Receptivity: p=.739; Involvement: p=548; Affect: p=.958; Depth: p=.286; Formality: p=.778). The effect of task on trust is therefore independent of relational communication.

As mentioned above, relational communication did not change based on our conditions (except for receptivity, which increased as a result of playing the game).

2.8. Discussion

We summarize our results, explain why the game works so well at facilitating trust, and discuss the implications of our findings in the broader context of games and interaction.

2.8.1. Summary of Results

The goal of this study was to investigate whether or not games are a legitimate option for fostering interpersonal trust in distributed teams. We compared a multiplayer cooperative game to a social task that was designed to facilitate casual conversation and personal information exchange – a strategy proposed by current literature on trust formation. Although both solutions helped to

facilitate trust formation, our game appeared to be more effective than our social task. This was not only true for interpersonal trust but also for how much the task satisfied relational needs and how receptive/trusting the partner was perceived to be.

A closer look at our results gives us an understanding of why a game is overall more effective than a social task. Under ideal conditions, our social task was as effective as our game for facilitating interpersonal trust. However, the effectiveness of our social task was sensitive to characteristics of the trustor as well as to the experience of the task, suggesting that when a team member is inherently less inclined to be trusting or doesn't enjoy social tasks, their ability to foster trust may break down. A similar trend was seen in the personality trait of agreeableness, which measures how socially harmonious people are. The notion that interpersonal trust formation is affected by characteristics of the trustor is coherent with literature on interpersonal trust [82,163,205]. Our results let us conclude that personal information exchange *can* be very effective at fostering trust; however, its effectiveness is fragile and dependent on circumstance. In contrast to this fragility, the game's ability to foster trust was robust to these factors.

The effectiveness of our game was unchanged by any of the measurements we collected in this study. The inherent propensity to trust, enjoyment of the game, or agreeableness did not affect its power to make people feel safe with one another. The effectiveness of the game was also not compromised by age or gender. Although there was a marginally-significant interaction with game play frequency, the results showed that the game was better than the social task for both frequent gamers and less-frequent gamers, but the magnitude of the difference was weaker for game enthusiasts, suggesting that games are a viable option for all demographics and levels of experience in games. These results suggest that games such as ours are the more reliable form of fostering trust among team members.

Equally interesting are the constructs that weren't changed by the task. We compared pairs that were talking about each other's preferences and personalities with pairs that talked about where to go on a game board or which tile to push. However, we did not observe any differences in involvement, affect, depth, and formality. This is consistent with literature on relational communication, which suggests that the content of a conversation is distinct from its emotional and relational components [43,197]. The results suggest that a game is as effective at fostering a

relational connection between two people as a social conversation.

2.8.2. Why Does the Game Work?

The results clearly indicate that a game has the power to facilitate interpersonal trust between players. Considering that the conversations in these games were without any meaning or consequence to the players' lives, these results may seem surprising. One might argue that the interaction that occurs between players in online games might be considered as an impoverished form of communication, and as a result, online games should not be effective at facilitating trust development. Unless games are intentionally designed to promote personal information exchange or similarity development through their mechanics, the limited amount of conversation that does occur will generally be about events in the game. We now explore the idea that a game is in fact a legitimate social interaction that can be optimal for trust formation. In particular, we focus on two components of play: the game's ability to simulate risk and interdependence, and the idea of game moves as conversational turns.

2.8.2.1. Simulating Risk and Interdependence

As described above, the formation of trust requires an appropriate amount of risk (i.e., consistent with the current level of trust between the individuals) and interdependence between two partners. A game is an artificial environment that can be designed specifically to create interdependence. Following existing frameworks on collaborative game design [52,135], we implemented mechanics like asymmetrical roles and the need for information exchange (e.g., position on the board) to induce interdependence between the players. In terms of risk, poor performance in the game had no real life consequences for the players. Because the stakes were artificial, the risk was relatively low, thereby ideal for initial trust formation between strangers who have no existing interpersonal trust. The conditions we created in our game therefore allow players to *rehearse* or *perform* cooperation and trusting behavior. These activity-based interactions build a relational connection through experiences, rather than through shared knowledge or similarities.

2.8.2.2. Game Moves as Conversational Turns

Although not explicitly about trust formation, similar patterns of relationship building to ours have been observed in Internet play rooms [128], MUDs [131], and virtual reality games [20]. In these

examples, players didn't communicate explicitly about non-game content; however, they still created social bonds. McEwan et al. [128] argue that moves within the game "*are legitimate forms of human contact which create a shared experience through an (albeit stylized) form of human interaction*". The notion that players can communicate nonverbally through the game is reflected in our recordings of the game sessions. Players would sometimes suddenly say "Good Idea!" or "Ah, now I get it" without the other player having proposed anything, clearly responding to a nonverbal game move. The game adds richness to computer-mediated communication by allowing for extra channels of communication (i.e., game moves as conversational turns). Our results suggest that these interactions create relational bonds between players that are as strong as those created through explicit verbal conversation.

2.8.2.3. Fragility of Conversation vs. Robustness of Games

We showed that the effect of social conversation on interpersonal trust is fragile because it is vulnerable to personality and enjoyment of the conversation. Games appear to be robust against these contingencies. We believe the reason for this robustness is due to the activity-based nature of social interaction within games. Based on literature on trust formation, personal information exchange facilitates trust because this information is *trust warranting* and highlights similarities between partners. These effects are however dependent on the content of the interaction. If the information exchanged is not trust warranting or only highlights differences between the partners, the interaction is not likely to facilitate trust formation. Some partners might not want to exchange information because they are generally more private or don't enjoy these kinds of interactions. In contrast, the social interactions in games are independent of content or explicit communication. Relational bonds are formed through action and game-related communication. These activity-based interactions appear to foster relational bonds between partners as well as personal communication, while being free of the contingencies that content-based interactions depend on.

2.8.2.4. What should be Said About the Properties of the Game

Our game was strongly affected by networking issues, which made the game more frustrating and difficult than we expected. This is reflected in the results. Performance in terms of gems collected was lower than we expected, and participants in the game condition scored low on competence and high on tension. Comments from the debrief as well as the recordings of the game session confirm

that many participants experienced a frustrating, 'buggy' game, rather than the playful experience we intended. The results of this study have to be interpreted with this in mind. Nevertheless, our results showed strong effects that support arguments for the effectiveness of our game. Submitted comments and the recorded conversations indicated that dealing with a 'buggy' game made the players bond over how frustrating and challenging the game was. Literature suggests that frustration in games can have positive consequences on player experience [64]. Our results show that performance, perceived competence, and enjoyment don't impact trust formation directly, supporting at least the assumption that the game doesn't have to be 'fun' or satisfy competence to facilitate trust. Social identity theory suggests that creating an 'out-group', which can be considered the common enemy, strengthens the cohesion of the 'in-group' [184] – in our case, the players can be considered as the in-group and the game system as the out-group. Alternatively, the frustration might have hampered an otherwise even more effective trust building intervention. Based on previous frameworks for team building games [52,135], frustration and poor usability should be avoided. The results support the assumption that increased tension inhibits trust formation. The role of frustration on trust formation in team building games is an interesting area of future research.

2.8.3. Design Implications

Our results suggest that online multiplayer games should be considered as a potential team-building activity to facilitate trust formation in distributed project teams; however, there are implications to other collaborative relationships and to aspects of interpersonal relationships beyond trust.

Games have long been used as a means of supporting social interaction. Family board game nights, tabletop gaming in board game stores, or weekly bridge meet-ups among friends can help us satisfy our psychological need for relatedness [167] and create shared experiences that draw us closer [63,78]. Online multiplayer games have the additional advantage of allowing distributed friends and families to maintain a connection—for example, people enhancing their friendship through play of social network games [203] or seniors playing online poker together to stay connected [178]. Trust is not just important in distributed project teams, but is valuable in many types of relationships. Consider, for example, an online dating site. Users who are matched chat via text to get to know one another before deciding whether or not to meet for a date. Our results suggest that playing an online game together might help potential couples to develop a trusting bond or to

develop positive relational communication patterns. Or consider families who are geographically separated from one another. Playing a networked game may help develop that trusting bond between, for example, a grandparent and their grandchild who lives in a different part of the world. Future work is needed to determine whether our results can be applied into contexts beyond distributed project teams.

2.8.4. Limitations and Future Work

Although our results strongly suggest the potential of games as trust-building activities, there are limitations in our study that should be addressed in future work. First we have to acknowledge the already discussed technical problems and the effects on our manipulations. The potential influence of in-game frustration on our results and the question of how well a non-frustrating game could facilitate interpersonal trust should be investigated. Second, we treated participants as individuals, when they were part of a dyad, and therefore not entirely independent. This also prevented us from investigating the effects of matchmaking. An interesting direction for future research would be to investigate the effect of team constellations (e.g., same sex vs. mixed dyads). Third, our method for measuring trust was a modified scale. Even though its metric properties made it a viable measure for trust, future research should try a more multi-methodological approach to measuring trust. Other studies investigating trust have, for example, implemented social dilemmas based on game theory to measure trust behaviorally [16,152]. Using these methods, it is possible to make assumptions about the fragility of trust, which is suggested to be a problem in distributed teams [16,156]. Future research could investigate the effect of games on the ‘thickness or fragility’ of trust compared to social tasks. Fourth, our results must be generalized with caution. Effects we found in this study might be specific to the mechanics implemented in our labyrinth game. Further research should investigate the effects of other games containing different game mechanics and narrative elements. Fifth, we attribute the results of this study to the game in general. Our findings raise the follow-up question of which mechanics or properties of the game specifically caused our results. Future research should further investigate what properties of the game (e.g., cooperation, interdependence, risk, frustration, playfulness) were the cause of our results. Lastly, we investigated dyads. While using dyads to investigate small group dynamics is a viable research method, future research should aim to investigate the effects of a game in bigger teams. We further

only assume that each individual is its own data point instead of investigating the dyad as our unit of analysis. We did not control for or include possible hieratical effects of dyad membership which might have affected our statistical analysis.

2.9. Conclusions

Based on current literature on trust development, we proposed that context factors like risk and interdependence could facilitate trust formation in distributed teams. We argued that games are an optimal medium to induce an appropriate amount of risk and a need for interdependent interaction between team members. In this paper, we showed that a game designed with these properties in mind could compete with a social task that was designed to facilitate trust through personal information exchange. In fact, it was better at facilitating trust than the social task. Our game was also as good as the social task in promoting relational communication between the partners in terms how involved or affectionate they perceived one another. These results support the notion that interactions in games, while being focused on the game itself, are as efficient at facilitating social bonds as social conversations. Our findings also suggest an explanation as to why games were better at fostering trust than the social task. Under optimal conditions, the conversations in the social task could effectively bring participants closer together. However, the efficacy of the conversation was vulnerable to a set of contingencies, whereas our game facilitated trust regardless of age, gender, personality, or experience. We conclude that games are simply more robust against factors that threaten the efficacy of social icebreakers.

The relationships built through gameplay are sometimes considered as impoverished versions of the rich bonds that are created through conversation. We contribute to a growing body of work recognizing the ability of games to shape and foster online social relationships, facilitating the development of deep and meaningful social bonds.

2.10. ACKNOWLEDGMENTS

Thanks to NSERC for funding, our participants, and the Interaction Lab for feedback. Thanks also to Sigrid, Horst, Miriam and Anna.

3. MANUSCRIPT B: Cooperation and Interdependence: How Multiplayer Games Increase Social Closeness[2]

3.1. Introduction to Manuscript B

The results from study one lay the groundwork for my research as we can now more confidently assume that digital games can foster social ties between players. The more interesting question we can now address is: 'How?', moving to the original question that drives my research: *What are the properties of play responsible for social ties between players?*

As described in the introduction, we can draw from an incredibly diverse set of previous work that has implemented games to jumpstart online relationships. In our review of this literature, we have already argued that the mechanics that have been so far proposed (e.g., 'complementary roles' [52,174], synergies between goals'[160], 'asymmetric knowledge' [71,73]) can be synthesized into two overarching mechanics: cooperation and interdependence. Unfortunately, we know very little about how these mechanics actually affect social ties between the players for two reasons: first, neither cooperation nor interdependence has been systematically compared to their inverse (i.e., competition, independence). We therefore do not know if cooperation is actually necessary as a mechanic for social play or by how much it increases the social component compared to competitive games. The same can be said about interdependence and 'independence'. Second, both mechanics have so far mostly been used in tandem (e.g., [14,52,71,111]) making it impossible to confidently attribute any social effects on either one of the mechanics. To further our understanding of social game design, we need to disentangle the mechanics and systematically evaluate them separately.

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[2] The manuscript in this chapter, reproduced with permission form ACM, was published as:

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3.2. Abstract

Games have long been used as a bonding activity; however, research on establishing and maintaining social closeness through games uses different terms, different mechanics and controls, and different contexts of use. As a result, designers have little guidance on which multiplayer game mechanics are most effective. We summarize literature on game design for social closeness into a framework with two collaborative mechanics: cooperation and interdependence. We then created four versions of an online game to independently test the effects of these game mechanics on relationship formation between paired online strangers, showing that cooperation and interdependence are two distinct factors that both can be used to improve play experience and increase social bonds. Additionally, we unpack the effect of interdependence, showing that the improved social closeness can be explained by the increase in conversational turns.

3.3. Introduction

Games have long been used to support social interaction: family board game nights, tabletop gaming in board game stores, and weekly poker games among friends can help us satisfy our need for relatedness [166,167] and create shared experiences that draw us closer together. Digital games are increasingly being employed to help form and maintain social relationships, with the additional advantage of assisting distributed friends and families to maintain social connections – for example, people enhance their friendship through playing social network games [203], seniors play online poker together to stay connected [178], and kids with mobility disabilities connect through online multiplayer games [78]. The Entertainment Software Association (ESA) reports that in 2016, the majority of gamers played in multiplayer mode at least weekly because they felt that video games help them connect with friends [53]. Multiplayer co-op modes are becoming increasingly common in games [129,143] and people are playing games online with both friends and strangers [53].

Research on facilitating social closeness through games suggests that multiplayer game mechanics can be used to build or strengthen relationships in various contexts. For example, in the context of supporting people with different game preferences and abilities (e.g., grandparents playing with grandchildren), Harris et al. [74] explore asymmetric games that embrace and cater to differences between players, but maintain tightly-coupled social interactions. Investigating the context of supporting distributed work teams, Depping et al. [37] show that playing a cooperative

interdependent digital game can facilitate trust formation between two strangers online. And in the context of family members with caring responsibilities, Gerling et al. [63] show that playing a motion-based game with cooperative, closely-coupled game mechanics can help caregivers bond with an older adult who has motor impairments.

Although these examples all demonstrate the benefits of multiplayer game mechanics for establishing or reinforcing social closeness, we cannot compare or contrast the advantages of the different approaches taken by the different research teams. Each project uses different terms for the multiplayer aspects (e.g., asymmetry vs. complementarity), different game mechanics and controls (e.g., a shooting mechanic in a motion-controlled game vs. a puzzle mechanic in a mouse-based game), and different contexts of use (e.g., supporting existing familial relationships vs. building new work relationships). These differences mean that game designers or researchers who wish to leverage multiplayer game mechanics to facilitate social relationships have little guidance on which mechanics or approaches to choose to implement for optimizing social closeness.

In this paper, we systematically explore how multiplayer game mechanics facilitate social closeness among dyads of strangers. First, based on a literature review of multiplayer game mechanics for relationship formation and maintenance, we establish cooperation and interdependence as two distinct multiplayer game mechanics that have been successfully employed. Second, we designed a game to investigate the efficacy of these two mechanics separately and in combination, but with all other structural elements of the game remaining consistent. Third, we conducted an experiment with dyads of strangers to determine how the mechanics affect the social relationship that results from playing together. Our results show the following:

- Collaboration and interdependence are two distinct mechanics that separately influence *game enjoyment and experienced relatedness* during play.
- Similarly, collaboration and interdependence are two distinct mechanics that separately and significantly influence the *experienced social closeness* as a result of play. Furthermore, they do not interact with each other.
- We additionally determine a primary mechanism through which interdependence works – the number of conversational turns between players fully mediated the prediction of interdependence on resulting social closeness.

Fourth, we explain our results and turn to theories of interpersonal interaction to describe why these two mechanics facilitate social closeness. And finally, we discuss the implications of our results for the design of games to establish and facilitate social closeness.

Social games have the potential to help form new relationships and strengthen existing ones. We contribute to the growing body of literature that aims to understand the potential of games to strengthen the bonds between people.

3.4. Related Literature

We reviewed literature on the benefits of multiplayer game mechanics for establishing or reinforcing social closeness.

3.4.1. Scope of Literature Review

To scope the review, we were specifically interested in including previous work that satisfied three conditions:

First, the primary goal of the research should be promoting or understanding social closeness, rather than it being a secondary benefit that "came for free" along with the main goal of interest. For example, we do not include multiplayer exergames in which the goal was to leverage social pressure to improve exercise adherence (e.g., [144]), or papers in which communication is more productive when using game interfaces that support simultaneous interaction (e.g., [173]).

Second, the research should be focused on games as a tool of intervention, rather than an ethnographic study of how playing games can bring people closer together. For example, we do not include work that examines how playing online games, such as World of Warcraft, helps people make friends (e.g., [27,186]) and build social capital (e.g., [212]).

Third, the research should have either built and evaluated, or analyzed collaborative games, as opposed to other forms of technology that promote social closeness. For example, we do not include in our review work on how domestic video technologies can be used to bring families together (e.g., [100,101]), how adolescents can engage in playful activities over videochat interfaces (e.g., [207]), or how grandparents can read to their kids over a distance (e.g., [6]).

Although there are important results that we draw from each of these out-of-scope areas, our intent

in the systematic review was to synthesize the literature on collaborative game mechanics that facilitate social closeness.

3.4.1.1. Goal of Literature Review

As noted in the introduction, researchers that investigate the effects of collaborative play on social closeness have implemented different mechanics with different goals and have used different terminologies. For example, Harris et al. investigated "asymmetric" game mechanics in the context of intergenerational play in the game *Beam Me 'Round, Scotty!* [71,72,74]. Beznosyk et al. investigate "closely-coupled" play in the context of six casual games using six different mechanics [14]. Rocha et al. identify collaborative design patterns like "complementarity" and "synergies between abilities" in an analysis of existing collaborative games [161].

Our primary goal was therefore to identify the commonalities between all of these implementations so that we could identify the abstract overarching patterns that connect the existing approaches. The three aforementioned examples might use very different mechanics in very different contexts; however, what they have in common is the goal of inducing a dependency between players. Based on our review of the literature on collaborative game mechanics and their potential to facilitate social bonds, we identified two overarching mechanics: cooperation and interdependence. In the next sections, we use these two dimensions to review existing literature on social closeness through play.

3.4.2. Cooperation

The most prevalent idea in the literature on collaborative play is the notion of players working towards the same goal. This stands in contrast to competitive play in which players have separate or in its most extreme, opposing goals. Rocha et al. [161] identify "shared goals" and "synergy between goals" as essential design pattern in collaborative play. The "synergy between goals" pattern acknowledges that collaboration does not necessarily mean complete cooperation. It is possible for players to simultaneously pursue individual goals (leveling up one's own character) and group goals (making sure the group wins). Zagal et al. [209] describe this phenomenon as the tension between 'individual utility' and 'group utility'. Another way of thinking about cooperation is by examining conflict. Definitions of 'games', as well as design guidelines, emphasize the important of conflict [61]. Competitive and cooperative games differ in where conflict originates.

Competitive games pitch players against each other and the conflict lies between the players. In cooperative games, players team up to overcome obstacles and challenges (e.g., limited time or resources) and the conflict originates between the players and the system or other groups.

The virtue of cooperation in the context of facilitating social bonds seems obvious and a matter or common sense and is often included in design frameworks [13,95]. It is therefore not surprising that every study we reviewed implicitly assumes cooperation to be the superior mechanic for facilitating social bonds. Seif El-Nasr et al. [174] investigated cooperative games like *Little Big Planet* or *Rock Band 2* to identify cooperative performance metrics. Depping et al. [37] investigated the trust facilitating properties of a cooperative puzzle game in the context of distributed teams. A number of cooperative 3D environment puzzle games have been found to effectively promote team building [52,111,117]. In the game *Operation Sting*, players share the goal of successfully performing a heist together [134,135]. Researchers found the game to have a positive effect on the social fabric of the group [134,135]. Only one study investigating the effect of a collaborative game on the players' perception of each other actually built a competitive version of the game [32]. Unfortunately, a direct comparison between cooperation and competition was not reported. The authors do, however, suggest that competition diminishes the extent to which players relate game outcomes to liking for their partner in a game [32].

The idea that games should be cooperative if they are to facilitate social closeness appears to be an assumption made by researchers and designers. Unfortunately, there has not been a direct comparison between cooperation and competition regarding their individual effects on the social bonds formed through play. Furthermore, cooperation has almost always been implemented in combination with interdependence. Without an investigation of cooperation separately from interdependence, we can only make assumptions about the effectiveness of either mechanic.

3.4.3. Interdependence

The second theme that emerges in the literature on collaborative play is focused on the level of dependence between players. Interdependence is a term from psychological frameworks on social and group interactions and is commonly defined as the 'degree to which group members must rely on one another to perform their task effectively' [169]. In the context of games, the 'task' can be viewed as the goal players want to achieve within the game. Rocha et al. [161] identify six design

patterns in their analysis of popular collaborative games. As already discussed, ‘shared goals’ and ‘synergies between goals’ are mechanics emphasizing cooperation. The other four design patterns are: ‘complementarity’ (specific to roles in the game), ‘synergies between abilities’, ‘abilities that can only be used on another player’ and ‘special rules for players of the same team.’ All of these patterns describe game mechanics that induce dependency, i.e., a need to rely on and interact with the other players [161]. Similarly, in their analysis of the collaborative board game *Lord of the Rings*, Zagal et al. [209] suggest that ‘a collaborative game should bestow different abilities or responsibilities upon the players’, emphasizing the importance of interdependent play. Beznosyk et al. [14] distinguish ‘closely-coupled’ from ‘loosely-coupled’ casual games and find that closely-coupled games rated higher overall in engagement. Unfortunately, they compare different games with each other, making it hard to distinguish what effects are due to the game and what effects are due to interdependence. Their results suggest however, that interdependence has a positive effect on player experience.

In the game *Zoom* [111], each player received one picture they had to describe to the others; the group then had to arrange the order to create a coherent story. The game utilized complementary knowledge to induce dependence between the players. Findings suggested that the game was a viable tool for team building [111]. Similarly, Ellis et al. [52] designed the games *Castle Builder* and the *Tower of Babble*, which each utilized complementary knowledge in a different way. In *Castle Builder*, only a few players were familiar with the blueprint of the castle that was supposed to be built. In the *Tower of Babble*, players were required to utilize perspectives of different viewpoints to ensure the tower was being built straight. In all of these games players were bound to interact because each member had a piece of information that was required to complete the task. All of these games appeared to have positive effects on the social fabric between the players. Nasir et al. [134,135] created a game called *Operation Sting* to facilitate team building. Players each had the same knowledge, however, the actions they were able to perform were different for each player, giving them complementary roles (e.g., thief, hacker). Also utilizing complementary roles, Harris et al. [71] created the game *Beam Me ‘Round, Scotty!*, a game utilizing “asymmetric” game mechanics inducing interdependence between players. The experimental design does not compare high interdependence to low interdependence; however, the participants’ quotes suggest a positive impact of the interdependence that was experienced. Gerling et al. built two interdependent games

to explore social play as an opportunity to connect caregiving dyads [63]. They found that dependence between players appeared to foster communication between the players.

Each of these studies used different games, mechanics and contexts to implement interdependence. The findings suggest, however, that a dependence between players and a necessity to interact and communicate could potentially facilitate social closeness. While these results seem promising, we do not know how high interdependence compares to low interdependence or how it affects social closeness when it is not confounded with cooperation.

3.4.4. Summary of Systematic Review

Although these examples suggest that cooperation and interdependence can promote social closeness, we cannot compare or contrast the advantages of both mechanics. While we have a rich understanding of different methods and contexts in which playing together facilitates social bonds, we have little guidance on the effects of the underlying mechanics. If we want our academic knowledge of collaborative games to effectively inform game design, we need to understand the different elements that make games so effective at reinforcing relationships. In previous studies, cooperation and interdependence have been implemented together. How the two mechanics affect relationships individually is yet unclear. Previous studies have also not systematically evaluated how the mechanics affect social bonds. Are the relationships formed through cooperation different from the relationships formed through competition? Finally, we have no knowledge about how the two mechanics interact. Common wisdom might suggest that both mechanics have to occur together in order to facilitate social closeness. Psychological theories on group work would even suggest that interdependence in combination with competition would elicit hostilities and distrust [98,99]. For game designers to be able to make informed design choices based on research, we need to look beyond the blanket term ‘collaboration’ and systematically disentangle and evaluate the underlying forces of collaborative play.

3.5. Experiment

We conducted an experiment to evaluate how cooperation (vs. competition) and interdependence (vs. independence) affect how players perceive the game and each other.

3.5.1. Game Design

We created a game in which both collaborative factors, i.e. cooperation and interdependence, could be varied independently. This resulted in a two-by-two matrix: crossing competition or cooperation with independence or interdependence resulted in four different games. In our design process, we ensured that all other structural elements of the game were identical, and that only the two game mechanics were manipulated. In the following sections, we will first describe the general design of the game, and then describe the implementation of the four versions.

3.5.1.1. Labyrinth Game

We created the game called *Labyrinth*: a networked, 2-player puzzle game implemented with the Unity Game Engine, based on a German board game of the same name. The game is a top-down 2D board-style game. The game board is comprised of tiles and the configuration of the tiles creates paths through the maze. The players control 2D avatar sprites that they can move along the paths using the arrow keys. The goal is to reach and collect gems that are positioned on the paths of the maze. The game is structured in individual puzzle 'sets'. A set starts with both players and one gem spawning in specific locations. A set lasts for a fixed period of time during which the players have to collect the gem (the set duration is different between the four versions for balancing purposes). Once the set time is up, a new set is loaded with new starting positions. If a gem is not reachable with the current configuration of the maze, the players can push rows and columns to reconfigure the maze and open new paths. Players change the maze by pressing the spacebar and walking against the wall they want to push. After a wall is pushed, the players have to wait until the wall automatically moves back to its original position before they can push another wall.

Before the multiplayer game, players completed an interactive single-player tutorial that took approximately three minutes. The tutorial used written instructions to present the rules of movement and wall pushing. Players could only progress to the multi-player experiment versions once they completed the tutorial.

Interdependence

In order to operationalize dependency or lack thereof between the players, we used two strategies: complementary roles and separate board games. Complementary roles meant that one player was only able to move walls but not collect (the '*pusher'*) while the other player was only able to collect gems but not push (the '*collector'*), leading to a high level of dependency in the interdependent versions of the game. In the independent game version, each player could use both abilities. To further avoid any effect one player might have on the other player's game experience we had them play on two separate game boards in the independent games.

Cooperation

We induced cooperation by manipulating the goal of players. In the cooperative conditions, players were instructed to work together to maximize the gems they collected as a team. To reinforce this,

Figure 3.1: Labyrinth Game board (Cooperative - Interdependent condition)

we presented the final team score. Depending on their score, they received a crown (bronze, silver, gold, or diamond), emphasizing the struggle of the players against the game system. In the

competitive conditions, players were informed that they were rivals and were to compete for the gems. To reinforce this, their scores were presented individually and the winner received a golden crown after the game, emphasizing comparison.

3.5.2. Game Versions

These variations resulted in four versions of the game (see video figure for audio-visual explanation):

3.5.2.1. Cooperative and Interdependent

Both players were positioned on the same game board. One was the pusher and the other was the collector. Together, they had to try to collect as many gems as possible. Each set consisted of a gem that was not reachable without pushing at least one wall; the most difficult sets required three wall pushes to reach the gem. The difficulty of the sets increased over time. The final score was the number of gems collected.

3.5.2.2. Competitive and Interdependent

Both players were positioned on the same game board. One was the pusher and the other was the collector. The collector was instructed to collect as many gems as possible. The pusher was instructed to prevent the collector from doing so. The gems were positioned in a way that made them reachable for the collector without any wall pushes. The pusher was spawned in a position that made it possible for them to re-arrange the maze so that the collector's path was blocked. The collector's score was based on the number of gems they collected. The pusher's score was based on the number of gems they prevented the collector from reaching before the set timed out and a new set was loaded. A winner was declared at the end.

3.5.2.3. Cooperative and Independent

Both players solved the same maze configuration; however, they were positioned on individual game boards. Both players were capable of pushing and collecting. Players were instructed to collect as many gems as possible as a team. The final score was the sum of both players' scores.

3.5.2.4. Competitive and Independent

Both players solved the same maze configurations; however, they were positioned on individual

game boards. Both players were capable of pushing and collecting. Players were instructed to collect more gems than their rival. Their final scores were compared to declare a winner.

In all versions, participants played two rounds of 5 minutes each (10 total minutes of gameplay). In the conditions with asymmetric roles, they switched roles in the second round to ensure that both players had experience with both roles. During gameplay, partners were connected over voice chat.

3.5.3. Measures

All responses were measured on a 7-point-Likert scale (see appendix for full questionnaires).

Interpersonal trust: Social closeness or the quality of a relationship has been measured in a variety of different ways. In the context of computer-mediated relationships, some research measures 'liking' [32,98] to describe the depth and quality of the relationship. However, the predominant construct that has reliably and authentically characterized social relationships in this context has been interpersonal trust [37,94,97,114,156,163]. To measure trust, we adopted a scale that was previously used in the context of brief initial encounters [37]. The scale consisted of 11 items that were derived from the Rempel trust scale [156] (e.g., *"I could count on my partner to be concerned about my welfare."*), the Dyadic Trust scale [114] (e.g., *"I feel that my partner can be counted on to help me."*), and the Specific Interpersonal Trust Scale [97] (e.g., *"I could expect my partner to tell the truth."*). As with previous research [37], the scale was an internally consistent measurement of trust (Cronbach's α=.922, M=5.46, SD=.93).

Intrinsic Motivation Inventory (IMI): To quantify the play experience, we measure interest/enjoyment (Cronbach's α=.843, M=5.29, SD=1.14), invested effort (Cronbach's α=.808, M=5.05, SD=.88) and pressure/tension (Cronbach's α=.877, M=3.77, SD=1.59) using the IMI [127].

Player Experience of Needs Satisfaction (PENS): We used the PENS scale, which measures need satisfaction of competence (Cronbach's α=.837, M=5.0, SD=1.27), autonomy (Cronbach's α=.71, M=4.61, SD=1.24) and relatedness (Cronbach's α=.681, M=4.29, SD=1.26) in-game. We also measured intuitiveness of controls (Cronbach's α=.792, M=5.23, SD=1.23) [167].

Conversational Turns: We quantified how responsive or involved the participants were with each other by calculating the number of conversational turns in the speech signal based on the audio that

we recorded during play (M=28.69, SD=19.35). Each change in who is talking is considered a turn in the conversation.

Propensity to Trust: We measured general propensity to trust (trait) as proposed by Yamagichi [205]. The 6-item questionnaire asks participants to rate statements such as "*Most people are basically honest."* (Cronbach's α=.904, M=4.88, SD=1.09)

3.5.4. Participants

The study was deployed on Amazon's Mechanical Turk (MTurk) crowdsourcing platform. MTurk connects paid workers to *Human Intelligence Tasks* (HITs) and has been shown to be a reliable research tool [124]. We recruited 138 participants, who received $3 for the 20 min study. Ethical approval was obtained from the behavioral research ethics board of our university, and participants were asked to give informed consent. To comply with ethical guidelines, the task was only made available to workers older than 18.

3.5.5. Procedure

We first presented participants with information about what was expected of them (a working microphone and the willingness to interact with another person for 10 uninterrupted minutes). They then completed the consent form and demographics and propensity to trust. Subsequently they performed the tutorial in which they learned the basic gameplay. Once they completed the tutorial, they progressed to matchmaking in which they were assigned a partner and then randomly assigned to a condition. They were connected over voice chat to their partner for the duration of the game. After 10 minutes of gameplay, they completed the PENS, IMI, and trust scales. Finally, there was a debriefing and an opportunity to leave comments.

3.5.6. Data Analyses

All analyses were performed with SPSS 24. We identified noncompliant participants based on two criteria and removed them from subsequent analysis. First we went through the comments in the debrief and the audio recordings to check if they actually had a working microphone and removed the ones who did not (N=14). Second, we checked for careless responses in the questionnaires using a response-time threshold. We removed participants who completed three or more questionnaires with an average time per item of less than 1.5 seconds (N=19). Our final dataset consisted of 105 participants (47 male, 58 female; age M= 32.9, SD= 10.37, min= 21, max= 75; for demographic breakdown of excluded participants see appendix). Our phonetic analysis of conversational turns required high sound quality. Despite microphone checks and careful instruction, in some cases the sound quality was not high enough to be accurately analyzed. For the analysis including conversational turns, we excluded an additional 39 participants due to poor sound; this left 66 participants for analyses involving conversational turns. Assumptions for

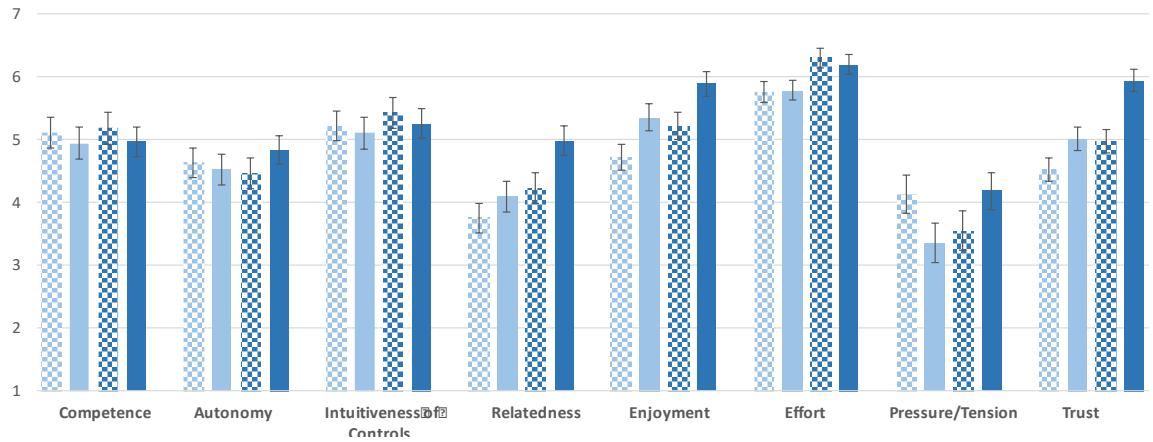

Figure 3.2: Means and standard errors for outcome variables. (light blue)=competition, (dark blue)=cooperation; (pattern)=independent, (solid)=interdependent (e.g., = Cooperative and Independent).

analysis of variance were met. Levene's test showed that variance for all dependent measures was equal across conditions. All variables appear to be normally distributed (for details on homogeneity and normality see appendix).

3.5.6.1. Group vs. Individual Variables

Although our survey items were completed by individual participants, their individual ratings are subject to the experience of being in a dyad with another participant. For statistical analyses, it is

important to determine whether the participants can be treated as independent cases. We conducted an inter-rater agreement (IRA) analysis [116]. The IRA was assessed using the r_{WG} index, which defines agreement in terms of the proportional reduction in error variance. It compares the observed variance on a variable over the group members to the variance drawn from a theoretical null distribution that represents complete lack of agreement [116]. We computed the multi-item r_{WG} index over all relevant constructs. Our r_{WG} index (M= .60, se= .06) was below the recommended threshold for group aggregation (.72). We therefore proceeded treating our psychometric measurements (i.e., surveys) as individual variables. Excluded from this analysis were conversational turns, which were inherently measured on a group level.

3.5.6.2. Propensity to Trust

Literature on trust formation has long acknowledged that a large factor in trust formation is someone's general propensity to trust [163,205]. To control for this, we used the participants' propensity to trust as a covariate in all subsequent models that use trust as an outcome.

3.6. Results

We explore the independent and joint effects of cooperation and interdependence by answering two questions: First, do the two mechanics affect how players experience the game? Second, how do the two mechanics affect the relationship between players outside of the game?

A two-way analysis of variance with two between-subjects factors (cooperation/competition and independence/inter-dependence) was conducted (using Bonferroni correction for multiple comparisons) to investigate the main effects and interaction of cooperation and interdependence on the dependent measures (see Figure 7). This analysis allowed us to investigate the distinct main effects of cooperation and interdependence as well as their interaction.

3.6.1. Player Experience

3.6.1.1. Are the Games Structurally Similar?

The different versions of the labyrinth game employed different mechanics that changed the gameplay significantly. The changes were designed to manipulate the multi-player experience; however, we intended our manipulation to be as equal as possible to avoid confounding factors. To

ensure our manipulations did not systematically vary in overall difficulty or the difficulty of the control scheme, we investigated the effect of our manipulations on the perceived competence and autonomy of players and on the intuitiveness of controls.

For perceived competence, we did not observe any significant main effects of cooperation ($F_{1,101}$=.05, p=ns, η^2=.00) or interdependence ($F_{1,101}$=.58, p=ns, η^2=.00). Neither was the interaction of the two mechanics significant ($F_{1,101}$=.00, p=ns, η^2=.00). Similarly, autonomy was not affected by cooperation ($F_{1,101}$=.08, p=ns, η^2=.00), interdependence ($F_{1,101}$=.32, p=ns, η^2=.00), or the interaction of the two mechanics ($F_{1,101}$=1.05, p=ns, η^2=.01). Finally, intuitiveness of control was also not affected by cooperation ($F_{1,101}$=.56, p=ns, η^2=.01), interdependence ($F_{1,101}$=.34, p=ns, η^2=.00), or the interaction of both mechanics ($F_{1,101}$=.01, p=ns, η^2=.00).

Based on these results, we can assume that there were no inadvertent differences in the perceived competence, autonomy, or the difficulty of the control scheme.

3.6.1.2. How were the Remaining Aspects of Player Experience Affected by Cooperation and Interdependence?

First we investigated differences in how related the players felt during the game. The ANOVA revealed significant main effects for cooperation ($F_{1,101}$=7.08, p=.01, η^2=.07) and interdependence ($F_{1,101}$=4.19, p=.04, η^2=.04) on experienced in-game relatedness. Both mechanics increase scores in relatedness but do not interact ($F_{1,101}$=1.19, p=ns, η^2=.01).

We also investigated the effect the two mechanics have on enjoyment. Similar to relatedness, there are significant main effects for cooperation ($F_{1,101}$=4.92, p=.03, η^2=.05) and interdependence ($F_{1,101}$=8.19, p<.01, η^2=.08) on enjoyment. Both cooperation and interdependence increase the enjoyment of the game. The two mechanics do not interact in their effect on enjoyment ($F_{1,101}$=.10, p=ns, η^2=.00).

The significant main effects and the lack of interactions indicate that cooperation and interdependence are two distinct mechanics. Both appear to increase experienced relatedness and enjoyment.

We observe a significant main effect on invested effort for cooperation ($F_{1,101}$=4.33, p=.01, η^2=.06); however, there was no main effect of interdependence ($F_{1,101}$=.28, p=ns, η^2=.00). Cooperation

increased invested effort over competition. The interaction of the two mechanics is also not significant ($F_{1,101}$=.68, p=ns, η^2=.01).

There were no main effects of cooperation ($F_{1,101}$=.16, p=ns, η^2=.00) or interdependence ($F_{1,101}$=.46, p=ns, η^2=.00) on experienced tension. The interaction term, however, is significant ($F_{1,101}$=5.21, p=.02, η^2=.05); the effect of interdependence on tension appears to depend on whether the players are competing or cooperating. When competing, interdependence decreases perceived tension. When cooperating, interdependence increases perceived tension.

3.6.1.3. Relationship Between Players

We were most interested in how the two mechanics affect the feelings of closeness and rapport that developed between the players as a result of gameplay.

Similar to enjoyment and relatedness, we can observe two distinct main effects of cooperation ($F_{1,101}$=.12.00, p<.01, η^2=.11) and interdependence ($F_{1,101}$=13.47, p<.01, η^2=.12) on interpersonal trust after gameplay. Cooperation facilitated trust development better than competition and interdependence facilitated trust better than independence. Furthermore, there was no significant interaction between cooperation and interdependence ($F_{1,101}$=2.32, p=ns, η^2=.02).

These findings further suggest that cooperation and interdependence are two distinct game mechanics that both influence the relationship individually and do not interact.

3.6.1.4. Unpacking the Effect of Interdependence

As explained previously, interdependence is likely to affect social bonds due to the increase in interaction and communication between the agents involved. Our ANOVA results support the idea that interdependence increases trust development between the players. Theory suggests that this relationship facilitation can be explained by the degree of interaction between the players during the game.

To explore this idea, we performed a mediated regression analysis using the Process macro [76] in which we investigated whether the prediction of interdependence on trust is mediated by the number of conversational turns (controlling for an individual's propensity to trust). The regression revealed that interdependence significantly predicted the number of conversational turns (b=25.75, SE=3.005, p<.001), explaining 52% of the variance and also directly predicted trust (b=.544,

SE=.227, p=.020). Conversational turns also directly predicted trust (b=.021, SE=.010, p=.038). Furthermore, when conversational turns were included in the model, interdependence was no longer a predictor of trust (b=-.017, SE=.353, p=.961), consistent with a full mediation. The indirect effect was tested using the bootstrap estimation approach with 10000 samples [76], revealing that conversational turns significantly mediated the prediction of interdependence on trust (b=.561, SE=.274, 95% CI=.1043, 1.1439). Approximately 20% of the variance in trust was explained by all predictors (R-sq= .20, including general propensity to trust).

There is no theoretical reason to assume that the number of conversational turns would mediate the effect of cooperation on trust as the theoretical underpinnings of cooperation as an effective game mechanic relate to shared goals and establishing an in-group effect (i.e., us against the game). A mediated regression supports this. Cooperation predicts trust (b=.697, SE=.231, p=.004), but not conversational turns (b=4.44, SE=4.48, p=.325). Furthermore, when the number of conversational turns is included in the model, the effect of cooperation on trust is still significant (b=.612, SE=.210, p=.005, 95% CI=.1915, 1.03).

3.7. Discussion

In this section, we summarize our results, provide some theoretical background for our findings, and discuss design implications, limitations and future directions.

3.7.1. Summary of Results

Our results demonstrate that cooperation and interdependence each affect the relationship between players. First we established comparability between the four versions of the game. The four different versions of our game were identical in terms of the dramatic elements and visual design; we further established that the players' perceived competence, autonomy, and intuitiveness of controls did not differ between versions. Ensuring these similarities between the game versions allows us to more confidently attribute our results to the manipulations of cooperation and interdependence. Second, we reveal how cooperation and interdependence affect different aspects of player experience. As expected, both collaborative mechanics appear to increase the relatedness that players experience during the game. Similarly, both cooperating and interdependence increase game enjoyment. When considering the invested effort and the perceived tension, the two

mechanics appear to have different effects. The effort players invest into the game increased when they were cooperating compared to competing. Sharing a goal with another player appears to be a key motivator to engage with the game. Interdependence between players seems to have no effect on the effort invested by players. Cooperation can also induce tension and pressure; however, only when the game is also interdependent. When players' actions do not affect each other (low interdependence), cooperating decreases the perceived tension. Third we confirm that cooperation (vs. competition) and interdependence (vs. independence) affect the relationship between players outside of the game. Similar to relatedness and enjoyment, we observe both mechanics separately affecting the interpersonal trust that developed between players. Informed by theory, we further offer a model as to how interdependence facilitates the relationship between players. As proposed by previous work, interdependent tasks increase the need for communication [37,40,98,99] and previous work in psychology has hypothesized that this increase in interaction between group members would be responsible for stronger social bonds between the group [16,93,94,99,163]. Our results confirm this hypothesis. The influence that interdependence has on interpersonal trust is fully explained by the increased number of conversational turns between the players.

3.7.1.1. Disentangling Collaborative Mechanics

Previous research has only implemented cooperation and interdependence together. This approach was enough to illustrate the potential of games to enhance social relationships. For game developers to make informed design choices, however, we need a more detailed understanding of how these different parts make collaborative games effective at establishing and reinforcing relationships. We need to look underneath the broad category of "collaboration" and start teasing out the underlying mechanics of social play. Our study is the first to disentangle two major mechanics and investigate them as separate properties of a collaborative game. We successfully demonstrate that cooperation and interdependence are in fact two separate forces shaping the players' perception of the game as well as the relationship that develops with their fellow players.

3.7.1.2. A Systematic Comparison

Looking back at existing literature, it becomes evident how much we already know about collaborative play. We have an understanding of which mechanics successful multiplayer games utilize [161,209]. Findings suggest that collaborative games can reinforce relationships between

work colleagues [52,111,117], caregiver and caretakers [63], or family members of different generations [74]. What we still lack are systematic evaluations of the mechanisms that we believe are driving the beneficial effects of games on relationships. Our study systematically compares cooperation with competition as well as interdependence with independence within an otherwise identical game. This allowed us to make assertions about how strongly each mechanic influences different outcomes. What we observe is that both mechanics have medium-sized effects on the perceived relatedness, enjoyment and tension. The invested effort in the game is only affected by shared goals, but also with a medium effect size. Regarding the relationship between the players, we observe that both mechanics exhibit large effects on interpersonal trust.

3.7.1.3. The Additive Model of Collaborative Play

Our experimental approach allowed us to also investigate how the two mechanics interact with each other. As cooperative and interdependent play have so far only been implemented together, we had no knowledge about if and how the two mechanics influence each other. One reason why these two mechanics are always used together might be the idea that a dependence between players is only conducive to their relationship if they are on the same team, working towards the same goal. Social interdependence theory [99], for example, proposes that interdependence in combination with competition would lead to oppositional, negative interaction resulting in conflict and distrust. Or perhaps researchers have only used the two mechanics in tandem because they thought that the two mechanics would amplify each other's effect on social bonds if they occurred together. These models of thinking about the inner workings of collaborative play represent ideas of interactions between the two mechanics. These models, however, have never been investigated in the context of games. Our study addresses this lack of knowledge by giving evidence in support of an additive model. Our findings support the notion that cooperating and being dependent on the other player are two separate mechanics that do not interact, but instead each provide their own influence on how players experience the game and each other. Our results indicate that both individual effects are additive, leaving the cooperation plus interdependence condition to be the most effective at facilitating social closeness. Only the effect on the perceived tension/ pressure appears to adhere to a conditional model.

3.7.2. Theories of Interpersonal Interaction

In the following section, we look to psychological theories offering explanations as to why cooperation and interdependence in games facilitate social closeness.

*Cooperation in Theory***:** The argument that working towards the same goal will facilitate social bonds is most commonly justified using Social Identity Theory (e.g., [52]), which argues that a large part of a person's self-concept is based on group membership [183]. As an individual can potentially identify with many different groups, an important concept within Social Identity Theory is *group saliency* [95]. When a group membership is more salient to the individual, they will likely identify more strongly with that group. Findings suggest that group saliency can be induced by a minimal set of identifiers–even randomly assigning people to a group can elicit group identification [95]. A game that pits the players together against another team or the system could therefore already be enough to create a sense of group membership reinforced by conflict, i.e., 'us vs. them'. Greater identification with a group has been linked to greater trust and cohesion among group members [1], greater individual contribution to the goals of the group [1], and increased group productivity [95].

*Interdependence in Theory***:** The concept of task interdependence comes from psychological frameworks on group work and is usually described as the 'degree to which group members must rely on one another to perform their task effectively' [169]. Regarding the formation of trust in relationships, psychological research supports the idea that task interdependence is a requirement. Trust towards another person is only required if that person's actions affect the trustor. A person is only vulnerable to a partner if they can be potentially hurt or helped by that person. Therefore, a context of interdependence is helpful, and perhaps even necessary for two people to build a trusting relationship [98,163]. According to Social Interdependence Theory [99], if a group or dyad performs a task that is high in interdependence, their need to interact and engage with each other increases. This increased interaction and communication between group members is believed to reinforce the formation and maintenance of social relationships. Interestingly the assumption that interdependence in competitive settings would diminish social closeness was not confirmed in our study. Our results suggest that even in competition, interdependence increases relatedness, enjoyment, and interpersonal trust.

3.7.3. Implications for Design

Given what we have learned from our results, and the psychological theory that explains the findings, we can derive some design implications for social games with the goal to facilitate relatedness, enjoyment, and the relationship between players.

3.7.3.1. Maximizing Cooperation

Our results show that sharing a goal with the other players affects the game positively. Building on social identity theory, we can further recommend that cooperative game mechanics should be designed with group identification in mind. Designs could maximize group saliency by emphasizing group identity. In-group identification can be enhanced by pitting the in-group against an outside force, such as a challenging system or another group. Many multiplayer games have been successfully using group membership as a tool to emphasize cooperation as a game mechanic. *World of Warcraft* (WoW) introduced two factions, creating strong in-group identification (e.g. "For the Horde!") and a clear enemy faction that players are pitched against in PvP games and ranking systems within WoW. A similar faction system was used in *Pokémon Go*. While there is little interdependence between fellow players in the same team (e.g. team Mystic), game designers used team colors, symbols, and unique Pokémon to create a sense of belonging to one particular group.

So far we have only discussed fully assured cooperation in which goals were pre-set as fully shared. In some games, however, players pursue multiple goals that might conflict. A support character in a MOBA game like *League of Legends* for example, is pursuing the individual goal to level up their own character. Their group goal, however, is to support other characters, which can result in fewer resources for them. As mentioned previously, Zagal et al. [209] describes this as the tension between individual utility and group utility. These scenarios add a level of uncertainty as the players cannot know whether the other players will act in their own best interest or what is best for the group. This uncertainty could hurt the social facilitation through the game or it could form even stronger bonds as cooperation is now a choice and thereby perceived as more meaningful. Our study has only investigated the effect of full cooperation. How conflicting goals affect the relationship between players remains to be investigated.

3.7.3.2. Maximizing Interdependence

Based on our results, we can conclude that a high level of dependency is a desirable property of a game if the goal is to strengthen the social bonds between players. We can furthermore suggest that any mechanic implemented to induce dependency between players (e.g., synergies between abilities, complementary knowledge) should be in service of increasing interaction between players. In this study, we used voice chat as a communication channel and operationalized 'interaction' through conversational turns. While our system configuration yielded very positive results, many games might not offer that communication channel to their players. Other games offer different means of interaction such as text chat or low bandwidth signals that signify simple massages like, for example, 'help', 'danger' or 'missing enemy' (as is implemented in *League of Legends)*. Research has even suggested that in-game actions can be interpreted as conversational turns [128]. Any mechanic that induces interdependence challenges the players to effectively coordinate and communicate. As a design guideline, we can recommend that any implementation of interdependence should be accompanied by a way for players to successfully send, receive and adequately interpret other players' signals. The communication channel has to allow for signals that are rich enough in information that players can effectively overcome the coordination challenges that the game poses.

Frameworks from literature on work and organizational psychology distinguish different kinds of interdependence [98,169,193] – specifically, task interdependence and outcome interdependence [193]. Johnson and Johnson [98] define *task interdependence* as the necessity for each member to take action for other members to do any part of their work. In contrast, *outcome interdependence* is defined as the degree to which the outcomes an individual receives depend on the performance of others [98]. As outcome interdependence does not actually require interaction during the task, we would recommend implementing task interdependence. In games, this means that the dependence between players should not be an addition of scores or damage or any other resource in the game, but be derived from a need to coordinate and interact during play.

3.7.3.3. *Working with Restrictions*

Ideally a game should employ both mechanics in pursuit of strengthening the social bonds between players. However, some games have core mechanics that are incompatible with some of our

recommendations. Some games might be inherently competitive and shared goals as a design option is unavailable. Online chess, for example, or multiplayer tower defense games are inherently zero sum paradigms that pit players against each other. Our results suggest that even competitive games can still reinforce relationships through interdependence. Other games might be entirely optimized for individual play independent of other people's influence or cooperation. *Clash of Clans* for example, is an interesting example of an inherently single player game that still successfully generates strong bonds between their players. The core game elements of building your village and raiding other villages are competitive and independent in nature. Game designers implemented clan membership, and clan-specific success metrics and leaderboards to induce group identification and an "us vs them" mentality. Game designers also created interesting ways to induce interdependence. Because the core game elements were asynchronous and optimized for a single-player experience, game designers opted for outcome interdependence. In 'Clan Wars' (battles between two clans), individual performances were added up to clan-specific performance metrics. Clan wars also induced a need for coordination, as attack strategies have to be discussed. Another mechanic they introduced was a reinforcement system. Other clan members can send reinforcements that support the single players in their raids. These design choices are all peripheral additions that do not fundamentally change the game. They rather leverage the psychological mechanics that underlie the benefits of cooperation and interdependence (group identification, increased interaction), without actually requiring the development of a fully cooperative and interdependent game.

3.7.4. Limitations and Future Work

Although our findings provide insights into multiplayer game mechanics for facilitating social closeness, we acknowledge the limitations of this work.

First, we only tested our results using one specific puzzle game. Comparing our conditions in an otherwise identical game was necessary for our research questions. How well our findings translate into game genres like platformers, first-person shooters, or even board games remains unclear. The psychological frameworks would suggest that dynamics like group identification and increased interaction would have similar effects regardless of genre; however, future research should investigate if our findings hold in different genres.

Second, we only tested with a specific set of mechanics. While we believe that these mechanics are valid representations of cooperation and interdependence, we cannot exclude the possibility that other mechanics inducing cooperation and interdependence might have led to different results.

Third, we focused on establishing a new relationship between two strangers in a brief game interaction. How the results extend to relationship maintenance or to establishing relationships that are intended to be deeper (e.g., longer term) or of a different nature (e.g., romantic) is still speculative.

Fourth, we examined dyads. Extending the findings to groups would provide value for the field.

Fifth, it is important to acknowledge that cooperation and interdependence are most likely not the only game elements that facilitate social closeness. Based on theory and the predominant themes discussed in the game literature, however, we found them to be the most prevalent. Future research should further identify mechanics that can bring players closer together.

Finally, our experimental setup did not anticipate the difficulties of sound quality we encountered. While we still found effects using phonetic analysis despite our reduced sample size, future research can draw a lesson from this and instructs participants to reduce background noise (e.g. radio, TV) and use headphones to avoid echo.

3.8. Conclusions

The motivational draw of video games comes from different needs they satisfy. While games can make players feel powerful, autonomous, and explorative, they can also make players feel socially connected to other players. In 2016, 54% of the most frequent gamers played socially, to bond with friends, family, or strangers through play [53]. This need is already being acknowledged by game researchers who investigate the social potential of games, as well as by the video game industry who continue to implement more multiplayer mechanics into their games. How do we design games that effectively promote social closeness between the players? We previously had a very narrow understanding of what social play should look like. The work on social play predominantly assumed that games need to be cooperative and interdependent to facilitate social closeness. Our results demonstrate that both factors do in fact positively influence the relationship between the players. Our findings additionally widen the perception of what collaborative play can entail. The

effects of cooperation and interdependence are not co-dependent, but are additive and can therefore be leveraged separately. A competitive game high in interdependence can still help two players form a connection. Similarly, shared goals and group identification alone could help players form communal bonds. The disentanglement of concepts previously only used in tandem broadens the design space that we can explore to innovate and further the use of social games. Our findings also help us better understand these mechanics. Interdependent play may only ever be as effective as the communication channels of the game allow it to be.

Forming and maintaining positive relationships between grandparents and grandchildren, caregivers and elderly caretakers, work colleagues, parents and their kids, or distributed friends can be difficult. Social games can be a powerful tool to help strengthen these bonds. The more we understand the underlying elements of social play, the more we can use games to bring people closer together.

3.9. Acknowledgements

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4. MANUSCRIPT C: Designing for Friendship: Modeling Properties of Play, In-Game Social Capital, and Psychological Well-being[3]

4.1. Introduction to Manuscript C

Until now, we have used controlled experiments with random assignments of participants and game conditions that were specifically designed for our research questions. One of the drawbacks of such a controlled experimental approach is that we do not know how well our findings can be generalized to a broader scale over different types of games in different types of gaming communities. Additionally, we have so far only tested the efficacy of interdependence and cooperation after a short period of playtime (i.e., 10 min). Finally, we tested the effects of interdependence and cooperation in interactions between dyads of strangers. How do these mechanics affect long-term relationships in a variety of different relationship types? Based on our findings so far, we have reason to assume that players who experience higher levels of interdependence or higher levels of cooperation with other players within a game are more likely to build stronger social bonds within those gaming communities. How well this assumption holds in a more general setting, however, is yet unclear. In this third study, we aim to test how well our assumed predictors of in-game relationships perform 'in the wild' (i.e., in naturalistic play settings) rather than in an experimental setting. Because we are now aiming to investigate more established social ties within communities, rather than in dyads, we are in the realm of investigating social capital. Choosing the social capital framework ties our findings to previous approaches touching on social ties in games. As we have discussed in the related literature, social capital is often used as a framework to evaluate social ties within specific contexts. Social capital is an interesting construct as it has generally been associated with positive outcomes regarding social wellbeing [150,199]. Within the context of games, however, this association is questionable. We further add a third dynamic we think is predictive of the social capital build within a game: toxicity – the level

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Co- authors to this paper were Colby Johansson as second author and Regan L. Mandryk as third author.

of hostility experienced within the game. In our experimental setting toxicity was not likely a factor as we investigated strangers who only interacted with each other for 10 minutes. In established gaming communities, however, hostile behavior is a frequent experience in many multiplayer games. We therefore think it might be explanatory for how strongly player build in-game social capital.

4.2. Abstract

Players are increasingly viewing games as a social medium to form and enact friendships; however, we currently have little empirically-informed understanding of how to design games that satisfy the social needs of players. We investigate how in-game friendships develop, and how they affect well-being. We deployed an online survey (N= 234) measuring the properties of games and social capital that participants experience within their gaming community, alongside indicators of the social aspects of their psychological wellbeing (loneliness, need satisfaction of relatedness). First, our findings highlight two strong predictors of in-game social capital: interdependence and toxicity, whereas cooperation appears to be less crucial than common wisdom suggests. Second, we demonstrate how in-game social capital is associated with reduced feelings of loneliness and increased satisfaction of relatedness. Our findings suggest that social capital in games is strongly and positively related to players' psychological well-being. The present study informs both the design of social games as well as our theoretical understanding of in-game relationships.

4.3. Introduction

Playing digital games has become a social experience for many players. According to the ESA [53], a frequent gamer spends an average of 6 hours a week playing with others online and 5 hours a week playing with others in person. People play multiplayer games with friends, family members, parents, and spouses [53]. Gameplay has been shown to often be socially motivated [59,67,90,91] – more than half of the most frequent gamers report that video games help them connect with their friends [53]. For example, *World of Warcraft (WoW)* players use the game as a platform to maintain preexisting relationships, form new ones, and even find romantic partners [200]. Stereotypes about the antisocial, lonely gamer have long been proven to be inaccurate [107,171]. It is safe to say: Players view games as a social medium on which they want to form and maintain friendships (e.g.,

[27,109,181,186,200]).

A large body of literature indicates that games can provide social experiences (e.g., [37,84,181,198]); while we know *that* games can foster social ties, we do not yet understand *how* they do so. What experiences within games best support players in forming social bonds? 'Multiplayer games' are incredibly diverse in terms of the underlying *game properties*, such as the game's mechanics, interactions, and design patterns. Raiding a dungeon in *WoW*, fighting a match in *Counter-Strike GO*, or playing a game of *Words with Friends* are all fundamentally different experiences of play, yet all three are examples of multiplayer games. Do they each promote social ties between players? What properties do they have in common that makes them 'social'? The underlying properties of play that are responsible for building social ties are not clearly identified. A rich body of literature studying different game mechanics in social contexts provides us with design recommendations to enhance social ties, such as including roles [135] or inducing a need for communication [52], yet very few studies have empirically investigated the efficacy of these recommendations [37,39]. As such, game designers who wish to design social games have to rely on common sense solutions derived from their intuition and expertise. There are no empirically-informed models for what properties of play best support in-game friendships.

Why are in-game friendships of interest to games researchers? As digital games become increasingly popular, concerns about problematic gaming behavior arise. For example, there is significant debate over the World Health Organization's proposal to include 'gaming disorder' in their international classification of diseases [10,204]. Similarly, research has suggested that the in-game relationships players foster online do not provide any benefits to overall well-being [84,181] and might even reduce the players' social embeddedness offline [106,177]. These types of debates call for further investigation into the relationship between digital gaming and the psychological well-being of players, which is especially relevant in the context of social play. The need to form lasting and caring relationships and the feeling of belonging are fundamental human needs [9,36] and a lack of social embeddedness has been identified as a serious threat to well-being [9,176]. Given the increasing prevalence of multiplayer digital games as a leisure activity, we must consider whether the social relationships that are established and enacted through digital games help or harm the social aspects of psychological well-being.

The present study aims to contribute to the ongoing discourse on social play by addressing two research questions:

- What properties of games foster social ties?
- What is the relationship between in-game social ties and psychological well-being?

These questions were addressed using a mixed-methods approach. To characterize our sample, we first took a qualitative approach to describe the nature of a participant's *gaming community*, including the types of relationships formed and maintained through a specific game that they play regularly with others. To answer our two research questions, we drew from theory on collaborative game design to identify three properties of play – *interdependence*, *cooperation*, and *toxicity* – that we hypothesized predict in-game *social capital*. We then investigated the relationship between in-game social capital and social aspects of psychological well-being, including feelings of *loneliness* and *need satisfaction of relatedness*.

Our findings contribute to the ongoing discourse of friendship formation in digital games in two ways: First, we identified what properties of play are associated with forming successful relationships in games. We found that interdependence between players is a crucial part of forming social ties in games. Toxicity of the game environment is a strong social inhibitor. Contrary to common wisdom, cooperation is not necessary to form social bonds in games, opening up the often-avoided design space of competitive play for social facilitation. Second, we demonstrate that in-game ties are strongly and positively linked to psychological well-being. The social capital formed in games was associated negatively with feelings of loneliness and positively with the satisfaction of relatedness. We discuss implications for design and theory as well as limitations and opportunities for future research.

4.4. RELATED WORK

4.4.1. Social Closeness in Games

Research on social ties in online contexts often uses the framework of social capital, more specifically the differentiation of two kinds of relationships: *bridging ties* and *bonding ties*. Based on Putnam [151], 'bridging ties' are characterized as tentative relationships that may lack depth but make up for it in breadth. Bridging ties broaden the social horizon of the holder as they expose

one to different world views, opinions, and resources [151,199]. In contrast, 'bonding ties' refer to strong relationships in which people feel emotional and social support. Bonding ties are characterized by relationships with less diversity but stronger personal connections. They provide strong, reciprocated, and substantive emotional support [151,199]. Studies have investigated the framework of social capital in the gaming communities of *World of Warcraft* [27,181,200], *Second Life* [84], and *Counter-Strike* [90,91], and have successfully shown that relationships in games are capable of generating social capital [84,181,201]. The general consensus appears to be that games are likely to lead to bridging ties, but are unlikely to generate bonding ties between players [84,181,200].

4.4.2. Antecedents of In-Game Social Ties

Literature on social ties in games provides an understanding of the social motivations of players [59,67] as well as the types of relationships they form within games [84,181,200]. While we know *that* games can foster social ties, we do not yet understand *how* they do so. What properties of gameplay are fostering social ties among players?

Researchers have started to investigate the predictors of in-game social capital by considering the motivations [46,177] of players as well as their play frequency [46,106,177]. While these predictors are associated with gaming behavior, they are not within the control of game designers who wish to build social games. Developers cannot control the motivations or time restraints of players. What they can control are the interactions players experience within the game. As the present study aims to inform design, we focus on the properties of the game rather than the properties of the gamer. Multiplayer games can take many different forms. A group raid in *World of Warcraft* is a fundamentally different experience than completing a race in *Mario Kart*. In what ways are these two examples different? How are they similar? Research on social ties in games should not only investigate *if* people play together but also *how* they play together. To date, very few studies take this approach of identifying the properties of play that foster social capital. For example, Trepte et al. successfully identified 'social proximity' in games as a predictor for social capital in games [186]. Shen & Williams measured play duration but also measured the intensity of communication [177].

Based upon recent contributions to the field of games research, we identified three properties of

play that we hypothesized would be explanatory of how and when games facilitate social closeness: *cooperation*, *interdependence*, and *toxicity*.

4.4.2.1. Cooperation & Interdependence

Depping et al. [38] reviewed the literature on collaborative game mechanics and their potential to facilitate the formation of trust. They identified two overarching multiplayer game mechanics: cooperation and interdependence. The authors argue that while these two dimensions are mostly used in tandem, they are theoretically distinct, which they demonstrated in an experimental setting in which both constructs appeared to separately facilitate trust formation.

Cooperation is the most common suggestion as a game mechanic that could be used to bring players closer together [37,52,135,161,209]. Cooperation is characterized by players working towards the same goal, in contrast to competition, in which players pursue separate or even opposing goals [39]. Goal sharing as a mechanic to facilitate social closeness has been suggested by literature investigating commercial games [161,174] and board games [209]. Goal sharing has also been successfully implemented in games designed to facilitate team building. For example, cooperative games in *Second Life* have been shown to facilitate team identification and social bonds within work groups [52,117,137]. Cooperative game mechanics have also been successfully used to facilitate social bonds between strangers online [32,37,39]. Vella et al. [194] have found that cooperating with others is positively associated with relationship formation.

Interdependence describes the level of dependence between players [39]. The term originated from psychological frameworks on social and group interaction and is commonly defined as the 'degree to which group members must rely on one another to perform a task.' [98]. In games, interdependence has been referred to as 'closely coupled' play [14], 'complementarity' (specific roles in the game) [161], or as the separation of 'different abilities or responsibilities' between players [209]. Interdependence is characterized by the need to interact and coordinate with other players [39]. Studies on collaborative play have implemented this need to interact using various game mechanics. Common ways of inducing interdependence have been through using complementary roles (i.e., giving players asymmetric abilities) [71,72,74], or complementary knowledge (i.e., players have to interact to exchange information) [52,111,117]. Research on interdependence and social facilitation has shown positive effects on team building [52,117,135]

as well as on trust formation between strangers [37].

Depping et al. [39] evaluated the effects of cooperation and interdependence on trust development and found that both mechanics are theoretically independent and separately facilitate trust formation between strangers online. The literature on collaborative game design strongly suggests a positive effect of cooperation and interdependence on social outcomes. However, the cooperation/interdependence framework has only been validated once in a highly-controlled experimental study, using one specific game, and evaluating very brief interactions between strangers [39]. While the framework potentially predicts how social ties develop in games, we do not presently know how well it translates into a natural play setting, into longer-lasting relationships, and into diverse games and game genres. In order to more effectively design social experiences for social communities in games, we aimed to investigate this framework in a natural play setting. Following the proposed conclusions by Depping et al. [39], we hypothesized that the degree to which players experience cooperation and interdependence during play will predict the degree to which players build social capital in their gaming community.

4.4.2.2. Toxicity

The third factor that promises to be predictive of social capital in games is *toxicity*. Toxic behavior in multiplayer games often takes the form of one player harassing another through slurs, spam, or verbal abuse [58]. In team games, it is any behavior that is counter-productive to team cohesion, such as having a negative attitude towards other team members, refusing to help your team, purposefully losing the game, or not participating in a match [112,158]. Although the number of toxic players in a group may be relatively small [148], they can affect a large number of players [58,146]. Even a single toxic player in a group can cause group dysfunction [55]. Toxic behavior not only affects a player's performance and overall experience within a game, but it can also have a very real effect on a person's psychological well-being outside the game. Previous research has suggested that toxicity in games can facilitate social exclusion, which leads to viewing interpersonal interactions through a negative lens, and may create a positive feedback loop of increasing toxicity [15]. We propose a negative relationship between toxicity and in-game social capital.

4.4.3. How In-Game Relationships Relate to Well-being

In the previous section, we proposed properties of play that might help understand how social bonds form in games; but how meaningful are those bonds to the players? Social capital in the physical world has generally been associated with positive outcomes of psychological well-being [151,199]. How does in-game social capital affect the well-being of players? The debate about gaming potentially being a problematic behavior is ongoing, touching on the relationship between gaming and violence [68], gaming addiction as a psychological disorder [10,204], and also gaming as a socially isolating activity [46,106]. Therefore, we do not want to simply investigate how social capital is generated in games, but also investigate how in-game social capital is related to the overall psychological well-being of players.

Do in-game relationships affect psychological well-being? Previous research has suggested that online social capital does not transfer to the offline realm [84,110,211]. Only a few studies have found a relationship between online interactions and offline social embeddedness [186], and most of these relationships appear to be negative. For example, Williams reported that gaming frequency had a negative impact on offline social capital and interpersonal trust [198]. Huvila et al. [84] found that *Second Life* users may build social capital within the game but that online and offline social capital do not converge. Kowert et al. [106] found that gaming frequency seems to be negatively associated with the quality and size of offline social circles.

These findings appear to suggest that players who focus their time and energy on fostering in-game relationships spend less time fostering their offline relationships [46,106,110,177]. Is this trend a threat to their well-being? To answer this question, we investigated how well in-game relationships satisfy our psychological needs for social contact and feelings of relatedness. A number of studies have suggested that social ties formed in games appear to be mostly ‘weak’ bridging ties that supposedly do not provide the same level of social support provided by in-person relationships [46,84,181,198–200].

Very little research has specifically investigated the relationship between in-game social capital and indicators of psychological well-being. Shen & Williams [177] observe what they call the ‘communication paradox’ where communication intensity within an MMO was negatively associated with psychosocial outcomes of the players. Similarly, Vella et al. [194] observe that

greater amounts of play is linked to lower levels of well-being. In contrast, Trepte el al. [186] found social capital within a game to be positively associated with offline social support. Their findings suggest that in-game social capital is in fact associated with how supported players feel offline, indicating effects on psychological well-being. These are just initial findings based on specific game communities and focused on one specific aspect of well-being. These initial findings demonstrate the heterogeneity of current findings and how we require further analysis to

Figure 4.1: Hypothesized Path Model

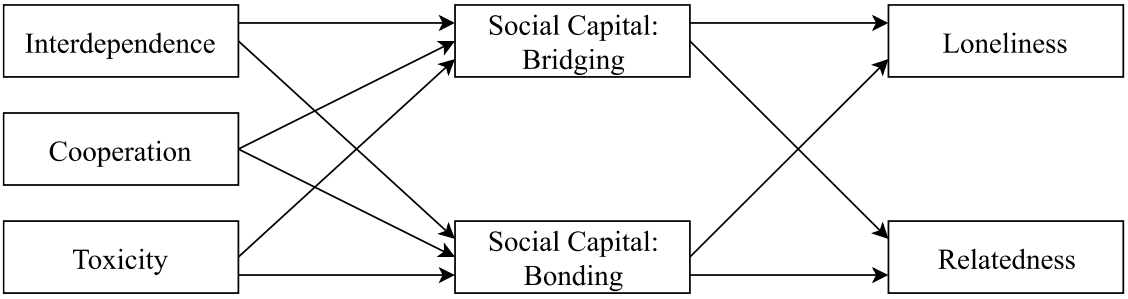
understand how in-game social capital affects psychological well-being. We aim to advance this research by considering this relationship not just in a single play setting (e.g., MMO, eSports), but across different types of games and different types of relationships. We also aim to broaden the concept of well-being by looking not just at social support, but adding two established indicators for social aspects of well-being: *loneliness* and *need satisfaction of relatedness. Loneliness* represents feelings of being isolated, disconnected, and lacking social connectedness [164]. *Relatedness* is one of the fundamental human needs proposed by Self Determination Theory [168]. The need to relate refers to 'the desire to feel connected to others – to love and care, and to be loved and cared for' [36]. We aim to uncover if in-game social capital is associated with subjective loneliness and need satisfaction of relatedness.

4.5. Study Design and Procedure

We conducted a survey to gather participant attitudes and opinions around their experiences of play, their gaming communities, and psychological well-being.

4.5.1. Hypotheses

The hypotheses we derive from the previously-presented literature can be expressed in the path model seen in Figure 8. The present study aims to identify properties of play that are predictive of in-game social capital. Drawing from theory on collaborative game design and previous literature on toxicity, we hypothesize that experiences of interdependence and cooperation are positively associated with social capital, while experiences of toxicity are negatively associated with social capital. Our path model hypothesizes a relationship between in-game social capital with feelings



of loneliness as well as the psychological need satisfaction of relatedness.

4.5.2. Recruitment and Participants

The survey was deployed on Amazon's Mechanical Turk (MTurk) crowdsourcing platform, which connects willing workers to Human Intelligence Tasks (HITs). MTurk has been used for HCI research [18,37,39,96], and has been demonstrated to be a reliable and valid platform to gather data [25,124,142]. We were interested in finding participants who regularly play games with others online, and so we first launched a pre-screen HIT.

4.5.2.1. Pre-screen

A total of 598 participants (226 female, 370 male, 2 'rather not say'; age M=32.8, SD=8.57) completed our pre-screen task, which paid $0.20 USD and took about a minute to complete. In our recruitment, we indicated that we were looking for participants who 'play video games'. In terms of the frequency at which they played games, 280 (46.8%) participants indicated that they played games every day, 232 (38.8%) played 'a few times per week', 33 (5.5%) played 'once per week', and 53 (8.9%) played less than once a week. We also asked them to rate (on a scale from 1 to 10) how much they self-identify as a gamer [123] and what proportion of time they spend playing alone (1) as compared to with others (10). We found that on average, participants considered themselves to be moderate gamers (M=4.43, SD=3.09), and choose to play slightly more with others rather than by themselves (M=6.51, SD=3.01).

Because responses from participants who do not play multiplayer games or hardly play games at all would not be useful data for the purposes of our study, we only invited those participants who reported that they played games at least 'a few times per week', considered themselves to be somewhat of a gamer (3/10 or higher), and spent at least some time playing with others (3/10 or higher). We excluded an additional 10 participants due to non-compliance issues in answering the

pre-screen. We invited back 314 participants to complete our main study.

4.5.2.2. Main Study

Of those we invited, 250 completed the study, which paid $5 USD and took about 20 minutes. We removed 16 participants (8 males and 8 females; age M= 27.53, SD= 4.19) due to noncompliant behavior, such as an extremely quick response time or high variance in their responses [18]. Our remaining 234 participants had an average age of 32.6 (SD=8.1, min=19, max=69), 159 (68%) were male, and 1 chose to not disclose their gender. The majority (n=147) played games every day, with the remainder playing a few times per week. Our participants identified as gamers (M=8.25, SD=1.63) and spent more than half of their gaming time playing with others (M=6.5, SD=1.96).

4.5.3. Measures

We used several measures to qualify play and the relationships that are formed in multiplayer games (for full questionnaires see appendix).

Game Considered. Participants were instructed to name one game that they frequently played with other people. We made it clear to them that this game would be the focus of any upcoming questions they might answer.

Types of Relationships. We presented two questions on a bipolar semantically-anchored scale from 1 to 10. The first asked what proportion of time participants spent playing with strangers (1) versus people they have played with before (10), and the second asked what proportion of time they spent playing with people from the physical world (1) versus people from the digital world (10). We also asked two open-ended questions:

When thinking about these people that you play regularly with, how well do you know each other?

Please describe the relationships that you have with people that you play with.

The responses to these questions were referred to as the participant's 'gaming community', which we asked them to consider when responding to the questionnaires. The two questions served as prompts to reflect on their gaming community, but were also thematically analyzed.

Cooperation was measured using a scale we created for the purposes of this study. Item creation was informed by theoretical conceptualizations of cooperation (in contrast to competition) [39].

Our scale for cooperation of play (7-pt scale, see appendix) showed good internal consistency (Cronbach's α=.93) as well as satisfactory descriptive indices (M=5.5, SD=1.5, Skewness=-.93, Kurtosis=-.47). The items were carefully crafted to be independent of game genre or mechanics.

Interdependence was measured using a scale we created, for the purposes of this study. Item creation was informed by scales measuring task interdependence in the context of work and organizational psychology [24,130] and the theoretical groundwork of interdependence in play [39]. Our scale for interdependence of play (7-pt scale, see appendix) showed good internal consistency (Cronbach's α=.85) as well as descriptive indices (M=5.2, SD=.89, Skewness=-.27, Kurtosis =-.20). It is important to note that this scale was created to subjectively measure the degree to which players must rely on one another, or are affected by other players during play. As with cooperation, this scale was crafted to measure the subjective experience of interdependence regardless of genre or specific mechanics.

In-Game Toxicity. We measured toxicity within the participant's specified gaming community with an in-game toxicity scale based on Anderson et al.'s State Hostility Scale [4]. We selected a subset of the items to use and added 'hurtful' and 'toxic' as items. Our scale for toxicity (7-pt scale, see appendix) showed good internal consistency (Cronbach's α=.90) as well as satisfactory descriptive indices (M=2.45, SD=1.18, Skewness=-.86, Kurtosis=-.43).

Social Capital. We used Williams's Internet Social Capital Scales [199] to measure bridging (Cronbach's α=.875, M=3.85, SD=.677; e.g., 'Interacting with people from my game community makes me feel like part of a larger community') and bonding (Cronbach's α=.913, M=3.21, SD=.92; (e.g., 'There are several people from my game community I trust to help solve my problems') (5-pt scale). Items were adjusted to refer to the player's gaming community.

Loneliness. To measure overall loneliness, we used Russell et al.'s UCLA Loneliness Scale [164] (4-pt scale; Cronbach's α=.944, M=1.74, SD=.6).

Relatedness. To measure overall need satisfaction of relatedness of our participants, we used the relatedness subscale from the Basic Psychological Need Satisfaction (BPNS) questionnaire [35] (7-pt scale; Cronbach's α=.9, M=5.28, SD=1.37).

4.5.4. Procedure

After providing informed consent, participants filled out the open-ended questions and scales described above. Once they had named their considered game, we asked questions to get a sense of the type of people they play with, and the relationships they have with them. We informed participants that we would refer to the people they play games with as their personal 'game community' and instructed them to keep that group in mind as they answered the upcoming questions. They rated the degree of cooperation, interdependence, and toxicity they experience while playing their specific game with their specific community. We then asked them to rate their in-game social capital within their game community. Finally, they rated scales for their overall loneliness and satisfaction of relatedness as a measure for psychological well-being.

		Mean	SD	1	2	3	4	5	6	7
1	Cooperation	5.52	1.43	-						
2	Interdependence	5.23	0.89	.244**	-					
3	Toxicity	2.41	1.16	-.133*	-0.04	-				
4	SC: Bridging	3.85	0.68	.210**	.475**	-.314**	-			
5	SC: Bonding	3.18	0.95	.211**	.333**	-.395**	.464**	-		
6	Loneliness	1.78	0.59	-0.04	-.252**	.324**	-.394**	-.320**	-	
7	Relatedness	5.28	1.39	.293**	.387**	-.434**	.592**	.743**	-.406**	-

*Table 4.1: Means, SD and Correlation coefficients for variables in SEM (** = p < .01)*

4.5.5. Data Analyses

Our data consisted of a mix of qualitative responses to open-ended questions and quantitative data in response to the scales used in our questionnaires.

4.5.5.1. Qualitative Data

Qualitative coding was conducted by two researchers, who were not the principal researcher. In

order to determine inter-rater reliability, the raters overlapped on 24% of the responses so that Cohen's kappa could be calculated. There was sufficient agreement between the two coders (κ=.752) [26]. For the final coded responses, the two coders went through the conflicts within the overlap case by case until an agreement was reached, and used these standards in coding the remaining responses.

4.5.5.2. Quantitative Data

We used a structural equation model (SEM) with the AMOS 19 statistical package using the maximum likelihood method. We only performed the path analysis between using the SEM. The variables in our path model were aggregated using SPSS and then fed into the SEM instead of feeding each individual items into the SEM.

4.6. Characterizing our Sample

In order to understand and interpret our findings, it is necessary to first clearly describe the sample of players from which these results were derived. We describe our sample based on what games participants thought of when filling out our survey, and what type of relationships participants thought of when we prompted for their *gaming community*.

4.6.1. What Games Were Considered?

Previous studies investigating social ties in games often focused on one specific game, such as *World of Warcraft* [27,181,200], or one setting of play (e.g., eSports) [186]. These approaches provided valuable insight into social play; however, the specificity of the samples also raise questions of generalizability. The present study aims to identify properties of play that are independent of game genre or specific mechanics, therefore we did not limit our sampling to specific games or genres. Participants were instructed to 'Name a game that you frequently play with other people', that they would be considering while responding to our questionnaires. 95 unique games were named, with the top ten most frequently listed games being *World of Warcraft* (23), *Overwatch* (16), *Call of Duty* (12), *League of Legends* (10), *PlayerUnknown's Battlegrounds* (7), *Hearthstone* (7), *Dota* (7), *Destiny* (7), *Final Fantasy XIV* (6), and *Diablo 3* (5). Participant quotes include the game they were considering while responding.

4.6.2. What Types of Relationships were Considered?

We asked participants to consider their community within the game that they specified when answering our questions, as we wanted to get a sense of what types of relationships that specific community included. The prompt 'gaming community' used in the survey was intentionally vague, to avoid biases towards specific forms of social play (e.g., playing in guilds/clans) as we wanted our sample to contain the full range of relationships players experience in games.

Previous research has pointed towards diversity in the origin of in-game relationships, with some originating from in-person relationships being carried over into a game world and others originating from within the game world [200]. In our sample, participants played slightly more often with people from the digital world than with those from the physical world (mean=6.05, SD=3.37, min=1, max=10, where 1=physical and 10=digital) and played about equally with strangers as with players they have played with before (mean=5.38, SD=3.05, min=1, max=10, where 1=strangers and 10=people they have played with before).

When analyzing the written responses, we found that every response included some indication of whether the participant knew their community though in-game interaction, out-of-game interaction, or a mix of both. Half of the participants (122, 52.1%) described their relationships within their game community as originating in-game. Examples include:

> *"I've known these people for a few months, I have never met these people in person and I have only communicated with one outside the game by Facebook messenger." – Grand Theft Auto*

> *"We've know each other for about a year or so. We met in the game and have never met in person. We are friendly, and will talk in and out of the game about a wide range of topics." – World of Warcraft*

A total of 47 (20.1%) participants described their relationships as originating outside of the game.

> *"They are my parents and other family." – Sorry (online)*

> *"We have been friends since grade school. We know each other very well. We used to all work nights and started playing games on Sunday nights well into the morning since we didn't have to be at work until the next afternoon. We have been playing for over 20 years." – Tomb Raider*

And a total of 63 (26.9%) participants described their relationships as consisting of a mix of people they met outside the game and in the game.

"Almost all friends that I play with online I have known since high school from a few years ago. There are some friends that I haven't met before but on average I have known those friends for as long as my real life friends." – PlayerUnknown's Battlegrounds

Our sample consisted of a diverse set of games from multiple genres (e.g., role-playing games, first-person shooters, multiplayer online battle arenas, sports games). The games mentioned also seemed to accurately represent contemporary and successful games (e.g., *League of Legends*, *Hearthstone*, *Overwatch*). Both the diversity as well as the representation of contemporary games speak to the ecological validity of the data presented in this study. The types of relationships we observed in our data appear to echo what previous literature [27,181] has observed: a mix of relationships, some formed entirely within the game and some formed in-person but maintained within the game. Our sample appeared to consist of slightly more relationships originating in-game.

4.7. Results

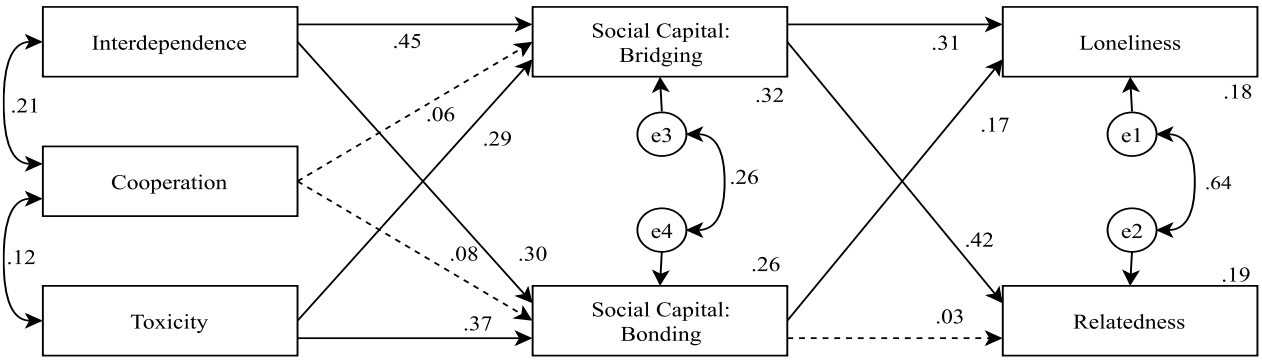
The following section reports the results of our hypothesized path model (Figure 8).

4.7.1. Structural Equation Model

In Table 1, we present the means, standard deviations and correlation coefficients for the variables included in the path model. As Table 1 shows, cooperation significantly correlated with interdependence (r=.24) and toxicity (r=-.13). The variables were therefore allowed to co-vary in our statistical model. Not surprisingly, bridging and bonding were also significantly correlated (r= .46), as were loneliness and relatedness (r=-.41). The error terms of the variables were therefore

Figure 4.2: Standardized coefficients of the hypothesized path model (dashed lines are non-significant paths).

allowed to co-vary in our statistical model (see Figure 9). Following the model fit threshold recommendations of Hu and Bentler [81], our statistical model exhibited a good fit with our data. χ_2/df was good with a value below 3 (2.37), with a significant p value which is to be expected given the sample size [81]. The Comparative Fit Index (.97) was good (above .95) and the Tucker Lewis Index (.94) was acceptable (above .90). The root mean square error of approximation was acceptable (.07) with a value below .08 [119]. Fit indices were calculated with non-significant paths remaining in the model. Removal of those paths only further increased the model fit.



4.7.2. How Properties of Play are Associated with In-Game Relationships

We expected that interdependence, cooperation, and toxicity would be associated with in-game social capital.

As hypothesized, interdependence significantly predicted bridging capital (β=.45, p<.01) as well as bonding capital (β=.30, p <.01). Toxicity negatively predicted bridging capital (β=-.37, p<.01) as well as bonding capital (β=-.30, p<.01), also confirming our hypotheses. Contrary to what we expected, cooperation neither predicted bridging capital (β=.06, ns) nor bonding capital (β=.09, ns). Overall, our path model explained 31% of the variance in bridging (R^2=.31), and 26% (R^2=.26) of the variance in bonding capital.

4.7.3. How In-Game Relationships are Associated with Psychological Well-Being

We hypothesized that the qualities of social relationships would be associated with the psychological well-being of players. As indicators for psychological well-being, we measured loneliness and the satisfaction of relatedness.

The path analysis showed that bridging capital was negatively associated with Loneliness (β=-.31, p<.01) and positively with Relatedness (β=.42, p<.01). Bonding capital significantly predicted Loneliness (β=-.17, p<.01), but not Relatedness (β= .03, ns). Overall, bridging and bonding social capital in games explained 18% (R^2=.18) of the variance in overall loneliness and 19% (R^2=.19) of the variance in overall need satisfaction of relatedness.

4.8. Discussion

We summarize the results, present implications for theory and design, and discuss limitations and future opportunities.

4.8.1. Summary of the Results

In this section, we summarize and interpret our findings in regard to our two research questions: What are experiences within games that foster social ties? What is the relationship between in-game social ties and psychological well-being?

4.8.1.1. Antecedents of In-Game Relationships

As we aim to inform design, the present study did not focus on properties of the player (e.g., motivation [177], frequency [46,106]) to predict social capital, but rather focused on the properties of play within the game. Based on game research, we hypothesized three aspects of play that would affect social ties: *Interdependence* – the degree to which players affect each other during gameplay, *Cooperation* – the degree of working towards a shared goal, and *Toxicity* – the degree of exposure to antisocial and hostile behavior.

As expected, interdependence was positively associated with bridging and bonding ties. Similarly, toxicity was negatively associated with bridging and bonding ties. Surprisingly, cooperation did not predict social capital. The non-significance of cooperation stands in stark contrast to common wisdom on social play. Our findings suggest that players do not need to work toward the same goal to form social bonds. Meanwhile, interdependence and a benevolent atmosphere are experiences within games that appear to foster social ties. Relationships are affected by a multitude of factors (e.g., personality, motivations, or circumstance). That our model explains 32% of the variance in bridging and 26% of variance in bonding shows how relevant interdependence and toxicity are for forming social ties in games [57].

These findings contribute to our understanding of in-game relationships in two ways. First, they provide insights into what specific aspects of games facilitate social bonds between players. We can now differentiate games based on interdependence and toxicity to better understand how they generate social capital. Second, designers who wish to create game environments that foster strong social communities can use these insights to enhance social capital between players.

4.8.1.2. In-Game Relationships and Well-Being

Our findings address concerns of the social effects that in-game relationships have on players' psychological well-being. Following previous studies on social relationships in games, we

operationalized the qualities of in-game relationships using the constructs of bridging and bonding ties. As outcome variables, we used established scales measuring loneliness as well as the psychological need satisfaction of relatedness. We found that the degree to which players form bridging and bonding ties within their game community was negatively associated with how lonely they feel. Bridging ties were also positively linked to the satisfaction of relatedness. Interestingly, the bonding ties were not associated with need satisfaction of relatedness, raising the question of how the two seemingly similar constructs of loneliness and relatedness differ in their link to bonding ties. Our model explains 18% of the variance in loneliness and 19% of the variance in relatedness with in-game social capital as predictors. Considering how complex and multifactorial feelings of loneliness and relatedness are, the observed effect sizes are surprisingly large [57]. According to our findings, in-game social ties players form are strongly connected to their psychological well-being.

The results of our statistical model were echoed in what we found in the written responses. Our participants described deep and meaningful bonds, which provide support even beyond the game.

> *"There was a time where i was very alone, and the social aspect of a game (not path of exile) and games in general, helped me to cope. I found people with like minds and similar problems, and it really saved me, i think." – Path of Exile*

Our respondents often acknowledged that in-game relationships work very differently, but emphasized how the emotional payoffs are comparable.

> *"They are very similar from an emotional perspective. We can hang out and laugh, tell stories and just be real with each other just like the people I hang out with in person." – NHL 2017*

Overall our structural equation model indicates that, depending on how they play, players build social capital in games, which is substantially linked to positive effects on their psychological well-being. Based on the data presented in the current study, we cannot make the causal claim that in-game social capital *leads to* psychological well-being. There is, however, a clear association between the constructs.

4.8.2. Implications for Design

Our findings allow us to make some statements about design decisions for games, aiming to enhance social interaction and player communities.

4.8.2.1. The (Ir)relevance of Cooperation

Surprisingly, cooperation was not predictive of social capital. This stands in stark contrast to previously-held beliefs stated by many researchers [52,135,161,209]. Design recommendations for collaborative play have pointed to cooperation as highly important [135,161,209]. Similarly, studies on team building [52] as well as social facilitation between strangers online [32,37] have suggested that cooperation would be crucial to the effective formation of relationships. The findings of this study, however, suggest that experiencing cooperative play is not essential to forming social capital. Many of our participants reported playing a competitive game such as online *chess, Mario Kart,* or *Hearthstone,* while still holding close ties with the people they play with. Others engaged with their friends through games, which can be played both cooperatively as well as competitively, such as *FIFA17, Minecraft,* or *Counter-Strike.* These are examples in which competition does not seem to be detrimental to relationship formation.

We offer three explanations for the contrast between our findings and the commonly-held beliefs about the importance of cooperation: First, many studies advocating the use of cooperation only *assume* its importance based on theoretical grounds (e.g., [52,135,161,209]). Second, the studies investigating collaborative play mostly conflate cooperation with interdependence [32,39,135]. Cooperation as a game mechanic has very rarely been disentangled from interdependence and systematically compared to the effects of competition. However, the one study that found cooperation, controlling for interdependence, to be beneficial to trust formation [39] stands in contrast to our findings. A third possible explanation might be related to the phase of relationship formation. The experimental setting of Depping et al.'s [39] work investigated brief interactions between strangers, while the current study is investigating established communities. Cooperation might be important in early relationship formation but grow less important as relationships develop. Nonetheless, our findings challenge the common wisdom that multiplayer games need to be cooperative to facilitate relationship formation.

4.8.2.2. Designing for Friendship

Our findings suggest some recommendations for multiplayer games. Overall, game designers who wish to facilitate the creation of social bonds should focus on creating games featuring highly interdependent play, with or without competition, with communities that are low in toxicity.

Interdependent play can be designed through the use of game mechanics that induce dependency and a need for interaction between players. For example, asymmetric abilities, asymmetric knowledge [72], synergies between abilities [161], or reinforcing the concepts of roles [52,161] can all lead to increased interdependence. Social Interdependence Theory [99] proposes that interdependence is beneficial for social ties because it forces people to interact. Previous findings have shown that the positive effect of interdependence on social bonds in games is mediated by the amount of conversation between the players [39]. Interdependence should therefore always be accompanied by sufficient communication channels to enable the players to interact and coordinate.

The absence of cooperation as an important factor in social facilitation opens up a largely unexplored field of possibilities for game designers. Competition has so far been avoided as a method to facilitate social relationships; however, pitting one player against another is an inherently interdependent experience. Exploring competition as a means to facilitate social relationships vastly expands the possible design space of interdependent games for facilitating social bonds.

Any time players interact with one another, there is the possibility that the interactions lead to toxic behavior. There are many well-known consequences of this behavior. It harms the player experience [58,112], reduces performance [112], can lead to bullying [112,146,206], and can cause a player to quit playing entirely [190]. We additionally find that even if a player is willing to tolerate toxicity, it will still affect the quality of social bonds they form within the game.

Too often, the response to toxicity is simply to disable communication channels – the same channels that could be used to facilitate social relationships [39]. For example, many competitive team games do allow players to interact with one another, but only with teammates (e.g., *Clash of Clans*). Even if a game does allow communication with opponents, it may be disabled by default (e.g., *League of Legends*), or the interaction may be restricted to only a handful of pre-programmed phrases (e.g., *Mario Kart 8*). While preventing competitors from communicating may effectively combat toxicity, it does so at the cost of simultaneously preventing interactions that might lead to valuable social ties. In addressing the toxicity of game environments, designers can consider the possible value of competitive interactions and should find innovative ways to prevent toxic behavior without sacrificing the benefits of in-game communication. It is important to acknowledge that toxicity in games is a very different, in most cases worse, experience for women

than it is for men [30]. In the confines of this study, we did not investigate gender differences in the relationship between toxicity and social capital. These differences do however need to be addressed in future work to avoid implementing mechanics that inadvertently discriminate based on gender.

4.8.3. Implications for Theory

In addition to informing the design of games and game environments, our work has several implications for theory.

4.8.3.1. Scope and Generalizability

We recruited our sample from a general audience on Mechanical Turk. This recruitment approach provided us with a sample diverse in gender and age: 32% of our participants were female and the average age was 32, an age distribution echoing general industry statistics on gamer age [53]. In comparison, another study [186] recruiting participants through an eSports platform reported 3.2% female participants and an average age of 19 years. The gaming communities we investigated in this study spanned over 95 different games from *World of Warcraft* and *Counter-Strike* to *Words with Friends* or online *Chess*. We also did not focus our investigation on hard-core eSport gamers or fan communities of specific games. Our results are based on a diverse set of contemporary games, with a representative population of gamers. The findings in this study may lack specificity to one game; however, they are ecologically valid and generalizable to a wide range of games. This approach helps advance our understanding of social ties in games by moving beyond the often-researched guilds in *World of Warcraft*.

4.8.3.2. 'Weak' Ties?

As games are becoming more popular, concerns have been raised about the effect of games on the mental health and well-being of players. While the stereotype of the 'antisocial, socially-isolated gamer' has been debunked [46,107,171], concerns about the social effects of digital gaming remain. For example, a recent study found that social online gameplay corresponds with smaller and lower quality offline social circles [106]. According to social displacement theories [110], this trend is concerning because in-game friendships are supposedly an impoverished, lesser version of 'real'

friendships. As previously mentioned, early studies on social interaction in *World of Warcraft* [181] and *Second Life* [84] have supported the notion that while games might be social, they predominantly promote bridging social capital, referred to as 'weak ties' [50,181]. Similarly Shen & Williams explain the above mentioned 'communication paradox', the fact that increased communication in game was associated with decreased well-being, with the notion that in-game ties tend to be 'shallower' bridging ties rather than rich offline bonding ties [177]. The present study adds to a body of work [186] challenging this notion.

Caring relationships are essential for our well-being because they provide us with social support and satisfy our basic human need to belong and relate to others [35]. How valuable and nourishing a relationship is to our psychological well-being should therefore be evaluated by how well it satisfies our emotional needs. Our findings demonstrate how strongly in-game social capital is associated with reduced feelings of loneliness and higher satisfaction of relatedness. Interestingly, bridging ties in particular appear to be a strong predictor in our model, challenging the idea that these ties are too shallow to be related to well-being. Bonding ties strongly correlate with feelings of relatedness, however do not significantly predict relatedness in our path model. As bridging and bonding ties are correlated, this discrepancy might be an artifact of collinearity [65]. We therefore restrain ourselves from interpreting the differences between bridging and bonding and their link to well-being outcomes. We can, however, state that in-game social ties, including bridging ties, are strongly associated with player well-being.

4.8.4. Limitations and Future Work

While our findings contribute to our understanding of social relationships in games, there are limitations and possible future directions we would like to address.

First, it is important to acknowledge that we cannot make statements on the direction of causality in our statistical model. We hypothesize that experiences of interdependence or toxicity during play *lead to* social capital. One might also argue that players with strong social ties might be more inclined to play interdependently and less inclined to exhibit toxic behavior. However, previous findings using random experimental assignment have shown that the aspects of play we studied (e.g., interdependence) affect social closeness between players [37,39]. Therefore, we have grounds to argue similar directionality of effects in our model. We cannot, however, exclude the

possibility of both effects being at work simultaneously. The relationship between in-game social capital and our indicators for well-being is unclear. It is, for example, possible that inherently sociable personalities generally feel less lonely and more related and due to their socially inclined personality, also generate more social capital within games. Longitudinal analyses on the social benefits of in-game relationships could further explain the directions of causality of our findings. Statistically controlling for possible tertiary variables, such as personality could additionally provide more depth in explanation.

Second, our analysis did not investigate different origins of relationships as a moderator, which promises to reveal interesting differences for future work. We observe that our dataset consists of preexisting relationships that were brought into the game as well as ones that originated online. The previous literature discusses how these two types of in-game relationships differ in depth and closeness [199]. Other findings suggest that relationship types have moderating effects on the way social capital is developed [194]. Future analysis using origin as a moderating variable might reveal interesting differences between relationship formation and relationship maintenance in games.

Third, our investigation of social capital remains at the level of general social closeness, rather than teasing out the differences between bridging and bonding. Previous research has proposed differences in bridging and bonding in games [181,198,200]. Our results suggest different effects on bridging and bonding in terms of the satisfaction of relatedness and future research could investigate how they differentially affect psychological well-being.

Finally, the qualitative responses in our survey were incredibly rich in information and deserve to be further analyzed in future work. Themes that emerged from our survey responses touched on many interesting topics (e.g., ‘the ability to be oneself online’, ‘finding similar minded people’, ‘seeking support for offline problems’). Thematic analysis could expose the different values player derive from in-game ties, further broadening our understanding of how in-game friendships foster psychological well-being.

4.9. Conclusion

As social multiplayer online games increasingly become a forum for social interactions, we have to better understand how we can design games that satisfy the social needs of players. The present

study contributes to our knowledge of social play – when in-game friendships develop, and how they affect well-being. First, we provide insights into what properties of play foster or threaten the formation of social capital in games. While we identify interdependence and toxicity as important properties of social play, cooperation appears to be less crucial than common wisdom suggests. Second, we demonstrate how social capital in games is associated with reduced feelings of loneliness and increased satisfaction of relatedness. Our findings suggest that social capital in games is strongly and positively related to the well-being of players.

The present study provides novel and generalizable insights on how to better design games that foster strong social communities. We also contribute to the ongoing debate about gaming as a potentially problematic behavior. It is easy to disregard in-game relationships, as they are fundamentally distinct from the in-person ones we think of as natural. We add to an emerging body of work demonstrating that in-game friendships appear to have very real and positive effects on well-being. Rather than being perceived as a threat, online social play could be viewed as an opportunity to enhance psychological well-being. The present study provides an empirically-supported model than informs the design of social games.

5. Overall Discussion

Each manuscript already contains a discussion of the results. This chapter therefore only briefly summarizes the main findings of each manuscript and then moves on to the lessons learned from this research regarding methodology and our three research questions.

5.1. Review of the Work in this Dissertation

In this section of the discussion, we briefly present the key findings of each manuscript.

5.1.1. Summary of Manuscript A

The goal of manuscript A was to investigate whether or not games are a legitimate option for fostering interpersonal trust in distributed teams. We compared a multiplayer cooperative game to a social task that was designed to facilitate casual conversation and personal information exchange – a strategy proposed by current literature on trust formation. Although both solutions helped to facilitate trust formation, our game appeared to be more effective than our social task. This was not only true for interpersonal trust but also for how much the task satisfied relational needs and how receptive/trusting the partner was perceived to be. Under ideal conditions, the social task was as effective as the game for facilitating interpersonal trust. However, the effectiveness of the social task was sensitive to characteristics of the trustor as well as to the experience of the task; for example, team members who were inherently less inclined to be trusting or didn't enjoy social tasks exhibited lower levels of trust. A similar trend was seen with the personality trait *agreeableness*. Equally interesting are the constructs that weren't changed by the task. We compared pairs that were talking about each other's preferences and personalities with pairs that talked about where to go on a game board or which tile to push. However, we did not observe any differences in involvement, affect, depth, and formality. This is consistent with literature on relational communication, which suggests that the content of a conversation is distinct from its emotional and relational components [43,197]. The results suggest that a game is as effective at fostering a relational connection between two people as a social conversation.

Considering that the conversations in these games were without any meaning or consequence to the players' lives, these results may seem surprising. One might argue that the interaction that occurs between players in online games might be considered as an impoverished form of

communication, and as a result, online games should not be effective at facilitating trust development. We present two possible explanations that are rooted in literature on trust formation and the activity of play as a social activity. First, we argue that games provide an ideal environment to simulate risk and interdependence, two contextual factors that have been associated with trust formation [163]. Second, we build on research arguing that actions within games are structurally similar to conversational turns [128]. Our results provide evidence that players occasionally verbally respond to non-verbal game moves as if following a neural flow of a conversation. Third, we argue that the robustness of games in their capability to foster trust between players may be due to the activity-based interaction, that does not rely on perils that come with content-based interactions.

5.1.2. Summary of Manuscript B

The motivational draw of video games comes from different needs they satisfy. While games can make players feel powerful, autonomous, and explorative, manuscript A demonstrates that they can also make players feel socially connected to other players.

In 2016, 54% of the most frequent gamers played socially, to bond with friends, family, or strangers through play [53]. This need is already being acknowledged by game researchers who investigate the social potential of games, as well as by the video game industry who continue to implement more multiplayer mechanics into their games. How do we design games that effectively promote social closeness between the players? We previously had a very narrow understanding of what social play should look like. The goal of manuscript B was to add a systematic and empirically evaluated approach to our understanding of the properties of play that facilitate social ties. We build on the framework described in the introduction, proposing two overarching properties of gameplay that are contributing to social facilitation through games: cooperation and interdependence. We then designed a game that allowed us to experimentally manipulate the two variables contrasting cooperation with competition and interdependence with independence. We then evaluated how the four different games affected trust development between strangers after 10 minutes of gameplay.

Our results demonstrate that cooperation and interdependence each affect the relationship between players. First we established comparability between the four versions of the game. The four

different versions of our game were identical in terms of the dramatic elements and visual design; we further established that the players' perceived competence, autonomy, and intuitiveness of controls did not differ between versions. Ensuring these similarities between the game versions allows us to more confidently attribute our results to the manipulations of cooperation and interdependence. Second, we reveal how cooperation and interdependence affect different aspects of player experience. As expected, both collaborative mechanics appear to increase the relatedness that players experience during the game. Similarly, both cooperation and interdependence increase game enjoyment. Third we confirm that cooperation (vs. competition) and interdependence (vs. independence) affect the relationship between players outside of the game. Similar to relatedness and enjoyment, we observe both mechanics separately affecting the interpersonal trust that developed between players. Informed by theory, we further offer a model as to how interdependence facilitates the relationship between players. As proposed by previous work, interdependent tasks increase the need for communication [37,40,98,99] and previous work in psychology has hypothesized that this increase in interaction between group members would be responsible for stronger social bonds between the group [16,93,94,99,163]. Our results confirm this hypothesis. The effect of interdependence on interpersonal trust is fully explained by the increased number of conversational turns between the players.

5.1.3. Summary of Manuscript C

The motivation behind this study was to transfer our previous findings into a field setting and evaluate how well cooperation and interdependence predict social capital in a naturalistic play setting with diverse communities, games and types of relationships. We added 'toxicity' as an additional predictor for social capital based on previous literature suggesting its effect on social dynamics within games. As expected, interdependence was positively associated with bridging and bonding ties. Similarly, toxicity was negatively associated with bridging and bonding ties. Surprisingly, cooperation did not predict social capital. The non-significance of cooperation stands in stark contrast to common wisdom on social play as well as our own findings in manuscripts A and B. We will further discuss this in a separate section. Our findings suggest that players do not need to work toward the same goal to form social bonds. Meanwhile, interdependence and a benevolent atmosphere are experiences within games that appear to foster social ties. Relationships

are affected by a multitude of factors (e.g., personality, motivations, or circumstance); the fact that our model explains 32% of the variance in bridging and 26% of variance in bonding shows how relevant interdependence and toxicity are for forming social ties in games [57].

Furthermore, our findings address concerns of the social effects that in-game relationships have on players' psychological well-being. Following previous studies on social relationships in games, we operationalized the qualities of in-game relationships using the constructs of bridging and bonding ties. As outcome variables, we used established scales measuring loneliness as well as the psychological need satisfaction of relatedness. We found that the degree to which players form bridging and bonding ties within their game community was negatively associated with how lonely they feel. Bridging ties were also positively linked to the satisfaction of relatedness. Interestingly, the bonding ties were not associated with need satisfaction of relatedness, raising the question of how the two seemingly similar constructs of loneliness and relatedness differ in their link to bonding ties. Our model explains 18% of the variance in loneliness and 19% of the variance in relatedness with in-game social capital as predictors. Considering how complex and multifactorial feelings of loneliness and relatedness are, the observed effect sizes are surprisingly large [57]. According to our findings, social ties players form in-game are strongly connected to their psychological well-being. The results of our statistical model were echoed in what we found in the written responses. Our participants described deep and meaningful bonds, which provide support even beyond the game.

5.2. Methodology

Throughout the three manuscripts, we made many methodological choices. Many of these decisions are described and justified in the actual manuscripts. We would like to use this section to discuss and reflect on some overarching themes that emerged throughout this research.

5.2.1. Experimental Research & Field Studies

In this dissertation, we combined two approaches to validate the framework we propose. Manuscripts A and B implemented controlled experiments comparing conditions that were designed to deliver a specific experience. In manuscript C, we moved away form an experimental setting and performed a field study. Both approaches add different layers to our validation and

allow us to make certain claims. They also come with their own set of drawbacks and limitations. The experimental approach used in manuscripts A and B allowed us to make claims regarding causality due to the randomised assignment of conditions. In manuscript A, this was important to unequivocally conclude that play can facilitate social ties. In manuscript B, randomized conditions let us attribute the effects we found to the factors we manipulated (cooperation, interdependence). The two-by-two experimental design in that study was also explicitly chosen so that we could investigate main effects and the interaction between the two factors. While the experimental setting provided us with the advantage of making causal claims while testing a controlled experience, the approach also entails drawbacks that we have to acknowledge. The experience of playing a 10-minute game with a complete stranger is an artificial one that is not representative of actual gameplay for most games. The context of an experiment in which the participants are financially motivated is also very removed from the natural setting in which players engage with games. We controlled for the duration of the relationships by matching strangers online. We also only investigate one game. Playtime, relationship duration, and the use of a singular game were all decisions that help us control for noise in our data. However, this control is also a restriction that reduces the range of generalizability of our findings to more established relationships and other games. In manuscript C, we aim to overcome these limitations by using a field study. The subject of our investigation is no longer confined by an experimental duration but investigates 'natural play'. This also includes no longer motivating the activity of play extrinsically through payment, but simply by asking participants to recall play that occurred in the past, presumably that was intrinsically motivated. We further no longer control for relationship types or game type but instead simply describe the sample on which our findings are based. Following up our experimental results with a field study allowed us to assess the strengths and weaknesses of our findings. The positive effect of interdependence on social ties appears to be a moderate effect size and robust across methods. Our initial findings on cooperation, however, appear to not be generalizable to other contexts. Were it not for the multi-method approach, we might have assumed cooperation to be always of importance. The field study approach, however, also pairs with its own set of drawbacks. Our data is a snapshot in time and relies on participants recalling experiences that might range far into the past. Participant perceptions might be prone to memory biases.

5.2.2. Measurements

The work presented in this dissertation focuses almost exclusively on measurement of specific, established constructs using psychometric scales. In order for us to answer the question we wanted to address, we were reliant on larger sample sizes. For example, in manuscript A, we wanted to investigate the interaction of our manipulations and personality traits of our participants. In order to do this in a clean way, we chose statistical procedures (i.e., moderation analyses) that required larger sample sizes. We also knew in advance which constructs we wanted to measure (e.g., trust, agreeableness, propensity to trust). Given our requirement for larger samples sizes and our clear understanding of what we wanted to measure, psychometric scales were the most obvious choice, as performing interviews with more than 100 participants would have been unrealistic. This approach, however, also means that we were not able to 'explore' the phenomenon of social play as we strictly confirmed and dis-confirmed pre-established hypotheses. There is most likely a wealth of experiences that we did not account for and are unaware of due to the restrictive nature of quantitative scales.

5.2.3. Amazon Mechanical Turk

All three papers presented in this dissertations used Amazon Mechanical Turk (MTurk) to recruit and compensate participants. The use of MTurk and other forms of internet-based behavioral research is not without criticism [25,124]. We would like to discuss some of the reasons why we chose MTurk and what our experiences were with the platform.

5.2.3.1. Subject Pool Access

One of the challenges we were anticipating was to find a large enough pool of willing participants to draw from. The experimental design of the studies conducted in manuscript A and B required us to find two participates who were available at the same time, who also didn't know each other. One of the advantages MTruk provides is stable access to a large pool of participants who are motivated to participate in studies.

5.2.3.2. Subject Pool Diversity

Another advantage MTurk provides is that its users come from a diverse background spanning over a wide range of age, ethnicity, gender, and socioeconomic status. Alternatives for recruitment

would have been recruiting from the lab participant pool or the university website, which would have provided us with a pool of undergraduate students, inherently introducing biases over most of the axes described above, most predominantly age and socioeconomic status. A diverse participant pool was important to us as we wanted our results to be generalizable to the population of gamers, who are diverse over age, gender, ethnicity and socioeconomic markers [53]. Testing at the University would have also made us vulnerable to criticism that games may only facilitate trust in young people, and that our findings would not translate to people beyond their twenties. MTurk provided us with an opportunity to broaden the generalizability of our studies beyond the population of undergraduate students. We did specify many who gets to participate in our HIT's by only allowing participants who have at least 90% rates of acceptance and are experienced MTurkers. These sampling techniques are common in MTurk to ensure quality participants. It is possible, however, that these sampling criteria have introduced biases into our data.

5.2.3.3. Low Cost and Fast Theory/Experiment Cycles

The steady and large pool of willing participants also allows for fast and cheap data collection. While we obviously compensated participants, we did not have to run experiments in our lab additionally paying lab personnel. The most beneficial aspect is, however, the speed at which data was collected. Data collection for the study in manuscript C for instance lasted less than a week. Studies in manuscripts A and B lasted longer as we needed to open smaller batches to not overburden the matchmaking and networking systems. Overall the speed and economic way of gathering many participants allows for quick cycles of theory, experimental design and then conducting the experiments. For us that meant we could run smaller batches to 'test' specific measurements or questions we asked. We did, for example, initially plan to use a behavioral measure for trust in the form of a prisoners-dilemma-type trading game after participants played one of the games in manuscript B. The trading game, however, did not work as planned, which we were able to see based on a small pilot experiment that we conducted to test the measurement. We subsequently removed the measurement for the main study.

5.2.3.4. Data Validity

One of the largest doubts we had regarding MTurk was the validity of the resulting data. We did not actually know who was participating, how much effort they would actually invest and whether

or not the measurement techniques we used (e.g., questionnaires that were validated in different settings) would still perform as intended. Literature, however, seems to suggest that the data collected on MTurk resembles data collected in other, more traditional, contexts [124]. For example, a large scale comparison between a normal internet-based sample and a MTurk sample with respect to several psychometric tests showed no significant differences and high test-retest reliability within the MTurk population [22]. Similarly, Paolacci et al. replicated a range of decision-making tasks both on MTurk and through traditional recruiting at a university [142]. They tested Tversky and Kahnemans's 'Asian disease' problem [188] to measure framing effects, the 'Linda' problem [189] to test conjunction fallacies and the 'Physician' problem [8] to test outcome biases. They found only minor differences between the testing conditions, and qualitatively the results were equivalent [142]. Generally, the literature comparing MTurk data with traditional experimental procedures suggests that MTurk data, for both psychometric scales as well as behavioral and decision making tasks, is equivalent to more traditional methods [22,124]. Similarly, we find that the psychometric scales we used performed as expected and demonstrated good internal consistencies. The decision-making task we wanted to implement as a behavioural measure for trust was an established trading game based on traditional game theory paradigms. The procedure did not work in the context of MTurk because our participants always acted pro-socially to maximize the total payoff for both partners. Further balancing in the payoff matrix might have changed this behavior. The original payoff matrix suggested by previous, non- MTurk, findings did not work in our sample. These findings suggest that there might be differences between MTurk and traditional experimental contexts regarding game theoretical paradigms. MTurkers might have felt a stronger sense of being 'observed' by us, leading to stronger social desirability of pro-social behavior, compared to traditional settings. Or perhaps they are simply more accustomed to the context of micropayments than the typical laboratory experiment participants of undergraduate students.

5.2.3.5. Context of Work

Besides a number of very valuable advantages, one drawback of this recruitment method was that Mechanical Turk is very much a context of 'work'. Participants sometimes did not initially understand that we want them to 'play' and engage hedonically with the game and the other partner.

MTurk users have a strong culture of efficiency and making as much money per hour as possible. We had to instruct participants to not multitask and perform our experiment while also performing another task. The quality of our data (and listening to the recordings of gameplay that were available) suggests that most participants complied with this, however, we cannot be absolutely certain that multitasking did not happen. Regardless of compliance the context of work is generally not an ideal setting to research 'play' and seems to subvert the hedonic mindset that players experience during natural play.

Overall, we think the advantages MTurk provided outweighed the disadvantages and made it a great choice to perform the studies presented in this dissertation.

5.3. Contribution of this Dissertation

We set out to achieve three research goals: First we wanted to identify properties of play that are likely responsible for social ties within digital games. Second, we wanted to evaluate the efficacy of these properties to make empirically-informed design recommendations. Third, we wanted to provide insight into the link between in-game relationships and general well-being. In the following sections, we discuss how well we achieved these goals and what the future directions are for research in each of these areas.

5.3.1. Identify Properties of Play that are Likely Responsible for Social Ties within Digital Games.

In this dissertation, we argue that the two most prevalent themes that emerge from the design literature are cooperation and interdependence. We furthermore provide theoretical backing from each theme drawing from social identity theory [183] and frameworks on interdependence as properties of tasks [99]. Much of the design literature we draw from recommends very specific mechanics to implement (e.g., 'asymmetric knowledge' [71,74], 'abilities that can be used on other players' [14,161]). The approach we take on the other hand, takes a few steps back and investigates more abstract, overarching themes. Clearly both of these approaches have advantages and disadvantages. What are the tradeoff between specificity and generalizability in the context of these design recommendations? A useful perspective to help distinguish these different approaches is the MDA framework [83], which we briefly describe and then apply to our question of specificity

vs generalizability.

5.3.1.1. Mechanics, Dynamics, Aesthetics

The MDA framework is a formal approach to analyze games [83]. MDA stands for *Mechanics*, *Dynamics* and *Aesthetics*. The framework proposes that we can describe games and game design based on these three layers.

Mechanics are the specific rules of a game. Mechanics are the actions and behaviours a player is afforded within the game and how the system for the game responds to these actions.

Dynamics are the experiences resulting from the mechanics of the game. Limited time (mechanic) might result in the experience of urgency. Unfavourable odds embedded in the rules (mechanic) might end in the experience of challenge.

Aesthetics refer to the mostly emotional reactions evoked by the experiences within the game. These reactions might be feelings of stress, frustration, determination, achievement, or any other feelings resulting from the game dynamics (e.g., trust or feelings of relatedness).

One of the assumptions the framework proposes is that designers and players approach a game from different directions (see Figure 10). While players predominantly experience how the game makes them feel, and upon reflection might discern the dynamics of the game, they will rarely be exposed to or systematically think about the the actual mechanics of the game. Meanwhile, designers who wish to develop a game only have control over the mechanics they implement. They will choose mechanics with the specific intention of creating a certain dynamic (e.g., time limit – urgency); however, the emotional reaction of the player is beyond their immediate control.

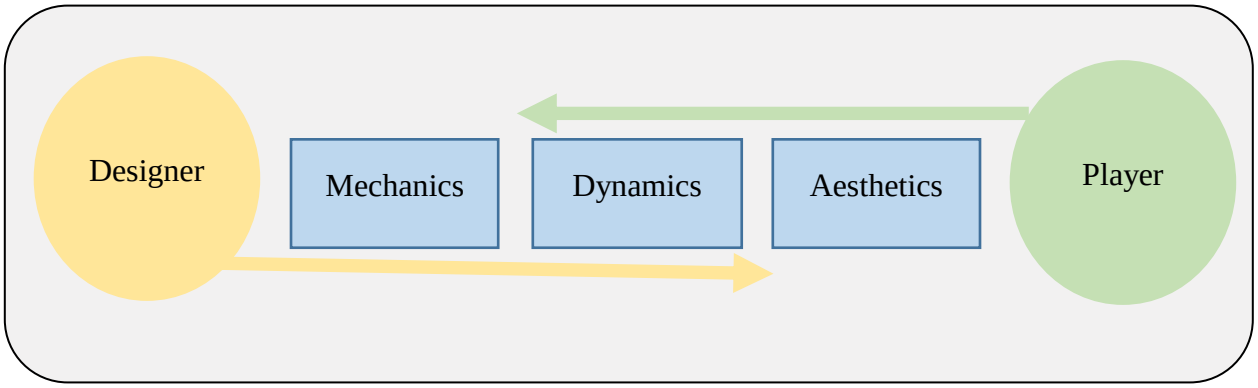


Figure 5.1: MDA Framework

Designers can only try to elicit their envisioned emotional response through the dynamics their game creates.

How does this framework apply to the question of specific and generalizable design recommendations? When mapping the design recommendations from the existing literature and the abstract properties we identify to the MDA framework, we argue that the vast majority of the existing literature describes mechanics. *Synergies*, ascribing *different abilities*, making players pick *roles* are properties that are hardcoded into the system. They are rules developers implement to elicit a specific experience; however, each mechanic in itself does not describe the intended experience. Until now we have known very little about what dynamics players should experience in a social play setting. The only recommendations given so far that constitute a 'dynamic' are related to *communication*. Communication is certainly important, as we have found in manuscript B ourselves; however, many games do not afford communication channels and still elicit strong social communities. Communication alone is insufficient to describe the dynamics games should elicit if they aim to foster social ties between players. The work in this dissertation and the framework we propose is in fact the first systematic approach to identify the *dynamics* – the experiences – that lead to social ties between players.

This contribution does not substitute, replace, or diminish the knowledge we have gained from previous literature; this framework puts our previous knowledge into focus. This dissertation provides design goals, guiding the specific design implementations we already know. Designers who wish to elicit feeling of relatedness and trust between players are recommended to aim for interdependence, cooperation, and a non-toxic environment. Specific mechanics such as roles, unique abilities, or synergies can be used, but should always lead toward interdependence between the players. Roles that do not create a need to monitor and coordinate will most likely not be effective. Shared goals, synergies between goals, shared puzzles, or special rules for players on the same team can all be used as mechanics, but should emphasize cooperation. A shared puzzle that still leaves players only looking out for their own utility and not for the group will most likely not be effective.

5.3.1.2. Limitations and Future Directions

While we did identify properties of play that are likely responsible for social ties between players,

this work is only an initial step into this direction. We would like to discuss two limitations of our findings:

First, factors of cooperation, interdependence, and the later added non-toxic environment, are three predominant factors that stood out based on previous literature; however, they are most likely not the only dynamics conducive to social experiences within play. The present work has therefore no claim to being comprehensive. Future work could aim to identify further dynamics. For example, theories on social ties in non-game environments often focus on self-disclosure as an important factor [66]. Could experiences of self-disclosure within games lead to stronger ties? Are there mechanics such as avatar customization, unique equipment, or specific types of communication abilities that would evoke a dynamic of self-disclosure?

Second, we do not address how these dynamics relate to one another. We argue that cooperation and interdependence are orthogonal constructs that are both theoretically and practically distinct, but we do not address other factors. For example, high interdependence appears to invite positive interactions, but it is also likely that being strongly affected by someone's actions can also lead to toxic behavior. Games that are famous for their toxic players, such as *League of Legends* or *Dota 2* [29], are also prime examples for interdependence. In manuscript C, we measure both experienced interdependence and experienced toxicity in participants' gaming communities and do not find a significant correlation ($r = -0.04$) between them. The instruction to think about the gaming community players already regularly play with might have biased this relationship. Extreme cases where interdependence leads to strong toxicity might have self-selected out of our sample because participants would no longer play within those circles. Future work could further investigate to what degree interdependence and toxicity are interlinked.

We also fail to address differences in group dynamics that are associated with gender. Our data in all three manuscripts consists of gender diverse subject pools. It would have possible for us to investigate moderating effects of gender on social play. As this was not the main focus of the research we neglected that possibility. Seeing that gaming is increasingly gender balanced and that toxicity often has sexist undertones future research should investigate the role of gender in social play.

5.3.2. Systematically Evaluate the Efficacy of these Properties to Make Informed Design Recommendations.

All three manuscripts deal with evaluating the efficacy of games to foster social ties. Our second research goal was to make empirically founded statements on how effectively games, more specifically our hypothesized factors of cooperation and interdependence, generate social ties between players. In the following sections we will discuss the implications of our findings, the methodological approaches we took in this work and the limitations of our findings in this area.

5.3.2.1. Implications of the Results

Each of the findings have already been discussed in each manuscript. In the following sections, we aim to point out some observations that emerge when looking at all manuscripts together in combination.

Not Just a Common Interest

A skeptical approach to social ties in games might be to argue that games are merely a common interest some people share and bond over, similarly to how people bond on online forums over their hobby of miniature train models or their passion for a TV show. Our findings, however, suggest there is more at play. In manuscript A, we demonstrate that games outperform a conversational icebreaker at fostering trust, suggesting that there are properties in the activity of play that fosters trust between strangers. Subsequently, manuscripts B and C demonstrate that the social ties formed through play are not about *whether* participants play but determined by *how* they play. These findings further suggest that it is not merely liking the same game, but actually the activity of play that is strengthening trust and social capital. 'Sharing an interest' probably adds to the social experience, but is clearly not the only factor. This substantially distinguishes games as a medium from other hobbies people pursue online.

Cooperation

The story of how cooperation affects social ties in play appears to be more complicated than we originally thought. While our findings give us a clear understanding of the reasons and pathways in which interdependence facilitates social ties, cooperation as an experience in games shows mixed results. As we have already mentioned, the relationship type might be a moderating factor.

Cooperation might simply be less important in already established relationships. In manuscript A, we discuss how games provide an ideal context in which players can rehearse trust because the systems encourage cooperation. This line of reasoning is supported by the fact that we found significant effects in manuscript B, in which participants did not know each other, however, no effects in manuscript C, in which participants described more established relationships.

The Relevance of Toxicity

Experiences of toxicity are highly associated with reduced social capital, suggesting that toxicity is a strong social inhibitor within gaming communities. These findings further demonstrate the importance of dealing with toxic behavior in games and online in general. Based on our findings, we cannot make specific recommendations to avoid toxicity; however, we can demonstrate that toxicity significantly affects the social experiences within play, which in turn appear to be associated with psychological well-being. Academically, toxicity in games is under-researched, considering how important it is to the social fabric of play.

The Importance of Informed Design

Manuscripts B and C distinguish different experiences within games, investigating *how* people play, not just *that* they play. Acknowledging these different experiences (e.g., interdependence vs. independence) appears to be useful when investigating the social ties players form in games. In manuscript B, we vary the degree of interdependence and cooperation while keeping the rest of gameplay identical. Main effects of cooperation ($F_{1,101}$=.12.00, p<.01, η^2=.11) and interdependence ($F_{1,101}$=13.47, p<.01, η^2=.12) on the dependent variable trust show moderate effect sizes. In manuscript C, our SEM predicting bridging and bonding ties explained 31% of the variance in in bridging (R^2=.31), and 26% (R^2=.26) of the variance in bonding capital. Based on our findings, we know that the majority of the explained variance can be attributed to the experienced interdependence and toxicity within the participants' gaming communities. The large amount of variance explained by the two predictors is coherent with the effect sizes we find in manuscript B. Trust, as well as social capital are both highly complex constructs, yet the predictors we use explain a surprisingly large amount of variance. These findings demonstrates how greatly the experiences within games affect the players' emotional and cognitive outcomes. Within the context of the MDA framework, this dissertation demonstrates the strong link between our proposed social dynamics

and the social aesthetics of gameplay (e.g., feelings of trust, social capital). For developers, these findings demonstrate just how important good design can be when trying to create a 'social game', further emphasizing the importance of an informed approach to game design.

5.3.2.2. Limitations and Future Directions

Regarding our systematic evaluation of the factors we proposed – cooperation, interdependence, toxicity – we discuss some of the shortcoming of this dissertations and how future work might address these.

When is Cooperation Useful?

As already discussed, we suspect cooperation to be mostly of value in early stages of relationship formation. This claim however needs to be empirically investigated. It is also possible that other moderating variables that we did not think of might affect the role cooperation plays in the context of social play. Further analysis is needed to investigate when cooperation plays a crucial role in social play and when cooperation simply does not matter.

Formation and Maintenance

The two pillars of relationships types that emerged from our data in manuscript C appear to be relationships that formed within the game and relationships that were formed face-to-face and are at least partially maintained within the game. If we want to further understand social play, a distinction between relationship formation and maintenance might be useful. Do our findings differ between these two groups? What design factors should be recommended for a game that tries to build new communities? What design factors should be recommended for a game designed to connect family members who want to stay in touch? Based on our research and the current literature, we cannot answer these questions. Future research could explicitly investigate differences between relationship formation and relationship maintenance.

Reducing Toxicity

Toxicity is a strong inhibitor for social capital in manuscript C. These findings are coherent with other results demonstrating the negative effects of toxicity on the player base [58,112]. The logical

consequence for developers is to try to implement mechanics that enhance benevolent behavior and inhibit toxicity. Based on our findings, we can however not make any statement on what mechanics might reduce toxicity. Initial correlations suggest that interdependence is not associated with toxicity; however, this relationship requires further investigation. An interesting direction might also be to investigate to what degree social capital or feelings of belonging to a community inhibit toxicity. The results in manuscript C do not allow us to make claims about casual directionality; it is therefore just as likely that social capital inhibits toxicity and not the other way around.

Qualitative Methods

As already discussed, the purely scale-based measurements prevent us from taking a more explorative approach to investigating the range of possible social experiences within contemporary gaming communities. Specifically, how the experience of cooperation, interdependence and toxicity translates to social ties might be an interesting avenue for future qualitative approaches.

5.3.3. Insights Into the Link Between In-Game Relationships and Psychological Well-being.

We have only addressed this question in the last manuscript as the link between play and well-being is difficult to investigate in an experimental setting. The field study approach, however, allowed us to investigate a cross-sectional look at social capital in gaming communities and its link to psychological well-being. In the following section, we address some of the broader ideas that extend beyond the manuscript and how they relate to future directions in game user research.

5.3.3.1. Framing of Research

In manuscript C, we argue that our approach differs from previous research because it investigates the effect of in-game relationships on the emotional payoffs for the players. Previous approaches had, for example, demonstrated the link between gaming behavior and the number of friends offline [46,106]. This approach is taken to investigate the phenomenon of *displacement* – the idea that relationships in digital contexts take away from relationships in the physical world. Displacement is an interesting topic and the research on investigating the tradeoffs between digital and non-digital relationships is a valuable contribution. However, framing research around confirming or disconfirming displacement does not contribute to our understanding of how in-game relationships

affect players emotionally; it simply confirms or disconfirms that people have different types of relationships in the digital age. Future research, in any field investigating digital relationships, should focus more on the effects to well-being than on the effects to offline relationships.

5.3.3.2. Depth of Investigation

The empirical approach we took using only established constructs, such as social capital or loneliness, allowed us to embed our findings into previous knowledge on digital relationships and well-being. It was an important step to expand our understanding of social communities and how they translate into well-being. Using established constructs and psychometric scales provided us with the construct validity we needed to make these arguments. This procedure, however, is aligned with some substantial shortcomings. As already discussed in the previous section on validating our frameworks, using psychometric scales only allowed us to investigate the constructs we measure and did not allow for exploration. The qualitative data we gathered in manuscript C promises a rich and diverse range of experiences. Future research on social communities and their link to psychological well-being would do well to investigate qualitatively how exactly in-game ties translate into well-being. Is the traditional model of superficial bridging ties and deep bonding ties even accurate in games? What are the behaviours and experiences that make players feel less lonely overall because they have in-game friends? These questions cannot be answered with the approaches we took in this dissertation.

5.3.3.3. Impact

As mentioned repeatedly in this dissertation, games have become a deeply entrenched part of many people's lives. In the US, 67% of all households own a device that is used ot play game [53]. On average each household is home to almost 2 (1.7) people who play digital games [53]. With such a far reaching popularity and salience in people's lives, game developers as well as game researchers are increasingly faced with the individual and societal impact games have. Academically, as well as politically, we are having debates about the impact of gaming in the context of addiction [10,204] and aggression [4,69], but also about the positive impact of games on mood repair [19], stress recovery [154], cognitive benefits [7,85], mental health assessment and treatment [122,123], and, of course, social aspects of psychological well-being.

The shift toward focusing on the impact a medium has as it grows in popularity is not unique to

games. Facebook started as an innocent platform for people to share pictures of their cats. Now that Facebook has 2.19 billion active monthly users worldwide [179], the developers of Facebook have to reconcile with its immense impact on their users' life satisfaction [192], what information users are exposed to [41,87], and arguably even US democratic elections [86]. With the immense popularity of Facebook also comes a sense of responsibility over how the technology affects its users outside of the website.

We would argue that the same responsibility applies to the medium of games and the people who develop and research them. As games touch so many people's lives, one could make the moral argument that we 'should' formalize and reinforce our approach to understanding the impact of games. The above mentioned MDA framework [83] investigates *mechanics*, *dynamics*, and *aesthetics* as the fundamental pillars of gameplay. All three properties are experiences that happen within the game. The framework does not account for long-term effects on behavioral, cognitive, or emotional effects outside the confines of the game. The above-mentioned research on impact of gaming cannot be placed within the MDA framework. Given the prevalence of games, perhaps it is time to add a fourth pillar to our understanding of gaming: 'Impact'.

6. Conclusion

What are the properties of play responsible for social ties between players? In this dissertation, we contribute to our knowledge of social play in three ways:

First, we combine psychological frameworks on social ties with the rich literature of design recommendations for social play. We synthesize the recommendations for social *mechanics* into two overarching *dynamics* of social play: cooperation and interdependence. We later add toxicity as a social inhibitor to the framework. These factors are not aimed to replace current design recommendations, which mainly focus on *mechanics*. Our framework illustrates the *dynamics* of social play by describing the experiences social mechanics in games should aim for. Second, we empirically support the validity and efficacy of these factors, both in an experimental setting as well as in a field setting. All three factors appear to play a fundamental role in the facilitation of social ties in games. While the roles of interdependence and toxicity appear to be just as expected, cooperation appears to not always be essential. Overall our work reveals that the social dynamics investigated in this dissertation strongly effect the social ties players formed. These findings emphasize the importance of well-informed design choices. Third we contribute to the ongoing debate about the legitimacy of in-game relationships by demonstrating that in-game social capital is positively associated with need satisfaction of relatedness and negatively associated with loneliness.

It is easy to disregard in-game relationships, as they are fundamentally distinct from the in-person ones we think of as natural. Yet we cannot ignore the emergence of digital games as a social medium. Players are increasingly looking to connect with others through play. This dissertation contributes to an emerging body of work addressing concerns about social play and its effects on social ties. The more we understand the underlying elements of social play, the better we can design games that bring people closer together.

References

1. Dominic Abrams and Michael A Hogg. 1999. *Social identity and social cognition*. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=psyh&AN=1999-02213-000&site=ehost-live

2. Dominic Abrams and Michael A Hogg. 2010. Social Identity and Self Categorization. *The SAGE Handbook of Prejudice, Stereotyping and Discrimination*, 1999: 180–193.

3. Fiona M. Alpass and S. Neville. 2003. Loneliness, health and depression in older males. *Aging and Mental Health* 7, 3: 212–216. https://doi.org/10.1080/1360786031000101193

4. Craig A Anderson, William E Deuser, and Kristina M DeNeve. 1995. Hot temperatures, hostile affect, hostile cognition, and arousal: Tests of a general model of affective aggression. *Personality and Social Psychology Bulletin* 21, 5: 434–448.

5. Craig Alan Anderson and Brad J Bushman. 2001. Effects of violent video games on aggressive behavior, aggressive cognition, aggressive affect, physiological arousal, and prosocial behavior: a meta-analytic review of the scientific literature. *Psychological science* 12, 5: 353–9. https://doi.org/10.1111/1467-9280.00366

6. Rafael Ballagas, Hayes Raffle, and others. 2013. Reading, Laughing, and Connecting with Young Children. In *Connecting Families*. Springer, 159–172.

7. Pauline L Baniqued, Michael B Kranz, Michelle W Voss, Hyunkyu Lee, Joshua D Cosman, Joan Severson, and Arthur F Kramer. 2014. Cognitive training with casual video games: points to consider. *Frontiers in psychology* 4: 1010.

8. Jonathan Baron and John C Hershey. 1988. Outcome bias in decision evaluation. *Journal of personality and social psychology* 54, 4: 569.

9. Roy F. Baumeister and Mark R. Leary. 1995. The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin* 117, 3: 497–529. https://doi.org/10.1037/0033-2909.117.3.497

10. Anthony M Bean, Espen Aarseth, Huub Boonen, Michelle Colder Carras, Mark Coulson, Dimitri Das, Jory Deleuze, Elza Dunkels, Johan Edman, Christopher J Ferguson, Maria C.

Haagsma, Karin Helmersson Bergmark, Zaheer Hussain, Jeroen Jansz, Daniel Kardefelt-Winther, Lawrence Kutner, Patrick Markey, Rune Kristian Lundedal Nielsen, Nicole Prause, Andrew Przybylski, Thorsten Quandt, Adriano Schimmenti, Vladan Starcevic, Gabrielle Stutman, Jan Van Looy, and Antonius J. Van Rooij. 2017. Scholars' open debate paper on the World Health Organization ICD-11 Gaming Disorder proposal. *Journal of Behavioral Addictions* 6, 3: 267–270. https://doi.org/10.1556/2006.5.2016.088

11. Martin Beer, Frances Slack, and Gillian Armitt. 2003. Community building and virtual teamwork in an online learning environment. In *System Sciences, 2003. Proceedings of the 36th Annual Hawaii International Conference on*, 9--pp.

12. Karl Bergström, Staffan Björk, and Sus Lundgren. 2010. Exploring aesthetical gameplay design patterns. In *Proceedings of the 14th International Academic MindTrek Conference on Envisioning Future Media Environments - MindTrek '10*, 17. https://doi.org/10.1145/1930488.1930493

13. Karl Bergström, Staffan Björk, and Sus Lundgren. 2010. Exploring aesthetical gameplay design patterns: camaraderie in four games. In *Proceedings of the 14th International Academic MindTrek Conference: Envisioning Future Media Environments*, 17–24.

14. Anastasiia Beznosyk, Peter Quax, Wim Lamotte, and Karin Coninx. 2012. The effect of closely-coupled interaction on player experience in casual games. In *International Conference on Entertainment Computing*, 243–255.

15. Max V Birk, Benjamin Buttlar, Jason T Bowey, Susanne Poeller, Shelby C Thomson, Nicola Baumann, and Regan L Mandryk. 2016. The Effects of Social Exclusion on Play Experience and Hostile Cognitions in Digital Games. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*, 3007–3019.

16. Nathan Bos, Judy Olson, Darren Gergle, Gary Olson, and Zach Wright. 2002. Effects of four computer-mediated communications channels on trust development. In *Proceedings of the SIGCHI conference on human factors in computing systems*, 135–140.

17. R. Wayne Boss. 1978. Trust and Managerial Problem Solving Revisited. *Group & Organization Management* 3, 3: 331–342. https://doi.org/10.1177/105960117800300306

18. Jason T Bowey, Ansgar E Depping, and Regan L Mandryk. 2017. Don't Talk Dirty to Me: How Sexist Beliefs Affect Experience in Sexist Games. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*, 1530–1543.

19. Nicholas D Bowman and Ron Tamborini. 2012. Task demand and mood repair: The intervention potential of computer games. *New Media & Society* 14, 8: 1339–1357.

20. Barry Brown and Marek Bell. 2006. Play and sociability in there: Some lessons from online games for collaborative virtual environments. In *Avatars at work and play*. Springer, 227–245.

21. Penelope Brown. 2000. Technology and trust in teams. In *Research Challenges, 2000. Proceedings. Academia/Industry Working Conference on*, 15–20.

22. Michael Buhrmester, Tracy Kwang, and Samuel D Gosling. 2011. Amazon's Mechanical Turk: A new source of inexpensive, yet high-quality, data? *Perspectives on psychological science* 6, 1: 3–5.

23. Moira Burke, Cameron Marlow, and Thomas Lento. 2010. Social network activity and social well-being. *Proceedings of the 28th International conference on Human factors in computing systems*: 1909–1912. https://doi.org/10.1145/1753326.1753613

24. Michael A Campion, Gina J Medsker, and A Catherine Higgs. 1993. Relations between work group characteristics and effectiveness: Implications for designing effective work groups. *Personnel psychology* 46, 4: 823–847.

25. Krista Casler, Lydia Bickel, and Elizabeth Hackett. 2013. Separate but equal? A comparison of participants and data gathered via Amazon's MTurk, social media, and face-to-face behavioral testing. *Computers in Human Behavior* 29, 6: 2156–2160.

26. Jacob Cohen. 1968. Weighted kappa: Nominal scale agreement provision for scaled disagreement or partial credit. *Psychological bulletin* 70, 4: 213.

27. Helena Cole and Mark D Griffiths. 2007. Social interactions in massively multiplayer online role-playing gamers. *CyberPsychology & Behavior* 10, 4: 575–583.

28. Gail Corbitt, Lorraine R Gardiner, and Lauren K Wright. 2004. A comparison of team

developmental stages, trust and performance for virtual versus face-to-face teams. In *System sciences, 2004. Proceedings of the 37th Annual Hawaii International Conference on*, 8--pp.

29. Graham Corking. 5 of the most toxic communities in all of gaming. Retrieved May 20, 2018 from https://www.elecspo.com/games/5-of-the-most-toxic-communities-in-all-of-gaming

30. Amanda C. Cote. 2017. "I Can Defend Myself": Women's Strategies for Coping with Harassment while Gaming Online. *Games and Culture* 12, 2: 136–155. https://doi.org/10.1177/1555412015587603

31. Laura A Dabbish. 2008. Jumpstarting Relationships with Online Games : Evidence from a Laboratory Investigation. *Online*: 353–356. https://doi.org/10.1145/1460563.1460620

32. Laura A Dabbish. 2008. Jumpstarting relationships with online games: evidence from a laboratory investigation. In *Proceedings of the 2008 ACM conference on Computer supported cooperative work*, 353–356.

33. T. K. Das and Bing Sheng Teng. 1998. Between trust and control: Developing confidence in partner cooperation in alliances. *Academy of Management Review* 23, 3: 491–512. https://doi.org/10.5465/AMR.1998.926623

34. Partha Dasgupta and Karl-Göran Mäler. 2000. Net national product, wealth, and social well-being. *Environment and development economics* 5, 1: 69–93.

35. Edward L Deci and Richard M Ryan. 2000. The" what" and" why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological inquiry* 11, 4: 227–268.

36. Edward L Deci and Richard M Ryan. 2000. The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological inquiry* 11, 4: 227–268.

37. A.E. Depping, R.L. Mandryk, C. Johanson, J.T. Bowey, and S.C. Thomson. 2016. Trust me: Social games are better than social icebreakers at building trust. In *CHI PLAY 2016 - Proceedings of the 2016 Annual Symposium on Computer-Human Interaction in Play*. https://doi.org/10.1145/2967934.2968097

38. Ansgar E. Depping and Regan L Mandryk. 2017. Cooperation and Interdependence: How Multiplayer Games Increase Social Closeness. In *CHI PLAY 2017 - Proceedings of the 2017*

Annual Symposium on Computer-Human Interaction in Play. https://doi.org/10.1145/3116595.3116639

39. Ansgar E Depping and Regan L Mandryk. 2017. Cooperation and Interdependence: How Multiplayer Games Increase Social Closeness. In *CHI PLAY 2017 - Proceedings of the 2017 Annual Symposium on Computer-Human Interaction in Play*. https://doi.org/10.1145/3116595.3116639

40. Morton Deutsch. 1949. An experimental study of the effects of co-operation and competition upon group process. *Human relations* 2, 3: 199–231.

41. Michael A DeVito. 2017. From editors to algorithms: A values-based approach to understanding story selection in the Facebook news feed. *Digital Journalism* 5, 6: 753–773.

42. M V Dignum and Rogier M Van Eijk. 2005. Towards a model to understand the influence of trust in knowledge sharing decisions. In *Workshop on Trust AAMAS'05*.

43. James Price Dillard, Denise Haunani Solomon, and Mark T Palmer. 1999. Structuring the concept of relational communication. *Communications Monographs* 66, 1: 49–65.

44. Kurt T. Dirks. 1999. The effects of interpersonal trust on work group performance. *Journal of Applied Psychology* 84, 3: 445–455. https://doi.org/10.1037/0021-9010.84.3.445

45. Kurt T. Dirks and Donald L. Ferrin. 2001. The Role of Trust in Organizational Settings. *Organization Science* 12, 4: 450–467. https://doi.org/10.1287/orsc.12.4.450.10640

46. Emese Domahidi, Ruth Festl, and Thorsten Quandt. 2014. To dwell among gamers: Investigating the relationship between social online game use and gaming-related friendships. *Computers in Human Behavior* 35: 107–115.

47. Carsten K.W. De Dreu, Ellen Giebels, and Evert Van De Vliert. 1998. Social motives and trust in integrative negotiation: The disruptive effects of punitive capability. *Journal of Applied Psychology* 83, 3: 408–422. https://doi.org/10.1037/0021-9010.83.3.408

48. Nicolas Ducheneaut, Robert J. Moore, and Eric Nickell. 2007. *Virtual "third places": A case study of sociability in massively multiplayer games*. https://doi.org/10.1007/s10606-007-9041-8

49. Nicolas Ducheneaut, Nicholas Yee, Eric Nickell, and Robert J Moore. 2006. “ Alone Together ?” Exploring the Social Dynamics of Massively Multiplayer Online Games. *Chi 2006*, March: 407–416. https://doi.org/10.1145/1124772.1124834

50. Nicolas Ducheneaut, Nicholas Yee, Eric Nickell, and Robert J Moore. 2006. “Alone Together ?” Exploring the Social Dynamics of Massively Multiplayer Online Games. *Chi 2006*, March: 407–416. https://doi.org/10.1145/1124772.1124834

51. Mark G Ehrhart, Karen Holcombe Ehrhart, Scott C Roesch, Beth G Chung-Herrera, Kristy Nadler, and Kelsey Bradshaw. 2009. Testing the latent factor structure and construct validity of the Ten-Item Personality Inventory. *Personality and individual Differences* 47, 8: 900–905.

52. Jason B Ellis, Kurt Luther, Katherine Bessiere, and Wendy A Kellogg. 2008. Games for virtual team building. In *Proceedings of the 7th ACM conference on Designing interactive systems*, 295–304.

53. Entertainment Software Association. 2016. Essential facts 2017. *ESA Report 2017* 2016: 1–3. Retrieved from http://www.theesa.com/wp-content/uploads/2017/04/EF2017_FinalDigital.pdf

54. Franz Faul, Edgar Erdfelder, Axel Buchner, and Albert-Georg Lang. 2009. Statistical power analyses using G* Power 3.1: Tests for correlation and regression analyses. *Behavior research methods* 41, 4: 1149–1160.

55. Will Felps, Terence R Mitchell, and Eliza Byington. 2006. How, when, and why bad apples spoil the barrel: Negative group members and dysfunctional groups. *Research in organizational behavior* 27: 175–222.

56. Jinjuan Feng, Jonathan Lazar, and Jenny Preece. 2004. Empathy and online interpersonal trust: A fragile relationship. *Behaviour & Information Technology* 23, 2: 97–106.

57. Christopher J Ferguson. 2009. An effect size primer: a guide for clinicians and researchers. *Professional Psychology: Research and Practice* 40, 5: 532.

58. Cy Foo and Emi Koivisto. 2004. Defining grief play in MMORPGs: Player and developer

perceptions. *Proceedings of the 2004 ACM SIGCHI International Conference on Advances in computer entertainment technology*: 245–250. https://doi.org/10.1145/1067343.1067375

59. Maria Frostling-Henningsson. 2009. First-person shooter games as a way of connecting to people:“Brothers in blood.” *CyberPsychology & Behavior* 12, 5: 557–562.

60. Maria Frostling-Henningsson. 2009. First-person shooter games as a way of connecting to people: “brothers in blood.” *Cyberpsychology & behavior: the impact of the Internet, multimedia and virtual reality on behavior and society* 12, 5: 557–562. https://doi.org/10.1089/cpb.2008.0345

61. Tracy Fullerton. 2008. *Game Design Workshop: A Playcentric Approach to Creating Innovative Games*. https://doi.org/10.1007/s13398-014-0173-7.2

62. Kimberly Furumo and John Michael Pearson. 2006. An empirical investigation of how trust, cohesion, and performance vary in virtual and face-to-face teams. In *System Sciences, 2006. HICSS'06. Proceedings of the 39th Annual Hawaii International Conference on*, 26c--26c.

63. Kathrin Gerling, Regan L Mandryk, and others. 2014. Designing video games for older adults and caregivers.

64. Kiel M Gilleade and Alan Dix. 2004. Using frustration in the design of adaptive videogames. In *Proceedings of the 2004 ACM SIGCHI International Conference on Advances in computer entertainment technology*, 228–232.

65. Richard Goldstein. 1993. Conditioning diagnostics: Collinearity and weak data in regression.

66. Kathryn Greene, Valerian J Derlega, and Alicia Mathews. 2006. Self-disclosure in personal relationships. *The Cambridge handbook of personal relationships*: 409–427.

67. Frederik De Grove, Verolien Cauberghe, and Jan Van Looy. 2016. Development and validation of an instrument for measuring individual motives for playing digital games. *Media Psychology* 19, 1: 101–125.

68. S.M. M Grüsser, R. Thalemann, and M.D. D Griffiths. 2007. Excessive Computer Game Playing: Evidence for Addiction and Aggression? *CyberPsychology & Behavior* 10, 2: 290–292. https://doi.org/10.1089/cpb.2006.9956

69. S.M. M Grüsser, R. Thalemann, and M.D. D Griffiths. 2007. Excessive Computer Game Playing: Evidence for Addiction and Aggression? *CyberPsychology & Behavior* 10, 2: 290–292. https://doi.org/10.1089/cpb.2006.9956

70. Päivi Häkkinen. 2004. What makes learning and understanding in virtual teams so difficult? *Cyberpsychology & behavior : the impact of the Internet, multimedia and virtual reality on behavior and society* 7, 2: 201–206. https://doi.org/10.1089/109493104323024465

71. John Harris, Mark Hancock, and Stacey Scott. 2014. Beam Me'Round, Scotty!: Exploring the effect of interdependence in asymmetric cooperative games. In *Proceedings of the first ACM SIGCHI annual symposium on Computer-human interaction in play*, 417–418.

72. John Harris, Mark Hancock, and Stacey D Scott. 2015. Beam Me'Round, Scotty!: Studying Asymmetry and Interdependence in a Prototype Cooperative Game. In *Proceedings of the 2015 Annual Symposium on Computer-Human Interaction in Play*, 775–778.

73. John Harris, Mark Hancock, and Stacey D Scott. 2016. Leveraging Asymmetries in Multiplayer Games: Investigating Design Elements of Interdependent Play. In *Proceedings of the 2016 Annual Symposium on Computer-Human Interaction in Play* (CHI PLAY '16), 350–361. https://doi.org/10.1145/2967934.2968113

74. John Harris, Mark Hancock, and Stacey D Scott. 2016. Leveraging Asymmetries in Multiplayer Games: Investigating Design Elements of Interdependent Play. In *Proceedings of the 2016 Annual Symposium on Computer-Human Interaction in Play*, 350–361.

75. Francis T Hartman. 2002. The role of trust in project management. *The frontiers of project manageemnt research. Newtown Square, PA: Project Management Institute.*

76. Andrew F Hayes. 2012. PROCESS: A versatile computational tool for observed variable mediation, moderation, and conditional process modeling.

77. James D. Herbsleb, Audris Mockus, Thomas A. Finholt, and Rebecca E. Grinter. 2000. Distance, dependencies, and delay in a global collaboration. In *Proceedings of the 2000 ACM conference on Computer supported cooperative work - CSCW '00*, 319–328. https://doi.org/10.1145/358916.359003

78. Hamilton A Hernandez, Mallory Ketcheson, Adrian Schneider, Zi Ye, Darcy Fehlings, Lauren Switzer, Virginia Wright, Shelly K Bursick, Chad Richards, and T C Graham. 2014. Design and evaluation of a networked game to supportsocial connection of youth with cerebral palsy. In *Proceedings of the 16th international ACM SIGACCESS conference on Computers & accessibility*, 161–168.

79. E Tory Higgins. 1987. Self-discrepancy: a theory relating self and affect. *Psychological review* 94, 3: 319.

80. Kim Holmberg, Stefan Ek, Gunilla Wide, and Isto Huvila. 2010. Social capital in Second Life. *Online Information Review* 34, 2: 295–316. https://doi.org/10.1108/14684521011037007

81. Li-Tze Hu and Peter M Bentler. 1995. Evaluating model fit.

82. Y-TC Hung, Alan R Dennis, and Lionel Robert. 2004. Trust in virtual teams: Towards an integrative model of trust formation. In *System Sciences, 2004. Proceedings of the 37th Annual Hawaii International Conference on*, 11--pp.

83. Robin Hunicke, Marc LeBlanc, and Robert Zubek. 2004. MDA: A formal approach to game design and game research. In *Proceedings of the AAAI Workshop on Challenges in Game AI*, 1–5.

84. Isto Huvila, Kim Holmberg, Stefan Ek, and Gunilla Widén-Wulff. 2010. Social capital in second life. *Online Information Review* 34, 2: 295–316.

85. Frederick Imbeault, Bruno Bouchard, and Abdenour Bouzouane. 2011. Serious games in cognitive training for Alzheimer's patients. In *Serious Games and Applications for Health (SeGAH), 2011 IEEE 1st International Conference on*, 1–8.

86. Mike Isaac. 2016. Facebook, in cross hairs after election, is said to question its influence. *The New York Times*.

87. Susan Jacobson, Eunyoung Myung, and Steven L Johnson. 2016. Open media or echo chamber: The use of links in audience discussions on the Facebook pages of partisan news organizations. *Information, Communication & Society* 19, 7: 875–891.

88. Keith James and Jeff Greenberg. 1989. In-Group Salience, Intergroup Comparison, and Individual Performance and Self-Esteem. *Personality and Social Psychology Bulletin* 15, 4: 604–616. https://doi.org/0803973233

89. J. Jansz and Lonneke Martens. 2005. Gaming at a LAN event: the social context of playing video games. *New Media & Society* 7, 3: 333–355. https://doi.org/10.1177/1461444805052280

90. Jeroen Jansz and Lonneke Martens. 2005. Gaming at a LAN event: the social context of playing video games. *New media & society* 7, 3: 333–355.

91. Jeroen Jansz and Martin Tanis. 2007. Appeal of playing online first person shooter games. *CyberPsychology & Behavior* 10, 1: 133–136.

92. Jeroen Jansz and Martin Tanis. 2007. Appeal of playing online First Person Shooter Games. *Cyberpsychology & behavior : the impact of the Internet, multimedia and virtual reality on behavior and society* 10, 1: 133–136. https://doi.org/10.1089/cpb.2006.9981

93. Sirkka L Jarvenpaa, Kathleen Knoll, and Dorothy E Leidner. 1998. Is anybody out there? Antecedents of trust in global virtual teams. *Journal of management information systems* 14, 4: 29–64.

94. Sirkka L Jarvenpaa and Dorothy E Leidner. 1999. Communication and trust in global virtual teams. *Organization science* 10, 6: 791–815.

95. A Järvinen. 2009. Game design for social networks: interaction design for playful dispositions. *Proceedings of the 2009 ACM SIGGRAPH Symposium …* 1, 212: 95–102. https://doi.org/10.1145/1581073.1581088

96. Colby Johanson and Regan L Mandryk. 2016. Scaffolding player location awareness through audio cues in first-person shooters. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*, 3450–3461.

97. Cynthia Johnson-George and Walter C Swap. 1982. Measurement of specific interpersonal trust: Construction and validation of a scale to assess trust in a specific other. *Journal of personality and social psychology* 43, 6: 1306.

98. David W Johnson and Roger T Johnson. 1989. *Cooperation and competition: Theory and research.* Interaction Book Company.

99. David W Johnson and Roger T Johnson. 2008. Social interdependence theory and cooperative learning: The teacher's role. *The teacher's role in implementing cooperative learning in the classroom*: 9–37.

100. Tejinder K Judge and Carman Neustaedter. 2010. Sharing conversation and sharing life: video conferencing in the home. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 655–658.

101. Tejinder K Judge, Carman Neustaedter, and Andrew F Kurtz. 2010. The family window: the design and evaluation of a domestic media space. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 2361–2370.

102. Prasert Kanawattanachai and Youngjin Yoo. 2002. Dynamic nature of trust in virtual teams. *The Journal of Strategic Information Systems* 11, 3–4: 187–213.

103. Corey Lee M. Keyes. 1998. Social Well-Being. *Social Psychology Quarterly* 61, 2: 121. https://doi.org/10.2307/2787065

104. Melvin J. Kimmel and et al. 1980. Effects of trust, aspiration, and gender on negotiation tactics. *Journal of Personality and Social Psychology* 38, 1: 9–22. https://doi.org/10.1037/0022-3514.38.1.9

105. Cameron Klein, Deborah DiazGranados, Eduardo Salas, Huy Le, C Shawn Burke, Rebecca Lyons, and Gerald F Goodwin. 2009. Does team building work? *Small Group Research* 40, 2: 181–222.

106. Rachel Kowert, Emese Domahidi, Ruth Festl, and Thorsten Quandt. 2014. Social gaming, lonely life? The impact of digital game play on adolescents' social circles. *Computers in human behavior* 36: 385–390.

107. Rachel Kowert, Ruth Festl, and Thorsten Quandt. 2014. Unpopular, overweight, and socially inept: Reconsidering the stereotype of online gamers. *Cyberpsychology, Behavior, and Social Networking* 17, 3: 141–146.

108. Rachel Kowert and Julian A. Oldmeadow. 2014. Playing for social comfort: Online video game play as a social accommodator for the insecurely attached. *Computers in Human Behavior* 53: 556–566. https://doi.org/10.1016/j.chb.2014.05.004

109. Rachel Kowert and Julian A Oldmeadow. 2015. Playing for social comfort: Online video game play as a social accommodator for the insecurely attached. *Computers in human behavior* 53: 556–566.

110. Robert Kraut, Michael Patterson, Vicki Lundmark, Sara Kiesler, Tridas Mukophadhyay, and William Scherlis. 1998. Internet paradox: A social technology that reduces social involvement and psychological well-being? *American psychologist* 53, 9: 1017.

111. Birgul Kutlu, Aysun Bozanta, and Nuket Nowlan. 2013. Multi-User Virtual Environments and Serious Games for Team Building in Organizations. In *Proceedings of the Sixth International Conference on E-Learning in the Workplace (ICELW 2013). New York, USA*.

112. Haewoon Kwak, Jeremy Blackburn, and Seungyeop Han. 2015. Exploring Cyberbullying and Other Toxic Behavior in Team Competition Online Games. https://doi.org/10.1145/2702123.2702529

113. James S. Larson. 1993. The measurement of social well-being. *Social Indicators Research* 28, 3: 285–296. https://doi.org/10.1007/BF01079022

114. Robert E Larzelere and Ted L Huston. 1980. The dyadic trust scale: Toward understanding interpersonal trust in close relationships. *Journal of Marriage and the Family*: 595–604.

115. Mathias Lasgaard, Luc Goossens, and Ask Elklit. 2011. Loneliness, depressive symptomatology, and suicide ideation in adolescence: Cross-sectional and longitudinal analyses. *Journal of Abnormal Child Psychology* 39, 1: 137–150. https://doi.org/10.1007/s10802-010-9442-x

116. James M LeBreton and Jenell L Senter. 2008. Answers to 20 questions about interrater reliability and interrater agreement. *Organizational research methods* 11, 4: 815–852.

117. Sheena Lewis, Jason B Ellis, and Wendy A Kellogg. 2010. Using virtual interactions to explore leadership and collaboration in globally distributed teams. In *Proceedings of the 3rd*

international conference on Intercultural collaboration, 9–18.

118. Niklas Luhmann. 2000. Familiarity, confidence, trust: Problems and alternatives. *Trust: Making and breaking cooperative relations* 6: 94–107.

119. Robert C MacCallum, Michael W Browne, and Hazuki M Sugawara. 1996. Power analysis and determination of sample size for covariance structure modeling. *Psychological methods* 1, 2: 130.

120. Eddie Makuch. Single-Player Games Are Not Dead But The Economics Are "Complicated," Xbox Boss Says. Retrieved May 20, 2018 from https://www.gamespot.com/articles/single-player-games-are-not-dead-but-the-economics/1100-6454339/

121. Eddie Makuch. Top 10 Best-Selling Games Of 2017 Revealed In The US.

122. Regan L Mandryk, Max V Birk, Adam Lobel, Marieke van Rooij, Isabela Granic, and Vero Vanden Abeele. 2017. Games for the assessment and treatment of mental health. In *Extended Abstracts Publication of the Annual Symposium on Computer-Human Interaction in Play*, 673–678.

123. Regan Lee Mandryk and Max Valentin Birk. 2017. Toward Game-Based Digital Mental Health Interventions: Player Habits and Preferences. *Journal of medical Internet research* 19, 4.

124. Winter Mason and Siddharth Suri. 2012. Conducting behavioral research on Amazon's Mechanical Turk. *Behavior research methods* 44, 1: 1–23.

125. Roger C Mayer, James H Davis, and F David Schoorman. 1995. An integrative model of organizational trust. *Academy of management review* 20, 3: 709–734.

126. D. J. McAllister. 1995. AFFECT- AND COGNITION-BASED TRUST AS FOUNDATIONS FOR INTERPERSONAL COOPERATION IN ORGANIZATIONS. *Academy of Management Journal* 38, 1: 24–59. https://doi.org/10.2307/256727

127. Edward McAuley, Terry Duncan, and Vance V Tammen. 1989. Psychometric properties of the Intrinsic Motivation Inventory in a competitive sport setting: A confirmatory factor analysis. *Research quarterly for exercise and sport* 60, 1: 48–58.

128. Gregor McEwan, Carl Gutwin, Regan L Mandryk, and Lennart Nacke. 2012. I'm just here to play games: social dynamics and sociality in an online game site. In *Proceedings of the ACM 2012 conference on Computer Supported Cooperative Work*, 549–558.

129. Kirk McKeand. The 25 Best Co-Op Games Ever Made. 2015. Retrieved April 14, 2017 from https://www.rockpapershotgun.com/2015/06/18/best-coop-games/

130. Frederick P Morgeson and Stephen E Humphrey. 2006. The Work Design Questionnaire (WDQ): developing and validating a comprehensive measure for assessing job design and the nature of work. *Journal of applied psychology* 91, 6: 1321.

131. Jack Muramatsu and Mark S Ackerman. 1998. Computing, social activity, and entertainment: A field study of a game MUD. *Computer Supported Cooperative Work (CSCW)* 7, 1–2: 87–122.

132. B Nardi and J Harris. 2010. Strangers and friends: Collaborative play in World of Warcraft. *International Handbook of Internet Research*: 395–410. https://doi.org/10.1007/978-1-4020-9789-8

133. Maaz Nasir, Kelly Lyons, Rock Leung, Anthea Bailie, and Fred Whitmarsh. 2015. The effect of a collaborative game on group work. *Proceedings of the 25th Annual International Conference on Computer Science and Software Engineering*: 130–139. Retrieved from http://dl.acm.org/citation.cfm?id=2886464

134. Maaz Nasir, Kelly Lyons, Rock Leung, Anthea Bailie, and Fred Whitmarsh. 2015. The effect of a collaborative game on group work. In *Proceedings of the 25th Annual International Conference on Computer Science and Software Engineering*, 130–139.

135. Maaz Nasir, Kelly Lyons, Rock Leung, and Ali Moradian. 2013. Cooperative games and their effect on group collaboration. In *International Conference on Design Science Research in Information Systems*, 502–510.

136. Vincent J. Nerviano and William F. Gross. 1973. A multivariate delineation of two alcoholic profile types on the 16 PF. *Journal of Clinical Psychology* 29, 3: 371–374. https://doi.org/10.1002/1097-4679(197307)29:3<371::AID-JCLP2270290326>3.0.CO;2-F

137. Kristel M De Nobrega and Anne-F Rutkowski. 2012. Fostering group collaboration in virtual worlds. In *System Science (HICSS), 2012 45th Hawaii International Conference on*, 983–992.

138. Ray Oldenburg. 1999. The Great Good Place. *The Great Good Place*: 368. Retrieved from http://books.google.com/books?id=0aOjHGdSKLMC

139. Judith S Olson and Gary M Olson. 2000. i2i trust in e-commerce. *Communications of the ACM* 43, 12: 41–44.

140. M Orleans and M Laney. 2000. Children's computer use in the home. *Social Science Computer Review* 18, 1: 56–72.

141. Tyler Pace, Shaowen Bardzell, and Jeffrey Bardzell. 2010. The rogue in the lovely black dress: intimacy in world of warcraft. *Proceedings of the 28th international conference on Human factors in computing systems - CHI '10*: 233–242. https://doi.org/10.1145/1753326.1753361

142. Gabriele Paolacci and Jesse Chandler. 2014. Inside the Turk: Understanding Mechanical Turk as a participant pool. *Current Directions in Psychological Science* 23, 3: 184–188.

143. Dennis Patrick. Top Upcoming Co-Op Games of 2017. Retrieved April 14, 2017 from http://gameranx.com/features/id/86957/article/top-upcoming-co-op-games-of-2017/

144. Wei Peng and Julia Crouse. 2013. Playing in parallel: The effects of multiplayer modes in active video game on motivation and physical exertion. *Cyberpsychology, Behavior, and Social Networking* 16, 6: 423–427.

145. B Perry. 2008. Virtual teams now a reality: Two out of three companies say they will rely more on virtual teams in the future. *Institute for Corporate Productivity [Retrieved from http://www. pr. com/press-release/103409]*.

146. Alex Pham. 2002. Online bullies give grief to gamers. *Los Angeles Times*.

147. Rajnandini Pillai, Chester A. Schriesheim, and Eric S. Williams. 1999. Fairness perceptions and trust as mediators for transformational and transactional leadership: A two-sample study. *Journal of Management* 25, 6: 897–933. https://doi.org/10.1177/014920639902500606

148. Patricia Pizer. 2003. Social game systems: cultivating player socialization and providing alternate routes to game rewards. *Massively multiplayer game development*: 427–441.

149. Thomas W. Porter and Bryan S. Lilly. 1996. THE EFFECTS OF CONFLICT, TRUST, AND TASK COMMITMENT ON PROJECT TEAM PERFORMANCE. *International Journal of Conflict Management* 7, 4: 361–376. https://doi.org/10.1108/eb022787

150. R. D. Putnam. 1995. Bowling alone: Amercia's declining social capital. *Journal of Democracy* 6, 1: 65–79. https://doi.org/10.1353/jod.1995.0002

151. Robert D Putnam. 2001. *Bowling alone: The collapse and revival of American community*. Simon and Schuster.

152. Irene Rae, Leila Takayama, and Bilge Mutlu. 2013. In-body experiences: embodiment, control, and trust in robot-mediated communication. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 1921–1930.

153. A Raes, Marielle G Heijltjes, Ursula Glunk, and Robert A Roe. 2006. Conflict, trust, and effectiveness in teams performing complex tasks: A study of temporal patterns.

154. Leonard Reinecke. 2009. Games and recovery: The use of video and computer games to recuperate from stress and strain. *Journal of Media Psychology: Theories, Methods, and Applications* 21, 3: 126.

155. Harry T Reis, Kennon M. Sheldon, Shelly L Gable, Joseph Roscoe, and Richard M Ryan. 2000. Daily Well-Being: The Role of Autonomy, Competence, and Relatedness. *Personality and Social Psychology Bulletin* 26, 4: 419–435. https://doi.org/10.1177/0146167200266002

156. John K Rempel, John G Holmes, and Mark P Zanna. 1985. Trust in close relationships. *Journal of personality and social psychology* 49, 1: 95.

157. GA Rich. 1997. The Sales Manager as a Role Model: Effects on Trust, Job Satisfaction, and Performance of Salespeople. *Journal of the Academy of Marketing Science* 25, 4: 319–328. https://doi.org/10.1177/0092070397254004

158. Riot Games Support. 2017. Reporting a Player. Retrieved September 13, 2017 from https://support.riotgames.com/hc/en-us/articles/201752884-Reporting-a-Player

159. Sandra L. Robinson. 1996. Trust and Breach of the Psychological Contract. *Administrative Science Quarterly* 41, 4: 574. https://doi.org/10.2307/2393868

160. José Bernardo Rocha, Samuel Mascarenhas, and Rui Prada. 2008. Game Mechanics for Cooperative Games. *ZON Digital Games 2008*: 72–80. https://doi.org/10.1523/JNEUROSCI.1920-10.2010

161. José Bernardo Rocha, Samuel Mascarenhas, and Rui Prada. 2008. Game mechanics for cooperative games. *ZON Digital Games 2008*: 72–80.

162. Julian B Rotter. 1967. A new scale for the measurement of interpersonal trust. *Journal of personality* 35, 4: 651–665.

163. Ellen Rusman, Jan Van Bruggen, Peter Sloep, and Rob Koper. 2010. Fostering trust in virtual project teams: Towards a design framework grounded in a Trustworthiness ANtecedents (TWAN) schema. *International Journal of Human Computer Studies* 68, 11: 834–850. https://doi.org/10.1016/j.ijhcs.2010.07.003

164. Dan Russell, Letitia A. Peplau, and Carolyn E. Cutrona. 1980. The revised UCLA Loneliness Scale: Concurrent and discriminant validity evidence. *Journal of Personality and Social Psychology* 39, 3: 472–480. https://doi.org/10.1037/0022-3514.39.3.472

165. Daniel W. Russell. 1996. UCLA Loneliness Scale (Version 3): Reliability, validity, and factor structure. *Journal of Personality Assessment* 66, 1: 20–40. https://doi.org/10.1207/s15327752jpa6601_2

166. Richard M Ryan. 1982. Control and information in the intrapersonal sphere: An extension of cognitive evaluation theory. *Journal of personality and social psychology* 43, 3: 450.

167. Richard M. Ryan, C. Scott Rigby, and Andrew Przybylski. 2006. The motivational pull of video games: A self-determination theory approach. *Motivation and Emotion* 30, 4: 347–363. https://doi.org/10.1007/s11031-006-9051-8

168. Richard M Ryan and Edward L Deci. 2000. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American psychologist* 55, 1: 68.

169. Richard Saavedra, P Christopher Earley, and Linn Van Dyne. 1993. Complex

interdependence in task-performing groups. *Journal of Applied Psychology* 78, 1: 61–72. https://doi.org/10.1037/0021-9010.78.1.61

170. Katie Salen and Eric Zimmerman. 2004. Rules of Play: Game Design Fundamentals. *Nihon Ronen Igakkai zasshi. Japanese journal of geriatrics*: 672. https://doi.org/10.1093/intimm/dxs150

171. Diane J. Schiano, Bonnie Nardi, Thomas Debeauvais, Nicolas Ducheneaut, and Nicholas Yee. 2014. The "lonely gamer" revisited. *Entertainment Computing* 5, 1. https://doi.org/10.1016/j.entcom.2013.08.002

172. Paul H. Schurr and Julie L. Ozanne. 1985. Influences on Exchange Processes: Buyers' Preconceptions of a Seller's Trustworthiness and Bargaining Toughness. *Journal of Consumer Research 11*, 939. https://doi.org/10.1086/209028

173. Stacey D Scott, Regan L Mandryk, and Kori M Inkpen. 2002. Understanding children's interactions in synchronous shared environments. In *Proceedings of the Conference on Computer Support for Collaborative Learning: Foundations for a CSCL Community*, 333–341.

174. Magy Seif El-Nasr, Bardia Aghabeigi, David Milam, Mona Erfani, Beth Lameman, Hamid Maygoli, and Sang Mah. 2010. Understanding and evaluating cooperative games. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 253–262.

175. Adam Shapiro and Corey Lee M. Keyes. 2007. Marital Status and Social Well-Being: Are the Married Always Better Off? *Social Indicators Research* 88, 2: 329–346. https://doi.org/10.1007/s11205-007-9194-3

176. Kennon M. Sheldon and Christopher P. Niemiec. 2006. It's not just the amount that counts: Balanced need satisfaction also affects well-being. *Journal of Personality and Social Psychology* 91, 2: 331–341. https://doi.org/10.1037/0022-3514.91.2.331

177. Cuihua Shen and Dmitri Williams. 2011. Unpacking time online: Connecting internet and massively multiplayer online game use with psychosocial well-being. *Communication Research* 38, 1: 123–149. https://doi.org/10.1177/0093650210377196

178. Nicholas Shim, Ronald Baecker, Jeremy Birnholtz, and Karyn Moffatt. 2010. TableTalk Poker: an online social gaming environment for seniors. In *Proceedings of the International Academic Conference on the Future of Game Design and Technology*, 98–104.

179. Statista. Number of monthly active Facebook users worldwide as of 1st quarter 2018. Retrieved May 20, 2018 from https://www.statista.com/statistics/264810/number-of-monthly-active-facebook-users-worldwide/

180. Constance A. Steinkuehler and Dmitri Williams. 2006. Where everybody knows your (screen) name: Online games as "third places." *Journal of Computer-Mediated Communication* 11, 4: 885–909. https://doi.org/10.1111/j.1083-6101.2006.00300.x

181. Constance A Steinkuehler and Dmitri Williams. 2006. Where everybody knows your (screen) name: Online games as "third places." *Journal of Computer-Mediated Communication* 11, 4: 885–909.

182. Henri Tajfel and J C Turner. 1986. The social identity theory of intergroup behavior. *Psychology of Intergroup Relations 2nd ed.*, 7–24. https://doi.org/10.1111/j.1751-9004.2007.00066.x

183. Henri Tajfel and John C Turner. 2004. The social identity theory of intergroup behavior.

184. Martin Tanis and Tom Postmes. 2005. A social identity approach to trust: Interpersonal perception, group membership and trusting behaviour. *European Journal of Social Psychology* 35, 3: 413–424.

185. Stephanie Teasley, Lisa Covi, M S Krishnan, and Judith S Olson. 2000. How does radical collocation help a team succeed? *Proceedings of the 2000 ACM conference on Computer supported cooperative work - CSCW '00*: 339–346. https://doi.org/10.1145/358916.359005

186. Sabine Trepte, Leonard Reinecke, and Keno Juechems. 2012. The social side of gaming: How playing online computer games creates online and offline social support. *Computers in Human Behavior* 28, 3: 832–839. https://doi.org/10.1016/j.chb.2011.12.003

187. Sabine Trepte, Leonard Reinecke, and Keno Juechems. 2012. The social side of gaming: How playing online computer games creates online and offline social support. *Computers*

in Human Behavior 28, 3: 832–839.

188. Amos Tversky and Daniel Kahneman. 1981. The framing of decisions and the psychology of choice. *Science* 211, 4481: 453–458.

189. Amos Tversky and Daniel Kahneman. 1983. Extensional versus intuitive reasoning: The conjunction fallacy in probability judgment. *Psychological review* 90, 4: 293.

190. April Tyack, Peta Wyeth, and Daniel Johnson. 2016. The appeal of MOBA games: What makes people start, stay, and stop. In *Proceedings of the 2016 Annual Symposium on Computer-Human Interaction in Play*, 313–325.

191. Md Sami Uddin, Carl Gutwin, and Benjamin Lafreniere. 2016. HandMark Menus: Rapid command selection and large command sets on multi-touch displays. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*, 5836–5848.

192. Sebastián Valenzuela, Namsu Park, and Kerk F Kee. 2009. Is there social capital in a social network site?: Facebook use and college students' life satisfaction, trust, and participation. *Journal of computer-mediated communication* 14, 4: 875–901.

193. Gerben Van Der Vegt, Ben Emans, and Evert Van De Vliert. 1998. Motivating effects of task and outcome interdependence in work teams. *Group & organization management* 23, 2: 124–143.

194. Kellie Vella and Daniel Johnson. 2015. Playing Alone , Playing With Others : Differences in Player Experience and Indicators of Wellbeing. *CHI PLAY '15 Proceedings of the 2015 Annual Symposium on Computer-Human Interaction in Play*: 3–12. https://doi.org/10.1145/2793107.2793118

195. Joseph B Walther. 1995. Relational aspects of computer-mediated communication: Experimental observations over time. *Organization science* 6, 2: 186–203.

196. Joseph B Walther, Ulla Bunz, and Natalya N Bazarova. 2005. The rules of virtual groups. In *System Sciences, 2005. HICSS'05. Proceedings of the 38th Annual Hawaii International Conference on*, 51b--51b.

197. Paul Watzlawick, Janet Beavin Bavelas, and Don D Jackson. 2011. *Pragmatics of human*

communication: A study of interactional patterns, pathologies and paradoxes. WW Norton & Company.

198. Dmitri Williams. 2006. Groups and goblins: The social and civic impact of an online game. *Journal of Broadcasting & Electronic Media* 50, 4: 651–670.

199. Dmitri Williams. 2006. On and Off the 'Net: Scales for Social Capital in an Online Era. *Journal of Computer-Mediated Communication* 11, 2: 593–628. https://doi.org/10.1111/j.1083-6101.2006.00029.x

200. Dmitri Williams, Nicolas Ducheneaut, Li Xiong, Yuanyuan Zhang, Nick Yee, and Eric Nickell. 2006. From tree house to barracks: The social life of guilds in World of Warcraft. *Games and culture* 1, 4: 338–361.

201. Dmitri Williams, Nicolas Ducheneaut, Li Xiong, Yuanyuan Zhang, Nick Yee, and Eric Nickell. 2006. From Tree House to Barracks. *Games and Culture* 1, 4: 338–361. https://doi.org/10.1177/1555412006292616

202. Jeanne M Wilson, Susan G Straus, and Bill McEvily. 2006. All in due time: The development of trust in computer-mediated and face-to-face teams. *Organizational behavior and human decision processes* 99, 1: 16–33.

203. Donghee Yvette Wohn, Cliff Lampe, Rick Wash, Nicole Ellison, and Jessica Vitak. 2011. The" S" in social network games: Initiating, maintaining, and enhancing relationships. In *System Sciences (HICSS), 2011 44th Hawaii International Conference on*, 1–10.

204. World Health Organization. 2018. Gaming disorder. Retrieved April 12, 2018 from http://www.who.int/features/qa/gaming-disorder/en/

205. Toshio Yamagishi and Midori Yamagishi. 1994. Trust and commitment in the United States and Japan. *Motivation and emotion* 18, 2: 129–166.

206. Shu Ching Yang. 2012. Paths to Bullying in Online Gaming: The Effects of Gender, Preference for Playing Violent Games, Hostility, and Aggressive Behavior on Bullying. *Journal of Educational Computing Research* 47, 3: 235–249. https://doi.org/10.2190/EC.47.3.a

207. Svetlana Yarosh, Kori M Inkpen, and A J Brush. 2010. Video playdate: toward free play across distance. *SIGCHI Conference on Human Factors in Computing Systems*, 1251–1260.

208. J. P. Zagal, Jochen Rick, and Idris Hsi. 2006. Collaborative games: Lessons learned from board games. *Simulation & Gaming* 37, 1: 24–40. https://doi.org/10.1177/1046878105282279

209. José P Zagal, Jochen Rick, and Idris Hsi. 2006. Collaborative games: Lessons learned from board games. *Simulation & Gaming* 37, 1: 24–40.

210. Akbar Zaheer, Bill McEvily, and Vincenzo Perrone. 1998. Does Trust Matter? Exploring the Effects of Interorganizational and Interpersonal Trust on Performance. *Organization Science* 9, 2: 141–159. https://doi.org/10.2307/2640350

211. Zhi-Jin Zhong. 2011. The effects of collective MMORPG (Massively Multiplayer Online Role-Playing Games) play on gamers' online and offline social capital. *Computers in Human Behavior* 27, 6: 2352–2363.

212. Zhijin Zhong. 2009. The effects of MMORPG play on online and offline social capital.

213. Roxanne Zolin. 2002. Trust in cross-functional, global teams: Developing and validating a model of inter-personal trust in cross-functional global teams. *Dissertation Abstracts International, UMI*, 3048641.

214. Roxanne Zolin, Renate Fruchter, and Pamela J Hinds. 2003. Communication, trust and performance: The influence of trust on performance in A/E/C cross-functional, geographically distributed work.

215. Roxanne Zolin, Pamela J Hinds, Renate Fruchter, and Raymond E Levitt. 2004. Interpersonal trust in cross-functional, geographically distributed work: A longitudinal study. *Information and organization* 14, 1: 1–26.

Appendix A – Consent Form of Study in Manuscript A

Usask Study

the interaction lab
university of saskatchewan

Before proceeding, please read the following. You must give your consent to continue.

Title: Usask Game Study

Researcher(s): Ansgar Depping, Dr. Regan Mandryk, Department of Computer Science, University of Saskatchewan, 306-966-2327, ansgar.depping@usask.ca

Purpose(s) and Objective(s) of the Research: The purpose of this project is to investigate how strangers get to know each other in an online enviroment.

Procedures:

- In this study you will be engage in two interactive tasks with another participant over voice chat. Before and after each exercise you will be asked to fill out questionnaires.
- This study will take approximately 25 minutes to complete.

Funded by: The Natural Sciences and Engineering Research Council of Canada (NSERC).

Potential Risks and Benefits: There are no known or anticipated risks to you by participating in this research. Your participation will help us understand relationship building in an online enviroment.

Confidentiality:

- Confidentiality will be maintained throughout the study. The entire process and data will be anonymized. Data will only be presented in the aggregate and any individual user comments will be anonymized prior to presentation in academic venues.
- Only the principal researcher and her research assistants will have access to the data to ensure that your confidentiality is protected.
- Storage of Data
  - Data (including survey and interview responses, logs of computer use, and videos of interaction) will be stored on a secure password-protected server for 7 years after data collection.
  - After 7 years, the data will be destroyed. Paper data will be shredded and digital data will be wiped from hard disks beyond any possibility for data recovery.

Right to Withdraw:

- Your participation is voluntary. You may withdraw from the research project for any reason, at any time without explanation.
- Should you wish to withdraw, you may do so at any point, and we will not use your data; we will destroy all records of your data.
- Your right to withdraw data from the study will apply until the data have been aggregated (one week after study completion). After this date, it is possible that some form of research dissemination will have already occurred and it may not be possible to withdraw your data

Follow up: To obtain results from the study, please contact Ansgar Depping (ansgar.depping@usask.ca).

Questions or Concerns:

- Contact the researcher(s) using the information at the top.
- This research project has been approved on ethical grounds by the University of Saskatchewan Research Ethics Board. Any questions regarding your rights as a participant may be addressed to that committee through the Research Ethics Office ethics.office@usask.ca (306) 966-2975. Out of town participants may call toll free (888) 966-2975.

Do you give your consent?

◯ I consent

◯ I do not consent

Appendix B – Questionnaires of Study in Manuscript A

Demographics

Please answer the following questions.

What is your Gender? *(drop down menu)*

Female

Male

Other

Rather not say

What is your age? *(numeric field, min = 0, max = 100)*

How often (on average) do you play games? *(drop down menu)*

Every day

A few times per week

Once per week

A few times per month

Once a month

A few times per year

Once per year

Not at all

What genre do you play most of the time?

Action

Platform games

First Person Shooter

Beat 'em up

Adventure

Role Playing Games

Massively Multiplayer Role Playing Games

Simulation

Vehicle Simulation

Strategy

Music Games

Puzzle Games

Sport Games

Other

Ten Item Personality Inventory

I see myself as:

	Disagree strongly	Disagree	Somewhat Disagree	Neither agree nor disagree	Somewhat Agree	Agree	Agree strongly
Item	1	2	3	4	5	6	7

Extraverted, enthusiastic.	1	2	3	4	5	6	7
Critical, quarrelsome.	1	2	3	4	5	6	7
Dependable, self-disciplined.	1	2	3	4	5	6	7
Anxious, easily upset.	1	2	3	4	5	6	7
Open to new experiences, complex.	1	2	3	4	5	6	7
Reserved, quiet.	1	2	3	4	5	6	7
Sympathetic, warm.	1	2	3	4	5	6	7
Disorganized, careless.	1	2	3	4	5	6	7
Calm, emotionally stable.	1	2	3	4	5	6	7
Conventional, uncreative	1	2	3	4	5	6	7

Propensity to Trust

Below you can read a number of statements. Read each statement and rate how much you agree or disagree with it.

	Disagree strongly	Disagree	Somewhat Disagree	Neither agree nor disagree	Somewhat Agree	Agree	Agree strongly

Item	1	2	3	4	5	6	7

Most people are basically honest.	1	2	3	4	5	6	7
Most people are trustworthy.	1	2	3	4	5	6	7
Most people are basically good and kind.	1	2	3	4	5	6	7
Most people are trustful of others.	1	2	3	4	5	6	7
I am trustful.	1	2	3	4	5	6	7
Most people will respond in kind when they are trusted by others.	1	2	3	4	5	6	7

Interpersonal Trust State

Below you can read a number of statements about the partner you just interacted with. Read each statement and rate how much you agree or disagree with it.

	Disagree strongly	Disagree	Somewhat Disagree	Neither agree nor disagree	Somewhat Agree	Agree	Agree strongly
Item	1	2	3	4	5	6	7

I would expect my partner to play fair.	1	2	3	4	5	6	7
I could expect my partner to tell the truth.	1	2	3	4	5	6	7
I could count on my partner to be concerned about my welfare.	1	2	3	4	5	6	7
I would feel very uncomfortable if my partner had to make decisions, which would affect me personally.	1	2	3	4	5	6	7

I could rely on my partner to react in a positive way if I exposed my weaknesses to them.	1	2	3	4	5	6	7
I could rely on my partner to keep the promises they make.	1	2	3	4	5	6	7
I would be willing to let my partner make decisions for me.	1	2	3	4	5	6	7
My partner would be honest and truthful with me.	1	2	3	4	5	6	7
I feel like I could trust my partner completely.	1	2	3	4	5	6	7
My partner would treat me fairly and justly.	1	2	3	4	5	6	7
I feel that my partner could be counted on to help me.	1	2	3	4	5	6	7

Relational Communication Scale

Please take a moment to think about your interaction with your partner in the previous exercise. Please rate how much you agree or disagree with the following statements that describe this interaction.

	Disagree strongly	Disagree	Somewhat Disagree	Neither agree nor disagree	Somewhat Agree	Agree	Agree strongly
Item	1	2	3	4	5	6	7

My partner was intensely involved in conversation.	1	2	3	4	5	6	7
My partner found the conversation stimulating.	1	2	3	4	5	6	7
My partner showed enthusiasm while talking to me.	1	2	3	4	5	6	7
My partner acted bored.	1	2	3	4	5	6	7
My partner communicated coldness rather than warmth.	1	2	3	4	5	6	7

My partner was interested in talking to me.	1	2	3	4	5	6	7
My partner did not want a deeper relationship between us.	1	2	3	4	5	6	7
My partner was NOT attracted to me.	1	2	3	4	5	6	7
My partner created a sense of distance between us.	1	2	3	4	5	6	7
My partner acted like we were good friends.	1	2	3	4	5	6	7
My partner seemed to desire further communication.	1	2	3	4	5	6	7
My partner acted very friendly.	1	2	3	4	5	6	7
My partner tried to move the conversation to a deeper level.	1	2	3	4	5	6	7
My partner made me feel he or she was very similar to me.	1	2	3	4	5	6	7
My partner was very honest in communicating with me.	1	2	3	4	5	6	7
My partner was willing to listen to me.	1	2	3	4	5	6	7
My partner was sincere.	1	2	3	4	5	6	7
My partner was open to my ideas.	1	2	3	4	5	6	7
My partner made the interaction very formal.	1	2	3	4	5	6	7
My partner wanted the discussion to be casual.	1	2	3	4	5	6	7

Intrinsic Motivation Inventory

Reflect on the task you just engaged in and rate your agreement with the following statements.

	Disagree strongly	Disagree	Somewhat Disagree	Neither agree nor disagree	Somewhat Agree	Agree	Agree strongly
Item	1	2	3	4	5	6	7

I enjoyed this task very much.	1	2	3	4	5	6	7
Doing this task was fun.	1	2	3	4	5	6	7
I would describe the task as very interesting.	1	2	3	4	5	6	7
While doing the task, I was thinking about how much I enjoyed it.	1	2	3	4	5	6	7
This task did not hold my attention.	1	2	3	4	5	6	7
I put a lot of effort into this task.	1	2	3	4	5	6	7
It was important to me to do well at this task.	1	2	3	4	5	6	7
I tried very hard while doing the task.	1	2	3	4	5	6	7
I didn’t try very hard at doing the task.	1	2	3	4	5	6	7
I felt tense while doing the task.	1	2	3	4	5	6	7
I felt pressured while doing the task.	1	2	3	4	5	6	7
I was anxious while doing the task.	1	2	3	4	5	6	7
I was very relaxed while doing the task.	1	2	3	4	5	6	7
I think I am pretty good at this task	1	2	3	4	5	6	7
I am satisfied with my performance at this task.	1	2	3	4	5	6	7
After doing this task for a while, I felt pretty competent.	1	2	3	4	5	6	7
I am pretty skilled at this task	1	2	3	4	5	6	7
I couldn’t do this task very well.	1	2	3	4	5	6	7
I find the relationships I form in this task fulfilling.	1	2	3	4	5	6	7
I find the relationships I form in this task important.	1	2	3	4	5	6	7
I don't feel close to my interaction partner.	1	2	3	4	5	6	7

Relatedness

Reflect on the task you just engaged in and rate your agreement with the following statements.

	Disagree strongly	Disagree	Somewhat Disagree	Neither agree nor disagree	Somewhat Agree	Agree	Agree strongly
Item	1	2	3	4	5	6	7

I find the relationships I form in this task fulfilling.	1	2	3	4	5	6	7
I find the relationships I form in this task important.	1	2	3	4	5	6	7
I don't feel close to my interaction partner.	1	2	3	4	5	6	7

Debriefing

Thank you for participating in our study.

What did you think this study was about? *(open text field)*

Do you have any comments? *(open text field)*

Appendix C – Consent Form of Study in Manuscript B

Usask Study

the interaction lab
university of saskatchewan

Before proceeding, please read the following. You must give your consent to continue.

Title: Usask Game Study

Researcher(s): Ansgar Depping, Dr. Regan Mandryk, Department of Computer Science, University of Saskatchewan, 306-966-2327, ansgar.depping@usask.ca

Purpose(s) and Objective(s) of the Research: The purpose of this project is to investigate how strangers get to know each other in an online enviroment.

Procedures:

- In this study you will be engage in two interactive tasks with another participant over voice chat. Before and after each exercise you will be asked to fill out questionnaires.
- This study will take approximately 25 minutes to complete.

Funded by: The Natural Sciences and Engineering Research Council of Canada (NSERC).

Potential Risks and Benefits: There are no known or anticipated risks to you by participating in this research. Your participation will help us understand relationship building in an online enviroment.

Confidentiality:

- Confidentiality will be maintained throughout the study. The entire process and data will be anonymized. Data will only be presented in the aggregate and any individual user comments will be anonymized prior to presentation in academic venues.
- Only the principal researcher and her research assistants will have access to the data to ensure that your confidentiality is protected.
- Storage of Data
  - Data (including survey and interview responses, logs of computer use, and videos of interaction) will be stored on a secure password-protected server for 7 years after data collection.
  - After 7 years, the data will be destroyed. Paper data will be shredded and digital data will be wiped from hard disks beyond any possibility for data recovery.

Right to Withdraw:

- Your participation is voluntary. You may withdraw from the research project for any reason, at any time without explanation.
- Should you wish to withdraw, you may do so at any point, and we will not use your data; we will destroy all records of your data.
- Your right to withdraw data from the study will apply until the data have been aggregated (one week after study completion). After this date, it is possible that some form of research dissemination will have already occurred and it may not be possible to withdraw your data

Follow up: To obtain results from the study, please contact Ansgar Depping (ansgar.depping@usask.ca).

Questions or Concerns:

- Contact the researcher(s) using the information at the top.
- This research project has been approved on ethical grounds by the University of Saskatchewan Research Ethics Board. Any questions regarding your rights as a participant may be addressed to that committee through the Research Ethics Office ethics.office@usask.ca (306) 966-2975. Out of town participants may call toll free (888) 966-2975.

Do you give your consent?

◯ I consent

◯ I do not consent

Appendix D – Questionnaires of Study in Manuscript B

Demographics

Please answer the following questions.

What is your Gender? *(drop down menu)*

Female

Male

Other

Rather not say

What is your age? *(numeric field, min = 0, max = 100)*

How often (on average) do you play games? *(drop down menu)*

Every day

A few times per week

Once per week

A few times per month

Once a month

A few times per year

Once per year

Not at all

What genre do you play most of the time?

Action

Platform games

First Person Shooter

Beat 'em up

Adventure

Role Playing Games

Massively Multiplayer Role Playing Games

Simulation

Vehicle Simulation

Strategy

Music Games

Puzzle Games

Sport Games

Other

Propensity to Trust

Below you can read a number of statements. Read each statement and rate how much you agree or disagree with it.

	Disagree strongly	Disagree	Somewhat Disagree	Neither agree nor disagree	Somewhat Agree	Agree	Agree strongly
Item	1	2	3	4	5	6	7

Most people are basically honest.	1	2	3	4	5	6	7
Most people are trustworthy.	1	2	3	4	5	6	7
Most people are basically good and kind.	1	2	3	4	5	6	7
Most people are trustful of others.	1	2	3	4	5	6	7
I am trustful.	1	2	3	4	5	6	7
Most people will respond in kind when they are trusted by others.	1	2	3	4	5	6	7

Interpersonal Trust State

Below you can read a number of statements about the partner you just interacted with. Read each statement and rate how much you agree or disagree with it.

	Disagree strongly	Disagree	Somewhat Disagree	Neither agree nor disagree	Somewhat Agree	Agree	Agree strongly
Item	1	2	3	4	5	6	7

I would expect my partner to play fair.	1	2	3	4	5	6	7
I could expect my partner to tell the truth.	1	2	3	4	5	6	7
I could count on my partner to be concerned about my welfare.	1	2	3	4	5	6	7
I would feel very uncomfortable if my partner had to make decisions, which would affect me personally.	1	2	3	4	5	6	7
I could rely on my partner to react in a positive way if I exposed my weaknesses to them.	1	2	3	4	5	6	7
I could rely on my partner to keep the promises they make.	1	2	3	4	5	6	7
I would be willing to let my partner make decisions for me.	1	2	3	4	5	6	7
My partner would be honest and truthful with me.	1	2	3	4	5	6	7
I feel like I could trust my partner completely.	1	2	3	4	5	6	7
My partner would treat me fairly and justly.	1	2	3	4	5	6	7
I feel that my partner could be counted on to help me.	1	2	3	4	5	6	7

Intrinsic Motivation Inventory

Reflect on the task you just engaged in and rate your agreement with the following statements.

	Disagree strongly	Disagree	Somewhat Disagree	Neither agree nor disagree	Somewhat Agree	Agree	Agree strongly
Item	1	2	3	4	5	6	7

I enjoyed this game very much.	1	2	3	4	5	6	7
Doing this game was fun.	1	2	3	4	5	6	7

I would describe the game as very interesting.	1	2	3	4	5	6	7
While playing this game, I was thinking about how much I enjoyed it.	1	2	3	4	5	6	7
This game did not hold my attention.	1	2	3	4	5	6	7
I put a lot of effort into this game.	1	2	3	4	5	6	7
It was important to me to do well at this game.	1	2	3	4	5	6	7
I tried very hard while playing the game.	1	2	3	4	5	6	7
I didn't try very hard at playing the game.	1	2	3	4	5	6	7
I felt tense while playing the game.	1	2	3	4	5	6	7
I felt pressured while playing the game.	1	2	3	4	5	6	7
I was anxious while playing the game.	1	2	3	4	5	6	7
I was very relaxed while playing the game.	1	2	3	4	5	6	7
I am pretty skilled at this task	1	2	3	4	5	6	7
I couldn't do this task very well.	1	2	3	4	5	6	7

Player Experience of Needs Satisfaction

Reflect on the task you just engaged in and rate your agreement with the following statements.

	Disagree strongly	Disagree	Somewhat Disagree	Neither agree nor disagree	Somewhat Agree	Agree	Agree strongly
Item	1	2	3	4	5	6	7

I feel competent at the game.	1	2	3	4	5	6	7

I feel very capable and effective when playing.	1	2	3	4	5	6	7
My ability to play the game is well matched with the game's challenges.	1	2	3	4	5	6	7
The game provides me with interesting options and choices.	1	2	3	4	5	6	7
The game lets you do interesting things.	1	2	3	4	5	6	7
I experienced a lot of freedom in the game.	1	2	3	4	5	6	7
I find the relationships I form in this game fulfilling.	1	2	3	4	5	6	7
I find the relationships I form in this game important.	1	2	3	4	5	6	7
I don’t feel close to other players.	1	2	3	4	5	6	7
Learning the game controls was easy.	1	2	3	4	5	6	7
The game controls are intuitive.	1	2	3	4	5	6	7
When I wanted to do something in the game, it was easy to remember the corresponding control.	1	2	3	4	5	6	7

Debriefing

Thank you for participating in our study.

What did you think this study was about? *(open text field)*

Do you have any comments? *(open text field)*

Appendix E – Consent Form of Study in Manuscript C

Personalizing, adapting, and balancing computer games

the interaction lab
university of saskatchewan

Before proceeding, please read the following. You must give your consent to continue.

Title: Personalizing, adapting, and balancing computer games

Researcher(s):
Ansgar Depping, Ph.D. Student, Department of Computer Science, University of Saskatchewan, 306-966-2327, ansgar.depping@usask.ca
Colby Johanson, Ph.D. Student, Department of Computer Science, University of Saskatchewan, 306-966-2327, colby.johanson@usask.ca
Dr. Regan Mandryk, Professor, Department of Computer Science, University of Saskatchewan, 306-966-4888, regan@usask.ca

Purpose(s) and Objective(s) of the Research: In this study, we collect information regarding the ways you play games.

Procedures:

- In this study, you will complete a series of questionnaires asking you about yourself and the ways in which you play games in others.
- This study will take approximately 30 minutes for you to complete.

Funded by: The Natural Sciences and Engineering Research Council of Canada (NSERC).

Potential Risks and Benefits: There are no known or anticipated risks to you by participating in this research. Your participation will help us understand the ways in which people play games with others.

Confidentiality:

- Confidentiality will be maintained throughout the study. The entire process and data will be anonymized. Data will only be presented in the aggregate and any individual user comments will be anonymized prior to presentation in academic venues.
- Only the principal researcher and her research assistants will have access to the data to ensure that your confidentiality is protected.
- Storage of Data
  - Data (including survey and interview responses, logs of computer use, and videos of interaction) will be stored on a secure password-protected server for 7 years after data collection.
  - After 7 years, the data will be destroyed. Paper data will be shredded and digital data will be wiped from hard disks beyond any possibility for data recovery.

Right to Withdraw:

- Your participation is voluntary. You may withdraw from the research project for any reason, at any time without explanation.
- Should you wish to withdraw, you may do so at any point, and we will not use your data; we will destroy all records of your data.
- Your right to withdraw data from the study will apply until the data have been aggregated (one week after study completion). After this date, it is possible that some form of research dissemination will have already occurred and it may not be possible to withdraw your data

Follow up: To obtain results from the study, please contact Dr. Regan Mandryk (regan@cs.usask.ca).

Questions or Concerns:

- Contact the researcher(s) using the information at the top.
- This research project has been approved on ethical grounds by the University of Saskatchewan Research Ethics Board. Any questions regarding your rights as a participant may be addressed to that committee through the Research Ethics Office ethics.office@usask.ca (306) 966-2975. Out of town participants may call toll free (888) 966-2975.

Do you give your consent?

◯ I consent

◯ I do not consent

Appendix F – Questionnaires of Study in Manuscript C

Prescreening/ Demographics

Please answer the following questions.

What is your Gender? *(drop down menu)*

Female

Male

Other

Rather not say

What is your age? *(numeric field, min = 0, max = 100)*

How often (on average) do you play games? *(drop down menu)*

Every day

A few times per week

Once per week

A few times per month

Once a month

A few times per year

Once per year

Not at all

How much do you self-identify as a gamer on the following scale: *(slider on continuous scale)*

Not at all *(value 0)* ⟷ Gamer *(value 100)*

Do you play multiplayer games? *(forced choice)*

Yes

No

How much time of you time spent playing games is with done with others compared to playing alone? *(slider on continuous scale)*

Play Alone *(value 0)* ⟷ Play with others *(value 100)*

Considering your response to the previous question, why do you choose to play with others or by yourself? Which do you prefer? *(open text field)*

List three games that you have played recently that you enjoyed playing. *(open text field)*

Community descriptions

Name a game that you frequently play with other people. *(open text field)*

From now on, every question you answer should be with that game in mind.

When playing the game you specified, what proportion of time do you play with strangers compared to people that you have played with before? *(slider on continuous scale)*

Strangers *(value 0)* ◄——————► People you have played with before *(value 100)*

When playing the game you specified, what proportion of time do you play with people that you know from the physical world compared to people that you know only from the digital (game) world. *(slider on continuous scale)*

physical world friends only *(value 0)* ◄——————► Digital world friends only *(value 100)*

When playing the game that you specified, how many different people do you regularly play with? *(Numeric field)*

Please take a few minutes to think about and answer the next questions on this page. We are interested in understanding the unique ways people play socially, we therefore would appreciate detailed responses.

When thinking about these people that you play regularly with, how well do you know each other? *(Open field)*

Please describe the relationships that you have with people that you play with. *(Open field)*

Moving forward, we refer to the people that you play regularly with as your "game community".

Cooperation

When answering the questions, consider the game you named earlier and the community that you described.

	Disagree strongly	Disagree	Somewhat Disagree	Neither agree nor disagree	Somewhat Agree	Agree	Agree strongly
Item	1	2	3	4	5	6	7

When I play with my game community...

we are trying to achieve the same goal.	1	2	3	4	5	6	7
we are working against each other.	1	2	3	4	5	6	7
we are on the same team.	1	2	3	4	5	6	7
they are competing against me.	1	2	3	4	5	6	7
my gain is their loss.	1	2	3	4	5	6	7
they want me to succeed.	1	2	3	4	5	6	7
we are trying to defeat someone or something else.	1	2	3	4	5	6	7
it's "us" vs someone or something else.	1	2	3	4	5	6	7

Interdependence

When answering the questions, consider the game you named earlier and the community that you described.

	Disagree strongly	Disagree	Somewhat Disagree	Neither agree nor disagree	Somewhat Agree	Agree	Agree strongly
Item	1	2	3	4	5	6	7

When I play with my game community...

my gameplay is strongly affected by them.	1	2	3	4	5	6	7
they influence my gameplay.	1	2	3	4	5	6	7
I have to keep an eye on what they are doing.	1	2	3	4	5	6	7
I can effectively play the game without interacting with them.	1	2	3	4	5	6	7

I don't have to focus on what they are doing.	1	2	3	4	5	6	7
I can strongly effect their gameplay.	1	2	3	4	5	6	7
I have to interact with them a lot.	1	2	3	4	5	6	7
my success in the game strongly depends on them.	1	2	3	4	5	6	7
my performance is effected by them.	1	2	3	4	5	6	7
I don’t communicate at all with them.	1	2	3	4	5	6	7
our actions are strongly linked.	1	2	3	4	5	6	7
our in-game actions are closely tied.	1	2	3	4	5	6	7
we have to communicate to play the game effectively.	1	2	3	4	5	6	7

Toxicity

When answering the questions, consider the game you named earlier and the community that you described.

	Disagree strongly	Disagree	Somewhat Disagree	Neither agree nor disagree	Somewhat Agree	Agree	Agree strongly
Item	1	2	3	4	5	6	7

The people I play with are sometimes...

angry.	1	2	3	4	5	6	7
offensive.	1	2	3	4	5	6	7
mean.	1	2	3	4	5	6	7
good-natured.	1	2	3	4	5	6	7
sympathetic.	1	2	3	4	5	6	7

friendly.	1	2	3	4	5	6	7
hurtful.	1	2	3	4	5	6	7
toxic.	1	2	3	4	5	6	7

Social Capital

Considering the game community you have mentioned, please agree or disagree to the following statements.

	Disagree strongly	Disagree	Neutral	Agree	Agree strongly
Item	1	2	3	4	5
There are several people from my game community I trust to help solve my problems.	1	2	3	4	5
There is someone my game community I can turn to for advice about making very important decisions.	1	2	3	4	5
There is no one from my game community that I feel comfortable talking to about intimate personal problems.	1	2	3	4	5
When I feel lonely, there are several people from my game community I can talk to.	1	2	3	4	5
If I needed an emergency loan of $500, I know someone from my game community I can turn to.	1	2	3	4	5
The people I interact with from my game community would put their reputation on the line for me.	1	2	3	4	5
The people I interact with from my game community would share their last dollar with me.	1	2	3	4	5
The people I interact with from my game community would be good job references for me.	1	2	3	4	5
I do not know people from my game community well enough to get them to do anything important.	1	2	3	4	5

The people I interact with from my game community would help me fight an injustice.	1	2	3	4	5
Interacting with people from my game community makes me interested in things that happen outside of my town.	1	2	3	4	5
Interacting with people from my game community makes me want to try new things.	1	2	3	4	5
Interacting with people from my game community makes me interested in what people unlike me are thinking.	1	2	3	4	5
Talking with people from my game community makes me curious about other places in the world.	1	2	3	4	5
Interacting with people from my game community makes me feel like part of a larger community.	1	2	3	4	5
Interacting with people from my game community makes me feel connected to the bigger picture.	1	2	3	4	5
Interacting with people from my game community reminds me that everyone in the world is connected.	1	2	3	4	5
I am willing to spend time to support general my game community's activities.	1	2	3	4	5
Interacting with people in my game community gives me new people to talk to.	1	2	3	4	5
In my game community, I come in contact with new people all the time.	1	2	3	4	5

Loneliness

Indicate how often you feel the way described in each of the following statements. Select one response for each.

	Never	Rarely	Sometimes	Often
Item	1	2	3	4

I feel in tune with the people around me.	1	2	3	4
I lack companionship.	1	2	3	4
There is no one I can turn to.	1	2	3	4
I do not feel alone.	1	2	3	4
I feel part of a group of friends.	1	2	3	4
I have a lot in common with the people around me.	1	2	3	4
I am no longer close to anyone.	1	2	3	4
My interests and ideas are not shared by those around me.	1	2	3	4
I am an outgoing person.	1	2	3	4
There are people I feel close to.	1	2	3	4
I feel left out.	1	2	3	4
My social relationships are superficial.	1	2	3	4
No one really knows me well.	1	2	3	4
I feel isolated from others.	1	2	3	4
There are people who really understand me.	1	2	3	4
I am unhappy being so withdrawn.	1	2	3	4
People are around me but not with me.	1	2	3	4
There are people I can talk to.	1	2	3	4
There are people I can turn to.	1	2	3	4

Need-satisfaction of Relatedness

Please read each of the following items carefully, thinking about how it relates to your life, and then indicate how true it is for you.

	Disagree strongly	Disagree	Neutral	Agree	Agree strongly
Item	1	2	3	4	5
I really like the people I interact with.	1	2	3	4	5
I get along with people I come into contact with.	1	2	3	4	5
I pretty much keep to myself and don't have a lot of social contacts.	1	2	3	4	5
I consider the people I regularly interact with to be my friends.	1	2	3	4	5
People in my life care about me.	1	2	3	4	5
There are not many people that I am close to.	1	2	3	4	5
The people I interact with regularly do not seem to like me much.	1	2	3	4	5
People are generally pretty friendly towards me.	1	2	3	4	5

Debriefing

Thank you for participating in our study.

What did you think this study was about? *(open text field)*

Do you have any comments? *(open text field)*

Appendix G – Additional Statistics Manuscripts A

Statistics on Assumptions

The correlation matrix of dependent variables shows multiple significant correlations between dependent variables. None of the correlations exceed coefficients of .8 suggesting the absence of multicollinearity:

Correlation matrix of dependent variables

		1	2	3	4	5	6	7
1	Trust State	1	.33**	.27*	.318**	.564**	0.061	.636**
2	Involvement	.33*	1	.76**	.79**	.499**	-0.196	.344**
3	Affect	.27*	.76**	1	.614**	.43**	-0.176	.334**
4	Depth	.318**	.79**	.614**	1	.492**	-0.271	.396**
5	Receptivity	.564**	.499**	.43**	.492**	1	-0.062	.483**
6	Formality	0.061	-0.196	-0.176	-0.271	-0.062	1	0.06
7	Relatedness	.636**	.344**	.334**	.396**	.483**	0.06	1

** Correlation is significant at the .01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Table G1

The Box's M tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups. The non-significance suggest we can assume equality of covariance across conditions:

Box's Test of Equality of Covariance Matrices	
Box's M	6.329
F	1.002
df1	6
df2	29925.712
Sig.	0.422

Table G2

Skewness and Kurtosis values of our dependent variables indicate no violations of normality:

	Skewness		Kurtosis	
	Statistic	Std. Error	Statistic	Std. Error
Trust State	-0.598	0.293	0.347	0.578
Involvement	-1.043	0.293	0.882	0.578
Affect	-0.587	0.293	0.265	0.578
Depth	-0.622	0.293	0.498	0.578
Relatedness	-0.544	0.293	0.4	0.578

Table G3

Details on Exclusion of Participants

The 36 excluded participants consisted of 20 males and 16 females (age: m = 32.11, SD = 10.16, min = 20, max 69). The distribution of gender and age in the excluded participants is similar to the remaining participants. Regarding the distribution of condition in the excluded participants there is a strong tendency towards the game condition with (N= 29) in contrast to the ice breaker task (N= 7). We largely attribute increased number of non-compliant participants in the game condition to the technical difficulties participants endured in that condition. Participants were likely more frustrated and less inclined to answer the questionnaires adequately. We compensated for the skewed exclusion by gathering additional data for the game condition leading to a final data set of 35 participants in the ice breaker task and 32 participants in the game condition.

Appendix H – Additional Statistics Manuscripts B

Statistics on Assumptions

Levene's test for equal variance tests the null hypothesis that the error variance of the dependent variable is equal across groups. Levene's test is non-significant for all outcomes suggesting homogeneity of variance:

	Levene's test for equality of error variance			
	F	df1	df2	Sig.
Competence	2.256	3	101	0.086
Autonomy	2.286	3	101	0.083
Control	1.246	3	101	0.297
Relatedness	0.725	3	101	0.539
Enjoyment	1.338	3	101	0.266
Effort	1.478	3	101	0.225
Pressure	0.505	3	101	0.68
Trust	0.857	3	101	0.466

Table H1

Skewness and Kurtosis of all outcomes suggest the variables considered are within the margins of normal distribution:

	Skewness		Kurtosis	
	Statistic	Std. Error	Statistic	Std. Error
Competence	-0.89	0.236	0.802	0.467
Autonomy	-0.545	0.236	0.526	0.467
Intuitive cont	-1.092	0.236	1.171	0.467
Relatedness	-0.183	0.236	0.032	0.467
Interest	-0.846	0.236	1.083	0.467
Effort	-0.872	0.236	0.989	0.467
Pressure	-0.051	0.236	-0.927	0.467
Trust State	-0.85	0.236	0.487	0.467

Table H2

Details on Exclusion of Participants

The 33 excluded participants consisted of 18 males and 15 females (age: m = 23.51, SD =32.6, min = 1, max 100). The distribution age cannot effectively be interpreted as ages such as 1 or 100 are clearly not accurate. Exclusion was fairly even across conditions (N= 6, 10, 10, 7) resulting in remaining samples of 28, 25, 25, 27 in the conditions.