You Teach Me and I'll Teach You: The Role of Social Interactions on Positivity Elicited From Playing Pokémon GO

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Abstract

Augmented Reality video games such as Pokémon GO have a structure that encourages face-to-face social interactions between players, leading to potentially unique benefits for positivity (positive affect). This study investigated how participants' social interactions while playing Pokémon GO relate to their positivity after gameplay, crucially, after accounting for other non-social factors typically associated with positivity (participants' satisfaction with their game accomplishments). Participants were 108 Pokémon GO players, consisting of 54 dyads who signed up for the study together. Dyads were asked to play Pokémon GO together for eight sessions over 2 weeks, and to report on their gameplay experiences and positivity after each session. Multilevel modelling analyses revealed that more positive social interactions with their gameplay partner incrementally predicted participants' greater positivity post-gameplay. The association between positive social interactions and greater positivity was accentuated for participants who reported more frequent noxious mood states (depressive symptoms) at the start of the study. Findings suggest that above and beyond typical contributions such as achieving game accomplishments, there may be affective benefits for Pokémon GO players from the social interactions they have within the game, especially for those with noxious mood states.

Introduction

There is growing recognition of the benefits that can be derived from playing video games (see Granic et al., 2014; Halbrook et al., 2019), such as less stress, better mood, and more positivity (positive affect; Hemenover & Bowman, 2018). Such affective benefits could be linked to several factors, one of which being players' social interactions within the game. The recent growth of Augmented Reality (AR) video games provides a valuable context in which to examine these questions, given that these games often have unique features that promote face-to-face social interactions, compared to traditional console-based games. The current study tested the incremental associations, beyond other common factors associated with positivity, between the quality of in-game social interactions and positivity among players of the popular AR video game Pokémon GO.

Factors That Promote Positivity in Video Games

Media consumption in general has been linked to the induction and maintenance of positivity, due to the enjoyment derived from the activity (Tamborini et al., 2011; Westermann et al., 1996; Zillmann, 1988). The Uses and Gratification Theory (UGT; Ruggiero, 2000) provides a useful framework from which to understand the mechanisms underlying this process. The UGT suggests that users interacting with media are active participants with specific motivations and hopes of meeting a particular need. To the extent that interactions with media satisfy these needs, this is thought to lead to increased positivity and well-being.

While the UGT framework has been applied to forms of passive media consumption such as television viewing (Ruggiero, 2000), the dynamic aspects of video games may expand the ways in which users' needs can be met and to what extent. For example, one important need that players likely have is for feelings of competence and mastery (Hemenover & Bowman, 2018), which have been shown to lead to positivity when fulfilled (Schutte & Malouff, 2021). Unlike those passively viewing television, video game players can gain a sense of competence through achieving quick and accessible goals in the virtual world—also referred to as gameplay accomplishments.

Another need for players may be engagement and interest, which may be particularly useful for reduction of boredom or stress. It has been suggested that the high task demands of gaming allow for increased engagement with pleasurable stimuli and escapism, leading to more positivity relative to other forms of media consumption (Bryant & Davies, 2006). Indeed, video games have been hypothesized to displace real life stress (Russoniello et al., 2009). Research has also demonstrated increases in emotional well-being through video game escapism (Granic et al., 2014), though other work acknowledges negative consequences of escapism such as problematic gaming (Chang et al., 2018) or internet addiction (Yee, 2006). Taken together, these findings suggest that consistent with the UGT framework, the achievement of in-game tasks and the engaging features of video games can engender positivity through the satisfaction of specific needs such as competence and interest.

Although nearly all video games allow players to accomplish in-game goals and are designed to be engaging, some video games may have additional features that help them better meet motivations that players have within the UGT framework, resulting in positivity. Below, we discuss evidence regarding how AR games like Pokémon GO, which overlay virtual game elements onto players' physical environments, might emphasize these features.

Unique Aspects of AR Games Relevant to Positivity

A recent review by Halbrook et al. (2019) concluded that across all different types of video games, positivity is most elicted by games that increase presence, include physical activity, and contain strong social elements. These features are all central to Pokémon GO and following from the UGT framework, may play an important role in fulfilling players' needs and motivations. Crucially, we think that presence and physical activity (which are enhanced in AR games such as Pokémon GO) can increase engagement and interest. The unique social elements of Pokémon GO can also meet players' needs for sociability.

First, Pokémon GO may increase presence through the catch overlay that shows virtual Pokémon on real life backgrounds via the phone camera (which anecdotally is rarely used), but importantly, through traveling to and interacting with virtual objects that are overlaid on the real world. Presence results in a more engaging gaming experience by enhancing players' feelings of "being there" in the game, which can help players escape from negative mood states (Laor, 2020). It has been suggested that this level of presence in AR games elicits greater positivity in players above that of a typical console video game (Hemenover & Bowman, 2018).

Second, while some traditional console games are designed to increase physical activity, Pokémon GO is likely superior in doing so. Multiple studies have found that playing Pokémon GO led to increased physical activity in some form (Althoff et al., 2016; Ewell et al., 2020; Kogan et al., 2017). Physical activity through AR videogames such as in Pokémon GO, may not only result in positivity due to the benefits of exercise, but also increase engagement in the gameplay experience because players are receiving sensory input both from their screens as well as their outdoor physical environments. Supporting this idea, existing work has linked physical activity to improved positivity and well-being both in games in general (Halbrook et al., 2019) and specifically in Pokémon GO (Bonus et al., 2018); although, we note there has been some skepticism regarding potential dangers associated with the physical mobility created by Pokémon GO (Laor et al. 2021). There may be other ways in which Pokémon GO increases engagement with gameplay, leading to greater positivity. For example, the affective benefits of Pokémon

GO have also been associated with the sense of nostalgia that the game may elicit for players that have had positive experiences with the Pokémon franchise in the past (Wulf & Baldwin, 2020).

The third crucial factor theorized to lead to positivity is the social element of gameplay, and this is the focus of the current study. We discuss the unique ways that AR games encourage social interaction in the following section.

Social Interactions as a Mechanism to Increase Positivity

Sociability is thought to be a core human need, which extends to video game players. Consistent with the UGT, social interactions are hypothesized to be a fundamental motivation for playing video games (Yee, 2006), and even early work on video games show that players report social aspects, such as support and communication, as being central to the benefits they gain from gaming (Seay et al., 2004). Many games now involve social features that encourage playing with others (Kaye & Bryce, 2012), and recent polls find that 63% of adult gamers play with peers (Entertainment Software Industry, 2019). In face-to-face contexts, the effect of social interactions on positivity is well-documented, particularly if the quality of these social interactions is positive (Brown et al., 2011; Helliwell & Putnam, 2004). Similar findings of social interactions resulting in positivity could occur in a gameplay context, as even weak social bonds can improve well-being (Sandstrom & Dunn, 2014).

Nonetheless, some researchers have posited that social interactions occurring purely within virtual, digital contexts such as video games lack affordances (e.g., facial expressions, physical proximity, and tone of voice) available in face-to-face settings, which diminish players' affective benefits from such social interactions (Nesi et al., 2018). Other inherent limitations of digital environments (i.e., potential anonymity and asynchrony of interaction; Wellman & Gulia, 1999) may result in superficial relationships and poorer interaction quality, with the caveat that technological advances have made it more possible for players of console-based games to use voice chat or video-conferencing to communicate with one another (Scriven, 2021). Nonetheless, some previous work suggests that the social interactions within traditional online console-based video games may be insufficient to engender positivity (Ryan et al., 2006). Following this line of thinking, the positivity players derive from video games would be better attributed to other aspects of gaming (such as players' in-game accomplishments that fulfill competence needs), as opposed to their in-game, digital social interactions fulfilling sociability needs.

However, as games like Pokémon GO continue to blur the lines between online and face to face communication, we wonder if social interactions that occur in the game could potentially carry more benefits for positivity, relative to interactions in traditional console-based games. Like other gamers, Pokémon GO players report sociability and relationship maintenance as one of the primary motivations for engaging in game activity (Laor, 2021; Marello et al., 2020). Crucially however, Pokémon GO leverages AR technology to encourage face-to-face interaction with other players who are physically nearby by using shared goals (such as raids) that can only be achieved through cooperation, often centered around real-world landmarks (Aal & Hauptmeier, 2019; Morschheuser et al., 2017). Thus, Pokémon GO is unique in that it facilitates players' face-to-face interaction, which provides players with physical cues such as tone of voice, subtle facial expressions, and body language (Berger, 2013). These face-to-face interactions between players occur outdoors, which is relevant given recent findings that, because of the COVID-19 pandemic, some players prefer to be physically distanced when playing games, which would typically mean virtual interaction (Laato et al., 2020; Scriven, 2021). Pokémon GO has even been suggested to have potential utility in helping Japanese youth with extreme social withdrawal to leave the house and interact with others (Tateno et al., 2016). Secondary data analyses have also shown that depression-related searches were disproportionately less frequent in areas where Pokémon GO was available (Cheng et al., 2022).

There are now several empirical studies that lend support to these ideas. Ewell et al. (2020) found that Pokémon GO gameplay was associated with having more interactions and conversations with both friends and strangers. Such in-game social experiences are linked to social motivations to play Pokémon GO (Caci et al., 2018), and may also contribute to players' engagement with and performance in the game (Khalis & Mikami, 2018). Accordingly, other studies have found that those who had social motivations to play Pokémon GO (Yang & Liu, 2017) or those who played the game for the sake of relationship maintence (Marello et al., 2020) showed greater increases in well-being compared to those who did not. Additionally, Laato et al. (2021) found that engaging with the cooperative aspects of the game (e.g., raids & trading), which involve some level of in-person interaction, resulted in increases in psychological well-being. Taken together, this research provides significant evidence that social interactions in Pokémon GO could result in positivity for players.

Moderators of Associations Between In-Game Social Interactions and Positivity

The current study explored whether any benefits from social interactions in terms of positivity might differ for individuals who more frequently experience noxious mood states. This was considered to be the sad mood and anhedonia that is characteristic of depressive affect, and/or the fear of negative evaluation and worry that is characteristic of social anxiety. Some researchers have put forward that the features of video games that elicit positivity, described above, could have unique effects for players with noxious mood states (Hemenover & Bowman, 2018). Interestingly, however, these features could either have an accentuated effect on those with noxious mood states, or an attenuated effect (Bowman & Tamborini, 2012). For example, positive social interactions in gameplay could bring more positivity to those with noxious mood states because such individuals have infrequent interactions of this nature. Alternatively, positive social interactions in gameplay could result in less positivity for those with noxious mood states because these individuals interpret the interactions in a way that minimizes their importance.

The current study also considered the nature of a player's relationship with a gameplay partner as a possible moderator of associations between the quality of in-game social interactions and positivity. Modern video games like Pokémon GO provide players with opportunities to interact with other players who range in their level of familiarity or closeness. A recent study found that most gameplay occurs between players who have already-established relationships (Vella et al., 2019), and other work has found gaming with friends leads to greater positivity compared to gaming with strangers (Ravaja et al., 2006). It is possible that players who are closer to those with whom they are interacting in-game might ascribe greater meaning to their positive interactions, leading to greater affective benefits as a result; this would parallel work in face-to-face contexts (Baumeister & Leary, 1995). Nonetheless, we know little about how players interpret their social interactions within video games. If players consider their interactions in a video game context as less significant compared to other social experiences (e.g., Nesi et al., 2018), the quality of any one in-game interaction that familiar dyads have with each other may have little effect on their overall positivity.

The Current Study

Based on the UGT framework, video games have been theorized to lead to positivity when they fulfill players' needs. Though most people have strong needs for social interaction, the ability for video game interactions to meet these sociability needs has been debated. Our study advances the literature by examining the incremental contribution of positive social interactions between players, even after parsing out the contributions of other non-social aspects of gaming, to positivity in the AR game Pokémon GO. Our primary research question was:

RQ1: Are there unique associations between social interactions occurring during gameplay and feelings of positivity immediately after gameplay, after accounting for satisfaction with game accomplishments (a non-social factor that may meet a need for competence and therefore result in positivity)?

Our exploratory research question was:

RQ2: Do the associations between positive social interactions and positivity differ for participants based on their experience of noxious mood states, and based on their closeness with their gameplay partner?

Methods

Participants

Participants were 108 Pokémon GO players recruited from the undergraduate student body at a public Canadian university (masked for review). Data were collected in 2017–2018, approximately 1 year after the initial release of Pokémon GO. The sample was 61% male and participants ranged in age from 17 to 31 years ($M = 19.45$, $SD = 1.96$). Our sample was diverse, with 42% of the sample being born in North America, 49% in Asia, 6% in Africa, 2% in Europe and 1% in Latin America. As this study required dyads during the game playing sessions, each participant signed up for the study with a gameplay partner who was known to them, yielding 54 dyads. Although participants were not prohibited from playing Pokémon GO with other partners outside these dyads during the study period, we did not expect gameplay with other partners to affect our study research questions or results. This is because

the current study focused specifically on the discrete, short-term associations between gameplay experiences and positivity that occurs immediately after the gameplay.

Procedure

At baseline, both participants in the dyad independently completed questionnaires in the lab regarding noxious mood states and relationship closeness with their gameplay partner. The dyad was then instructed to play Pokémon GO together eight times for a minimum of 15 minutes each time over the next 2 weeks. After each gameplay session, participants independently completed a short online questionnaire (which they could access from their phone) about their social interactions with their partner during gameplay, satisfaction with their gameplay accomplishments, and positivity. This design allowed us to examine the associations between the positive social interactions that participants had during discrete gameplay sessions, and their feelings of positivity immediately after these sessions, after parsing out the contribution of gameplay accomplishments (a non-social factor also thought to relate to positivity).

The majority of participants completed at least five gameplay sessions with their study gameplay partner, and also completed the online questionnaires after the gameplay. Specifically, 46 dyads played together for at least five sessions, and all but one of the participants in these dyads completed the questionnaire data, yielding a final $n = 91$. In these dyads, the mean number of gameplay sessions completed was 6.5, and the median amount of time spent playing was approximately 20 minutes per session. Participants were provided monetary compensation for completing each of the gameplay sessions and questionnaires.

Measures

In-Game Positive Social Interactions (Predictor)

After each gameplay session, participants completed 17 questions about their experience (see Appendix A). Items were based on the Pokémon GO Study Questionnaire used by Tabacchi et al. (2017), which we adapted for our study to better capture more types of in-game social interactions that participants might have with their gameplay partner. Two items reflecting specific in-game interactions (related to gym battles and raids) were subsequently removed from our analyses as modal responses were zero. As a means of data reduction and to explore potential factors underlying our measure, principal components analysis (PCA) with oblimin rotation was conducted on the remaining 15 items in the questionnaire. The Kaiser-Meyer-Olkin measure of sampling adequacy indicated that the strength of the relationships among variables was acceptable (KMO = .82). Bartlett's test of sphericity, $\chi^2(105) = 4084.72$, $p < .001$ also indicated that the correlations between variables was large enough for a PCA.

Four factors were extracted from the PCA, all with eigenvalues higher than Kaiser's criterion of 1, and all together accounted for 65.8% of the total variance in the model. Loadings indicated factors representing Positive Social Interactions (4 items), Negative Social Interactions (2 items), Interaction Frequency (4 items), and Satisfaction with Game Accomplishments (5 items). We considered Positive Social Interactions to be our key predictor, as we believed the quality of in-game interactions to be more germane to participants' positivity relative to Interaction Frequency. Negative Social Interactions, while theoretically interesting, had extremely low base rates (likely given the nature of the study), and thus was not considered further. A score for Positive Social Interactions was calculated by taking the mean of the four items that loaded onto this factor. These items reflected participants' perceptions of how satisfied they were with their interactions with their partner and how well they and their partner got along.

Satisfaction With Game Accomplishments (Covariate)

From the questionnaire described above, we also used Satisfaction with Game Accomplishments as a covariate in analyses. This score was calculated by taking the mean of the five items that loaded onto this factor. These items reflected participants' satisfaction with specific in-game achievements, such as Pokémon caught or Pokéstops visited. We used Satisfaction with Game Accomplishments as a covariate in order to better disentangle the unique associations between the quality of social interactions with positivity, beyond other non-social elements of participants' gameplay experiences that might also affect positivity.

Positivity (Outcome Measure)

After each gameplay session, participants completed the positivity items on the Positive and Negative Affect Schedule (PANAS), a widely used measure of current affect (Watson et al., 1988). Participants rated how much, at that moment, they identified with each of 10 positive (e.g., determined, excited) adjectives on a scale of 1 = *very slightly* or *not at all* to 5 = *extremely*. A composite score was calculated by averaging all items. Internal consistency (Cronbach's Alpha) in our sample of this measure was .93; this reflects how well the 10 items hang together, and Cronbach's Alphas over .7 are usually considered acceptable.

Noxious Mood States (Moderator)

At baseline, participants completed the Depression subscale from the Brief Symptom Inventory (BSI; Derogatis, 1993), which is widely used as a measure of self-reported psychopathology symptoms in both clinical and community samples (Derogatis & Savitz, 2000). There are six items, each rated on a 5-point scale of distress from 0 (*not at all*) to 4 (*very much*). A mean score was calculated from all items, with higher scores indicating greater depressive symptoms. Internal consistency of the six items (Cronbach's Alpha) in our sample was .85.

Participants completed the Social Interaction Anxiety Scale (SIAS; Mattick & Clarke, 1998), a 20-item self-report measure that assesses social anxiety. Items are rated on a five-point Likert scale (0 = *not at all characteristic* or *true of me*; 4 = *extremely characteristic* or *true of me*). The SIAS has been found to demonstrate good internal consistency (Mattick & Clarke, 1998). The mean of all items was calculated, with appropriate items reverse-scored and higher scores indicating greater social anxiety symptoms. Internal consistency (Cronbach's Alpha) of this scale in our sample was .79.

Relationship Closeness (Moderator)

At baseline, participants also completed the Network of Relationships Inventory—Relationship Quality Version in reference to their gameplay partner (Buhrmester & Furman, 2008). The 15 items assess positive features of relationships that indicate relationship closeness (e.g., *How often do you spend fun time with this person?*). Participants responded to questions asking how often their relationship was characterized by each of these features on a scale of 1 = *never* or *hardly at all* to 5 = *always* or *extremely much*. Acceptable reliability and validity for this measure has been established (Furman & Buhrmester, 2009; Hibbard & Buhrmester, 2010). A composite relationship closeness score, composed of the average of all items, was used. Internal consistency (Cronbach's Alpha) in our sample was .95.

Data Analytic Plan

Data analyses were conducted in R 4.0.5, using lmerTest 3.1-3 (Kuznetsova et al., 2017; R Core Team, 2021). We created a series of linear multilevel growth models each predicting our outcome variable of Positivity and accounting for the nested structure of the data: measurements on eight gameplay sessions (Level 1) were nested within participants (Level 2), who were nested within dyads (Level 3). The variable Gameplay Session represented the session number, with 0 indicating the first session; thus, the model intercept provided an estimate of Positivity at baseline. Using Akaike Information Criterion (AIC) values, we determined that a three-level design modelling time linearly produced the best fit. Due to concern for the reliability of mean estimates for within-participant centering, we excluded the 8 dyads (16 participants) missing data on five or more play sessions, and the one participant from one dyad who played with their partner but did not complete questionnaires. This resulted in a final sample size of 91 participants within 46 dyads. The excluded participants did not differ from retained participants on any demographic variable.

For the unconditional model, variation in the slopes of Positivity across gameplay sessions at the participant level (Level 2) appeared low, and thus, we constrained these slopes to be fixed. To test our primary research question (whether more positive social interactions predict greater positivity), we produced a conditional model incorporating Positive Social Interactions as the key predictor, with Satisfaction with Game Accomplishments as a statistical control, for the outcome variable of Positivity. Three subsequent models were produced to test our exploratory questions regarding whether noxious mood states and relationship closeness might moderate associations between social interactions and positivity. For each model, the moderator variable (Depressive

Symptoms, Social Anxiety Symptoms, or Relationship Closeness) was entered at Level 2, in addition to its cross-level interaction with Positive Social Interactions. Model coefficients were estimated using restricted maximum likelihood estimation. Please see Appendix B for further details.

Results

Descriptive Statistics

These data are presented in Table 1. Overall, participants reported having moderate to high positive social interactions (M = 4.04–4.37, SD = 0.65–0.82), corresponding to perceiving their interactions as "pretty much" positive, being "very satisfied" with them, and talking with their partner "often" about topics unrelated to Pokémon GO. They also tended to endorse levels of noxious mood states that are typical for a community sample (i.e., reporting "a little" distress from depressive symptoms, M = 1.90, SD = 0.68, and being "slightly" socially anxious, M = 1.06, SD = 0.68), and feeling "somewhat" (M = 3.50, SD = 0.77) close with their gameplay partner. Participants also reported experiencing between "a little" and "moderate" positivity across all gameplay sessions. Interestingly, a negative association between Gameplay Session and Positivity, $\hat{\beta}_1$ = −.05, p < .001, 95% CI [−.08, −.03], indicated that that positivity tended to slightly decrease as sessions progressed, but that participants continued to experience mild to moderate positivity overall.

Table 1. *Descriptive Statistics for Uncentered Level 1 and 2 Model Variables.*

| Level 1 Variables | Gameplay Session | | | | | | | | |
	1	2	3	4	5	6	7	8	Total
Positivity									
N Missing	1	0	1	0	5	6	10	17	40
Mean (*SD*)	2.71 (0.80)	2.55 (0.91)	2.49 (0.84)	2.42 (0.90)	2.39 (0.93)	2.25 (0.88)	2.30 (0.90)	2.36 (0.97)	2.44 (0.90)
Range	1.00–4.40	1.00–4.60	1.00–4.30	1.00–4.70	1.00–5.00	1.00–4.10	1.00–4.10	1.00–4.40	1.00–5.00
Positive Social Interactions									
N Missing	2	0	1	0	5	6	10	17	41
Mean (*SD*)	4.10 (0.66)	4.09 (0.82)	4.04 (0.76)	4.18 (0.69)	4.21 (0.72)	4.21 (0.75)	4.17 (0.65)	4.37 (0.65)	4.17 (0.72)
Range	2.33–5.00	2.00–5.00	1.00–5.00	2.33–5.00	2.00–5.00	1.33–5.00	2.67–5.00	3.00–5.00	1.00–5.00
Satisfaction With Game Accomplishments									
N Missing	3	2	4	3	7	9	12	19	59
Mean (*SD*)	2.98 (0.71)	2.94 (0.81)	2.90 (0.77)	2.94 (0.91)	3.03 (0.91)	2.98 (0.83)	2.90 (0.89)	3.12 (0.86)	2.97 (0.84)
Range	1.40–4.20	1.20–4.80	1.00–4.80	1.00–5.00	1.00–5.00	1.00–5.00	1.20–5.00	1.00–5.00	1.00–5.00

Level 2 Variables	*N* Missing	Mean (*SD*)	Range
Pokémon GO Level	0	18.56 (10.77)	3.00–39.00
Relationship Closeness	1	3.50 (0.77)	1.53–4.93
Depressive Symptoms	7	1.90 (0.68)	1.00–4.00
Social Anxiety Symptoms	2	1.06 (0.68)	0.00–2.67

Note. Of a possible 728 Positivity measurements for this sample, we obtained 688 (5.5% missing data at Level 1).

## Associations Between Quality of Social Interactions and Positivity

See Table 2 and Figure 1 for the analyses addressing our primary study aim. We found that having more Positive Social Interactions across gameplay sessions was incrementally associated with greater Positivity post-gameplay, after controlling for Satisfaction with Game Accomplishments, $\hat{\beta}_2$ = .21, p < .001, 95% CI [.13, .29]. As has been found in existing literature, the covariate of Satisfaction with Game Accomplishments also predicted higher Positivity, $\hat{\beta}_3$ = .23, p < .001, 95% CI [.17, .29].

Table 2. *Results for Conditional and Moderator Models of Positivity Following Pokémon GO Gameplay.*

Predictors	Conditional Model			Closeness Model			Depression Model			Social Anxiety Model		
	B	SE	95% CI	B	SE	95% CI	B	SE	95% CI	B	SE	95% CI
(Intercept)	2.66***	0.10	2.46–2.85	2.66***	0.10	2.46–2.86	2.69***	0.11	2.48–2.90	2.66***	0.10	2.45–2.86
Gameplay Session	−0.06***	0.01	−0.08−−0.04	−0.06***	0.01	−0.08−−0.04	−0.05***	0.01	−0.08−−0.03	−0.05***	0.01	−0.08−−0.03
Positive Int.	0.21***	0.04	0.13–0.29	0.23***	0.04	0.15–0.31	0.22***	0.04	0.13–0.30	0.21***	0.04	0.13–0.28
Game Sat.	0.23***	0.03	0.17–0.29	0.23***	0.03	0.17–0.29	0.26***	0.03	0.20–0.32	0.26***	0.03	0.20–0.32
Rel. Closeness				−0.03	0.12	−0.27–0.20						
Positive Int. × Rel. Closeness				0.09	0.05	−0.02–0.19						
Depressive							0.10	0.11	−0.12–0.32			
Positive Int. × Depressive							0.14*	0.06	0.02–0.26			
Social Anxiety										−0.10	0.11	−0.32–0.13
Positive Int. × Social Anxiety										0.02	0.06	−0.11–0.14
Random Effects												
σ²	0.17			0.17			0.16			0.17		
τ₀₀	.31 Participant			.30 Participant			.29 Participant			.32 Participant		
	.26 Dyad			.28 Dyad			.33 Dyad			.28 Dyad		
τ₁₁	.00 Dyad			.00 Dyad			.00 Dyad			.00 Dyad		
ρ₀₁	−.12 Dyad			−.10 Dyad			−.31 Dyad			−.24 Dyad		
Observations	669			661			619			653		
Marginal R^2	.058			.060			.065			.065		
Conditional R^2	.791			.791			.801			.796		

Note. Positive Int. = Positive Social Interactions; Game Sat. = Satisfaction with Game Accomplishments; Rel. Closeness = Relationship Closeness; Depressive = Depressive Symptoms; Social Anxiety = Social Anxiety Symptoms. *p < .05, **p < .01, *** p < .001.

Figure 1. *Associations Between Gameplay Session, Positive Social Interactions, and Satisfaction With Game Accomplishments With Positivity.*
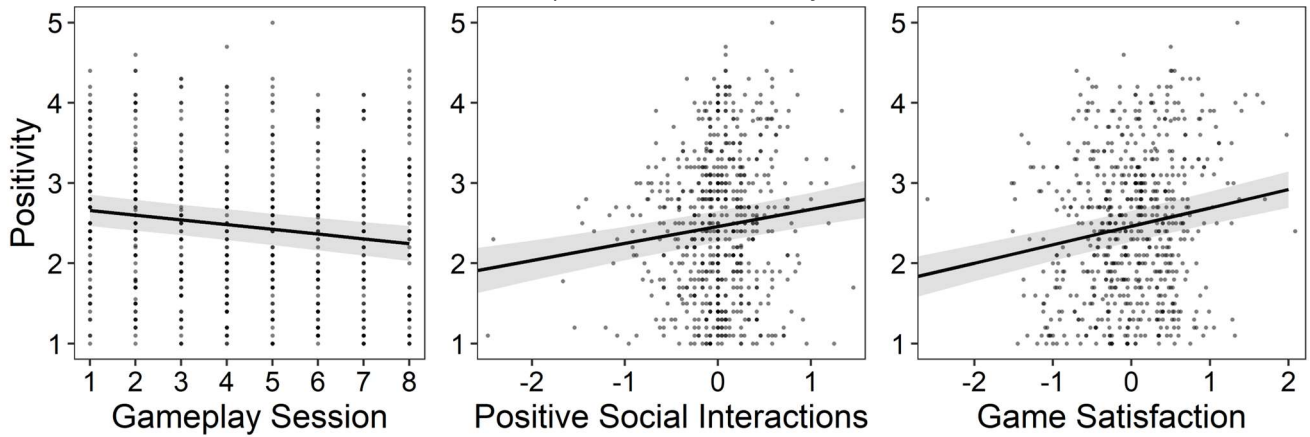

Note. Game Satisfaction = Satisfaction with Game Accomplishments. Plots depicting main effects of the *conditional* model predictors (solid line). These associations were statistically significant (*p*s < .001). Dots represent raw data points for the corresponding model predictor. The confidence bands show 95% confidence limits for the predicted values.

Exploratory Analyses

The results for our exploratory analyses testing moderators are also in Table 2. Regarding representations of noxious moods, the interaction term for Depressive Symptoms and Positive Social Interactions was significant, $\hat{\gamma}_{21}$ = .14, *p* = .026, 95% CI [.02, .26], in predicting Positivity. Post-hoc probing found that the relationship between more Positive Social Interactions and Positivity was stronger and significant for participants reporting Depressive Symptoms 1 SD above the sample mean, $\hat{\gamma}_{20}$ = .31, *p* < .001, 95% CI [.18, .44]. By contrast, the relationship was weaker, albeit still statistically significant, when Depressive Symptoms were 1 SD below the sample mean, $\hat{\gamma}_{20}$ = .12, *p* = .028, 95% CI [.01, .23]. This interaction is illustrated in Figure 2. Neither Social Anxiety Symptoms, $\hat{\gamma}_{21}$ = .02, *p* = .805, 95% CI [.11, .14], nor Relationship Closeness, $\hat{\gamma}_{21}$ = .09, *p* = .104, 95% CI [−.02, .19], were significant moderators of the association between Positive Social Interactions and Positivity.

Figure 2. *Interaction Between Positive Social Interactions and Depressive Symptoms on Positivity.*
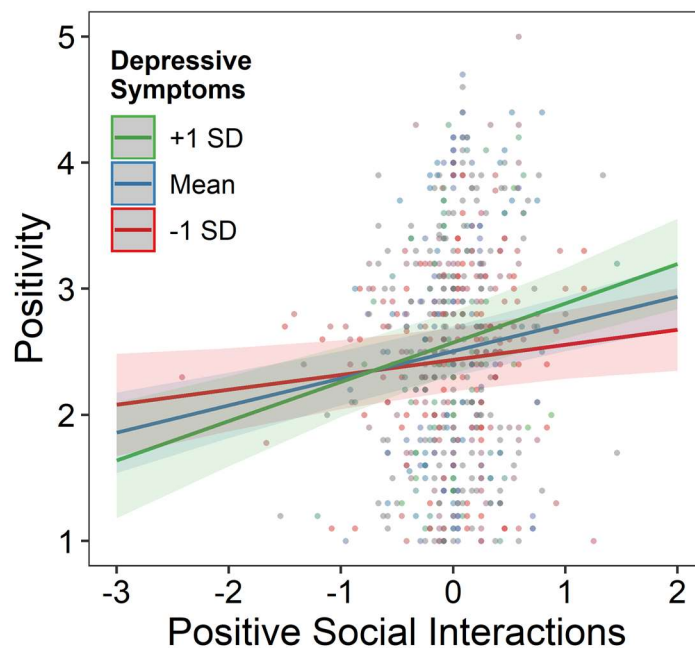
Note. Plot showing the interaction between Positive Social Interactions and Depressive Symptoms. Dots represent raw data points. The confidence bands show 95% confidence limits for the predicted values.

Discussion

The current study represented a methodologically innovative effort to investigate how the quality of social interactions within an AR video game environment (Pokémon GO) may uniquely affect positivity immediately after gameplay, after accounting for non-social game aspects that are also known to relate to positivity. We found that across eight gameplay sessions over a 2-week period, and while controlling for players' satisfaction with their gameplay accomplishments, having positive social interactions while playing Pokémon GO predicted greater positivity post-gameplay. Regarding our exploratory questions, players with higher noxious mood states (represented by depressive symptoms) experienced a stronger association between more positive social interactions and positivity relative to those with lower noxious mood. However, social anxiety symptoms and relationship closeness did not moderate associations between social interactions and positivity.

Unique Associations Between Social Interactions and Positivity

Aligned with previous studies investigating other video game environments (Rieger et al., 2014), the non-social factor of Pokémon GO players' satisfaction with their game accomplishments predicted more positivity. That is, players who were more satisfied with the Pokémon they caught and the Pokéstops they visited during their gameplay session also reported greater positivity after playing. This provides empirical support for existing theoretical work on the role of in-game accomplishments (which may fulfill players' needs for competence, in line with the UGT framework) in conferring affective benefits of playing video games (Kaye & Bryce, 2014; Przybylski et al., 2010). However, given that nearly all video games contain the feature of allowing players to achieve in-game goals and experience the associated feelings of mastery and competence, we believe this finding is unlikely to be unique to AR games.

Our study advances existing work by finding that, after accounting for players' satisfaction with game accomplishments, having positive social interactions with a partner during gameplay also showed a unique incremental association with players' positivity. This aligns with work in other gameplay settings (e.g., table-top board games) that link affective benefits to the social interactions had during gameplay (Abbott et al., 2022). The UGT suggests that most players have needs for sociability, a finding borne out by empirical studies (e.g., Laor, 2021). Nonetheless, some previous work has argued that social interactions within digital contexts such as traditional online console-based video games are insufficient to meet those sociability needs, and therefore may not engender positivity (Nesi et al., 2018; Ryan et al., 2006). Crucially, our study took place within an AR video game environment (Pokémon GO) in which the relevance of in-game social interactions is likely amplified compared to traditional console games. Indeed, Pokémon GO may be exceptionally equipped to meet players' needs for sociability because interactions between players occur face-to-face rather than being computer mediated. This provides players greater access to interpersonal cues (i.e., physical proximity, body language, subtle facial expressions, and tone of voice), that may allow for richer interactions and lead to players deriving greater affective benefits from such interactions (Sherman et al., 2013). Even while advances in communication technology allow for richer social interaction in traditional gaming environments than have previously existed (Scriven, 2021), it is likely that AR games like Pokémon GO provide additional affordances in meeting the social needs of players.

Although this was not central to our research questions, we found it interesting that individuals' positivity after gameplay decreased slightly across gameplay sessions, though it consistently remained between a little and moderate level of positivity. We speculate that although participants may have initially found the study task to be novel and fun, this sense of novelty might have diminished slightly over time as participants grew bored. Extant work on motivation suggests that boredom (which may consequently lead to less positivity) can arise when people expend efforts on tasks they perceive as obligatory (Weissinger et al., 1992). Because participants in our study were specifically asked to play (and compensated for doing so), this may have reduced their intrinsic motivation for the activity.

Exploratory Findings

In the media, Pokémon GO has specifically been recommended to help individuals with noxious mood states (Conditt, 2016). To our knowledge, however, this has all been based on anecdotal evidence without empirical work testing this assertion to date. Intriguingly, players in our study who reported higher depressive symptoms displayed a stronger association between in-game positive social interactions and more positivity, relative to

players with lower depressive symptoms. We postulate several reasons for this finding. As people with depressive symptoms often report having few positive social interactions (Hames et al., 2013), it may that be when such interactions do occur, the affective benefits associated with them are accentuated. Indeed, existing work also suggests that people with depressive symptoms experience greater reward responsiveness to the occurrence of positive social interactions (Steger & Kashdan, 2009). We also considered whether this finding may have instead reflected a ceiling effect, such that players with lower depressive symptoms were already reporting high positivity and may have had little room for further increases. However, closer examination of Figure 2 revealed this to not be the case, as among participants with more positive social interactions, players with higher depressive symptoms actually reported greater positivity than those with lower symptoms.

This finding is exciting because it suggests that people with noxious mood states potentially derive benefits from social interactions that occur in an AR video game, and possibly to a greater extent than do people without noxious mood states. This runs counter to prior beliefs that people who experience noxious moods or maladjustment will engage in digital interactions that are superficial and unfulfilling versions of face-to-face interactions (Kraut et al., 1998, 2002). Instead, our results emphasize contemporary views of gaming that dispel the myth of socially maladjusted gamers (Herodotou et al., 2014) and underscore that social interactions players have while playing Pokémon GO can be meaningful and beneficial.

In contrast, social anxiety symptoms did not moderate the associations between social interactions and positivity in our sample. This is interesting, given that depression and social anxiety are highly co-occurring (Jacobson & Newman, 2017). However, other studies point to distinctions in the interpersonal processes between depression and social anxiety (Alden & Phillips, 1990). Symptoms of social anxiety are predominantly, if not nearly exclusively, expressed in interactions with less familiar people. This may be attributable to more uncertainty and concerns about negative evaluations within such interactions. Our study participants were asked to play Pokémon GO with a familiar gameplay partner of their choosing. Thus, the impact of social anxiety on links between players' in-game social interactions and positivity may have been attenuated, as these interactions may have been less anxiety provoking in general.

Participants' closeness with their gameplay partner also did not moderate the association between their social interactions and positivity. The current study sample consisted of participant dyads who already knew one another and signed up for the study together, which might have resulted in limited variability in their closeness, thus attenuating the effect of this variable. Future research could examine the extent to which in-game social interactions relate to positivity within samples comprised of a broader range of interpersonal closeness (i.e., strangers versus acquaintances versus friends).

Study Limitations

Several study limitations warrant discussion. First, there are limitations related to the generalizability of our findings to other Pokémon GO players. Our sample consisted of university students in participant dyads who already knew one another; thus, our findings do not necessarily speak to in-game interactions that occur within other interpersonal relationships, such as with strangers or family members. Participants were able to self-select their gameplay partner, which raises the potential for other relationship factors unmeasured in the current study, beyond the social interactions occurring during gameplay, to affect positivity. Nonetheless, we argue that the current research design allows for a naturalistic and real-world examination of gameplay experiences, given statistics that most people play video games with familiar others (Entertainment Software Industry, 2019). Thus, our research design may mimic how people are actually playing Pokémon GO in the real world.

Other limitations relate to our measurement strategies. Our study relied on self-report measures of constructs. Thus, we note the possibility that results may have been driven by shared rater and method variance. This line of research may benefit from the use of observational measures or reports from other informants. Nonetheless, that participants were asked to rate their gameplay experience and positivity immediately after playing using an online survey that they could access through their mobile phone, may minimize the potential for recall bias that may have emerged if participants were asked to report on these experiences retrospectively. Finally, a mixed-method design involving interviews could also allow participants to provide rich qualitative information that might not otherwise be captured by self-report questionnaires.

Additionally, the measure of positive social interactions was designed specifically for the present study and would benefit from further psychometric validation. Another limitation is that the present study only investigated

associations with positivity and not negativity. As our study participants were a community sample, and they were playing an enjoyable video game with a partner of their own choosing, positivity was most relevant for this sample.

Third, although the use of a short-term longitudinal design allowed us to better model the trajectory of positive social interactions and positivity over gameplay sessions, all variables were assessed concurrently at each time point. Thus, we are unable to infer the causality of such associations. Future research could employ an experimental design that randomly assigned participants to play with a partner of their choosing (as in the current study), a stranger, or alone, which would presumably manipulate the level of positive social interactions experienced.

Implications and Future Directions

Given our finding that positive social interactions while playing Pokémon GO are associated with greater positivity post-gameplay, and that this association is pronounced for players with noxious mood states, we wonder whether people who experience depressive symptoms and the commonly associated difficulties with face-to-face social interaction may be optimally positioned to benefit from social video game environments. Video games such as Pokémon GO that encourage social interaction can make the hurdles to socializing smaller for those who might otherwise struggle interpersonally. Unlike in free-form socializing contexts (such as at a party) which lack structure, players in Pokémon GO who are engaging with others can allow the activity to guide their interactions. For example, a lull in a conversation can often be filled by returning to discussions about what Pokémon someone might have recently caught. In addition, given the inherently hedonic nature of video games, people with noxious mood states may be more motivated to engage in interactions that occur in-game as opposed to other social contexts that lack clear behavioral expectations. Future research could explore whether video game environments can enhance existing psychosocial interventions for at-risk groups such as those with depressive symptoms.

Another exciting direction for future research involves the exploration of the specific features of social interactions during video games that contribute to players' positivity. As our study focused on participants' global reports of their interaction quality with a gameplay partner, we are unable to speak to the specific events or behaviors that may have occurred between dyad members. For instance, to what extent were dyad members high in positive social interactions supporting one another regarding in-game goals (e.g., saying "nice catch"), providing instrumental support (e.g., "there's a rare Pokémon over there"), or simply talking about non-game related topics (e.g., "oh, I like that pizza place, too!"). Future work aimed at identifying the types of social experiences that may engender greater positivity will help inform guidelines for how players can derive the most benefit from their gameplay.

Finally, the current study design allowed us to investigate the associations between in-game social interactions had by Pokémon GO players during discrete gameplay sessions and their feelings of positivity immediately following these sessions. A longer-term longitudinal study could allow us to observe how these associations may unfold or whether they may persist over extended periods of time.

Conclusion

The present study is one of the first to prospectively explore the associations between positivity and the quality of social interactions in video game environments, and to extend these questions to the AR video game context. Among participants playing Pokémon GO with a partner across multiple gameplay sessions across 2 weeks, more positive in-game social interactions (as well as greater satisfaction with game accomplishments) were associated with greater positivity post-gameplay. These findings align with the UGT, suggesting that players of Pokémon GO may derive affective benefits through the fulfillment of needs for competence and sociability within their gameplay sessions. Particularly interesting is the finding that this association may be especially pronounced for players with high depressive symptoms. This work could potentially inform new possibilities for interventions to improve the well-being of individuals experiencing noxious mood states who may struggle in face-to-face social contexts

Conflict of Interest

Authors' Contribution

References

Aal, K., & Hauptmeier, H. (2019). Pokémon GO: Collaboration and information on the GO. In *Proceedings of 17th European conference on computer-supported cooperative work*. European Society for Socially Embedded Technologies (EUSSET). https://dl.eusset.eu/handle/20.500.12015/3253

Abbott, M. S., Stauss, K. A., & Burnett, A. F. (2022). Table-top role-playing games as a therapeutic intervention with adults to increase social connectedness. *Social Work With Groups, 45*(1), 16–31. https://doi.org/10.1080/01609513.2021.1932014

Alden, L. E., & Phillips, N. (1990). An interpersonal analysis of social anxiety and depression. *Cognitive Therapy and Research, 14*(5), 499–512. https://doi.org/10.1007/BF01172970

Althoff, T., White, R. W., & Horvitz, E. (2016). Influence of Pokémon GO on physical activity: Study and implications. *Journal of Medical Internet Research, 18*(12), Article 315. https://doi.org/10.2196/jmir.6759

Baumeister, R. F., & Leary, M. R. (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

Berger, J. (2013). Beyond viral: Interpersonal communication in the internet age. *Psychological Inquiry, 24*(4), 293–296. https://doi.org/10.1080/1047840X.2013.842203

Bonus, J. A., Peebles, A., Mares, M.-L., & Sarmiento, I. G. (2018). Look on the bright side (of media effects): Pokémon GO as a catalyst for positive life experiences. *Media Psychology, 21*(2), 263–287. https://doi.org/10.1080/15213269.2017.1305280

Bowman, N. D., & Tamborini, R. (2012). Task demand and mood repair: The intervention potential of computer games. *New Media & Society, 14*(8), 1339–1357. https://doi.org/10.1177/1461444812450426

Brown, L. H., Strauman, T., Barrantes-Vidal, N., Silvia, P. J., & Kwapil, T. R. (2011). An experience-sampling study of depressive symptoms and their social context. *Journal of Nervous and Mental Disease, 199*(6), 403–409. https://doi.org/10.1097/NMD.0b013e31821cd24b

Bryant, J., & Davies, J. (2006). Selective exposure to video games. In P. Vorderer & J. Bryant (Eds.), *Playing video games: Motives, responses, and consequences* (pp. 181–194). Lawrence Erlbaum Associates.

Buhrmester, D., & Furman, W. (2008). *The Network of Relationships Inventory: Relationship Qualities Version* [Unpublished inventory]. University of Texas, Dallas.

Caci, B., Scrima, F., Tabacchi, M. E., & Cardaci, M. (2018). The reciprocal influences among motivation, personality traits, and game habits for playing Pokémon GO. *International Journal of Human-Computer Interaction, 35*(14), 1303–1311. https://doi.org/10.1080/10447318.2018.1519167

Chang, S.-M., Hsieh, G. M. Y., & Lin, S. S. J. (2018). The mediation effects of gaming motives between game involvement and problematic internet use: Escapism, advancement and socializing. *Computers & Education, 122*, 43–53. https://doi.org/10.1016/j.compedu.2018.03.007

Cheng, Z. A., Greenwood, B. N., & Pavlou, P. A. (2022). Location-based mobile gaming and local depression trends: A study of Pokémon GO. *Journal of Management Information Systems, 39*(1), 68–101. https://doi.org/10.1080/07421222.2021.2023407

Conditt, J. (2016, July 13). *Pokemon Go's mental health benefits are real*. Engadget. https://www.engadget.com/2016-07-13-pokemon-go-mental-health-science.html

Derogatis, L. R. (1993). Brief Symptom Inventory: Administration, scoring, and procedure manual. In National Computer Systems (4th ed.).

Derogatis, L. R., & Savitz, K. L. (2000). The SCL-90-R and the Brief Symptom Inventory (BSI) in primary care. In M. E. Maruish (Ed.), *Handbook of psychological assessment in primary care settings* (pp. 297–334). Lawrence Erlbaum Associates. https://doi.org/10.1037/024099

Entertainment Software Industry. (2019). *Essential facts about the computer and video game industry 2019.* https://www.theesa.com/wp-content/uploads/2019/05/ESA_Essential_facts_2019_final.pdf

Ewell, P. J., Quist, M. C., Øverup, C. S., Watkins, H., & Guadagno, R. E. (2020). Catching more than pocket monsters: Pokémon GO's social and psychological effects on players. *The Journal of Social Psychology, 160*(2), 131–136. https://doi.org/10.1080/00224545.2019.1629867

Furman, W., & Buhrmester, D. (2009). Methods and measures: The Network of Relationships Inventory: Behavioral Systems Version. *International Journal of Behavioral Development, 33*(5), 470–478. https://doi.org/10.1177/0165025409342634

Granic, I., Lobel, A., & Engels, R. C. M. E. (2014). The benefits of playing video games. *American Psychologist, 69*(1), 66–78. https://doi.org/10.1037/a0034857

Halbrook, Y. J., O'Donnell, A. T., & Msetfi, R. M. (2019). When and how video games can be good: A review of the positive effects of video games on well-being. *Perspectives on Psychological Science, 14*(6), 1096–1104. https://doi.org/10.1177/1745691619863807

Hames, J. L., Hagan, C. R., & Joiner, T. E. (2013). Interpersonal processes in depression. *Annual Review of Clinical Psychology, 9*, 355–377. https://doi.org/10.1146/annurev-clinpsy-050212-185553

Helliwell, J. F., & Putnam, R. D. (2004). The social context of well-being. *Philosophical Transactions of the Royal Society B: Biological Sciences, 359*(1449), 1435–1446. https://doi.org/10.1098/rstb.2004.1522

Hemenover, S. H., & Bowman, N. D. (2018). Video games, emotion, and emotion regulation: Expanding the scope. *Annals of the International Communication Association, 42*(2), 125–143. https://doi.org/10.1080/23808985.2018.1442239

Herodotou, C., Kambouri, M., & Winters, N. (2014). Dispelling the myth of the socio-emotionally dissatisfied gamer. *Computers in Human Behavior, 32*, 23–31. https://doi.org/10.1016/j.chb.2013.10.054

Hibbard, D. R., & Buhrmester, D. (2010). Competitiveness, gender, and adjustment among adolescents. *Sex Roles, 63*(5), 412–424. https://doi.org/10.1007/s11199-010-9809-z

Jacobson, N. C., & Newman, M. G. (2017). Anxiety and depression as bidirectional risk factors for one another: A meta-analysis of longitudinal studies. *Psychological Bulletin*, *143*(11), 1155–1200. https://doi.org/10.1037/bul0000111

Kaye, L. K., & Bryce, J. (2012). Putting the "fun factor" into gaming: The influence of social contexts on experiences of playing videogames. *International Journal of Internet Science, 7*(1), 23–37.

Kaye, L. K., & Bryce, J. (2014). Go with the flow: The experience and affective outcomes of solo versus social gameplay. *Journal of Gaming and Virtual Worlds, 6*(1), 49–60. https://doi.org/10.1386/jgvw.6.1.49_1

Khalis, A., & Mikami, A. Y. (2018). Who's gotta catch 'em all?: Individual differences in Pokèmon Go gameplay behaviors. *Personality and Individual Differences, 124*, 35–38. https://doi.org/10.1016/j.paid.2017.11.049

Kogan, L., Hellyer, P., Duncan, C., & Schoenfeld-Tacher, R. (2017). A pilot investigation of the physical and psychological benefits of playing Pokémon GO for dog owners. *Computers in Human Behavior, 76*, 431–437. https://doi.org/10.1016/j.chb.2017.07.043

Kraut, R., Kiesler, S., Boneva, B., Cummings, J., Helgeson, V., & Crawford, A. (2002). Internet paradox revisited. *Journal of Social Issues, 58*(1), 49–74. https://doi.org/10.1111/1540-4560.00248

Kraut, R., Patterson, M., Lundmark, V., Kiesler, S., Mukopadhyay, T., & Scherlis, W. (1998). Internet paradox: Social technology that reduces social involvement and psychological well-being. *American Psychologist, 53*(9), 1017–1031. https://doi.org/10.1037/0003-066X.53.9.1017

Kuznetsova, A., Brockhoff, P. B., & Christensen, R. H. B. (2017). lmerTest package: Tests in linear mixed effects models. *Journal of Statistical Software, 82*(13), 1–26. https://doi.org/10.18637/jss.v082.i13

Laato, S., Islam, M., & Laine, T. H. (2020). Did location-based games motivate players to socialize during COVID-19?. *Telematics and Informatics, 54*, Article 101458. https://doi.org/10.1016/j.tele.2020.101458

Laato, S., Islam, N., & Laine, T. H. (2021). Playing location-based games is associated with psychological well-being: An empirical study of Pokémon GO players. *Behaviour & Information Technology, 9*(6), Article 55. https://doi.org/10.1080/0144929X.2021.1905878

Laor, T. (2020). The race to escape: Location-based escapism and physical activity as a motivator in the consumption of the AR game Pokémon GO. *Cyberpsychology: Journal of Psychosocial Research on Cyberspace, 14*(2), Article 6. https://doi.org/10.5817/CP2020-2-6

Laor, T. (2021). Running away with the Pokémon GO gang: Three consumption needs. *International Journal of Human–Computer Interaction, 38*(14), 1321–1332. https://doi.org/10.1080/10447318.2021.2002041

Laor, T., Rosenberg, H., & Steinfeld, N. (2021). Oh, no, Pokémon GO! Media panic and fear of mobility in news coverage of an augmented reality phenomenon. *Mobile Media & Communication, 10*(3), 365–386. https://doi.org/10.1177/20501579211052227

Marello, M. M., Clark, M. S., & Patrick, J. H. (2020). Pokémon GO: Gotta catch 'em all... but with my younger friends. *The Computer Games Journal, 9*(2), 207–219. https://doi.org/10.1007/s40869-020-00102-8

Mattick, R. P., & Clarke, C. J. (1998). Development and validation of measures of social phobia scrutiny fear and social interaction anxiety. *Behavior Research and Therapy, 36*(4), 455–470. https://doi.org/10.1016/S0005-7967(97)10031-6

Morschheuser, B., Riar, M., Hamari, J., & Maedche, A. (2017). How games induce cooperation? A study on the relationship between game features and we-intentions in an augmented reality game. *Computers in Human Behavior, 77*, 169–183. https://doi.org/10.1016/j.chb.2017.08.026

Nesi, J., Choukas-Bradley, S., & Prinstein, M. J. (2018). Transformation of adolescent peer relations in the social media context: Part 2—Application to peer group processes and future directions for research. *Clinical Child and Family Psychology Review, 21*(3), 295–319. https://doi.org/10.1007/s10567-018-0262-9

Przybylski, A. K., Rigby, C. S., & Ryan, R. M. (2010). A motivational model of video game engagement. *Review of General Psychology, 14*(2), 154–166. https://doi.org/10.1037/a0019440

R Core Team. (2021). *R: A language and environment for statistical computing.* R Foundation for Statistical Computing. https://www.r-project.org/

Ravaja, N., Saari, T., Turpeinen, M., Laarni, J., Salminen, M., & Kivikangas, M. (2006). Spatial presence and emotions during video game playing: Does it matter with whom you play? *Presence: Teleoperators and Virtual Environments, 15*(4), 381–392. https://doi.org/10.1162/pres.15.4.381

Rieger, D., Wulf, T., Kneer, J., Frischlich, L., & Bente, G. (2014). The winner takes it all: The effect of in-game success and need satisfaction on mood repair and enjoyment. *Computers in Human Behavior, 39*, 281–286. https://doi.org/10.1016/j.chb.2014.07.037

Ruggiero, T. E. (2000). Uses and gratifications theory in the 21st century. *Mass Communication & Society, 3*(1), 3–37. https://doi.org/10.1207/S15327825MCS0301_02

Russoniello, C. V., O'Brien, K., & Parks, J. M. (2009). The effectiveness of casual video games in improving mood and decreasing stress. *Journal of Cyber Therapy and Rehabilitation, 2*(1), 53–66. https://www.researchgate.net/publication/289131468_The_effectiveness_of_casual_video_games_in_improving_mood_and_decreasing_stress

Ryan, R. M., Rigby, C. S., & Przybylski, A. (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

Sandstrom, G. M., & Dunn, E. W. (2014). Social interactions and well-being: The surprising power of weak ties. *Personality and Social Psychology Bulletin, 40*(7), 910–922. https://doi.org/10.1177/0146167214529799

Schutte, N. S., & Malouff, J. M. (2021). Basic psychological need satisfaction, affect and mental health. *Current Psychology, 40*(3), 1228–1233. https://doi.org/10.1007/s12144-018-0055-9

Scriven, P. (2021). From tabletop to screen: Playing Dungeons and Dragons during COVID-19. *Societies, 11*(4), Article 125. https://doi.org/10.3390/soc11040125

Seay, A. F., Jerome, W. J., Lee, K. S., & Kraut, R. E. (2004). Project Massive: A study of online gaming communities. *In CHI'04 extended abstracts on Human factors in computing systems* (pp. 1421–1424). ACM. https://doi.org/10.1145/985921.986080

Sherman, L. E., Michikyan, M., & Greenfield, P. M. (2013). The effects of text, audio, video, and in-person communication on bonding between friends. *Cyberpsychology: Journal of Psychosocial Research on Cyberspace*, *7*(2), Article 3. https://doi.org/10.5817/CP2013-2-3

Steger, M. F., & Kashdan, T. B. (2009). Depression and everyday social activity, belonging, and well-being. *Journal of Counseling Psychology, 56*(2), 289–300. https://doi.org/10.1037/a0015416

Tabacchi, M. E., Caci, B., Cardaci, M., & Perticone, V. (2017). Early usage of Pokémon GO and its personality correlates. *Computers in Human Behavior, 72*, 163–169. https://doi.org/10.1016/j.chb.2017.02.047

Tamborini, R., Grizzard, M., Bowman, N. D., Reinecke, L., Lewis, R. J., & Eden, A. (2011). Media enjoyment as need satisfaction: The contribution of hedonic and nonhedonic needs. *Journal of Communication, 61*(6), 1025–1042. https://doi.org/10.1111/j.1460-2466.2011.01593.x

Tateno, M., Skokauskas, N., Kato, T. A., Teo, A. R., & Guerrero, A. P. S. (2016). New game software (Pokémon GO) may help youth with severe social withdrawal, hikikomori. *Psychiatry Research, 246*, 848–849. https://doi.org/10.1016/j.psychres.2016.10.038

Vella, K., Johnson, D., Cheng, V. W. S., Davenport, T., Mitchell, J., Klarkowski, M., & Phillips, C. (2019). A sense of belonging: Pokémon GO and social connectedness. *Games and Culture, 14*(6), 583–603. https://doi.org/10.1177/1555412017719973

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology, 54*(6), 1063–1070. https://doi.org/10.1037//0022-3514.54.6.1063

Weissinger, E., Caldwell, L. L., & Bandalos, D. L. (1992). Relation between intrinsic motivation and boredom in leisure time. *Leisure Sciences, 14*(4), 317–325. https://doi.org/10.1080/01490409209513177

Wellman, B., & Gulia, M. (1999). Net-surfers don't ride alone: Virtual communities as communities. In B. Wellman (Ed.), *Networks in the global village: Life in contemporary communities* (pp.) Routledge. https://doi.org/10.4324/9780429498718

Westermann, R., Spies, K., Stahl, G., & Hesse, F. W. (1996). Relative effectiveness and validity of mood induction procedures: A meta-analysis. *European Journal of Social Psychology, 26*(4), 557–580. https://doi.org/10.1002/(SICI)1099-0992(199607)26:4<557::AID-EJSP769>3.0.CO;2-4

Wulf, T., & Baldwin, M. (2020). Being a kid again: Playing Pokémon GO contributes to wellbeing through nostalgia. *SCM Studies in Communication and Media, 9*(2), 241–263. https://doi.org/10.5771/2192-4007-2020-2-241

Yang, C., & Liu, D. (2017). Motives matter: Motives for playing Pokémon GO and implications for well-being. *Cyberpsychology, Behavior, and Social Networking, 20*(1), 52–57. https://doi.org/10.1089/cyber.2016.0562

Yee, N. (2006). The demographics, motivations, and derived experiences of users of massively multi-user online graphical environments. *Presence: Teleoperators and Virtual Environments, 15*(3), 309–329. https://doi.org/10.1162/pres.15.3.309

Zillmann, D. (1988). Mood management: Using entertainment to full advantage. In L. Donohew, H. E. Sypher, & E. T. Higgins (Eds.), *Communication, social cognition, and affect* (pp. 157–171). Lawrence Erlbaum Associates.

Appendix

Appendix A

Table A1. *Items and Factor Loadings for Pokémon GO Gameplay Experience Questionnaire.*

	Factor Loadings
Satisfaction with Game Accomplishments	
All in all, how satisfied were you with what you accomplished overall in the game during this period?	.854
How satisfied were you with the *number* of Pokémon you caught (including egg hatching)?	.844
How satisfied were you with the *kind* of Pokémon you caught (including egg hatching)?	.836
How satisfied were you with the number of Pokestops you hit?	.797
How satisfied were you with items you received from Pokestops?	.722
Positive Social Interactions	
At this point, how well would you say you get along with your Pokémon GO partner?	−.816
How positive would you say your interactions were with your Pokémon GO partner today?	−.749
All in all, how satisfied were you with the interactions you had with your Pokémon GO partner during this period?	−.722
How much did you and your partner talk to each other about non-Pokémon GO related things, such as classes, work, other things you like to do for fun (that aren't Pokémon GO), other people you both know, etc.?	−.622
Negative Social Interactions	
How negative would you say your interactions were with you Pokémon GO partner today?	.904
How forced, strained, or awkward would you say your interactions were with your Pokémon Go partner today?	.873
Interaction Frequency	
How much did you and your partner talk to each other about where to go?	−.781
How much did you and your partner talk about other things about the game that weren't directly about your game play at the current time, such as what Pokémon you have, where you have played before, what level your character is at, what Pokémon are common where you live, etc.?	−.762
How much did you and your partner talk to each other about Pokémon Raids?	−.738
How much did you and your partner tell each other when you saw a Pokémon?	−.595
Items not included*	
How satisfied were you with the gym battles you participated in?	
How satisfied were you with the raids you participated in?	

Note. * = Items were removed from PCA as majority of participants reported not participating in any gym battles or raids.

Appendix B: Supplemental Description of Data Analytic Plan

To ensure a three-level modelling strategy was appropriate, we computed a model with random intercepts and slopes that accounted only for the effects of session number (an *unconditional* growth model), to which we compared to model variants, including intercept-only and two-level models. We further tested two- and three-level models that estimated quadratic effects of session number. Using AIC values, we determined that a three-level design modelling time linearly produced the best fit. Equations of our model was as follows:

Level 1:

$$\text{Positivity}_{ijk} = \beta_{0jk} + \beta_{1jk}(\text{Gameplay Session}_{ijk}) + \beta_{2jk}(\text{Positive Social Interactions}_{ijk}) + \beta_{3jk}(\text{Satisfaction with Game Accomplishments}_{ijk}) + r_{ijk}$$

Level 2:

$$\beta_{0jk} = \gamma_{00k} + u_{0jk}$$
$$\beta_{1jk} = \gamma_{10k} + u_{1jk}$$
$$\beta_{2jk} = \gamma_{20k}$$

$$\beta_{3jk} = \gamma_{30k}$$

Level 3:

$$\gamma_{00k} = \delta_{000} + v_{00k}$$
$$\gamma_{10k} = \delta_{100} + v_{10k}$$
$$\gamma_{20k} = \delta_{200}$$
$$\gamma_{30k} = \delta_{300}$$

To test our whether depressive symptoms, social anxiety symptoms, and relationship closeness moderate the association between positive social interactions and positivity, we produced three subsequent models with the following Level 2 equations:

$$\beta_{0jk} = \gamma_{00k} + \gamma_{01k}(Moderator) + u_{0jk}$$
$$\beta_{1jk} = \gamma_{10k} + u_{1jk}$$
$$\beta_{2jk} = \gamma_{20k} + \gamma_{21k}(Moderator)$$
$$\beta_{3jk} = \gamma_{30k}$$

The variables of Positive Social Interactions and of Satisfaction with Game Accomplishments, which were measured after each gameplay session (Level 1), were centered around each participant's mean. As a result, model coefficients represent estimates that hold constant Level 1 variables at each participant's mean measurement. All person-level (Level 2) variables were grand-mean centered.

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