Designing for Friendship: Modeling Properties of Play, In-Game Social Capital, and Psychological Well-being

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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.

Author Keywords
Games; Multiplayer; Friendship; Social capital; Well-being

ACM Classification Keywords
K.8.0 [Personal Computing]: General - Games.

INTRODUCTION
Playing digital games has become a social experience for many players. According to the ESA [22], 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 [22]. Gameplay has been shown to often be socially motivated [26,28,35,36]—more than half of the most frequent gamers report that video games help them connect with their friends [22]. 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 [72]. Stereotypes about the antisocial, lonely gamer have long been proven to be inaccurate [42,62]. It is safe to say: Players view games as a social medium on which they want to form and maintain friendships (e.g., [11,43,66,67,72]).

A large body of literature indicates that games can provide social experiences (e.g., [16,34,66,70]); 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 [52] or inducing a need for communication [21], yet very few studies have empirically investigated the efficacy of these recommendations [16,18]. 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 [3,74]. Similarly, research has suggested that the in-game relationships players foster online do not provide any benefits to overall well-being [34,66] and might even reduce the players' social embeddedness offline [41,65]. 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 [2,14] and a lack of

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social embeddedness has been identified as a serious threat to well-being [2,64]. 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 qualitative and quantitative 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 social 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.

RELATED WORK

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 [57], '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 [57,71]. 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 [57,71]. Studies have investigated the framework of social capital in the gaming communities of *World of Warcraft* [11,66,72], *Second Life* [34], and *Counter-Strike* [35,36], and have successfully shown that relationships in games are capable of generating social capital [34,66,73] as well as civic engagement [40,50]. The general consensus appears to be that games are likely to lead to bridging ties, but are unlikely to generate bonding ties between players [34,66,72].

Antecedents of In-Game Social Ties

Literature on social ties in games provides an understanding of the social motivations of players [26,28] as well as the types of relationships they form within games [34,66,72]. 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 [19,65] of players as well as their play frequency [19,41,65]. 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 [67]. Shen & Williams measured play duration but also measured the intensity of communication [65].

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*.

Cooperation & Interdependence

Depping et al. [17] 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 [16,21,52,59,76]. Cooperation is characterized by players

working towards the same goal, in contrast to competition, in which players pursue separate or even opposing goals [18]. Goal sharing as a mechanic to facilitate social closeness has been suggested by literature investigating commercial games [59,63] and board games [76]. 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 [21,47,53]. Cooperative game mechanics have also been successfully used to facilitate social bonds between strangers online [13,16,18]. Vella et al. [69] have found that cooperating with others is positively associated with relationship formation.

Interdependence describes the level of dependence between players [18]. 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.' [38]. In games, interdependence has been referred to as 'closely coupled' play [4], 'complementarity' (specific roles in the game) [59], or as the separation of 'different abilities or responsibilities' between players [76]. Interdependence is characterized by the need to interact and coordinate with other players [18]. 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) [30–32], or complementary knowledge (i.e., players have to interact to exchange information) [21,45,47]. Research on interdependence and social facilitation has shown positive effects on team building [21,47,52] as well as on trust formation between strangers [16].

Depping et al. [18] 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 [18]. 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. [18], 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.

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 [25]. 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 [46,58]. Although the number of toxic players in a group may be relatively small [56], they can affect a large number of players [25,55]. Even a single toxic player in a group can cause group dysfunction [23]. 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 [5]. We propose a negative relationship between toxicity and in-game social capital.

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 [57,71]. 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 [29], gaming addiction as a psychological disorder [3,74], and also gaming as a socially isolating activity [19,41]. 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 [34,44,77]. Only a few studies have found a relationship between online interactions and offline social embeddedness [67], 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 [70]. Huvila et al. [34] 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. [41] 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 [19,41,44,65]. 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 'weak' bridging ties that do not provide the same level of social support provided by in-person relationships [19,34,66,70–72].

Very little research has specifically investigated the relationship between in-game social capital and indicators of psychological well-being. Shen & Williams [65] 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. [69] observe that greater amounts of play is linked to lower levels of well-being. In contrast, Trepte el al. [67] 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 social 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 understand how in-game social capital affects psychosocial 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 [60]. *Relatedness* is one of the fundamental human needs proposed by Self Determination Theory [61]. The need to relate refers to 'the desire to feel connected to others—to love and care, and to be loved and cared for' [14]. We aim to uncover if in-game social capital is associated with subjective loneliness and need satisfaction of relatedness.

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.

Hypotheses

The hypotheses we derive from the previously-presented literature can be expressed in the path model seen in Figure 1. We propose the following hypotheses:

H1: Experiences of interdependence (H1a) and cooperation (H1b) are positively associated with in-game social capital.

H2: Experiences of toxicity are negatively associated with in-game social capital.

We further aim to investigate the relationship between in-game social capital and feelings of loneliness as well as the psychological need satisfaction of relatedness.

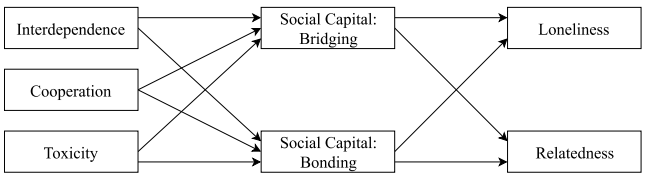

Figure 1. Hypothesized Path Model

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 [7,16,18,37], and has been demonstrated to be a reliable and valid platform to gather data [9,49,54]. We were interested in finding participants who regularly play games with others online, and so we first launched a pre-screen HIT.

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 [48] 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.

Main Study

Of those we invited, 250 completed the study, which paid $5 USD and took about 20 minutes. We removed 16 participants due to noncompliant behavior, such as an extremely quick response time or high variance in their responses [7]. 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).

Measures

We used several measures to qualify play and the relationships that are formed in multiplayer games.

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) [18]. 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 [8,51] and the theoretical groundwork of interdependence in play [18]. 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 [1]. 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 [71] to measure bridging (e.g., 'Interacting with people from my game community makes me feel like part of a larger community') and bonding (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 [60] (4-pt scale).

Relatedness. To measure overall need satisfaction of relatedness of our participants, we used the relatedness subscale from the Basic Psychological Need Satisfaction (BPNS) questionnaire [15] (5-pt scale).

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.

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.

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) [10]. 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.

		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 1. Means, SD and Correlation coefficients for variables in SEM (=p<.01, *=p<.05)**

Quantitative Data

We used a structural equation model with the AMOS 19 statistical package using the maximum likelihood method.

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*.

What Games Were Considered?

Previous studies investigating social ties in games often focused on one specific game, such as *World of Warcraft* [11,66,72], or one setting of play (e.g., eSports) [67]. 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.

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 [72]. 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 [11,66] 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.

RESULTS

The following section reports the results of our hypothesized path model (Figure 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 allowed to co-vary in our statistical model (see Figure 2). Following the model fit threshold recommendations of Hu and Bentler [33], our statistical model exhibited a good fit with our data (Table 2).

	Index	Threshold
Chi2/df	2.37	< 3 good
p-value	0.01	< .05
CFI	0.97	>.95 great; >.90 traditional
TLI	0.94	>.95 great; >.90 traditional
RMSEA	0.07	<.05 great <.10 acceptable

Table 2: Model Fit Indices

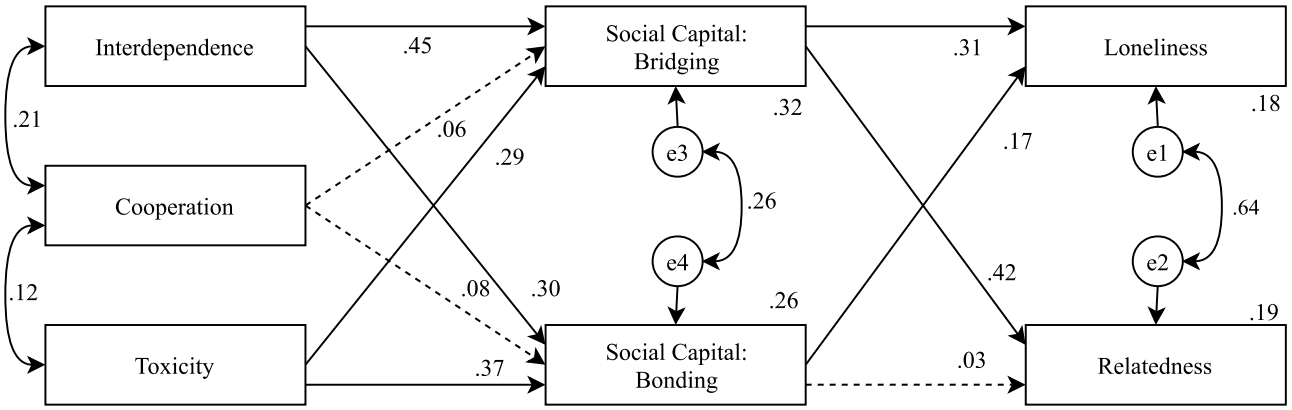

Figure 2. Standardized coefficients of the hypothesized path model (dashed lines are non-significant paths).

Fit indices were calculated with non-significant paths remaining in the model. Removal of those paths only further increased the model fit.

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 in H1a, 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 hypothesis (H2). Contrary to what we expected H1b, 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.

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.

DISCUSSION

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

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?

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 [65], frequency [19,41]) 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 [24].

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.

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 [24]. 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 that 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.

Implications for Design

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

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 [21,52,59,76]. Design recommendations for collaborative play have pointed to cooperation as highly important [52,59,76]. Similarly, studies on team building [21] as well as social facilitation between strangers online [13,16] 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 that 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., [21,52,59,76]). Second, the studies investigating collaborative play mostly conflate cooperation with interdependence [13,18,52]. 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 [18] 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 [18] 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.

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 [31], synergies between abilities [59], or reinforcing the concepts of roles [21,59] can all lead to increased interdependence. Social Interdependence Theory [39] 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 [18]. 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 [25,46], reduces performance [46], can lead to bullying [46,55,75], and can cause a player to quit playing entirely [68]. 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 [18]. 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. Previous works discusses community based 'tribunals' or machine learning approaches to detecting toxicity [6]. 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 [12]. 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.

Implications for Theory

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

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 [22]. In comparison, another study [67] 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*.

'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 [19,42,62], 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 [41]. According to social displacement theories [44], 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* [66] and *Second Life* [34] have supported the notion that while games might be social, they predominantly promote bridging social capital, referred to as 'weak ties' [20,66]. 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 [65]. The present study adds to a body of work [67] 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 [15]. 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 [27]. 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.

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 [16,18]. 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 [71]. Other findings suggest that relationship types have moderating effects on the way social capital is developed [69]. 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 [66,70,72]. 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 social well-being.

Fourth, our model only investigated three possible predictors of in-game social capital. While our statistical model explains a large portion of the variance in social capital, the three predictors we used are certainly not a comprehensive list of experiences within games that are predictive of social capital. For example, a reasonable hypothesis would be that team performance might affect the bonds formed within a group. Future work could further identify experiences in games that make players form bonds.

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.

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 social well-being. The present study provides an empirically-supported model than informs the design of social games.

APPENDIX

Items rated on a 7-pt Likert scale from "disagree strongly" to "agree strongly." * indicates that the item is reverse coded.

In-Game Cooperation: When I play with my gaming community…
*We are working against each other.**
We are on the same team.
*They are competing against me.**
*My gain is their loss.**
They want me to succeed.
It's 'us' vs someone or something else.

In-Game Interdependence: When I play with my gaming community…
My gameplay is strongly affected by them.
They influence my gameplay.
I have to keep an eye on what they are doing.
*I can effectively play the game without interacting with them.**
*I don't have to focus on what they are doing.**
I can strongly effect their gameplay.
I have to interact with them a lot.
My success in the game strongly depends on them.
My performance is effected by them.
*I don't communicate at all with them.**
Our actions are strongly linked.
Our in-game actions are closely tied.
We have to communicate to play the game effectively.

In-Game Toxicity: The people I play with are sometimes…
Angry, Offensive, Mean, Good-natured, Sympathetic*, Friendly*, Hurtful, Toxic*

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