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Catch Them All: Exploring the Psychological Impact of Playing Pokémon Go

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Abstract

Using the self-determination theory, this study examined the relationship between seven Pokémon GO features and three psychological outcomes – sense of community, sense of companionship, and psychological well-being. Results showed frequency of collecting Pokémon, customizing Pokémon, performing gym related activities, purchasing special items, and taking pictures with the Pokémon led to increased sense of community, sense of companionship, and psychological well-being. In addition, sense of community and sense of companionship mediated the relationship between frequency of using these five Pokémon GO features and psychological well-being respectively.

Keywords: Pokémon GO, mobile AR game, sense of community, sense of companionship, psychological well-being

Introduction

Pokémon GO is a popular location-based mobile augmented reality game which created a buzz among millions of people globally in summer 2016. Augmented reality is a variation of virtual environments. Unlike virtual reality, which completely immerses a user into the virtual environment, augmented reality allows the user to see the real world with virtual objects superimposed upon with the real world so that the virtual objects and the real world coexist in the same space (Azuma, 1997). Pokémon GO's augmented reality feature mainly reflects on its collection feature. When users are trying to catch a Pokémon, they can either do it inside a house or outside the house. The environment the user is in is the real world, whereas the Pokémon and the ball are virtual objects. Currently, there are still five million daily active Pokémon GO users and 65 million monthly active users globally (Weinberger, 2017). Players spend an average of 26 minutes playing Pokémon GO daily and male millennials (people aged between 18 to 34) are the major players of Pokémon GO (Murnane, 2016).

The primary function of Pokémon GO is the curation function, which allows players to catch and collect Pokémon. Besides the curation function, Pokémon GO also allows players to perform gym related activities (i.e. defeat, battle, and hold gyms), to purchase special items (i.e. lure module, incense, fruit), to use special items (i.e. lure, incense, fruit), to upgrade the Pokémon (i.e. transfer, evolve), to customize the Pokémon (i.e. name your Pokémon), and to take pictures with the Pokémon. All seven features are frequently used by Pokémon Go players.

Since the release of Pokémon GO, researchers have examined the motivations of playing Pokémon GO (Yang & Liu, 2017), the relationship between personality traits and playing Pokémon GO (Tabacchi, Caci, Gardaci, & Perticone, 2017), the physical impact of playing Pokémon GO (Althoff, White, & Horvitz, 2017; Kaczmarek, Misiak, Behnke, Dziekan, & Guzik, 2017; Xian, Xu, Xu, Liang, Hernandez, Wang, & Peterson, 2017), and the psychosocial impact of playing Pokémon GO (Bonus, Peebles, Mares, & Sarmiento, 2017; Yang & Liu, 2017; Zach & Tussyadiah, 2017).

A previous study showed playing Pokémon GO was associated with increased psychological well-being (Bonus et al., 2018). Another study also identified catching Pokémon and winning battles as the two major motivations for playing Pokémon GO (Zach & Tussyadiah, 2017). However, besides these two motivations, other frequently

used Pokémon GO features, such as customizing Pokémon and taking pictures with Pokémon, are understudied. These features may also provide psychological benefits to the players. Meanwhile, a sense of community and a sense of companionship are two major psychological benefits of playing mobile augmented reality games. These two concepts are understudied in previous Pokémon GO studies. Thus, this study aims to explore the relationship between the seven Pokémon GO features and three psychological outcomes including sense of community, sense of companionship, and psychological well-being.

Literature Review

Self-Determination Theory

Self-determination theory is a theory of human motivation, which includes both the intrinsic motivation and the extrinsic motivation. The intrinsic motivation is defined as engaging in an activity for the pleasure and satisfaction derived from the activity itself (Ryan & Deci, 2000). Extrinsic motivation refers to behaviors that are carried out to attain outcomes unrelated to the activity itself (Deci & Ryan, 1985). The primary proposition of self-determination theory is that individuals hold three basic psychological needs: autonomy, competence, and relatedness (Ryan & Deci, 2000). Autonomy refers to a person's desire to experience ownership of his or her behavior and to act with a sense of volition (Ryan & Deci, 2000). Competence refers to the need to successfully achieve desired outcomes, meet performance standards, and manage different challenges (Boezeman & Ellemers, 2009). Relatedness refers to the sense of connecting to and caring for others, and also the feeling of being cared for by others (Vansteenkiste et al., 2007). According to self-determination theory, the more basic psychological needs are satisfied, the more self-determined the motivation becomes (Ryan & Deci, 2002).

Self-determination theory has been frequently used as a theoretical framework in gaming studies. A series of studies have found that the three psychological needs in the self-determination theory could mediate the relationship between online game play and enjoyment (Kim et al., 2015; Neys et al., 2014; Rogers, 2017; Ryan et al., 2006). Ryan et al. (2006) found perceived in-game autonomy and competence were associated with game enjoyment, preferences, and changes in well-being pre- and post-game play. Competence and autonomy perceptions were also related to the intuitive nature of game controls and the sense of presence or immersion in participants' online game play experiences. Neys et al. (2014) found gamer identity strength was a positive predictor of autonomy, competence, and relatedness. Casual and heavy gamers were

motivated to continue to play due to feelings of enjoyment and connectedness. Kim et al. (2015) found autonomy, competence, and relatedness mediated the relationship between in-game customization and game enjoyment. Rogers (2017) found feedback, rules, and social elements of games fulfilled the dimensions of self-determination theory. Dimensions of self-determination theory predicted enjoyment. Games that emphasized flexible rules led to feelings of competence while games that emphasized social elements led to feelings of relatedness. Competence and relatedness then led to feelings of enjoyment.

Other studies explored the relationship between game features and the three psychological needs proposed in the self-determination theory (Bormann & Greitemeyer, 2015; Peng et al., 2012; Wu, Lei, & Ku, 2013). Wu et al. (2013) found autonomy, competence, and relatedness were all negatively correlated with problem game playing. Purpose in life mediated the relationship between autonomy, competence, and relatedness, and problem game playing (Wu et al., 2013). Bormann and Greitemeyer (2015) found the facilitation of immersion and an immersion-mediated enhancement of autonomy and relatedness need satisfaction through in-game storytelling. Peng et al. (2012) manipulated three game features in their study. The first game feature allowed the gamers to customize their avatars. The second game feature was players could choose how to donate treasures to different gods at the altar in exchange for different types of rewards. The third feature was players could choose a range of different answers when conversing with other non-players. The study found that these manipulated game features led to the corresponding need satisfaction. Manipulated autonomy supportive and competence supportive features had main effects on most motivation and engagement outcomes. Autonomy and competence were mediators for the relationship between game features and the motivation for engagement outcomes.

The above-mentioned studies have primarily focused on autonomy and competence. It is suggested that these two concepts could mediate the relationship between online game play and enjoyment. Sense of community and sense of companionship are concepts closely associated with relatedness as they are all dealing with one's feeling of being involved in a social environment (Ryan & Deci, 2000). Thus, it can be postulated that sense of community and sense of companionship may mediate the relationship between game features and psychological well-being. The following sections will review literature on sense of community, sense of companionship, psychological well-being and the linkage between Pokémon GO features and these three psychological outcomes.

Sense of Community

Sense of community is “a feeling that members have of belonging, a feeling that members matter to one another and to the group, and a shared faith that members’ needs will be met through their commitment to be together” (McMillan & Chavis, 1986, p. 9). Sense of community consists of four components: membership, influence, integration and fulfilment of needs, and shared emotional connection (McMillan & Chavis, 1986). In recent years, sense of community has also been applied to the online context. A new concept called sense of virtual community has emerged, which refers to human experience of a community feeling in a virtual environment (Tonteri, Kosonen, Ellonene, & Tarkiainen, 2011).

Sense of community has been studied under the context of social media (i.e. Wang, Yang, Zheng, & Sundar, 2016), blogging (i.e. Stavrositu & Sundar, 2012), online discussion forum (i.e. Tonteri et al., 2011), and gaming (i.e. O’Connor, Longman, White, & Obst, 2015). Gaming literature showed online gamers usually have a sense of community when they are playing games (O’Connor, Longman, White, & Obst, 2015) or modifying games (Poor, 2013). O’Connor et al. (2015) examined World of Warcraft players’ experience of Massively Multiplayer Online Role Playing Games-based social relationships. They found participants reported experiencing a Massively Multiplayer Online Role Playing Game-based sense of community, which is a sense of belonging within the gaming or WoW community. Poor (2013) examined the motivations and sense of community of the modders, people who make modifications to computer games through computer programming (Poor, 2013). Results showed modders have strong senses of community and enjoy helping others (Poor, 2013).

Pokémon Go is a community-based game. When Pokémon GO players are performing gym related activities such as winning the battle in a gym, they need to cooperate with other Pokémon GO players to achieve this goal. Thus, frequently performing gym related activities may increase Pokémon GO players’ sense of community. In addition, some Pokémon GO players like to collect Pokémon with a group of players instead of playing alone, thus, frequently collecting Pokémon may also enhance one’s sense of community. Thus, the following hypothesis is posed:

H1: Sense of community is positively associated with using the seven Pokémon GO features.

Sense of Companionship

Companionship is a relationship involving company, including relationships with partners, families, friends, and pets. Companionship has been defined as the social involvement pursued for intrinsic reasons of satisfaction or enjoyment by sharing activities (Rook, 1987). Sense of companionship is defined as the combination of attachment, commitment, and intimacy (Hatfield, Pillermer, O'Brien, & Le, 2008).

Sense of companionship has been widely studied in the field of robots and virtual pets. Previous literature suggests interacting with a socially assistive robot could enhance sense of companionship (Birnbaum, Mizrahi, Hoffman, Reis, Finkel, & Sass, 2016; Fasola & Mataric, 2012). Fasola and Mataric (2012) found participants preferred to interact with relational robots than with non-relationship robots due to higher level of enjoyableness and companionship. It is found that participants enjoyed interacting with the robot and had positive attitudes towards the robot for the intended activity when they enjoyed the voice and the companionship of the robot (McColl & Nejat, 2013). Another study showed participants' desire for companionship was stronger toward the responsive robot than with the unresponsive robot (Birnbaum et al., 2016).

Sense of companionship can also be obtained through interacting with a virtual pet (Chesney & Lawson, 2007; Lawson & Chesney, 2007; Li & Luh, 2017). Li and Luh (2017) found the game motivations for online pet game players were primarily immersion and achievement. Players with the immersion and achievement motivation had a substantially enhanced flow experience and companionship with their online pets. Chesney and Lawson (2007) found a Nitendog (a screen-based virtual pet) could provide companionship to human beings; however, such companionship was lower compared with the companionship provided by a real pet. Lawson and Chesney (2007) also found that younger pet owners experienced closer companionship with their virtual pets than with older owners. Meanwhile, virtual pets offered more emotional engagement to younger owners than to older owners.

Previous Pokémon GO study found participants felt less anxious leaving the house, interacting with strangers, and going to new places after they began playing Pokémon GO (Kogan, Hellyer, Duncan, & Schoenfeld-Tacher, 2017), which reflects the companionship function of Pokémon GO. Pokémon GO's recent new function - allowing players to choose a Pokémon as their partner so that the player and the partner Pokémon can catch Pokémon

together - is another example of the companionship function of Pokémon GO. Thus, the following hypothesis is posed:

H2: Sense of companionship is positively associated with using the seven Pokémon GO features.

Psychological Well-being

Psychological well-being is defined as a type of happiness that consists of six dimensions: self-acceptance, positive relations with others, autonomy, environmental mastery, purpose in life, and personal growth (Ryff, 1989). Concepts such as self-esteem, loneliness, and life satisfaction are often used as indicators of psychological well-being. Psychological well-being has been well studied in the context of the internet (i.e. Chen, 2012), social media (i.e. Liu & Yu, 2013), and gaming (i.e. Jung, Li, Janissa, Gladys, & Lee, 2009).

Some gaming studies found gaming was negatively associated with psychological well-being (Kirby, Jones, & Copello, 2014; Smyth, 2007). For example, Kirby et al. (2014) found a negative correlation between Massive Multiplayer Online Role Playing Game's playing time and psychological well-being. Such relationship occurred when playing Massive Multiplayer Online Role Playing Game was motivated by immersion or when Massive Multiplayer Online Role Playing Game playing became problematic. Similarly, Smyth (2007) found the Massive Multiplayer Online Role Playing Game group reported more hours spent playing, worse health, worse sleep quality, and greater interference in "real-life" socializing and academic work compared with the control group.

Other gaming studies show the positive association between gaming and psychological well-being (Kaczmarek, & Drazkowski, 2014; Vella, Johnson, & Hides, 2013; Vella et al., 2015; Jung et al., 2009). These studies found that individuals with escapist motivation endorsed stronger realism beliefs and spent more time playing Massive Multiplayer Online Role Playing Game, which increased gamers' online social support but decreased their offline social support. Then both online social support and offline social support increased the player's well-being (Kaczmarek, & Drazkowski, 2014). Vella et al. (2013) found age, social play, relatedness during gameplay and flow were positively associated with player's well-being. Vella et al. (2015) then studied the impact of player experience on well-being and found that solo players experienced greater well-being when experiencing game autonomy. Social players experienced greater well-being when playing with strangers and when experiencing in-game bridging social capital. Jung et al. (2009) found playing Wii games had a positive impact on overall well-being,

including affect, self-esteem, loneliness, and physical activity for the elderly, compared to a control group that played traditional board games.

Recent Pokémon GO studies also detected the positive linkage between playing Pokémon GO and psychological well-being (Oleksy & Wnuk, 2017; Bonus et al., 2018; Zach & Tussyadiah, 2017). Oleksy and Wnuk (2017) studied the impact of playing Pokémon GO on place attachment. Place attachment refers to the relationship between people and places, which may benefit individual well-being. They found positive emotions triggered by playing Pokémon GO could impact players' place attachment via the process of gamification (Oleksy & Wnuk, 2017). Satisfaction from playing Pokémon GO and the social relations made during playing positively predicted place attachment (Oleksy & Wnuk, 2017). Bonus et al. (2018) found playing Pokémon Go was associated with various positive responses such as increased positive affect, increased nostalgic reverie, increased friendship formation, increased friendship intensification, and increased physical activity. These positive responses then led to enhanced well-being. Zach and Tussyadiah (2017) found improved daily functions and psychosocial functions were consequences of playing Pokémon Go. All these studies suggest playing Pokémon GO could increase one's psychological well-being; thus, the following hypothesis is raised:

H3: Psychological well-being is positively associated with using the seven Pokémon GO features.

Previous literature indicates sense of community and sense of companionship are antecedents of psychological well-being (Ryff & Singer, 1996). Previous study also demonstrates the positive association between playing Pokémon GO and psychological well-being (i.e. Bonus et al., 2018). Thus, it is reasonable to postulate that sense of community and sense of companionship may mediate the relationship between playing Pokémon GO and psychological well-being respectively. Thus, the following hypotheses are proposed:

H4a: Sense of community will mediate the relationship between frequency of using the seven features of Pokémon GO and psychological well-being.

H4b: Sense of companionship will mediate the relationship between frequency of using the seven features of Pokémon GO and psychological well-being.

Method

Sample

An online survey was conducted in the summer of 2016 including a total of two hundred and seventy-four respondents ($N = 274$) recruited via Amazon Mechanical Turk (MTurk). A filter question, "Have you played Pokémon GO before?" was asked at the start of the survey. If participants answered "no" to this question, they were not allowed to take the survey. The online survey was hosted on Qualtrics. Participants provided their informed consent before they completed the survey. Each participant received 50 cents as a compensation for completing the survey.

The sample consisted of 120 females (43.8%) and 154 males (56.2%). Respondents' ages range from 18 to 60, with a mean of 30.6 years old ($SD = 8.86$). The majority of the respondents were Whites (81.8%, $n = 224$), followed by Asians (10.2%, $n = 28$). Respondents spent an average of 52 minutes ($SD = 65.7$) playing Pokémon GO daily.

Measurement

Use of Pokémon GO Game Features

Use of Pokémon GO game features was measured by asking respondents to evaluate their frequency of using various game features on a seven-point Likert scale (1 = never; 7 = all the time): collecting Pokémon ($M = 5.97$, $SD = 1.28$), performing gym-related activities (e.g., battle, hold gyms, etc.) ($M = 4.14$, $SD = 1.85$), purchasing special items ($M = 2.96$, $SD = 1.94$), using special items ($M = 4.62$, $SD = 1.73$), upgrading Pokémon ($M = 5.15$, $SD = 1.78$), customizing Pokémon ($M = 3.70$, $SD = 2.12$), and taking pictures of Pokémon ($M = 3.48$, $SD = 2.03$).

Sense of Community

Sense of community ($M = 4.00$, $SD = .91$, Cronbach's $\alpha = .95$) was measured by nine items adopted from Peterson, Spear, and McMillan (2008) on a seven-point Likert scale (1 = strongly disagree; 7 = strongly agree). Some example items are "Pokémon GO game community helps me fulfill my needs," and "I belong in the Pokémon GO game community."

Sense of Companionship

Sense of companionship ($M = 3.5$, $SD = 1.34$, Cronbach's $\alpha = .98$) was measured by 25 items on a seven-point Likert scale (1 = strongly disagree; 7 = strongly agree) adopted from the companionship for the artificial pets scale (Luh, Li, & Kao, 2014). Some example items include "My Pokémon provide me with companionship," and "My Pokémon has become a part of my life."

Psychological Well-being

Psychological well-being ($M = 4.62$, $SD = 1.15$, Cronbach's $\alpha = .98$) was measured using 29 items on a seven-point Likert scale (1 = strongly disagree; 7 = strongly agree) from Hills and Argyle (2001). Some example items include "When I am playing the Pokémon game, I feel that life is very rewarding," and "When I am playing the Pokémon game, I am very happy."

Results

Multiple regression analysis was used to examine the first three hypotheses, which testifies the impact of using each Pokémon GO game feature on individuals' sense of community (H1), sense of companionship (H2), and psychological well-being (H3). Four demographic variables, race (dummy coded), education (dummy coded), gender, and age, were entered as control variables on an initial step, followed by independent variables such as frequency of collecting Pokémon, performing gym-related activities, purchasing special items, using special items, upgrading Pokémon, customizing Pokémon, and taking pictures of Pokémon, which were entered into the second block in the hierarchical regression analyses (see Table 1).

Table 1. Frequency of using *Pokémon features predicting sense of community, sense of companionship, and psychological well-being*

Predictors	Sense of Community β	Sense of Companionship β	Psychological Well-being β
Step 1			
Gender	-0.14*	-0.12*	-0.14*
Age	-0.08	-0.12	-0.001
Education	-0.05	-0.08	-0.01
Race	0.007	0.03	-0.02
Step 2			
Gender	-0.08	-0.05	-0.10
Age	-0.01	-0.08	0.06
Education	0.01	-0.02	0.03
Race	0.01	0.03	-0.03
Collect Pokémon	0.14*	0.11	0.25***
Perform Gym Activities	0.19**	0.20**	0.07
Purchase Special Items	0.31***	0.26***	0.07
Use Special Items	-0.03	0.03	-0.02
Upgrading Pokémon	0.08	-0.10	0.08
Customize Pokémon	0.11	0.16**	0.13*
Take Pictures of Pokémon	0.07	0.15*	0.09

Note. * $p < .05$, ** $p < .01$, *** $p < .001$

In step one, control variables (race, education, gender, and age) accounted for 2.9% of the variance, $F(4, 269) = 2.01, p = .09$. Adding independent variables to step two accounted for additional 33.2% of the variance, $F_{change}(7, 262) = 19.49, p < .001$. Frequency of collecting Pokémon, engaging gym activities, and purchasing special items have significant unique impacts on individuals' sense of community after controlling for age, gender, education, and race. (see Table 1). The final model accounted for a total of 36.2% of the variance in the dependent variable, $F(11, 262) = 13.49, p < .001$.

The same control variables and independent variables were entered into the analysis in the same fashion to predict players' companionship. Control variables together accounted for 2.4% of the variance in the sense of companionship ($F(4, 269) = 2.67, p = .03$). Adding independent variables accounted for additional 32.8% of the variance ($F_{change}(7, 262) = 19.39, p < .001$), which generated the final model that explained 36.6% of the variance in the dependent variable ($F(11, 262) = 13.77, p < .001$). The final model indicated that frequency of engaging gym activities, purchasing special items, customizing Pokémon, and taking pictures of Pokémon were

positively associated with individuals' sense of companionship (see Table 1).

The last set of regression analysis indicated that independent variables together accounted for 19.8% of variance in psychological well-being with $F_{change}(7, 262) = 9.47, p < .001$. With all variables entered, the final model accounted for a total of 21.9% of variance in the dependent variable ($F(11, 262) = 6.68, p < .001$). Frequency of collecting Pokémon and customizing Pokémon were positively associated with individuals' psychological well-being (see Table 1).

To test H4a and H4b, Hayes' PROCESS Macro - model 4 with 95% bias-corrected confidence intervals using 2,000 bootstrap resamples was employed. Prior findings indicated a total of five independent variables significantly predicted at least one of the mediators. These five independent variables are: frequency of collecting Pokémon, frequency of customizing Pokémon, frequency of performing gym activities, purchasing special items, and frequency of taking pictures of Pokémon. Therefore, both proposed mediation paths were tested for each independent variable. To be consistent with previous analyses, race, education, gender, and age, along with the other six of seven independent variables (except for the one that is being tested for mediation) were also included as covariates. The findings indicated that sense of community and sense of companionship mediated the relationships between frequency of gym activities and purchasing special items and the dependent variable, psychological well-being. Frequency of taking pictures of Pokémon and customizing Pokémon were positively associated with players' psychological well-being only via an enhanced sense of companionship. In contrast, the positive relationship between frequency of collecting Pokémon and psychological well-being was mediated only by sense of community (see Table 2). These findings suggested that more frequently performing gym activities and purchasing special items would lead to higher levels of sense of community and sense of companionship, which could subsequently enhance players' psychological well-being. Moreover, the other three game features operated through different mechanisms. On the one hand, customizing and taking pictures of Pokémon would lead to higher levels of sense of companionship and, subsequently, better psychological well-being; on the other hand, more frequently collecting Pokémon heightens players' sense of community, which would lead to better psychological well-being. Lastly, among the five independent variables, only frequency of collecting Pokémon had a significant direct effect on the outcome variable, indicating that the collecting behavior, which is the main game feature, could directly enhance psychological well-being, in addition to the mediation path

reported above.

Table 2. Mediation Analyses

Independent variable (IV)	Parallel mediators	Dependent variable (DV) Psychological well-being		Direct effects of IV on DV	
		<i>B (SE)</i>	95% CI [LL, UL]	<i>B (SE)</i>	95% CI [LL, UL]
Frequency of collecting Pokémon	Sense of community	.033 (.019)	[.003, .079]	.16 (.058)	[.048, .276]
	Sense of companionship	.028 (.018)	[-.001, .065]		
Frequency of customizing Pokémon	Sense of community	.015 (.012)	[-.003, .041]	.034 (.034)	[-.033, .10]
	Sense of companionship	.025 (.012)	[.004, .052]		
Frequency of performing gym activities	Sense of community	.029 (.016)	[.005, .066]	-.020 (.038)	[-.095, .054]
	Sense of companionship	.035 (.017)	[.008, .074]		
Frequency of purchasing special items	Sense of community	.046 (.018)	[.012, .083]	-.049 (.038)	[-.123, .026]
	Sense of companionship	.043 (.016)	[.016, .078]		
Frequency of taking pictures of Pokémon	Sense of community	.009 (.011)	[-.009, .036]	.021 (.034)	[-.046, .088]
	Sense of companionship	.023 (.013)	[.003, .053]		

Note. CI = confidence interval. LL and UL indicate the lower and upper limits of a confidence interval, respectively. If the range between LL and UL of a 95% CI does not contain 0, the corresponding effect coefficient is significant at $p < .05$. Age, gender, education, race, and the other gameplay behavioral variables (except for the IV) were included in the model as covariates.

Discussion

Previous virtual pet studies have been focusing on examining the health benefits of interacting with virtual pets (i.e. Ahn et al., 2017). Previous Pokémon GO studies have frequently examined the physical benefits of playing Pokémon GO (i.e. Xian et al., 2017). Recent Pokémon GO studies investigated the companionship function (Kogan et al., 2017), and the place attachment function of playing Pokémon GO (Oleksy & Wnuk, 2017). However, the psychological benefits of playing Pokémon GO have been under-investigated.

One major finding of the study is that the more frequent Pokémon GO gamers collect Pokémon, perform gym-related activities, and purchase special items, the more they feel that they belong to the Pokémon GO gaming community. Performing gym-related activities may offer Pokémon GO gamers a sense of community in that Pokémon GO gamers in the same group need to get together to defeat or defend the gym. Similarly, collecting Pokémon and

purchasing special items may also rely on the group work. This finding is consistent with the results of previous studies in the context of online community, which indicated that community building (Wang et al., 2016) and participation (Tonteri et al., 2011) were positively associated with individuals' sense of community. It also corroborates the previous findings of the positive effects of online game playing (O'Connor et al., 2005) and modification (Poor, 2013) on sense of community and extends the knowledge to an AR mobile game context.

Another finding showed frequency of performing gym-related activities, purchasing special items, customizing Pokémon, and taking pictures of Pokémon positively predicted sense of companionship. The behaviors of customization, taking pictures, and purchasing special items were all intended to build a long-term relationship with the Pokémon. Research has shown that sense of companionship can provide psychological satisfaction, which may facilitate building the long-term relationship (Mival & Benyon, 2007). Research has also shown that sense of companionship can be obtained via interacting with the virtual pets (i.e. Chesney & Lawson, 2007). Customizing and taking picture with Pokémon are typical interaction behaviors between the Pokémon GO players and the Pokémon. Since Pokémon can also be considered as a form of virtual pets, it makes sense that the frequent interaction between the Pokémon GO players and the Pokémon can bring more sense of companionship to the Pokémon GO players. When Pokémon GO players perform the gym-related activities, they usually need to accomplish this task with their teammates. Research has shown that playing with peers can offer people a higher level of sense of companionship compared with playing by oneself (Parker & Asher, 1993). Hence, frequently performing gym-related activities can bring more companionship to Pokémon GO players.

Frequency of collecting Pokémon and customizing Pokémon were also shown as positive predictors of psychological well-being. Consistent with previous Pokémon GO studies (e.g., Bonus et al., 2018), this finding further points out the specific features of Pokémon GO that lead to the increased psychological well-being. Collecting Pokémon can offer Pokémon GO players a sense of community, while customizing Pokémon can offer Pokémon GO players a sense of companionship. Sense of community and sense of companionship are two precursors of psychological well-being, so it makes sense that frequency of collecting and customizing Pokémon will lead to increased psychological well-being. This finding was further corroborated by a follow-up mediation analysis examining the mediating role of sense of community and sense of companionship

on the relationships between in-game activities of collecting Pokémon and customizing Pokémon and players' psychological well-being.

The mediation analyses showed that sense of community and sense of companionship were two parallel mediators between frequency of using some Pokémon GO features, including collecting Pokémon, customizing Pokémon, taking pictures of Pokémon, participating in Pokémon gym activities, and purchasing special items, and individuals' psychological well-being. Previous literature shows sense of community is the mediator between personal journaling and autonomy (Stavrositu & Sundar, 2013). Sense of companionship can be obtained through interacting with a virtual pet (Chesney & Lawson, 2007) or a socially assistive robot (Fasola & Mataric, 2012).

Two Pokémon GO features (upgrade Pokémon and use special items) did not have any impact on the three psychological outcomes, likely that these two features were designed to increase the entertaining and enjoyment aspect of the game; these two features may fulfill the need in competence. However, both sense of companionship and sense of community belong to the need in relatedness. Thus, these two features will not impact sense of community and sense of companionship nor would they influence psychological well-being.

This study has both theoretical implications and practical implications. Theoretically, it contributes to the literature on psychological impact of playing mobile AR games by showcasing the linkage between specific game features and psychological outcomes. Practically, it offers design insights for future mobile AR game designers. Among the seven Pokémon GO features, the curation behavior and the customization behavior offer more psychological benefits, such as providing increased sense of companionship and increased sense of community compared with other features; thus, mobile AR game designers can take these two features into consideration when designing and developing future mobile AR games. Mobile AR game designers should also keep exploring the game features that can bring sense of community and sense of companionship to gamers.

Limitations and Future Directions

The major limitation of the study is that the sample size is relatively small. The major participants were Whites and Asians. Blacks, Hispanics, and Latinos were not represented. Future study should try to recruit a more diverse group so that the external validity of the study can be improved. Another limitation of the study is that its focus on Pokémon GO players. It is possible that these Pokémon GO

players are also gamers with high issue involvement toward playing games. It may be argued that Pokémon GO can only offer psychological benefits to gamers who like to play games. Future study could close this gap by recruiting both gamers and non-gamers so that it can be tested whether playing Pokémon GO can bring psychological benefits to both players and non-players. Future study could also measure people's issue involvement toward playing games so that this variable can be controlled or be used as a moderator between playing games and psychological well-being.

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