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The Pikachu effect: Social and health gaming motivations lead to greater benefits of Pokémon GO use

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A B S T R A C T

Several studies provided evidence for the effectiveness of gamification of health behaviors (e.g., exercising or walking) via video games. However, little is known about whether individuals who endorse specific gaming motivations are more likely to derive health benefits from gaming. Building upon previous studies on gamification of health behaviors, we examined whether specific gaming motives (e.g., potential health benefits) influenced Pokémon GO gaming time and gaming health outcomes, a phenomenon we termed *The Pikachu Effect*. We introduced health motivation as a novel component among previously established gaming motives, which reflects the ongoing gameplay transformation and increased health potential of modern games. Volunteers ($N = 444$) completed two measurements of Pokémon GO motivations, gaming time, physical activity, and time spent outdoors within a 6 week interval. The results supported the Pikachu effect hypothesis as health motivation and social motivation were related to health outcomes. Furthermore, we replicated previous findings indicating that individuals who spent more time playing Pokémon GO were more physical active. We also evidenced a new Pokémon GO playing behavioral benefit, i.e., increased time spent outdoors among more active players. We explored meaningful individual differences; for example, men played more and derived more benefits from Pokémon GO. These findings suggest that health motivation operates in parallel with previously identified main motives for gaming. Accounting for motivation is essential for a more accurate prediction of gaming time and gaming-related health behaviors.

1. Introduction

Pokémon GO (Niantic Inc., USA) is a mobile game that requires participants to walk outdoors in order to progress. Several older games also involve gamified physical activity (Lau, Wang, & Maddison, 2016; McNarry & Mackintosh, 2016; Staiano & Calvert, 2011). Yet, Pokémon GO is unique due to its unprecedented popularity, which has facilitated a significant behavioral change in public health (Althoff, White, & Horvitz, 2016; Dillet, 2016). Little is known about how specific gaming motivations influence health outcomes among Pokémon GO players. Gaming motivations determine what people focus on within the game environment and in turn what costs and benefits they derive from gaming (De Grove, Breuer, Chen, & Quandt, 2017; Kaczmarek & Drążkowski, 2014; Yee, 2006). Understanding motivations is vital to explaining and influencing how players benefit from gaming as well as to progress the development of games that satisfy more needs.

In this study, we extended prior research on gaming motivation (Yee, Ducheneaut, & Nelson, 2012) and gaming health benefits (Althoff et al., 2016) by examining how different motivations predict health behaviors (physical activity and time spent outdoors) among Pokémon GO players. We aimed to introduce the pursuit of health benefits as a new motive for gaming complementary to previously identified gaming motives such as achievements, immersion, and socializing (Yee et al., 2012). It is essential to account for health motivation in gaming due to an ongoing process of addressing health behaviors in games, e.g., Ingress (Niantic, Inc., USA), Zombies, Run! (Six to Start & Naomi Alderman, UK). The

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motivation to play a game because of health benefits determines how a player plays a game. This initial choice is important, similarly to the initial choice in the Pokemon games, where the player voices the catch-phrase "I choose you, Pikachu!". From this signature phrase, emphasizing the willful choice of the player, we derive the name for this effect.

1.1. Gaming and health

Video gaming used to be a sedentary activity, because players were required to sit in front of a television set, computer, or gamepad screen. However, game developers have started to enhance the gaming experience with controllers that introduce physical movements into the gameplay (e.g., exercising with Nintendo Wii console). Such games improve health by increasing energy expenditure among diverse risk groups such as children and adolescents (McNarry, & Mackintosh, 2016; Verhoeven, Abeele, Gers, & Seghers, 2015), older adults (Hall, Chavarria, Maneeratana, Chaney, & Bernhardt, 2012), or patients with cardiovascular risk factors and diseases (Dithmer et al., 2016). Recently, game developers have started to use geolocation systems with online data transmission available in most smartphones. This has introduced changing the player's current location by walking, running, or cycling into the gameplay. Consequently, video games have become capable of enhancing outdoor physical activity (Althoff et al., 2016).

Increasing outdoor physical activity is important because individuals who endorse higher physical activity are more likely to be healthy (Miles, 2007). For instance, physically active individuals maintain healthier body composition and weight (Ness et al., 2007), have lower risk of diseases such as hypertension or diabetes (Buttriss & Hardman, 2005), and live longer (Lee et al., 2012). Furthermore, spending more time outdoors may be beneficial due to longer sunlight exposure especially in populations at higher latitudes with greater seasonal variations in daytime (see Gillie, 2006 for a review). Lack of sunlight leads to lower vitamin D production and concentration, increasing the risk of rickets (Ward, Gaboury, Ladhani, & Zlotkin, 2007), cancer (Giovannucci, 2005), tuberculosis (Chan, 2000), multiple-sclerosis (Willer et al., 2003), and reproductive diseases (Thys-Jacobs, Donovan, Papadopoulos, Sarrel, & Bilezikian, 1999). Moreover, regular sun exposure is important for melatonin secretion, which is the key pace-setter for proper circadian rhythms (Mead, 2008). In sum, these findings suggest that games such as Pokémon GO are likely to provide health benefits as long as the gameplay translates into more physical activity and outdoor time.

1.2. Health behaviors in Pokémon GO

Pokémon GO gameplay is centered around several outdoor physical activities. In Pokémon GO, individuals play the role of Pokémon trainers who explore their real-world surrounding and collect virtual characters called Pokémon, an activity termed *wild Pokémon hunting*. Pokémon GO is an augmented-reality game where the real-world location of participants—based on smartphone GPS—determines the location of their game avatar. Thus, Pokémon GO players need to walk in order to progress in the game. Besides wild Pokémon hunting, Pokémon GO includes other elements of gamified physical activity and outdoor time. For instance, trainers need to walk long distances (up to 10 km) in order to hatch eggs into new Pokémon, with rarer Pokémon hatching in even longer distances. Furthermore, Pokémon GO rewards players for regular visits to specific spots in their neighborhood (*PokéStops*) where in-game resources can be replenished. Research using accelerometry has revealed that individuals who play Pokémon GO increase their physical activity significantly (Althoff et al., 2016).

Pokémon GO also provides an opportunity for players to interact face-to-face with each other and socialize (e.g., make new friends, build teams), which has emerged as a social factor that has been related to greater engagement in games involving physical activity (Dithmer et al., 2016; Paw, Jacobs, Vaessen, Titze, & van Mechelen, 2008). However, there are some aspects of the game that produce progress with minimal physical output, such as fighting against the Pokémon characters of other gamers in fighting arenas called *Gyms*. Training in gyms motivates players to spend more time outdoors, because gyms are located at specific spots in the neighborhood. Yet, they do not motivate players to engage in more physical activity. In sum, Pokémon GO can increase outdoor physical activity among gamers. However, this outcome is likely to depend on gaming style and motivations that determine specific activities, which players select from the Pokémon GO gameplay repertoire.

1.3. Gaming motivations

Motivation is a fundamental feature of human action-readiness (Mendes & Park, 2014). Individuals are more motivated to initiate actions when they see many benefits of a particular behavior (Ajzen, 2011). Models of motivation towards role-playing games have accounted for three main motives: achievements, immersion, and socializing (Yee, 2006; Yee et al., 2012). Individuals who endorse high achievements motivation are focused on acquiring and testing their power within the game. For instance, in Pokémon GO they can enjoy searching for rare items (i.e., strong and rare Pokémon) and competing with other players' Pokémon in gyms. Individuals with high immersion motivation appreciate the unique characteristics of the game world and its story. They enjoy exploring the Pokémon GO universe just for the sake of exploring it, e.g., learning about different Pokémon species and regions in the Pokémon world. Finally, gamers with social motivation use games to seek opportunities to interact with other players and expand their social networks. Pokémon GO facilitates social gatherings and meeting new people in the real-world at PokéStops and Gyms. Pokémon GO players can socialize with other players face-to-face or interact via social networking sites, e.g., via Pokémon GO Facebook profiles. In sum, these three motives influence what individuals focus on within the game. Additionally, the choice of gaming activities influences costs and benefits derived from gaming such as changes in well-being and social networks (Kaczmarek & Drążkowski, 2014).

We argue that gamification of health behaviors is likely to provide a new gaming motive, i.e., health motivation for gaming. Individuals who endorse health gaming motivation expect that the game will help them introduce or maintain healthy behaviors (e.g., regular physical activity). This is important because regular practice of health behaviors is problematic for many people (Webb, Joseph, Yardley, & Michie, 2010). Pokémon GO is representative of such health-related video games, and it has been widely discussed within a health context in the media (Arndt, 2016; Haelle, 2016). However, gaming for health motives and the role of gaming in predicting health outcomes has not been explicitly addressed in the literature. Thus, we expected that health motivation would explain additional gaming time after controlling for previously identified motivations.

1.4. Present study

In the present study, we examined how gaming motivations influence the effectiveness of gamification of outdoor physical activity with the Pokémon GO mobile game, a phenomenon we termed the Pikachu effect. Building upon prior studies on Pokémon

GO (Althoff et al., 2016), we expected that Pokémon GO gaming time would predict more physical activity and more time spent outdoors. We also hypothesized that individuals with an explicit health motive for gaming would engage more and reap more behavioral benefits. Furthermore, we explored whether other well-established motivations for gaming (socializing, immersion, and the pursuit of achievements) predicted game use and its behavioral health outcomes. We controlled for gender because physical activity and gaming behaviors differ between women and men (Caspersen, Pereira, & Curran, 2000; Winn & Heeter, 2009). We also controlled for age because younger participants tend to be more physically active (Hallal et al., 2012) and spend more time with electronic games (Greenberg, Sherry, Lachlan, Lucas, & Holmstrom, 2010).

2. Methods

2.1. Participants

Participants were 444 Pokémon GO players aged 12–50 years ($M = 23.4$, $SD = 5.88$). These volunteers constituted 43.65% of the initial sample of 1017 players. Participants dropped out of the final sample because they failed to complete the follow-up questionnaire (52.31%), provided false information in the follow-up questionnaires (1.77%), were younger than 12 years old (0.19%), or did not agree with a control question asking whether they provided reliable answers which should be included in the analysis (0.39%). Participants who remained in the sample were older, $t(1015) = 5.01$, $p < 0.01$, $d = 0.34$, less physically active, $t(990.57) = -3.48$, $p < 0.01$, $d = 0.22$, and less socially motivated towards the game, $t(1015) = -2.64$, $p < 0.05$, $d = 0.16$, compared to participants who dropped out from the study. Cohen's d indicated that these differences were small. Women were more likely to remain in the sample, $\chi^2(1) = 19.90$, $p < 0.01$. Listwise deletion was used for participants with missing data (1.57%). Participants were recruited online at Pokémon GO websites. They completed the first measurement, Time 1 (T1), during the last week of September and the first two weeks of October 2016, 16–90 days after they started to play Pokémon GO ($M = 67.19$, $SD = 12.55$). The second measurement, Time 2 (T2), was completed 6 weeks later. There was a similar number of women ($n = 219$; 49.3%) and men ($n = 225$; 50.75%) in the sample. Given that outcome variables in the model were planned to regress upon up to 10 predictors, power analyses with G*Power 3.1.9.2 (Faul, Erdfelder, Buchner, & Lang, 2009) suggested that a total sample size of 395 would be the minimum required to detect small effects of $f^2 = 0.02$ with an $\alpha = 0.05$ and power of 0.80. The study was conducted in accordance with the guidelines of the Institutional Ethics Committee. Participation in the study was voluntary and each participant provided an informed consent. Participants received a chance to win one out of three cinema vouchers for completion of the follow-up measurement.

2.2. Measures

2.2.1. Gaming time

The measure of gaming time reflected time spent within the game environment over the past seven days (Kaczmarek & Drążkowski, 2014). Participants reported the number of hours spent on gaming for each day of the week separately. Scores above three standard deviations (above 12 h a day) were trimmed. Data was log-transformed to adjust the positive skew of the initial data.

2.2.2. Outdoor time

The measure of outdoor time reflected the average time spent outdoors. Participants also reported the number of hours spent on gaming for each day of the week separately. Scores above 12 h a day were trimmed. Data for each day were log-transformed.

2.2.3. Physical activity

We accounted for physical activity with the short version of the International Physical Activity Questionnaire (Craig et al., 2003). This questionnaire focused on four groups of items regarding vigorous physical activity; moderate physical activity; walking and sitting during the last seven days at work; as part of house and yard work; to get from place to place; and for recreation, exercise, or sport. For each level of physical activity (e.g., walking), participants reported how many days they did this type of activity, and how much time they spent doing this type of activity on one of those days. The index of physical activity in each intensity was calculated as the product of the number of days and the average daily time. This product was further weighted by estimated metabolic equivalent energy expenditures (×8 for vigorous activity, × 4 for moderate activity, and × 3.3 for walking). Self-reports with this questionnaire have good test-retest reliability and correlate with objective measures of physical activity via accelerometry. According to the guidelines of the IPAQ Research Committee (2005), vigorous physical activity, moderate physical activity, and walking were trimmed to 4 h. Log transformation of each physical activity measure was used in the analyses to adjust the positive skew of the initial data.

2.2.4. Gaming motivation

Gaming motivation was measured with the Online Gaming Motivations Scale (Yee et al., 2012). The participants were asked about the importance of the following specific gameplay elements: social motivation (4 items [e.g., "Being part of a team"]), immersion (4 items [e.g., "Learning about stories and lore of the world"]), and achievements (4 items [e.g. "Becoming powerful"]). We slightly adjusted the wording of some items to fit the Pokémon GO mechanics (e.g., "teams" instead of "guilds"). Health motivation was measured with three additional items developed for the purpose of the study: "Potential health benefits of this game use", "Staying outdoors during the gameplay", and "Initiating physical activity while playing." Responses were provided on a 7-point Likert-scale ranging from 1 (*not at all important*) to 7 (*extremely important*). Items showed good internal consistency for health ($\alpha = 0.85$), social relationships ($\alpha = 0.83$), immersion ($\alpha = 0.74$), and achievement ($\alpha = 0.77$).

2.3. Analytical strategy

We performed structural equation modeling to test if behavioral outcomes (e.g., physical activity, outdoor time, and gaming time) were predicted by gaming motivations after controlling for gender and age of the participants. Latent variables were constructed for each scale. The residual variance of the same observed variables at different times were freed to correlate among each other (Raykov, 1992). Following guidelines for evaluation of model fit (Hu & Bentler, 1999), we calculated SRMR (values < 0.08 indicating a good fit), supplementing it with RMSEA (values < 0.06 indicating a good fit). In addition to direct effects (a single path from a predictor to an outcome), we tested the total effect of one variable on another that comprised the direct effect and indirect effects (products of coefficients for two or more significant paths) (Hayes, 2013). Structural equation modeling with maximum likelihood estimator and Satorra-Bentler scaled chi-square was performed with mPlus 7.2 a latent variable modeling program (Muthén & Muthén, 2012).

3. Results

3.1. Model fit

Descriptive statistics and inter-correlations are presented in Table 1. The hypothesized structural model depicting differences in the underlying motivations of gaming and health outcomes is presented in Fig. 1. This model fit the empirical data well, χ^2 (1193) = 2455.50, $p < 0.01$, SRMR = 0.075, RMSEA = 0.049, 90% CI [0.046, 0.052]. Inclusion of insignificant paths had no effect on the model fit, $\Delta\chi^2$ (23) = 17.58, $p > 0.05$; thus, they were removed.

3.2. Gaming time and health behaviors

We found that individuals who spent more time playing Pokémon GO at T1 were more physically active six weeks later (T2), as indicated by a significant total effect of gaming time at T1 on physical activity at T2, $b = 0.35$, SE $b = 0.05$, $p < 0.01$. This total effect comprised a significant direct effect, $b = 0.11$, SE $b = 0.05$, $p < 0.05$, and a significant indirect effect that operated through higher physical activity at T1, $b = 0.24$, SE $b = 0.04$, $p < 0.01$.

Furthermore, individuals who spent more time playing Pokémon GO at T1 spent more time outdoors at T2. This phenomenon was indicated by a significant total effect, $b = 0.62$, SE $b = 0.03$, $p < 0.01$, that consisted of a significant direct effect, $b = 0.61$, SE $b = 0.04$, $p < 0.01$, a significant indirect effects via outdoor time at T1, $b = -0.05$, SE $b = 0.04$, $p < 0.01$, and a significant indirect effect via gameplay time at T2, $b = 0.06$, SE $b = 0.01$, $p < 0.01$.

3.3. The effects of gaming motivation

We expected that Pokémon GO players with stronger health motivation would play more and, in turn, maintain higher levels of health behaviors. In line with this hypothesis, we found that individuals with stronger health motives were more physically active at T1 and T2 with a significant indirect effect on physical activity at T2 via physical activity at T1, $b = 0.14$, SE $b = 0.04$, $p < 0.01$. Players with stronger health motivation spent more time outside because they spent more time playing; a finding indicated by a significant indirect effect of health motivation on outdoor time via gaming time at T2, $b = 0.03$, SE $b = .01$, $p < 0.05$.

Players with stronger social motivation were not more physically active. Yet, the effects of social motivation on physical activity were complex, i.e., opposing effects cancelled each other out producing a non-significant total effect of social motivation on physical activity at T2, $b = -0.02$, SE $b = 0.04$, $p > 0.05$. More specifically, there was a significant direct effect, $b = -0.13$, SE $b = .04$, $p < 0.01$, a significant indirect effect via gaming time at T1 and physical activity at T1, $b = 0.07$, SE $b = 0.02$, $p < 0.01$, and an insignificant indirect effect via gaming time at T1, $b = 0.03$, SE $b = .02$, $p > 0.05$.

However, individuals who endorsed social motives spent more time outdoors six weeks later. This finding was indicated by a significant total effect on outdoor time at T2, $b = 0.18$, SE $b = 0.03$, $p < 0.01$. The total effect comprised significant indirect effects via gaming time at T1, $b = 0.18$, SE $b = .03$, $p < 0.01$, a significant indirect effect via gaming time at T1 and outdoor time at T1, $b = -0.02$, SE $b = .007$, $p < 0.05$, and a significant indirect effect via gaming time at T1 and gaming time at T2, $b = 0.02$, SE $b = .005$, $p < 0.01$. This indicates that socially-oriented players spent more time outdoors because they spent more time playing Pokémon GO.

Similarly, immersion motivation predicted more outdoor time but not more physical activity. The indirect effect of immersion motivation on physical activity at T2 via physical activity at T1 was not significant, $b = -0.07$, SE $b = .04$, $p > 0.05$. However, individuals with immersion motivation spent more time outdoors at T2 as indicated by a significant indirect effect of immersion motivation on outdoor time at T2 via gaming time at T2, $b = 0.04$, SE $b = 0.01$, $p < 0.01$. Noteworthy, that fact that individuals with stronger immersion motivation spent more time outdoors was explained by longer Pokémon GO gaming time.

Finally, players with higher achievements motivation spent less time outdoors at T2 with a negative indirect effect on outdoor time at T2 via outdoor time at T1, $b = -0.03$, SE $b = .01$, $p < 0.05$.

3.4. Gender differences

Men initiated more physical activity at T2 as indicated by a significant total effect of gender on physical activity at T2, $b = 0.16$, SE $b = .03$, $p < 0.01$. Men maintained their greater physical activity observed at T1. Furthermore, men were more physically active partly because they played Pokémon Go more compared to women. In statistical terms, the total effect of gender on physical activity at T2 comprised a significant indirect effect of gender on physical activity at T2 via physical activity at T1, $b = 0.10$, SE $b = .03$, $p < 0.01$,

Table 1
Descriptive statistics and correlations among study variables.

	1	2	3	4	5	6	7	8	9	10	11
1. Gaming time T1											
2. Gaming time T2	0.20**										
3. Physical activity T1	0.53**	0.07									
4. Physical activity T2	0.34**	0.13**	0.44**								
5. Outdoor time T1	0.41**	0.46**	0.20**	0.15**							
6. Outdoor time T2	0.57**	0.37**	0.38**	0.51**	0.29**						
7. Health motivation	0.10*	0.17**	0.09	0.08	0.11*	0.13*					
8. Social motivation	0.27**	0.07	0.21**	0.10*	0.20**	0.20**	0.44**				
9. Immersion motivation	0.09	0.08	0.02	0.09	0.14**	0.10*	0.25**	0.39**			
10. Achievements motivation	0.14**	0.09	0.10*	−0.01	0.23**	0.05	0.23**	0.38**	0.35**		
11. Age	−0.02	0.26**	−0.08	−0.10*	0.11*	0.06	0.13**	−0.26**	−0.23**	−0.10	
12. Gender	0.18**	0.15**	0.16**	0.15**	0.07	0.19**	−0.04	0.05	−0.06	0.09	−0.08
M	1311.62	433.10	6151.05	5050.60	752.05	846.45	15.94	16.11	14.65	20.31	23.40
SD	907.96	478.44	5028.56	4635.74	609.52	669.08	4.02	6.06	5.48	5.07	5.88
M_{Ln}	33.69	21.59	8.36	8.05	30.40	27.56	–	–	–	–	–
SD_{Ln}	6.08	10.68	1.03	1.23	6.40	8.15	–	–	–	–	–

Note: Gaming time = minutes per week. Outdoor = minutes per week. Gender coded as 0 = women, 1 = men. Ln = log transformed data.
$^{*}p < 0.05$.
$^{**}p < 0.01$.

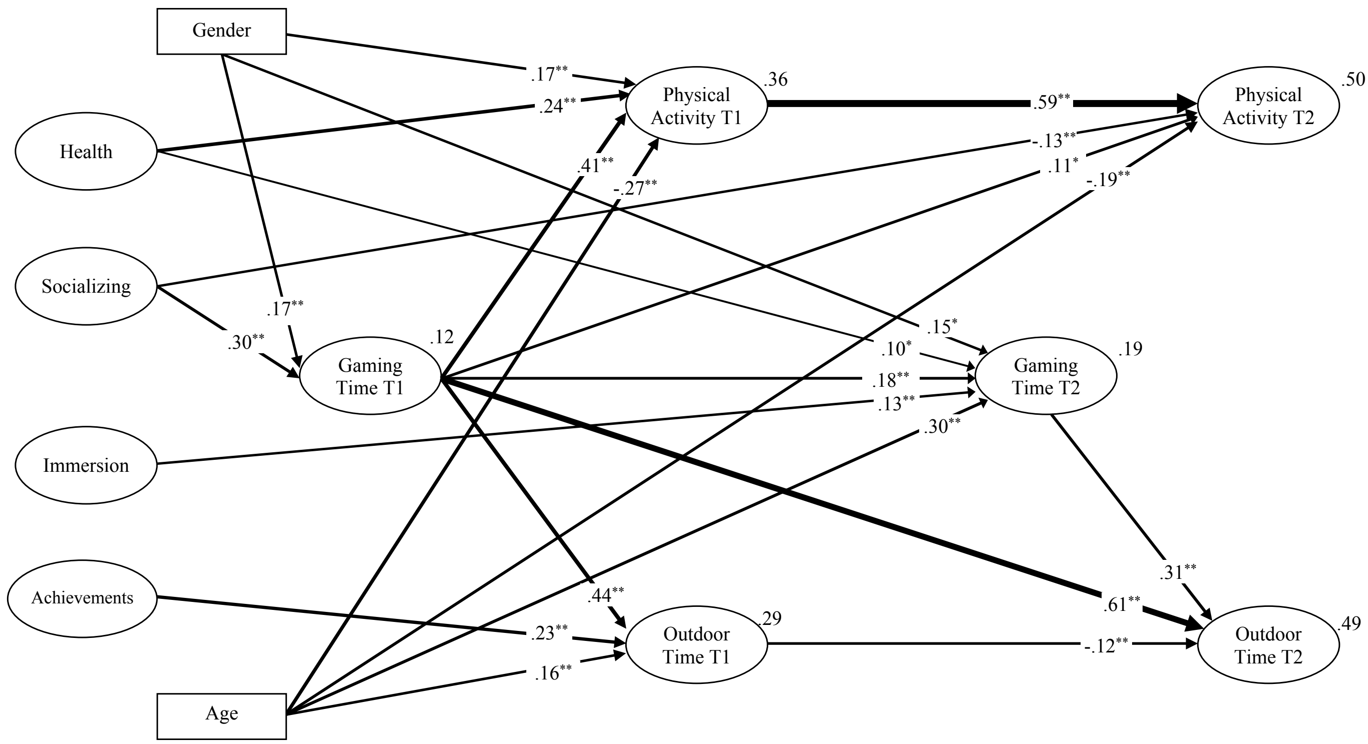

Fig. 1. Effects of gaming motivations on gaming time, outdoor time, and physical activity. *Notes*. Standardized parameters. The percent of explained variance (R^2) is presented in the top right corner for each dependent variable. Rectangles represent observed variables. Ellipses represent latent variables. Thicker lines represent stronger effects. T1 = first measurement, T2 = second measurement. Gender coded as 0 = women, 1 = men. $^{*}p < 0.05$, $^{**}p < 0.01$.

a non-significant indirect effect on physical activity at T2 via gaming time at T1, $b = 0.02$, SE $b = .01$, $p > 0.05$, and a significant indirect effect via gaming time at T1 and physical activity at T1, $b = 0.04$, SE $b = .01$, $p < 0.01$.

Men were also more likely to spend time outdoors at T2 and it was due to their longer gaming time. This was indicated by the significant total effect of gender on time spent outdoors, $b = 0.15$, SE $b = .03$, $p < 0.01$, that comprised a significant indirect effects operating through gaming time at T1, $b = 0.11$, SE $b = .03$, $p < 0.01$, gaming time at T2, $b = 0.05$, SE $b = .01$, $p < 0.01$, gaming time at T1 and outdoor time at T1, $b = -0.01$, SE $b = 0.004$, $p < 0.05$, and gaming time at T1 and gaming time at T2, $b = 0.01$, SE $b = 0.003$, $p < 0.01$.

3.5. Age differences

Older participants were less physically active as indicated by a significant negative total effect of age on physical activity at T2, $b = -0.35$, SE $b = .04$, $p < 0.01$. Yet, the effect of Pokémon GO players' age on their physical activity was not relevant to Pokémon GO gaming time. This total effect was produced by a significant direct effect, $b = -0.19$, SE $b = 0.05$, $p < 0.01$, and a significant indirect effect via physical activity at T1, $b = -0.16$, SE $b = .03$, $p < 0.01$. However, older participants spent more time outdoors due to Pokémon GO gaming. This was indicated by a significant total effect of age on outdoor activity at T2, $b = 0.07$, SE $b = 0.02$, $p < 0.01$, that comprised significant indirect effects via outdoor time at T1, $b = -0.02$, SE $b = 0.009$, $p < 0.05$, and via gaming time at T2, $b = 0.09$, SE $b = 0.02$, $p < 0.01$.

4. Discussion

Based upon evidence of successful gamified outdoor physical activity with Pokémon GO (Althoff et al., 2016), we applied the Pikachu effect hypothesis to examine whether individuals with stronger health motives for gaming derived health benefits from playing. First, we found that players who intended to play Pokémon GO for health behavior reasons spent more time playing and spent more time outdoors compared to their less health-focused peers. Health motives predicted higher physical activity; yet, this effect was not due to Pokémon GO gaming. Second, individuals who endorsed social motives spent more time gaming and more time outdoors but did not increase physical activity levels. Third, replicating previous findings (Althoff et al., 2016), we observed that individuals who played more at the beginning of the study were more physically active and spent more time outdoors six weeks later. Finally, we found meaningful gender and age differences that predicted game use and its health benefits, with older participants and men benefitting more.

We observed that individuals who spent more time playing Pokémon GO were more physically active and spent more time outdoors. They also were more successful with these health behaviors six weeks later. These findings provide new evidence for the efficacy of gamification of health behaviors. It is also the first evidence of gamification of outdoor time. In addition to replicating previous findings regarding increased physical activity among Pokémon GO players, (Althoff et al., 2016), we revealed that Pokémon GO is also effective in increasing outdoor time—a significant precursor to several health outcomes (Gillie, 2006). Given that low physical activity and passive indoor leisure has been a concern for public health (Lee et al., 2012), interventionists might capitalize on these findings in the pursuit of more effective health-behavior change techniques (Michie et al., 2011). Pokémon GO appears to be a novel delivery vehicle for healthy behavioral change.

In this study, we introduced health motives as a novel category that supplemented other previously identified motives for gaming (De Grove, Breuer, Chen, & Quandt, 2017; Yee, 2006; Yee at al., 2012). For instance, we asked how important it is for the participants to derive health benefits from Pokémon GO gameplay. This conceptual advancement was needed because increasing numbers of new games, e.g., Zombies, Run! (Six to Start & Naomi Alderman, UK) or Ingress (Niantic Inc., USA), have promised significant health benefits. The results from the current study showed that health motivations had a significant effect on gaming time after controlling for other motives of game use. Individuals who planned to play Pokémon GO as a health-enhancing activity spent more time playing in the following weeks after controlling for social motivation, immersion, and achievements. This supports our expectation that explicit health motives are particularly relevant for the explanation of health-related game use. However, we obtained mixed results regarding the actual completion of health goals. We found that health motives predicted more outdoor time as a function of greater game use. Yet, contrary to expectations we did not observe any effects of health motivation on greater physical activity. This might suggest that when Pokémon GO is used as a health behavior change tool, it is effective in facilitating greater outdoor time but not greater physical activity. However, it is noteworthy that individuals who endorsed health motives were already more physically active at the beginning of the study compared to individuals with lower levels of health motivation. Consequently, it might have been more difficult for them to increase their general physical activity output even further compared to less active individuals. This explanation might correspond well with observations that less physically active Pokémon GO users have more room to grow (i.e., they increase their physical activity to a greater extent than the most physically active users who might already have reached their top levels) (Althoff et al., 2016). Taken together, the results seem to provide the first evidence that accounting for health motivation is essential for a comprehensive evaluation, explanation, and prediction of outcomes for the gamification of health.

We found that social motivation was particularly effective in increasing gaming time. Players who appreciated social aspects of Pokémon GO (e.g., keeping in touch with their friends or being a part of a team) spent more time playing. This suggests that Pokémon GO is an effective gamification of a fundamental social need for grouping and interacting with other people (Baumeister & Leary, 1995). Social motivation was more relevant to gaming time than health motivation, immersion motivation, and achievements motivation. However, social motivation and health motivation (and to a lesser extent immersion motivation) operated in parallel, facilitating game use. Individuals with higher social motivation were more likely to spend time outdoors 6 weeks later. However, the effects of social motivation on physical activity were mixed. Social motives predicted greater game use and this in turn predicted more physical activity at T2 (an indirect effect). Yet, with the exception of Pokémon GO playing, socially motivated individuals were less physically active in general (a direct effect). These two contradicting processes operated in parallel and canceled each other out, producing a non-significant total effect. These findings suggest that Pokémon GO gaming protects socially-oriented individuals against the risks of decreased physical activity. This asserts that gamification of health is likely to protect against negative outcomes (prevention effects) in certain groups who might be at a greater risk of low physical activity. These findings are in line with previous research on social facilitation effects in health-related gaming (Dithmer et al., 2016; Paw et. al., 2008).

Individuals with immersive motives generated more physical activity and outdoor time, although they did not play more than less immersion-focused players. This suggests that individuals focused on immersion employ a healthier game style (i.e., they seem to endorse more physical and outdoor tasks). This finding suggests that the game story and the game world is a successful form of gamification of health behaviors.

With a comparable number of men and women in the sample and a wide range of ages, we were able to examine how demographic differences predicted Pokémon GO use. Despite almost identical numbers of female and male players who volunteered to participate in both parts of this study, men spent more time playing compared to women. Furthermore, we found higher levels of physical activity and outdoor time among men; Pokémon GO gaming time explained a part of this effect. This finding is important because men are at higher levels of behavioral health risk (Byrnes, Miller, & Schafer, 1999), initiate fewer health behaviors (Griffiths, 1996), and are more resistant to health-behavior change techniques (Cameron & Bernardes, 1998). Older participants spent more time playing Pokémon GO, yet this increased engagement did not translate into more physical output. Furthermore, we observed that older participants initiated less physical activity, a finding consistent with a well-established fact that physical activity declines with age (Hallal et al., 2012).

This study may have practical implications. First, these results may be of interest to healthcare providers. An increasing number of individuals choose computer gaming over leisure outdoor physical activities (Aguiar & Hurst, 2006). Successful gamification of outdoor physical activity with mobile devices is likely to counteract this tendency, because it combines the opportunity to interact with computers and stay outdoors at the same time. Pokémon GO's beneficial behavioral outcomes observed in this study are likely to be facilitated by game mechanics that reflect well-established physical activity change techniques such as goal setting (via the Pokémon GO *medal system*), setting graded tasks (i.e., increasing effort required to reach further milestones), provision of rewards for successful behavior (e.g., rare Pokémon obtained from long-distance egg hatching), or facilitating social comparison (e.g., comparing against other players in gym battles). Second, our findings may be of interest to game developers. In line with the Pikachu effect hypothesis, players choose different game styles that determine gaming use and its consequences. Most notably, we identified that the pursuit of achievements was the least motivating aspect of the game in the prediction of gaming time. Social benefits (such as teaming with other players and interacting with them) were the most significant motives behind Pokémon GO use. Moreover, with the introduction of health motivation into the gaming motives repertoire, we have provided new evidence that health-enhancing aspects of a game matter to the game user. Developers might capitalize on this fact, prompting more health-enhancing activities. For instance, the Pokémon GO gaming system might target and reward higher physical activity intensities of longer continuous duration, since vigorous or moderate activity lasting at least 20 min is recommended to maximize health gains from physical activity (World Health Organization, 2010). Along the same lines, Pokémon GO could contribute more to public health if its system rewarded gameplay during the day (e.g., noon Pokémon hunts) in order to ascertain sufficient daily doses of sun exposure among players. Finally, this study adds to the accumulating evidence that Pokémon GO facilitates health behaviors. Advertising strategies might benefit from this evidence to attract more diverse users and produce greater income.

5. Limitations and future research

The following limitations should be considered when interpreting our findings. First, though structural equation modeling of longitudinal data allows for interpretation of causal effects (Pearl, 2012), only experimental designs that manipulate gaming motivations can provide direct evidence for causal validity of the model. Experimental evidence is vital to guide evidence-based motivation interventions administered to participants as a health-behavior change strategy (Michie et al., 2010). Second, we focused on self-report measures of gaming time, physical activity, and outdoor time. Despite evidence that behavioral self-reports produce reliable data (Dishman, Washburn, & Schoeller, 2001), self-reports are less accurate than objective measures (e.g., measuring physical activity among players with accelerometers that were used in a previous study with Pokémon GO players) (Althoff et al., 2016). However, it is important to use different research methods, because greater research diversity adds to the validity of findings. For instance, using data from participants' own accelerometers is likely to over-represent health-focused, wealthier individuals who are keen on technology. Third, the six weeks between both measurements in our study is a relatively short interval and more consecutive measurements are needed to establish stronger longitudinal designs (e.g., latent growth modeling), which may account for more confounding factors (e.g., seasonal variations that influence outdoor physical activity) (Tucker & Gilliland, 2007). Furthermore, it would be worthwhile to explore moderating effects of age and gender, as a supplement for the current findings regarding direct and indirect effects. This, however, will require studies with a larger sample size to ascertain adequate statistical power. Finally, this study has been focused on health gains exclusively. However, there is some evidence published in the media that playing Pokémon GO can be risky (e.g., increased risk of injuries or car accidents due to inadequate awareness of one's surrounding while playing) (Joseph & Armstrong, 2016). Thus, it is essential to balance health gains and health risks in the final evaluation of Pokémon GO's impact on health (Serino, Cordrey, McLaughlin, & Milanaik, 2016).

6. Conclusion

The strength of this study is that we successfully introduced health motive into gaming motivation theory. We demonstrated that accounting for motivations (health motives and social motives in particular) explained why some individuals are more likely to benefit from gamification of health behaviors. In addition to this conceptual contribution, we extended the range of documented benefits of Pokémon Go use (more time spent outdoors) as well as the variety of methods used to test Pokémon GO health effects.

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