ELSEVIER

Did location-based games motivate players to socialize during COVID-19?

Samuli Laato[a,b], A.K.M. Najmul Islam[a,c], Teemu H Laine[d,*]

[a] *Department of Future Technologies, University of Turku, Finland*
[b] *Department of Teacher Education, University of Turku, Finland*
[c] *LUT School of Engineering Science, LUT University, Lappeenranta, Finland*
[d] *Department of Computer Science, Electrical and Space Engineering, Luleå University of Technology, Skellefteå, Sweden*

ABSTRACT

Location-based games (LBGs) are typically played outdoors, as moving in the game is done by moving in the real world. However, during the COVID-19 pandemic, people were advised and even forced by governments to stay home and avoid social contact to slow down the spreading of the virus. The major LBG developers reacted by making in-game adjustments that allow playing from home, while still maintaining some incentives for players to go outdoors and socialise. For investigating factors influencing intention to play LBGs socially during the on-going pandemic, we collected cross-sectional survey data (N = 855) from Finnish players of the most popular LBG, Pokémon GO. The results showed that perceived severity of the pandemic and a positive attitude towards both governmental measures and in-game changes for combatting COVID-19 predicted intention to reduce social playing. Fear of missing out and deficient self-regulation increased playing intensity, which in turn negatively correlated with the intention to reduce social playing. Our findings demonstrate the influence that LBGs can have on human behaviour even during global crises such as COVID-19. As such, LBGs can be considered a resource in designing interventions for influencing movement at a population level.

1. Introduction

The COVID-19 pandemic is arguably the greatest global challenge that humanity as a whole has had to face in the current millennium. What makes the pandemic so persistent and troublesome is that patients with the virus typically develop severe respiratory symptoms later on in the disease, and do not necessarily notice for days or at all they are carrying the virus due to its long incubation period (Lai et al., 2020; Lauer et al., 2020). The virus is transmitted between humans in close proximity, making isolation one of the key measures for reducing its spreading (World Health Organization, 2020). Without any pandemic control such as quarantine measures and other movement restrictions, the reproductive number of COVID-19 could be as high as 3.58 (Liu et al., 2020), implying that each individual who contracts the disease spreads it to at least three more people on average. Already before the World Health Organization declared COVID-19 a global pandemic on March 11th, 2020, governments were issuing restrictions on movement and social meetings to combat the spread of the disease (Anderson et al., 2020; Wilder-Smith et al., 2020). By April 2020, quarantine measures, travel bans, cancelled social events and closed public services had become ubiquitous (Kokudo and Sugiyama, 2020).

Under these circumstances the video game and entertainment industries flourished, as people were recommended to or even forced to stay at home (Farooq et al., 2020). Schools, hobby facilities, libraries and several other public services and activities were closed (Rundle et al., 2020). Video game publishers began offering incentives for people to stay home and avoid going out (Laato et al., 2020d). Some games were offered for free, while others gave premium bonuses and free buffs to players, and some marshalled events and new content for players. A genre of games that stood out was location-based games (LBGs), which under regular circumstances are played mainly by walking outside. Previous work has demonstrated how specific LBGs can influence players' movement patterns in the real world (Colley et al., 2017; Papangelis et al., 2020) and bring people together for face-to-face communication (Bhattacharya et al., 2019). However, during COVID-19 people were advised to avoid unnecessary movement outside and social contact (Farooq et al., 2020). In this setting, understanding the impact of LBGs on their players' behaviour is interesting for at least two reasons. First, it may reveal insights on how games can be used to incentivize recommended health measures in pandemic situations, and second, it may reveal new insights on human behaviour as a whole.

Under regular circumstances, LBGs belong to one of the healthier genres of games. They can be regarded as exergames, that is, games that motivate people for physical activity (Laato et al., 2020c), but also as games that increase players' social activity and psychological well-being (Vella et al, 2019; Zach and Tussyadiah, 2017). LBGs have the potential to teach about places in the players' surroundings (Oleksy and Wnuk, 2017) and support navigation skills (Carbonell Carrera et al., 2018). However, during movement restrictions and quarantines, LBGs suddenly become games which can motivate unwanted or even irresponsible behaviour by providing players incentives to go outside and socialise. In other words, a healthy genre of games turned into games that potentially jeopardize public health.

LBG developers reacted to the COVID-19 situation by making several in-game changes. Jurassic World: Alive was updated in March 2020 to contain a wide variety of stationary gameplay and the same applied to LBGs such as The Walking Dead: Our World and Harry Potter: Wizards Unite (Laato et al., 2020d). Some games, such as Orna, which already included good possibilities for stationary play, did not make major in-game changes. The currently most popular LBG, Pokémon GO, was updated several times in March and April 2020. Each update introduced changes to support stationary play. In their communication about these changes to the players the developers specifically mentioned that the changes are temporary and are meant to encourage stationary playing that does not require going outdoors (Niantic 2020a,b).

Despite the evidence of LBGs impacting player movement (Carbonell Carrera et al., 2018; Colley et al., 2017; Juhász and Hochmair, 2017; Papangelis et al., 2020) and the observed in-game changes made by developers due to COVID-19, it remains unclear whether the LBGs really had an impact on players' social activity and behaviour during COVID-19. For example, previous studies suggest that while LBGs can influence player propensity while playing (Colley et al., 2017), they do not cause permanent adoption of unwanted behaviours (Alomar et al., 2019). To investigate the effect of LBGs on players' intention to play the games socially during COVID-19, we employ cross-sectional data (N = 855) from an online survey sent to Finnish Pokémon GO players in April 2020. We explore three categories of factors: (1) health beliefs; (2) organisational measures; and (3) individual playing motivation. The findings show that the game did motivate players to go out and socialise to a small extent, however, the participants rather complied with the government's and health officials' recommendations to avoid unnecessary socialising, than gave in to the incentives provided by the game to go out and play socially.

The rest of the study is structured as follows. First, in the background section we review previous literature on human behaviour during pandemics as well as how LBGs influence human behaviour. We then present the theoretical foundations for our work based on which we build our structural model. This is followed by the hypotheses generating section where based on the protection motivation theory (PMT) and self-determination theory (SDT) and previous studies, we propose seven hypotheses between eight constructs on how personality, health and organisational factors influence players' intention to play LBGs socially. We then present our research methods and the structural model results, followed by some post-hoc analyses relating to the impacts of age and gender of the participants. In the discussion section we go through our key findings, and present the theoretical and practical implications of the results, limitations and future work. Finally, we conclude our work with a conclusions section.

2. Background

2.1. Human behaviour during pandemics

"In the current absence of medical treatment and vaccination, the unfolding COVID-19 pandemic can only be brought under control by massive and rapid behaviour change. To achieve this we need to systematically monitor and understand how different individuals perceive risk and what prompts them to act upon it" - Betsch (2020)

Human behaviour during pandemics and epidemics has been studied in the contexts of swine flu (Rubin et al., 2009), Ebola (Alicino et al., 2015) and others. However, a pandemic of the caliber of COVID-19 has not been seen since the Spanish flu (Atkeson, 2020). As of April 15th 2020, in addition to being declared a global pandemic by the World Health Organisation on March 11th 2020, the COVID-19 had spread to almost every country in the world with over two million confirmed cases (John Hopkins University, 2020). On top of these numbers, there are likely several untested or unreported cases (Lau et al., 2020). In March and April 2020, with the number of infections still increasing at a growing rate globally, several countries reacted by heavy quarantine measures which included restricting movement, closing borders, cancelling social events, forbidding social gatherings and advising people to stay at home and avoiding social contact whenever possible (Anderson et al., 2020; Chinazzi et al., 2020; Sahin et al., 2020; Spina et al., 2020).

A recently published column in Nature suggested research into understanding how individuals perceive the ongoing pandemic situation and what causes them to adapt the suggested individual health measures (Betsch, 2020). While a major proportion of actions against the disease are coordinated at a governmental level, individual health behaviour remains highly important as well (Sharifirad et al., 2014; Bish and Michie, 2010). Furthermore, as the government-enforced quarantines hurt the economy, it is more cost-efficient to rely on individuals' actions to minimise the spreading of the disease. A review study on human behaviour during pandemics identified perceived severity to be a persistent factor causing people to adopt protective behaviours during pandemics (Bish and Michie, 2010). Perceived severity is understood in the context of PMT to be part of an individual's own assessment of how threatening the situation is (Rogers, 1975; Ling et al., 2019). Accordingly, previous intervention strategies aiming to increase intrinsic motivation to adopt health measures have aimed at stressing the severity of the situation (Miller et al., 2012).

Among the suggested health measures for a pandemic disease such as COVID-19 are primarily: (1) washing hands often; (2) avoiding touching surfaces and face; and (3) social isolation (World Health Organization, 2020). Out of these measures the one that is relevant in the context of the current study is social isolation. As COVID-19 is transmitted from human to another via close proximity, isolation is an effective countermeasure (Hellewell et al., 2020). Accordingly, governments and the World Health Organization actively propagated the knowledge to citizens to avoid social contact (World Health Organization, 2020). Some countries enforced quarantines and restrictions on moving outside, while others, such as Finland, left it to an individual's responsibility to self-isolate (Farooq et al., 2020).

2.2. Location-based games

The behavioural effects of LBGs are manifold. As a genre of games that rely on traversing the real world to move in the game world, LBGs are natural exergames i.e. games which motivate towards physical activity (Laato et al., 2020c). In addition, many LBGs include gameplay which facilitates social interaction in the real world, thus bringing players spontaneously together for face-to-face communication (Bhattacharya et al., 2019; Laato et al., 2020a; Riar et al., 2020). In addition to these benefits, LBGs often require navigating to points of interest (PoIs) using a navigational interface based on real-world maps (Colley et al., 2017) which can improve spatial orientation and cartographic skills (Carbonell Carrera et al., 2018). While these three aspects: (1) physical exercise; (2) social interaction; and (3) navigation-related skills are characteristic to the LBG genre, not all games support or include them (Laato et al, 2019; Zach and Tussyadiah, 2017).

Currently, the overwhelming majority of scientific LBG literature focuses on the game Pokémon GO, which was released in 2016 and is still as of April 2020 the most popular LBG despite several new games emerging in recent years. Besides the term LBG, games where moving in the real world is part of the gameplay have been called geo games, global positioning system (GPS) games, location-based augmented reality (AR) games, location-sensitive games, location-aware games, mixed reality games, hybrid reality games and pervasive games among others. As LBGs were popularised and made possible with the development of satellite navigation, smartphone technologies and the ubiquitous access to cheap data connections, the genre can still be seen to be at its infancy. The same applies for research on LBGs, as despite some studies on LBGs emerging as early as 2002 (Sotamaa, 2002), the quantity of research on the genre proliferated only in 2016.

Findings from Alha et al. (2019) suggest that personal life circumstances are the biggest reason why people quit playing Pokémon GO. The reasons to continue playing include having a sense of progression, a habit of playing and positive outdoor experiences (Alha et al., 2019) as well as enjoying the game generally (Hamari et al., 2019). As the COVID-19 had a major impact on lives in general, it seems natural in the light of these findings that COVID-19 could cause people to quit the game or at least reduce the intensity of playing. However, even if players quit the game, they might remain in the habit of regularly going out, as LBGs have been shown to have lasting effects on movement that outlive the actual playing (Harris, 2019). The game has also significant impacts on players' social circles, creating friendships and providing a fun social activity (Laato et al., 2020b; Riar et al., 2020), which might be missed if players were suddenly forced to quit playing.

While LBGs can have several health benefits (e.g. Althoff et al., 2016; Laato et al., 2020a,b), they have also been criticized. Kaczmarek et al. (2019) found excessive playing to be linked with increased reports of back pain and problems with vision. Previous studies have identified that playing LBGs offer an inefficient form of exercise and people looking for exercise should, if possible, choose other hobbies for the purpose of improving physical fitness (Beach et al., 2019). Some have theorised LBGs where players need to navigate to fixed locations in the real world can lead to players adopting negative behaviours, however, studies have found this not to be the case (Alomar et al., 2019; Ono et al., 2018).

Another issue in LBG studies is that the data for the studies is collected during the same time period, i.e. the launch of Pokémon GO in 2016 (e.g. Alha et al., 2019; Althoff et al., 2016; Hamari et al., 2019; Rasche et al., 2017), and as such, the results of the studies depict the opinions of early adopters and not those who ended up playing the game for extensive periods of time. For example, studies using early datasets have not identified socialising or social play to have an impact on intention to reuse (Hamari et al., 2019) while studies relying on datasets collected later have shown social playing to have a major impact on the playing experience and enjoyability of the game (Bhattacharya et al., 2019). It is also worth noting that Pokémon GO has been updated significantly since its launch and several new game mechanics, features and content have been added, many of which boost social playing (Niantic 2020a,b). More recent studies on understanding the impact of LBGs specifically on player behaviour are thus needed. This study addresses this by using Pokémon GO as an example, and investigating how strong an influence LBGs can have on players through conducting a cross-sectional study during the COVID-19 pandemic. The pandemic situation is especially interesting as due to health recommendations on self-isolation (World Health Organization, 2020), much of the normally healthy gameplay can actually be considered irresponsible and unhealthy.

2.3. Theoretical lens of the current study

One of the most popular theories that has often been used to understand human behaviour during pandemics is the protection-motivation theory (PMT) (Rogers, 1975). As the name implies, PMT is concerned about people's protection motivation, and the theory divides it to be the result of individual-level threat and coping appraisal. In practise, a high perceived severity and threat level assessment of the situation contributes towards increased probability of having protection motivation, whereas a positive evaluation of personal ability to cope with the threat lowers the protection motivation. The threat and coping appraisals are often divided further in models using the theory to explain behaviour. For example, in the case of pandemics, previous work using PMT have measured perceived severity and perceived susceptibility as components of threat appraisal and self-efficacy, coping efficacy and response cost as components of coping appraisal (Ling et al., 2019). Previous work using PMT to understand human behaviour during pandemics and epidemics has identified perceived severity of the situation to be one of the main drivers behind protection motivation (Bish and Michie, 2010). We decided to adopt PMT as a framework for our study, by introducing two threat appraisal constructs, perceived susceptibility and vulnerability (Farooq et al., 2020; Ling et al., 2019). For modelling the response costs of coping appraisal we looked at costs associated with not being able to play LBGs. Subsequently for understanding these, we employed the self-determination theory (SDT).

SDT is used for understanding human motivational and personality factors that are independent of external influence (Deci and Ryan, 2012). Originally developed empirically in controlled laboratory environments, the theory has since been used successfully to explain behaviour in the fields of, for example, social well-being, education, sports (Gagné and Deci, 2005) and more recently, video games (Yang and Liu, 2017). SDT is built on the presumption that humans have a biological tendency to constantly seek new challenges that result in cognitive or social development or both. At its core, SDT postulates that human intrinsic motivation can be divided into (1) autonomy, that is, the desire to be an autonomous actor; (2) competence, that is, to seek the ability to influence the surrounding world; and (3) relatedness, that is, the will to be connected with other people via interaction (Deci and Ryan, 2012).

In the context of video games, SDT has been used with the assumption that the better the game fills the intrinsic needs described by SDT, the more enjoyable the playing experience is (Oliver et al., 2016). More recent studies have supported this idea, testing hypotheses on what kind of gameplay could support the three SDT dimensions of autonomy, competence and relatedness (Rogers, 2017). Accordingly, SDT can also be used to explain engagement and enjoyment in LBGs. For this study we look at two relevant factors influencing intrinsic motivation: fear of missing out (FoMO) (Przybylski et al., 2013), which is connected to the "relatedness" of SDT, and deficient self-regulation (Assunção and Matos, 2017) that can be conceptualised to belong to the "autonomy" and "competence" in SDT. FoMO can be understood as a form of social pressure (Przybylski et al., 2013) but also as a desire for materialistic gains. In the context of LBGs and especially Pokémon GO, the games frequently feature events that are advertised to yield unique rewards, encouraging players to carpe diem and play. The social dimension of FoMO manifests typically through social game events (e.g. raids in Pokémon GO (Bhattacharya et al., 2019)) and chat groups and social media where players share their latest achievements and rare Pokémon they found. Connected to playing and lack of self-discipline is deficient self-regulation (DS-R), which refers to the lack of ability to regulate behaviour (Seay and Kraut, 2007). In the current study context DS-R manifests as excessive amounts of playing on the expense of free time, welfare or even work duties (Lee and LaRose, 2007). During the COVID-19 pandemic, self-regulation skills seem particularly relevant as people were encouraged for behavioural change (World Health Organization, 2020) that can have significant perceived response costs.

Combining PMT with SDT and previous studies in the context of LBGs, we propose the following constructs to be relevant when focusing on social playing during the COVID-19 pandemic: (1) playing intensity as impacted by (2) FoMO and (3) DS-R; attitude towards (4) government; and (5) game developer; measures against COVID-19, and as threat appraisal constructs from PMT, (6) perceived severity; and (7) perceived susceptibility. Finally, for the dependent variable, we used (8) reduced social play intention; to capture social playing during COVID-19. In the following section we hypothesise how these constructs are related to each other by referring to PMT, SDT as well as prior literature conducted on LBGs and human behaviour during pandemics.

3. Research model and hypotheses

3.1. Effects of playing motivation factors

LBGs at large seek to keep players hooked, and strategically aim to create playing experiences that are not only fun and engaging, but also encourage players to spend money on the game. As a result, the games become addictive, and to ward against playing impacting normal functioning in society, players need to develop or already possess sufficient self-regulation skills (Seay and Kraut, 2007). In the case of DS-R, players are unable to keep their playing under control so that it starts to have negative impacts in their lives (LaRose et al., 2003). Thus, DS-R is connected to an increased amount of playing as well as to impulsive behaviour (Seay and Kraut, 2007). Players with DS-R may also be more drawn to get immersed in the gameplay and playing more intensively. Thus, we formulate the following hypothesis:

H1: Deficient self-regulation increases playing intensity.

One of the psychological tricks that LBGs may employ to provide players incentives to play is FoMO. It is customary for modern games to feature events with unique rewards that are advertised to players. For example, since Halloween season 2016, Pokémon GO has been constantly featuring *events*, which are advertised as unique opportunities to capture certain pokémon or get their shiny

forms (Niantic 2020a,b). The developer of Pokémon GO communicates to players constantly about the unique opportunities they might miss if they do not play now (Niantic 2020a,b). As another example, The Walking Dead: Our World has changing gameplay and unique enemies and weapons which can be obtained from frequently changing events. However, FoMO is often studied as a social phenomenon, meaning people are scared of missing out on social events rather than in-game content (Przybylski et al., 2013). LBGs which feature events can draw on this psychological tendency as well, by, for example, asking players to share photos of them playing online. Furthermore, in addition to photos, players may wish to share their in-game achievements via social media and other channels to other players and friends. We can therefore conclude that the LBGs use FoMO for the purpose of getting players to play their game. Accordingly, we theorise the following:

H2: Fear of missing out increases playing intensity.

Playing intensity is measured not only by the number of hours spent playing, but also by how players perceive the game to be a part of their lives. For intensive players, playing is a daily part of their lives and a habit that might not be easy to give up even if external circumstances (such as the COVID-19 pandemic) demand it. We hypothesised both FoMO and DS-R to increase playing intensity, but we know from previous studies (Alha et al., 2019; Hamari et al., 2019; Rasche et al., 2017) that players have several other intrinsic and extrinsic reasons to play. As intensive players might have trouble controlling their playing, we suggest that playing intensity negatively impacts the willingness to change playing behaviour, including social playing. Thus, we propose the following hypothesis:

H3: Playing intensity has a negative effect on reduced social playing intention.

3.2. Effects of health factors

Perceived severity of the situation during a pandemic crisis has been shown to lead to behavioural responses and adapting personal health measures (Bish and Michie, 2010). Playing LBGs involves moving outside as well as some social playing when people physically gather in the same place at the same time. During a global pandemic these behaviours can be regarded to be risky and irresponsible. While some of the health behaviour during pandemics may be enforced by law, in many countries, such as Finland which serves as our study context, much of the health behaviour was left to individuals' responsibility during March-May 2020 (Farooq et al., 2020). We hypothesise that perceiving the pandemic situation as severe will cause players to reduce their social meetings, which also applies for LBG players. Furthermore, we theorise that a personal perceived susceptibility for contracting the disease may have a similar effect. Thus, we summarise our two hypotheses as follows:

H4: Perceived severity decreases intention to play socially.
H5: Perceived susceptibility decreases intention to play socially.

3.3. Effects of organisational factors

Both governments and LBG developers reacted to COVID-19. While the governmental measures were enforced by law and had holistic impacts on societies, the changes LBG developers made were more subtle, providing players better options for stationary playing and removing incentives to play the game socially. These changes allowed players better opportunities to continue playing from indoors during quarantine and to avoid face-to-face confrontations when playing.

As globally the governmental and LBG developer measures and changes were put in place, players may have had varying reactions to them. We envision some felt the changes were necessary and timely, whereas others considered them to be unnecessary. It is also possible that some people felt the governments and LBG developers did not do enough. For people who were playing intensively before the COVID-19 pandemic, the restrictions on movement and social gatherings might have forced them to reduce playing. However, in many countries, people were still allowed to move outside as before, and thus, adoption of health behaviours, namely social isolation, could be seen as voluntary.

While LBG developers cancelled certain social events and created opportunities for stationary play, they did not remove any of the central gameplay components, still keeping the opportunity to play the game as prior to the pandemic. Players' attitude towards the government and developer measures could thus be used to predict their overall attitudes towards the pandemic. This then in turn could be seen as a predictor of adopting the recommended (and in some countries, enforced) health measures, such as self-isolation and restrictions on social gatherings. Thus, we hypothesise the following:

H6: Acceptance of governmental measures to combat the COVID-19 pandemic decreases intention to play socially.
H7: Acceptance of LBG developers' measures to combat the COVID-19 pandemic decreases intention to play socially.

Our final research model connecting the proposed hypotheses is shown in Fig. 1. In addition to the seven proposed hypotheses, we have included the effects of age and gender in the model as control variables.
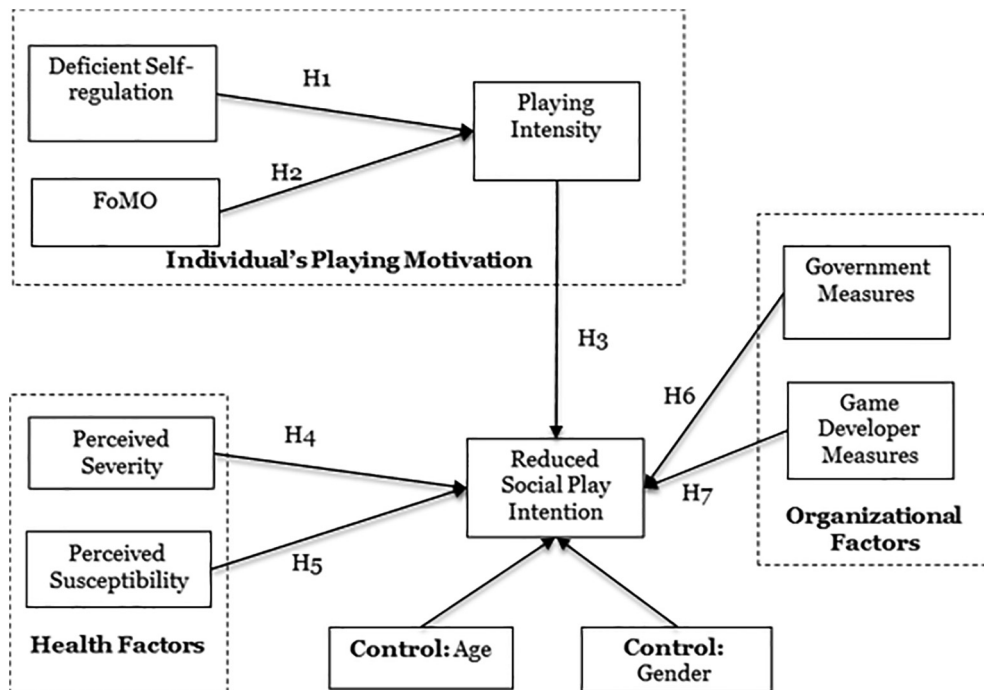
Fig. 1. Research Model.

4. Research design

4.1. Study context

While the overrepresentation of Pokémon GO in academic studies can be seen as a limitation of our understanding of LBGs as a game genre, it also has positive aspects. As studies focus on the same game, they are comparable to each other and the fixed research context provides an opportunity to focus on understanding the underlying factors of player behaviour better. A recent study argues that the findings of Pokémon GO can be generalised to cover other similar LBGs as long as the game mechanics are similar (Laato et al., 2020c). Pokémon GO is also the currently most popular LBG, making data collection from its players the easiest. For these reasons, we chose Pokémon GO as the target game in our study.

Pokémon GO, similarly to many other LBGs, has been shown to decrease sedentary behaviour (Althoff et al., 2016; Barkley et al., 2017) and provide a fun social activity for players (Bhattacharya et al., 2019). The game encourages players to move to certain locations which are dictated by the locations of the in-game PoIs (Colley et al, 2017). Pokémon GO impacts human movement in the real world (Juhász and Hochmair, 2017) and the magnitude of this effect is significant, because the game has been downloaded several hundreds of millions times.

Looking at the in-game changes made to Pokémon GO during the COVID-19 pandemic is important for our current study. On March 19th, 2020, Pokémon GO, featured a new raid boss (for an academic analysis of raids, see Bhattacharya et al., 2019) in the middle of the global pandemic that typically requires at least five players to come together in close physical proximity (a roughly 10 m radius) from each other to beat it. Later, on March 31st, Niantic, the developer of Pokémon GO, doubled the radius in which players need to stand to complete raids, allowing players to better socially distance themselves from others while playing. However, the raids did not go away, nor did the encouragement the game provides to go out to play and socialise. On April 15th, Niantic made further changes to Pokémon GO's social playing features, this time allowing remote raiding (no longer requiring physical proximity with other players) and creating a breadth of additional daily gameplay that does not require moving outside (Niantic, 2020b). Our data collection took place in this setting, from April 8th to April 14th, 2020.

4.2. Data collection

The measurement items for perceived severity, perceived susceptibility, playing intensity, and deficient self-regulation were sourced from prior literature with minor changes to fit with the context of our study. The full list of items and related constructs are available in Appendix A. A recent study (Whelan et al., 2020) observed that the measurement items of FoMO (Przybylski et al., 2013) do not correlate with each other. Furthermore, when observing the original FoMO items of Przybylski et al., (2013), we realised that the items need to be adjusted to fit our study context. Therefore, the items of FoMO, as well as the required constructs for which we could not find a validated scale from prior literature (i.e. the items measuring governmental measures, LBG developer measures and

social play intention) were developed in this study by following the scale development approach described by Moore and Benbasat (1991). The first author of this paper is an experienced Pokémon GO player and researcher well connected with the Pokémon GO community. Therefore, by discussing among the authors of this work and with selected players (n = 3) from the community, we generated a pool of 5 items for each developed construct. We also included adapted versions of the original FoMO items as well (Przybylski et al., 2013).

During the initial item development, we paid attention to ensure content validity. Thereafter, these items iterated through several rounds of wording changes between all authors to ensure that the items are understandable and accurately describe the construct. At this stage duplicate items and items not directly related to the construct were removed. When deleting the items, we ensured we had at least three items per construct remaining and that the measurement items had content validity. After this stage, we ended up with 16 new items (three for social play intention, three for government measures, three for gaming company measures, and seven for FoMO). Next we invited seven judges to a card sorting exercise from among the friends of the authors. We provided the definitions of the constructs and asked the judges to place a particular item to the category they feel aligns with the definition. The hit ratio of this card sorting exercise was 91%, which was considered to be high enough for the survey items to work as constructs.

As the respondents were Finnish speaking people, we translated the entire questionnaire in Finnish. One native Finnish speaker first translated the English version of the questionnaire to Finnish. Then another native Finnish speaker translated the Finnish version of the questionnaire to English. There were some discrepancies in the translation, mostly grammatical, which were then resolved by joint conversation between the two translators. The understandability and content validity of the survey items was checked once more by the two authors during the translation process and following discussion. Once the entire survey was drafted, we sent it to 12 respondents in a closed Pokémon GO chat to comment on the overall understandability of the items and ensure there were no problems with the survey or its implementation. A few minor suggestions were made by the respondents, at this point purely grammatical, which were immediately fixed. At the beginning of the survey we added our contact information, a brief description of the survey as well as what we intended to study with the data, how it is kept and a statement that by proceeding to fill the survey the respondent gives permission to use their answers in the study.

The final survey (items available in Appendix A) was distributed as an online link to Finnish Pokémon GO players via posting it on local chat groups (Telegram and Whatsapp) in four major Finnish cities: Pori, Turku, Tampere, Helsinki. The survey was also posted on two Facebook groups, with the larger one (Pokémon GO Finland) having almost 30 k members. The survey was available online 8th-14th of April 2020, and participants were asked for their consent to participate in the research. Altogether the survey received 855 accepted responses where all questions were answered (605 female, 234 male and 16 other). Pokémon GO and LBGs in general are known for being a genre of games that attract a wide playing audience. This was also seen in the age of the respondents. 158 were below the age of 25, 454 were between the ages 26–40, 221 were between 41 and 60 and 22 were over 60. A strikingly large number of participants reported to have reached the maximum level in Pokémon GO, with 470 (55,9%) meaning the sample can be regarded to be quite representative of players who have a lot of experience about the game.

5. Data analysis and results

Before conducting the structural model analysis, we verified the validity and reliability of the collected data. For this end, we used the smartPLS software. More specifically, we looked at both convergent and discriminant validity.

The convergent validity means that the items in a scale need to measure the same construct. For testing this, we looked at the loadings of the items, composite reliabilities, and average variance extracted values. For a suitable criteria, we adopted the suggestion from Fornell and Larcker (1981) who imply that the loadings need to be at least at 0.7 and the composite reliabilities have to be at least at 0.8. In addition, the average extracted variance values need to be at least 0.5. The results of this analysis are displayed in Appendix A and show that the data fills the requirement of sufficient convergent validity.

Discriminant validity is about making sure that the scale measuring a particular construct does not measure other (related) constructs. In order to verify this, we looked at the correlation matrix with square roots of the average variance extracted values (see Appendix B). We see from this table that the square root of average variance extracted values (shown diagonally) are consistently greater than the correlation values. We also checked the loadings and cross-loadings[1] and observed that the loadings are higher than the cross-loadings of all the items. In summary, these tests ensure that our data fulfils the requirement of discriminant validity.

After ensuring the validity and reliability of our data, we continued to examine how well our model fits the data. For this purpose, we utilized the standardized root mean square residual (SRMR) and goodness-of-fit (GoF) statistics as guided by Henseler et al. (2014). Wetzels et al., (2009) provided an equation for calculating GoF based on AVEs and provided thresholds of small = 0.1; medium = 0.25 and large = 0.36 for determining the goodness of fit. Our data gave the value 0.47, indicating that our model fits well with the data. We then proceeded to calculate SRMR. Hu and Bentler (1998) indicated that the SRMR value should be below 0.08 for a good model fit. For our data the value was 0.07. Thus, we concluded that our data was adequate for testing the structural model.

The structural model results are displayed in Fig. 2. All hypotheses were supported by our data except the relationship between perceived susceptibility and social play intention. The model explained 28% variance of decreased social play intention. We further investigated if age and gender moderates the effects of the predictors on reduced social play. The results are shown in Appendix C. Only two effects turned significant. First, we found that the interaction effect of playing intensity and age had a positive effect on reduced social play intention (beta = 0.09; p < 0.05). Second, the interaction effect of the game developer measures and age was

---

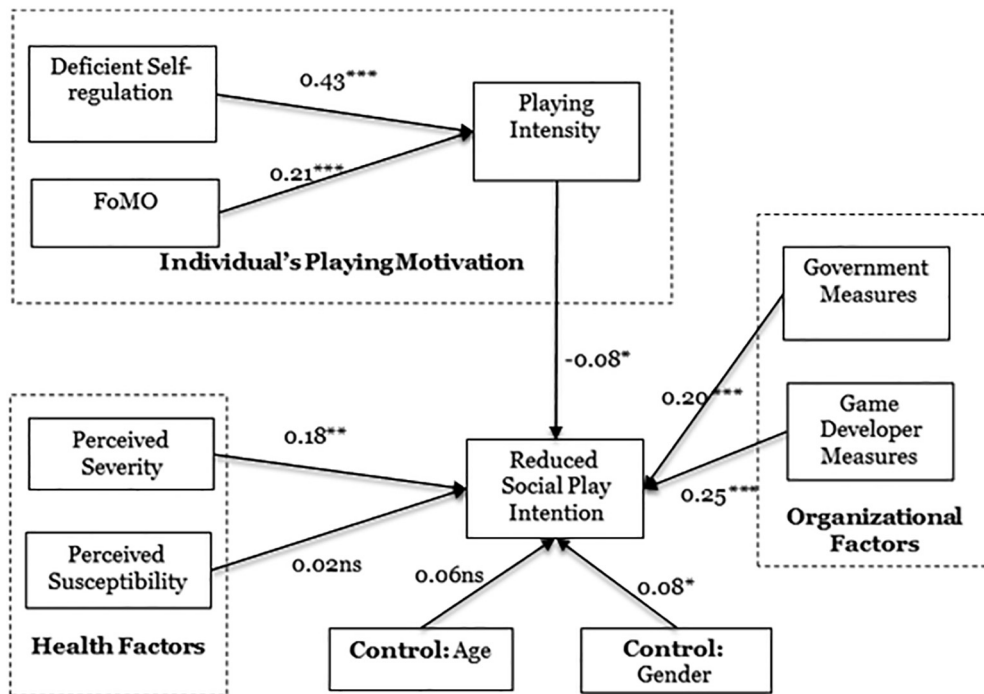[1] Loadings and cross-loadings will be provided upon request

Fig. 2. PLS analysis results (***p < 0.001; **p < 0.01; *p < 0.05).

also turned significant (beta = 0.07; p < 0.05).

6. Discussion

6.1. Key findings

Both organisational factors: (1) attitude towards governmental measures to combat the COVID-19 pandemic; and (2) attitude towards the in-game changes the game developer made to combat the pandemic; had a significant positive correlation with the intention to reduce social playing. From the health factors, perceived severity of the pandemic situation influenced positively the intention to reduce social playing. Interestingly, perceived susceptibility had no impact on intention to reduce social playing. This echoes previous work using PMT, where perceived severity of the situation has had more an impact on protection-motivation than perceived vulnerability (Bish and Michie, 2010; Farooq et al., 2020). We noticed that gender also had a significant impact, more specifically, being female was associated with increased likelihood of reducing social playing during the pandemic.

Among the findings there was only one construct which had a negative impact on reduced social play intention, and that was playing intensity. Playing intensity was in turn strongly influenced by FoMO and DS-R. In practise this means that while the developer of the case game Pokémon GO made several in-game changes to provide opportunities for playing from home and avoid social playing (Niantic 2020a,b), the game still continued to motivate players to a small extent to maintain social playing behaviour, which had become an unwanted behaviour due to the self-isolation being a countermeasure for the spread of COVID-19. However, this impact was quite small overall. In summary, players seem more motivated by the perceived severity of the pandemic to reduce social playing than they are to continue social playing due to the incentives provided by LBGs.

6.2. Theoretical implications

We showed empirically that LBGs provide players' incentives to socialise even during pandemics. This finding strengthens the understanding of the behavioural consequences of LBGs which have been explored in previous studies (e.g. Alomar et al., 2019; Bhattacharya et al., 2019; Laato et al., 2020b; Papangelis et al., 2020; Riar et al., 2020). We also provided the novel study context of the COVID-19 pandemic which allowed us to explore whether LBGs motivate people to go out and socialise even when the health officials advise not to do so. Furthermore, we showed that FoMO and DS-R have strong effects on playing intensity, which is something that has been overlooked in the extant literature on why people play LBGs (e.g. Alha et al., 2019; Hamari et al., 2019; Rasche et al., 2017). As FoMO is related to SDT's relatedness, our findings suggest that playing LBGs fulfills players' need for relatedness by helping them socialise. Previous work (e.g. Vella et al., 2019) have shown Pokémon GO to increase players' social connectedness. Our findings demonstrate that this connection with other players manifests as a psychological need which players may not wish to give up even if the real world circumstances suggest to do so.

In addition, we developed three constructs in this paper: (1) attitude towards governmental measures against COVID-19; (2) attitude towards in-game changes made to combat COVID-19; and (3) reduced social play intention. While the first two constructs were specific to the COVID-19 pandemic, they can be adopted to understand players' attitudes towards measures taken by governments, as well as application and service developers, during pandemics in other contexts than LBGs. The third developed construct, reduced social play intention, can find use in LBG research where change in we-intention (e.g. Riar et al., 2020) or social play more generally is studied. In addition to the developed constructs, we also adopted and validated the use of the FoMO items (Przybylski et al., 2013) in the LBG context, addressing an issue identified by a recent study (Whelan et al., 2020), where the FoMO items did not correlate with each other. Finally, in addition to these contributions, we validated all the scales used in this study in the Finnish context.

Using the newly developed constructs as well as those adopted from prior literature, we investigated the associations between them. We noticed the attitudes towards governmental measures and the game developers' measures to have strong significant effects on intention to reduce social playing. This shows that the constructs can be useful for predicting LBG player behaviour during pandemics, as well as how the players are influenced by LBGs in their adoption of recommended health measures. In fact, the constructs often used in PMT to explain protection motivation during pandemics, (perceived severity and perceived susceptibility (Ling et al., 2019)), had a smaller impact on intention to avoid social playing than the organisational constructs. Our findings encourage further research into the ability of LBGs to influence player behaviour and the magnitude of this influence.

6.3. Practical implications

The results show that the in-game changes made to Pokémon GO because of the pandemic (Niantic 2020a,b) were well received by the players. However, Pokémon GO kept providing players motivation to go out and socialise with others in the form of legendary raids during March and April 2020. The finding that FoMO (through playing intensity) decreases motivation to reduce social playing, is interesting from a broader perspective of how modern game companies engage their players. Viewing FoMO through the lens of SDT implies that LBGs satisfy players' social needs. An increasing number of game companies are leveraging FoMO by introducing a combination of multiplayer elements and a constant stream of unique exclusive events to players. This has proven to be an effective strategy for engaging players, but can lead to problematic behaviour such as reluctance to adopt recommended health measures, as evidenced by the current study.

Some countries and regions issued full curfews and banned unnecessary outdoor activity, however, in Finland, solitary outdoor exercise was not forbidden or even discouraged during the data collection period; only social meetings were. Thus, the Finnish setting could be characterized as a partially voluntary lockdown. In this setting, LBG players could contribute to reducing the spread of COVID-19 by reducing their social play. While our data demonstrated Pokémon GO to influence behavioural change through making in-game changes, previous work has shown LBGs to be even capable of influencing where players move (Carbonell Carrera et al., 2018; Colley et al., 2017). Because of these reasons, understanding and leveraging LBGs for human movement during pandemics is important. As LBGs influence player movement without enforcement, the games may show promise for future intervention strategies for curbing the spread of pandemics.

Following our findings, questions about LBG developers' responsibility during pandemics arise. One way to observe the situation is by accepting LBGs as part of the status quo before a pandemic hits. From this standpoint, drawing from PMT (Farooq et al., 2020; Rogers, 1975), the influence of LBGs can be seen to manifest as response costs. While things such as perceived severity of the pandemic increase protection-motivation, response costs lower it (Farooq et al., 2020). In this context LBGs have the ability to lower the response costs of adopting self-isolation measures by removing game mechanics which bring people together, or by providing alternative gameplay. We know from observing the made in-game changes that the developer of Pokémon GO chose only the latter solution (Niantic 2020a,b). This leaves the question would LBG players have socialised less if, for example, legendary raids would have been put on hold. Nonetheless, our findings showed that ultimately the magnitude of the negative impact of playing intensity during COVID-19 remained small, and furthermore, it may have positive impact such as motivating people to exercise.

6.4. Limitations and future research

The data for the current study was collected in Finland during April 2020. At the time the pandemic situation in Finland was not severe, with below 2000 people having tested positive for COVID-19 before the data collection period ended on April 14th, 2020. While the capital city of Finland, Helsinki, and the area surrounding it was quarantined, people in the rest of the country were free to move around. Furthermore, while social meetings of 10 + people were forbidden, this rule was not widely enforced. The collected data and the subsequent results also need to be understood in this context. In other countries where moving outside was completely forbidden or severely restricted during the pandemic, the results might have been different. The survey may also yield different results in other cultures that emphasise social interaction. The large representation of female respondents (70,7%) might be explained by the main data collection venues being Facebook groups and Telegram and Whatsapp channels. Previous studies of LBG players in Finland have had similarly an overrepresentation of female respondents (Alha et al., 2019; Laato et al., 2020). Finally, the survey was cross-sectional, and accordingly did not account for any change over time in behaviour that occurred during the pandemic. Because of these limitations, future work in other countries under heavy movement restrictions that are actively enforced and monitored, as well as in different cultural contexts, could be conducted as comparison cases.

While the results of this study suggest that LBGs do seem to motivate unwanted behaviour during pandemics, they have been shown to have several positive effects on social well-being in previous studies (Laato et al., 2020c; Riar et al., 2020; Zach and

Tussyadiah, 2017). During a pandemic such as COVID-19 it is easy to forget other health issues and focus on only preventing the disease. Preventing the spread of the pandemic is of course important, but if low-cost and health-preserving measures can be taken to increase social well-being in the difficult situation, such measures probably should be taken. Thus, a major venue for future studies is to look at the impact of playing LBGs on social well-being during the COVID-19 pandemic. Furthermore, our results open new possibilities for looking more broadly on how LBGs and games could be used as a part of health behaviour interventions during global pandemics and other events of massive scale that require population control.

7. Conclusions

We developed a model to explain how LBG players react to a situation where they are suddenly encouraged to alter their playing habits or quit playing entirely due to external circumstances. Because isolation was a key response to stop the spreading of COVID-19, we adopted intention to reduce social playing as our dependent variable. To test the model, we collected data during the COVID-19 pandemic in April 2020, a unique time when governments had issued close-downs on almost all major public services except for critical services such as health care. Knowledge regarding COVID-19 was still vague and it remained unclear how fast the disease would spread. In addition to governments responding with emergency legislation, individuals were prompted to adapt recommended safety measures. In this context, our findings show that the most intensive LBG players, in particular those experiencing FoMO and DS-R, were motivated to keep on socialising. On the other hand, positive perceptions regarding government's and the game developer's measures against COVID-19, and perceiving COVID-19 to be serious, correlated with reduced social playing intention. We posit that LBGs remain an interesting topic for future work due to their ability to influence human movement in the real world.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. . The survey items, loadings, composite reliabilities, and average variance extracted values

Construct	Items	Loading
Perceived severity (Ling et al., 2019) CR: 0.80 AVE: 0.62	1. The negative effects of COVID-19 are or will be high. 2. COVID-19 can be dangerous for me. 3. COVID-19 is a life threatening disease for several people.	Removed 0.76 0.82
Perceived susceptibility (Ling et al., 2019) CR: 0.87 AVE: 0.76	1. I am vulnerable to contracting COVID-19 under current circumstances. 2. I don't think I am likely to get the COVID-19. 3. 3. I am at risk of catching the COVID-19.	0.82 Removed 0.92
Deficient Self-regulation (Assunção, R. S., & Matos, P. M. 2-017) CR: 0.86 AVE: 0.67	1. I have a hard time keeping my Pokémon GO playing under control. 2. I have tried unsuccessfully to cut down on the amount of time I spend playing Pokémon GO. 3. I sometimes try to conceal how much time I spend playing Pokémon GO from my family or friends. 4. I feel my Pokémon GO playing is out of control.	0.91 Removed 0.70 0.85
Fear of missing out (adapted from Przybylski et al., 2013) CR: 0.83 AVE: 0.62	1. I fear others will get more shinies or legendary pokémon than me if I don't play. 2. I get worried when I find out my friends are raiding or playing an event without me. 3. I get anxious when someone takes down a gym from me. 4. 4. I am not worried that my gyms are captured or I don't get coins I don't play for a few days.	0.78 0.79 0.81 Removed
Attitude towards government's measures against COVID-19 (self-developed) CR: 0.91 AVE: 0.84	1. I agree with the measures the Finnish government has taken against COVID-19 2. I think the Finnish government has done right to restrict individual movement due to COVID-19. 3. The movement restrictions done by the Finnish government are insufficient for the COVID-19	0.92 0.91 Removed
Attitude towards Niantic's measures against COVID-19 (self-developed) CR: 0.80 AVE: 0.66	1. I think cancelling social events due to COVID-19 was justified. 2. I don't think Niantic should make changes to the game because of the pandemic. 3. Doubling the gym radius to enable playing while isolated was a good change.	0.86 0.77 Removed
Playing intensity (Whelan et al., 2020) CR: 0.84 AVE: 0.56	1. Playing Pokémon GO is part of my everyday activity. 2. I feel out of touch when I haven't played Pokémon GO for a while. 3. I would be frustrated if I could not play Pokémon GO. 4. How many minutes per day do you spend playing Pokémon GO?	0.70 0.82 0.82 0.67
Reduced social play intention (self-developed) CR: 0.86 AVE: 0.76	1. I have avoided playing PG outside with others due to COVID-19. 2. I kept distance from others while playing due to COVID-19. 3. I have met other PG players to trade/battle/raid normally due to COVID-19	0.86 0.88 Removed

Appendix B. . Correlations among the constructs and square roots of average variance extracted values.

	Age	DSR	FoMO	Playing Intensity	Gaming Company measures	Gender	Government Measures	Perceived Severity	Perceived Susceptibility	Reduced Social Play Intention
Age	1.00									
DSR	0.01	0.82								
FoMO	−0.11	0.55	0.79							
Playing Intensity	0.15	0.55	0.45	0.75						
Gaming Company measures	0.07	−0.04	−0.07	−0.00	0.81					
Gender	0.09	−0.15	−0.18	−0.04	0.086	1.00				
Government Measures	0.10	−0.15	−0.15	−0.06	0.43	0.17	0.92			
Perceived Severity	0.18	−0.03	−0.04	0.07	0.27	0.16	0.39	0.79		
Perceived Susceptibility	0.12	0.01	−0.00	0.04	0.17	0.06	0.25	0.38	0.87	
Reduced Social Play Intention	0.07	−0.0	−0.06	−0.07	0.40	0.17	0.40	0.34	0.18	1.00

Appendix C. . Interaction effects of age and gender

Predictors	Reduced Social Play Intention
Perceived Severity	0.19***
Perceived Susceptibility	0.01
Government Measures	0.18***
Game Developer Measures	0.27***
Playing Intensity	−0.07*
Age	0.00
Gender	0.06*
Perceived Severity* Age	−0.04 ns
Perceived Susceptibility* Age	−0.04 ns
Government Measures* Age	−0.00 ns
Game Developer Measures* Age	0.07*
Playing Intensity* Age	0.09*
Perceived Severity* Gender	−0.06 ns
Perceived Susceptibility* Gender	0.05 ns
Government Measures* Gender	−0.06 ns
Game Developer Measures* Gender	0.04 ns
Playing Intensity* Gender	0.07 ns
R2	30%

References

Alha, K., Koskinen, E., Paavilainen, J., Hamari, J., 2019. Why do people play location-based augmented reality games: a study on Pokémon GO. Comput. Hum. Behav. 93, 114–122.

Alicino, C., Bragazzi, N.L., Faccio, V., Amicizia, D., Panatto, D., Gasparini, R., Orsi, A., 2015. Assessing Ebola-related web search behaviour: insights and implications from an analytical study of Google Trends-based query volumes. Infect. Dis. Poverty 4 (1), 54.

Alomar, N., Alsaleh, M., Alarifi, A., 2019. Behavioral consequences of Pokemon GO: the exaggerated picture. Comput. Hum. Behav. 90, 223–245.

Althoff, T., White, R.W., Horvitz, E., 2016. Influence of Pokémon Go on physical activity: study and implications. J. Med. Internet Res. 18 (12), e315.

Anderson, R.M., Heesterbeek, H., Klinkenberg, D., Hollingsworth, T.D., 2020. How will country-based mitigation measures influence the course of the COVID-19 epidemic? Lancet 395 (10228), 931–934.

Assunção, R.S., Matos, P.M., 2017. The generalized problematic internet use scale 2: validation and test of the model to Facebook use. J. Adolescence 54, 51–59.

Atkeson, A., 2020. What will be the economic impact of COVID-19 in the US? Rough estimates of disease scenarios (No. w26867). National Bureau of Economic Research.

Barkley, J.E., Lepp, A., Glickman, E.L., 2017. "Pokémon Go!" may promote walking, discourage sedentary behavior in college students. Games Health J. 6 (3), 165–170.

Beach, C., Billstrom, G., Anderson Steeves, E.T., Flynn, J.I., Steeves, J.A., 2019. The physical activity patterns of greenway users playing Pokémon Go: a natural experiment. Games Health J. 8 (1), 7–14.

Betsch, C., 2020. How behavioural science data helps mitigate the COVID-19 crisis. Nat. Hum. Behav. 1.

Bhattacharya, A., Windleharth, T.W., Ishii, R.A., Acevedo, I.M., Aragon, C.R., Kientz, J.A., Lee, J.H., 2019. Group interactions in location-based gaming: a case study of raiding in Pokémon GO. In: Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems, pp. 1–12.

Bish, A., Michie, S., 2010. Demographic and attitudinal determinants of protective behaviours during a pandemic: a review. Brit. J. Health Psychol. 15 (4), 797–824.

Carbonell Carrera, C., Saorín, J.L., Hess Medler, S., 2018. Pokémon GO and improvement in spatial orientation skills. J. Geogr. 117 (6), 245–253.

Chinazzi, M., Davis, J. T., Ajelli, M., Gioannini, C., Litvinova, M., Merler, S., Viboud, C., 2020. The effect of travel restrictions on the spread of the 2019 novel coronavirus (COVID-19) outbreak. Science.

Colley, A., Thebault-Spieker, J., Lin, A.Y., Degraen, D., Fischman, B., Häkkilä, J., Wenig, D., 2017. The geography of Pokémon GO: beneficial and problematic effects on places and movement. In: Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems, pp. 1179–1192.

Deci, E.L., Ryan, R.M., 2012. Self-determination theory. In P. A. M. Van Lange, A. W. Kruglanski, & E. T. Higgins (Eds.), Handbook of theories of social psychology (p. 416–436). Sage Publications Ltd. https://doi.org/10.4135/9781446249215.n21.

Farooq, A., Laato, S., Islam, A.K.M.N., 2020. Impact of online information on self-isolation intention during the COVID-19 pandemic: cross-sectional study. J. Med. Internet Res. 22 (5), e19128.

Fornell, C., Larcker, D.F., 1981. Structural equation models with unobservable variables and measurement error: Algebra and statistics.

Gagné, M., Deci, E.L., 2005. Self-determination theory and work motivation. J. Organiz. Behav. 26 (4), 331–362.

Hamari, J., Malik, A., Koski, J., Johri, A., 2019. Uses and gratifications of Pokémon Go: why do people play mobile location-based augmented reality games? Int. J. Human-Computer Interact. 35 (9), 804–819.

Harris, Marc Ashley, 2019. Maintenance of behaviour change following a community-wide gamification based physical activity intervention. Prev. Med. Rep. 13, 37–40. https://doi.org/10.1016/j.pmedr.2018.11.009.

Hellewell, J., Abbott, S., Gimma, A., Bosse, N.I., Jarvis, C.I., Russell, T.W., Flasche, S., 2020. Feasibility of controlling COVID-19 outbreaks by isolation of cases and contacts. Lancet Global Health.

Henseler, J., Dijkstra, T.K., Sarstedt, M., Ringle, C.M., Diamantopoulos, A., Straub, D.W., Ketchen, D.J., Hair, J.F., Hult, G.T.M., Calantone, R.J., 2014. Common beliefs and reality about partial least squares: comments on Rönkkö & Evermann (2013). Organiz. Res. Meth. 17 (2), 182–209.

Hu, L.-T., Bentler, P.M., 1998. Fit indices in covariance structure modeling: sensitivity to underparameterized model misspecification. Psychol. Methods 3 (4), 424–453.

John Hopkins University (2020), Coronavirus research center [ONLINE], available at : https://coronavirus.jhu.edu/map.html , checked April 15th, 2020.

Juhász, L., Hochmair, H.H., 2017. Where to catch 'em all?–a geographic analysis of Pokémon Go locations. Geo-spatial Inform. Sci. 20 (3), 241–251.

Kaczmarek, L.D., Behnke, M., Dżon, M., 2019. The Gengar effect: Excessive Pokémon Go players report stronger smartphone addiction, phubbing, pain, and vision-related problems.

Kokudo, N., Sugiyama, H., 2020. Call for international cooperation and collaboration to effectively tackle the COVID-19 pandemic. Glob. Health Med.

LaRose, R., Lin, C.A., Eastin, M.S., 2003. Unregulated Internet usage: addiction, habit, or deficient self-regulation? Media Psychol. 5 (3), 225–253.

Laato, S., Pietarinen, T., Rauti, S., Paloheimo, M., Inaba, N., Sutinen, E., 2019. A review of location-based games: do they all support exercise, social interaction and cartographical training.

Laato, S., Hyrynsalmi, S., Rauti, S., Islam, A.K.M.N., Laine, T.H., 2020c. Location-based games as exergames-from pokémon to the wizarding world. Int. J. Serious Games 7 (1), 79–95.

Laato, S., Hyrynsalmi, S., Rauti, S., Sutinen, E., 2020a. The effects playing pokémon GO has on physical activity-a systematic literature review. Proceedings of the 53rd Hawaii International Conference on System Sciences.

Laato, S., Inaba, N., Paloheimo, M., 2020b. The effect of team choice in ingress and pokémon GO for players' social circles and attitudes towards game slang. Proceedings of the 53rd Hawaii International Conference on System Sciences.

Laato, S., Laine H, T., Islam, A.K.M.N., 2020d. Location-Based Games and the COVID-19 Pandemic: An Analysis of Responses from Game Developers and Players. Multimodal Technol. Inter. 4 (2). https://doi.org/10.3390/mti4020029.

Lai, C.C., Shih, T.P., Ko, W.C., Tang, H.J., Hsueh, P.R., 2020. Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and corona virus disease-2019 (COVID-19): the epidemic and the challenges. Int. J. Antimicrobial Agents, 105924.

Lau, H., Khosrawipour, V., Kocbach, P., Mikolajczyk, A., Ichii, H., Schubert, J., Khosrawipour, T., 2020. Internationally lost COVID-19 cases. Journal of Microbiology, Immunology and Infection.

Lauer, S.A., Grantz, K.H., Bi, Q., Jones, F.K., Zheng, Q., Meredith, H.R., Lessler, J., 2020. The incubation period of coronavirus disease 2019 (COVID-19) from publicly reported confirmed cases: estimation and application. Ann. Intern. Med.

Lee, D., LaRose, R., 2007. A socio-cognitive model of video game usage. J. Broadcast. Electronic Media 51 (4), 632–650.

Ling, M., Kothe, E.J., Mullan, B.A., 2019. Predicting intention to receive a seasonal influenza vaccination using Protection Motivation Theory. Soc. Sci. Med. 233, 87–92.

Liu, Y., Gayle, A.A., Wilder-Smith, A., Rocklöv, J., 2020. The reproductive number of COVID-19 is higher compared to SARS coronavirus. J. Travel Med.

Miller, S., Yardley, L., Little, P., 2012. Development of an intervention to reduce transmission of respiratory infections and pandemic flu: Measuring and predicting hand-washing intentions. Psychol. Health Med. 17 (1), 59–81.

Moore, G.C., Benbasat, I., 1991. Development of an instrument to measure the perceptions of adopting an information technology innovation. Inform. Syst. Res. 2 (3), 192–222.

Niantic, 2020. Pokémon GO Updates [ONLINE], available at: https://pokemongolive.com/en/, accessed April 14th, 2020.

Niantic, 2020b. New ways to raid, power up your Pokémon, receive Gifts to send out, and more, [ONLINE], available at: https://pokemongolive.com/post/raid-battleupdate-april2020, accessed 15th of April, 2020.

Oleksy, T., Wnuk, A., 2017. Catch them all and increase your place attachment! The role of location-based augmented reality games in changing people-place relations. Comput. Hum. Behav. 76, 3–8.

Oliver, M.B., Bowman, N.D., Woolley, J.K., Rogers, R., Sherrick, B.I., Chung, M.Y., 2016. Video games as meaningful entertainment experiences. Psychol. Popular Media Culture 5 (4), 390.

Ono, S., Ono, Y., Michihata, N., Sasabuchi, Y., Yasunaga, H., 2018. Effect of Pokémon GO on incidence of fatal traffic injuries: a population-based quasi-experimental study using the national traffic collisions database in Japan. Injury Prevent. 24 (6), 448–450.

Papangelis, K., Chamberlain, A., Khan, V., Lykourentzou, I., Saker, M., Liang, H., Sadien, I., Cao, T., 2020. Performing the Digital Self: Understanding Location-Based Social Networking, Territory, Space, and Identity in the City. ACM Transactions on Computer-Human Interaction (TOCHI) 27 (1). https://doi.org/10.1145/3364997.

Przybylski, A.K., Murayama, K., DeHaan, C.R., Gladwell, V., 2013. Motivational, emotional, and behavioral correlates of fear of missing out. Comput. Hum. Behav. 29 (4), 1841–1848.

Rasche, P., Schlomann, A., Mertens, A., 2017. Who is still playing pokemon Go? A Web-based survey. JMIR Serious Games 5 (2), e7.

Riar, M., Morschheuser, B., Hamari, J., Zarnekow, R., 2020, January. How game features give rise to altruism and collective action? Implications for cultivating cooperation by gamification. In Proceedings of the 53rd Hawaii International Conference on System Sciences.

Rogers, R.W., 1975. A protection motivation theory of fear appeals and attitude change1. J. Psychol. 91 (1), 93–114.

Rogers, R., 2017. The motivational pull of video game feedback, rules, and social interaction: another self-determination theory approach. Comput. Hum. Behav. 73, 446–450.

Rubin, G.J., Amlôt, R., Page, L., Wessely, S., 2009. Public perceptions, anxiety, and behaviour change in relation to the swine flu outbreak: cross sectional telephone survey. BMJ 339, b2651.

Rundle, A.G., Park, Y., Herbstman, J.B., Kinsey, E.W., Wang, Y.C., 2020. COVID-19 related school closings and risk of weight gain among children. Obesity.

Sahin, A.R., Erdogan, A., Agaoglu, P.M., Dineri, Y., Cakirci, A.Y., Senel, M.E., Tasdogan, A.M., 2020. 2019 novel coronavirus (COVID-19) outbreak: a review of the current literature. EJMO 4 (1), 1–7.

Seay, A.F., Kraut, R.E., 2007, April. Project massive: Self-regulation and problematic use of online gaming. In Proceedings of the SIGCHI conference on Human factors in computing systems (pp. 829-838).

Sharifirad, G., Yarmohammadi, P., Sharifabad, M.A.M., Rahaei, Z., 2014. Determination of preventive behaviors for pandemic influenza A/H1N1 based on protection motivation theory among female high school students in Isfahan, Iran. J. Educ. Health Promotion 3.

Sotamaa, O., 2002, June. All The World's A Botfighter Stage: Notes on Location-based Multi-User Gaming. In CGDC Conf..

Spina, S., Marrazzo, F., Migliari, M., Stucchi, R., Sforza, A., Fumagalli, R., 2020. The response of Milan's emergency medical system to the COVID-19 outbreak in Italy. Lancet 395 (10227), e49–e50.

Vella, K., Johnson, D., Cheng, V.W.S., Davenport, T., Mitchell, J., Klarkowski, M., Phillips, C., 2019. A sense of belonging: pokemon GO and social connectedness. Games Culture 14 (6), 583–603.

Wetzels, M., Odekerken-Schroder, G., van Oppen, C., 2009. Using PLS path modeling for assessing hierarchical construct models: guidelines and empirical illustration. MIS Quarterly 33 (1), 177–196.

Whelan, E., Islam, A.N., Brooks, S., 2020. Is boredom proneness related to social media overload and fatigue? a stress–strain–outcome approach. Internet Res.

Wilder-Smith, A., Chiew, C.J., Lee, V.J., 2020. Can we contain the COVID-19 outbreak with the same measures as for SARS? Lancet. Infect. Dis.

World Health Organization, 2020. Considerations for quarantine of individuals in the context of containment for coronavirus disease (COVID-19): interim guidance, 29 February 2020 (No. WHO/2019-nCov/IHR_Quarantine/2020.1). World Health Organization.

Yang, C.C., Liu, D., 2017. Motives matter: motives for playing Pokémon Go and implications for well-being. Cyberpsychol. Behav. Social Network. 20 (1), 52–57.

Zach, F.J., Tussyadiah, I.P., 2017. To catch them all—the (un) intended consequences of Pokémon GO on mobility, consumption, and wellbeing. In Information and communication technologies in tourism 2017 (pp. 217-227). Springer, Cham.