How location-based gaming affects players' nature and forest experiences

Samuli Laato
Gamification Group,
Tampere University
samuli.laato@tuni.fi

Daniel Fernández Galeote
Gamification Group,
Tampere University
daniel.fernandezgaleote@tuni.fi

Ferran Altarriba Bertran
Gamification Group,
Tampere University
ferran.altarribabertran@tuni.fi

Konstantinos Papangelis
Niantic x RIT Geo Games and Media Research Lab,
Rochester Institute of Technology
kxpigm@rit.edu

Juho Hamari
Gamification Group,
Tampere University
juho.hamari@tuni.fi

Abstract

In our digitized modernity, there are an increasing number of discourses related to the benefits of returning to nature for well-being, health, lived daily experiences and promoting ecological sustainability. Concurrently, location-based games (LBGs), such as Pokémon GO, have become a prominent game-technological trend, which influences players' movement out and about in nature. Therefore, LBGs could potentially provide a fruitful development to re-establish some of the human-nature relationships lost in urbanization and industrialization. The aim of this study, therefore, is to explore how contemporary LBGs affect peoples' relationship with nature. We conducted a qualitative study through semi-structured interviews among LBG players. We focused on two complementary seeding points of departure, (1) what aspects of the games affect how players interact with nature and/or are enticed to move in nature, and (2) how LBGs affect the experience in and of nature. The findings detail the multifaceted and bi-directional relationship of how LBGs affect players' perceptions of nature, but simultaneously, nature changes and shapes players' movement and experiences, potentially resulting in increased well-being and more sustainable gaming praxis.

Keywords: Nature, forest, location-based games, pervasive games, augmented reality

1. Introduction

"There is no WiFi in the forest, but I promise you will find a better connection" -Ralph Smart

This famous quote by the British psychologist

Ralph Smart suggests that there is something special in human-forest relationships. The scientific evidence also supports this claim. For example, the literature on forest-bathing has highlighted psychological benefits such as attention restoration ((Ohly et al., 2016), stress recovery (Lee et al., 2011; Park et al., 2010) and reduced anxiety (Kotera et al., 2020). Similar results have been produced on multiple occasions, in various settings and through both physical measurements (e.g. blood cortisol levels) (Lee et al., 2011; Park et al., 2010) as well as self-reported psychometric surveys (Moran, 2019). Taken together, the evidence regarding positive benefits of forest-going is substantial (Ohly et al., 2016), despite a recent call for more careful examinations of what exactly users do in forests (Kotera et al., 2020). Overall the observed benefits have led academics to suggest that forest-bathing could be used as an intervention to treat population level health issues such as addictive behaviors (Kotera and Rhodes, 2020).

Returning to the quote by Ralph Smart, it also hints that forests, and by extension nature, is a technology free environment, a place with *"no WiFi"*. Here the argument can be made that getting rid of technology and periodically returning to nature has health benefits. For example, a recent comparison study suggests that time spent in digital forests does not lead to the same health benefits as the real forest (Markwell and Gladwin, 2020). Yet, technology has become ubiquitous, and thus, we should investigate how technology shapes and mediates human-nature relationships. In fact, recent developments in the accessibility of mobile data coupled with the rapidly increased performance of smart devices has contributed to the emergence of new forms of play, such as mobile exergames (Laine and Suk, 2016) and location-based games (LBGs) (Leorke, 2019), both of which can bring people to nature and impact their

experiences therein.

So far a few academic studies have been published on the topic of motivational health technologies for boosting forest-going, all taking a generally positive stance on the topic (Laato, Fernández Galeote, et al., 2022; Laato, Pynnönen, et al., 2022; Saaty, Haqq, Dooley, et al., 2021; Saaty, Haqq, Toms, et al., 2021; Schaal, 2020; Schneider and Schaal, 2018). There are also various commercial tools and applications that are regularly used in forest and nature environments ranging from treasure hunt apps (e.g. geocaching) to map assistant tools (e.g., OpenStreetMaps, My Tracks). These developments suggest the presence of both industry and academia attention on motivational information systems (IS) (Hamari et al., 2014; Koivisto and Hamari, 2019) for promoting forest-going. One crucial technology in this field are location-based games (LBGs), which are played out in the real world and influence players' real world mobility (Laato, Kordyaka, et al., 2022). However, there is a dearth of evidence on how LBGs and other similar information systems influence and shape players' perceptions of nature. In this study we tackle this area of inquiry in the context of commercial LBGs such as Pokémon GO, and accordingly formulate the following research question (RQ) to guide this study:

RQ: *How do LBG players perceive nature while playing in a forest environment?*

In order to answer the RQ, we interviewed LBG players (n=21) in Finland, and analyzed the data via reflexive thematic analysis (Braun and Clarke, 2019). With this approach, we contribute new knowledge in the field of motivational health technology design, particularly in the setting of LBGs in forest-bathing and forest-going. The rest of this study is structured as follows. First, we review the literature on forest-going as a way to promote personal health with a focus on LBGs. We then present our methods and results, followed by a discussion on our main findings, limitations and future research directions.

2. Background

2.1. Forest-going as a way to promote personal health

The psychological health benefits of nature experiences on affect, cognition and stress among others have been observed and reaffirmed through countless studies and study contexts such as forest bathing (Kotera et al., 2020) and habitual walks in nature (Song et al., 2018). Going to nature is inherently a physical activity, and has therefore also physiological benefits. Past work on personal health management

has advocated for the usefulness of smartphones to monitor movement (Chiang et al., 2014), and recently also wearable health devices such as rings, watches and bands have gained traction in the academia and the industry (Gao et al., 2015; Talukder et al., 2021). On top of these technological platforms, app designers have come up with motivational health applications which include gamified apps, exergames and LBGs (see e.g., Saaty, Haqq, Toms, et al., 2021).

A recent meta-synthesis of the forest-bathing literature highlights the need to understand people's activities within the forest better (Kotera et al., 2020). Instead of viewing a forest as a homogeneous setting and forest-bathing as a singular activity, researchers should aim to understand the human-forest interaction processes more deeply (Kotera et al., 2020). For example, individuals engaging in hiking (Mitten et al., 2018) can have largely different experiences and outcomes in comparison to those engaging in shorter habitual forest walks (Martens et al., 2011). Furthermore, despite a general preference for greenery and bodies of water, and a distaste of lifeless areas such as deserts and grey urban scenery, individuals perceive landscapes differently (Hartmann and Apaolaza-Ibanez, 2010). On top of these factors, there is the potential influence of technology, as it can alter, enhance or diminish specific aspects of the users' forest experience (Laato, Fernández Galeote, et al., 2022; Saaty, Haqq, Dooley, et al., 2021; Saaty, Haqq, Toms, et al., 2021; Schneider and Schaal, 2018).

Regarding the theoretical approaches for understanding the health benefits of forest-going, a few have risen to prominence. These are attention restoration theory (Ohly et al., 2016) and stress recovery theory (Ulrich et al., 1991), both of which describe the mechanisms through which spending time in nature environments can lead to the respective health benefits (attention restoration and stress recovery). Recently evolutionary psychology has also been widely applied, perhaps not as a theory, but rather an epistemic approach, for understanding the health benefits of spending time in nature (Hartmann and Apaolaza-Ibanez, 2010). The central postulation here is that as humans have evolved over the course of million years in nature environments, they have become tuned to nature in various ways. For example, the biophilia hypothesis of E.O. Wilson posits that humans have a natural tendency to spend time with, and get to know, other lifeforms (Wilson, 1984). These activities have obvious survival benefits, such as learning which plants are edible, where wild animals can be found and which beasts to run away from. A study published in the Science magazine even suggests that the biophilia

tendency of humans is so strong, that it explains engagement with fictional animal-like creatures such as Pokémon (Balmford et al., 2002). Such findings suggest it is prudent to study how fictional worlds and technology could perhaps augment, enhance or in some other way influence users' nature experiences.

2.2. Commercial location-based games and their influence on player movement

We define LBGs as mobile games where the players' physical location matches their avatar's location on a map, and where movement in the game world consequently occurs by moving in the real world. Despite being around since the beginning of the 2000s (Leorke, 2019), LBGs saw a massive spike in popularity with the release of Pokémon GO in summer 2016 (Hamari et al., 2019; Laato, Kordyaka, et al., 2022). The popularity of Pokémon GO was quickly followed by other commercial LBGs from popular franchises such as NextGames' The Walking Dead: Our World, Ludia's Jurassic World: Alive and Spokko's The Witcher: Monster Slayer. There are a few key characteristics of these games that are relevant for the current study. First, contemporary commercial LBGs typically provide more playable content in cities as opposed to rural areas and forests (Tregel et al., 2017). Second, all these mentioned LBGs are online live service games monetized by microtransactions and playing is primarily motivated by various progression systems. The main gameplay of these LBGs consists of navigating to points of interest (PoIs), engaging in minigames, obtaining rewards and upgrading things. This game design influences how LBGs are played and what their behavioral outcomes are. Third, contemporary LBGs are multiplayer games, meaning they are played with and/or against other real people.

Regarding the research on commercial LBGs and nature, there is a dearth of knowledge on how LBGs actually shape players' interactions when in forests. The early work suggests that LBGs would have a minimal (Schneider and Schaal, 2018), or even a diminishing effect (Saaty, Haqq, Dooley, et al., 2021) on the benefits of nature-going. However, recent findings from a design workshop (Laato, Pynnönen, et al., 2022) and a player diary study (Saaty, Haqq, Toms, et al., 2021) suggest that the situation may be more complex, that even if playing LBGs has a diminishing effect on some nature-related benefits when in forests, they may provide other positive benefits. Due to the complexity of this area of inquiry, there is a need to qualitatively explore phenomena related to players' experience of forests and nature while playing LBGs.

3. Materials and methods

3.1. Data collection

In order to address the research question *"how do LBG players perceive nature while playing in a forest environment?"*, we conducted 21 semi-structured interviews with experienced LBG players in Finland, a heavily forested country. We selected the semi-structured interview approach, since we wanted to ensure we cover certain key questions in the interviews, and still wanted to allow for the emergence of unexpected conversation topics that might be relevant to the study. We formulated questions related to two thematic areas: (1) what aspects of the games affect how players interact with nature and/or are enticed to move in nature, and (2) how LBGs affect the experience in and of nature. Under these themes we had a set of specific questions such as *"Which game is the most fun to play in a city? What about in a forest?"* and *"How would you describe the areas in which you most typically play?"* under Theme 1, and *"Do you think you would behave differently in nature if you would not be playing the game?"* and *"Can you tell some examples of how you have played either game in a forest? What was interesting/fun in that experience?"* under Theme 2. We additionally asked clarifying questions when relevant.

Participants were recruited through Telegram and WhatsApp channels of active Pokémon GO, Ingress Prime and Pikmin Bloom players in Finland in two waves: November 2021 and January 2022. As a reward from participation, players were promised a promotional code worth roughly 10 USD. All interviews were carried out through Zoom. The interviews were recorded and subsequently transcribed using the Microsoft Word auto-transcribe tool. In our material, this tool was flawless in detecting who was speaking, but some manual cleaning had to be done to the transcriptions and quotes. The interviews lasted from 30 mins to 70 mins, with the mean duration being roughly 40 mins.

Demographic information of the interview participants is displayed in Table 1. The majority of the players reported to primarily play Pokémon GO, which is unsurprising considering that the game is globally roughly ten times as popular as the second most installed LBG, Ingress Prime. Most players also stated to have begun playing LBGs at the launch of Pokémon GO in summer 2016, which shows prominently in the play experience tab. There were a few exceptions such as P8 and P10 who had prior experience with apps such as geocaching, as well as P4 and P21 who had begun playing a bit later. Since we were focusing on players' forest and nature experiences, we wanted

Table 1. The demographic profile of the interview participants

ID	Gender	Age Range	Play experience (years)	Rural/urban
1	Male	31-40	5	Urban
2	Male	31-40	5	Rural
3	Male	21-30	5	Rural
4	Male	41-50	2	Urban
5	Female	31-40	5	Rural
6	Female	21-30	5	Urban
7	Male	21-30	5	Urban
8	Male	31-40	9	Urban
9	Female	41-50	5	Urban
10	Male	21-30	7	Urban
11	Male	31-40	5	Rural
12	Male	41-50	5	Rural
13	Male	51-60	5	Urban
14	Male	41-50	5	Urban
15	Female	31-40	5	Urban
16	Female	31-40	5	Rural
17	Male	21-30	5	Urban
18	Male	31-40	5	Rural
19	Male	21-30	5	Urban
20	Male	41-50	5	Urban
21	Male	31-40	2	Urban

to obtain an idea whether players lived their daily lives in the proximity of forests or not. For this, we collected the players' hometown (whether they lived in a larger urban setting or a small town) as well as asked them to describe their daily playing. From this information we derived an estimate whether the players primarily played in an urban or rural environment. This information is displayed on the fourth column.

3.2. Analysis

For answering the RQ regarding how LBGs can influence players' interactions with nature, we used reflexive thematic analysis (Braun and Clarke, 2019). This method has recently gained substantial popularity among qualitative researchers for its interpretive rigor and ability to extract nuances in data. Reflexive thematic analysis differs from some other popular IS methods such as the Gioia method (Gioia et al., 2013) in that it does not produce a rigid template or a hierarchical data structure, but rather, takes full advantage of the richness of the qualitative data and leaves more room for surprising findings and interpretations (Mees-Buss et al., 2022).

The analysis process itself took place over the course of months, and partially overlapped with the data collection. Nonetheless, in principle, the analysis process followed two key steps: (1) familiarization with the data; (2) extraction of key themes and phenomena to develop a theoretical framework. Both steps were iterated through multiple times, during which we refined our interpretation and extracted new ideas and knowledge from the data. Constant refining of the interpretation of the data is important in reflexive thematic analysis, since the approach relies on the authors' accumulated expertise to interpret the data and synthesize knowledge for obtaining insights (Braun and Clarke, 2019).

In the first step of familiarization, the authors read the interview transcripts and listened to the transcriptions. They made notes of interesting findings and observations. In the second step, in order to form a thematic framework for describing the data, the authors arranged altogether five analysis meetings. The first four were organized two weeks apart from each other and they partially overlapped with the data collection. These meetings were held online in Zoom and lasted between 60m min and 90 min. In addition to these meetings, the authors discussed the content asynchronously via in-person meetings and Slack. After producing the first draft of the findings section, all authors participated in suggesting changes and improvements to it. As an outcome of these meetings, the authors derived key themes that describe the data. After the themes were finalized, the authors returned to the transcripts, and selected quotes that depicted or illuminated aspects related to the themes. A summary of the findings is displayed in Fig. 1.

4. Findings

4.1. Directing attention

One of the key aspects discussed from various viewpoints in the interviews was LBGs' influence on where they directed players' attention while in nature. LBGs themselves can act as a distraction, as players have to look at their mobile devices in order to play the game. The following quote from P11 highlights this issue:

"You are there looking at your phone while there's all this nature around you. I think I do still get some greenery in the corner of my eyes (laughs). And there is the moving around and the smell and the air - those are there in any case." (P11)

As a redeeming element to the issue of constantly looking at the mobile device, some LBGs feature the opportunity to use wearable technologies or other means
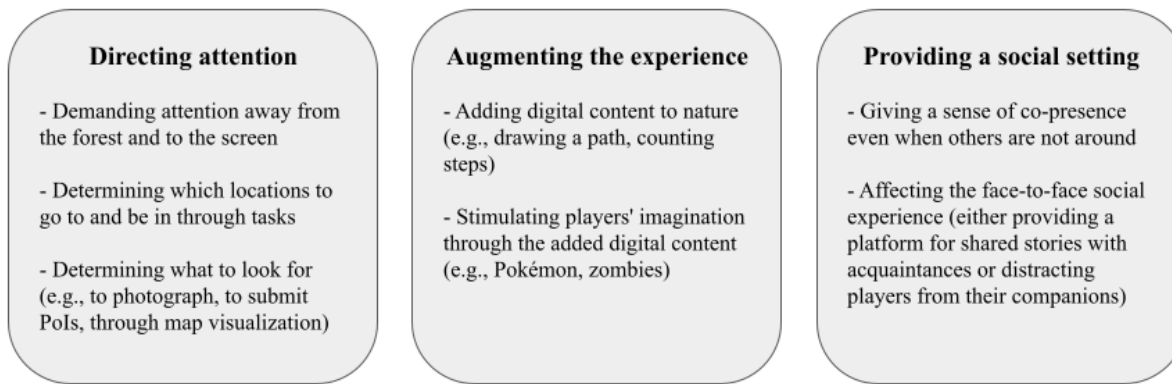
Directing attention

- Demanding attention away from the forest and to the screen

- Determining which locations to go to and be in through tasks

- Determining what to look for (e.g., to photograph, to submit PoIs, through map visualization)

Augmenting the experience

- Adding digital content to nature (e.g., drawing a path, counting steps)

- Stimulating players' imagination through the added digital content (e.g., Pokémon, zombies)

Providing a social setting

- Giving a sense of co-presence even when others are not around

- Affecting the face-to-face social experience (either providing a platform for shared stories with acquaintances or distracting players from their companions)

Figure 1. How LBGs affect players' experiences in and of nature

to play without having to focus on the mobile device's screen. For example, among the interviewed players the majority owned some kind of an "auto-playing wearable device", such as Pokémon GO +, PokéBall + or Gotcha, that enabled them to play Pokémon GO without looking at their screen. Some games such as Pikmin Bloom are designed to be played without looking at the screen - where the mobile device merely tracks the players' footsteps and movement. In addition to these solutions for liberating players' attention from their mobile device, several informants (e.g., P6, P8, P16) mentioned that in forest environments the LBGs typically require less attention, or that they even voluntarily decide to pay less attention to the game. As an example, P6 mentioned that she primarily goes to forests to relax, but may look at her phone when arriving at PoIs she knew about beforehand. P16 mentioned that she typically goes nature to play and photograph, and that she does a bit of both. P8 was the most strict when discussing purposeful visits to forests:

"When going to forest you go to forest - there you put the game away" (P8)

When going through the informants' experiences across multiple different LBGs, it became clear to the researchers that the game itself, and the available affordances, are crucial in directing players' attention in nature. Depending on the game, players were given various tasks such as hacking portals in Ingress Prime, spinning stops or deploying to gyms in Pokémon GO, or simply grinding through enemies in The Witcher: Monster Slayer. Some activities like battling gyms or capturing portals could at worst take hours, in case the opposing party was defending it from afar, while other activities only required a few seconds from the player. When forced by the game mechanics to stay in one place, players would have the ability to look around their environment and focus more on the details of a specific spot. This was made possible by the gameplay being

mostly just tapping the screen, requiring little focus from the player. This is exemplified by the following quote:

"The best feelings are when you have time and snacks, and [then the opposing team controlling a gym] starts feeding the gym golden berries." (P12)

However, for some players (particularly Pokémon GO players), it was annoying that they could not predict whether they had to spend extended amounts of time in the same location because of the game or not. The reason was the game mechanic where defending a gym is up to the opposing party - who may partake in the activity or not. One way to cope with these situations for players was to carry multiple in-game accounts and devices - since that made taking down the locations easier. Several of the interview participants (P2, P9, P11, P12, P18, P19) reported playing LBGs on multiple phones simultaneously, but there were also other reasons for this besides taking down gyms. This behavior also required effort and attention from players, also in forest environments as explained by P2:

"I like trading shinies, I like to raid gyms on my own. It is a lot of trouble [to manage so many accounts] and yea sometimes I think if it makes any sense." (P2)

Returning to the game mechanics, some LBGs (e.g., Pokémon GO and The Walking Dead: Our World) feature tasks where players are prompted to take AR photos. This activity could encourage players to look for their surroundings for an interesting photograph. Players could, for example, aim to take pictures of grass pokémon in their natural habitat: the forest, or water pokémon near bodies of water. The interview material suggests this activity is more prominent when players' are traveling to interesting new locations. Furthermore, photographing appeared to be a hobby that was easily combined with playing LBGs in nature. In fact, two informants explicitly mentioned that they combine their playing with a photography hobby:

"I try to go to [place a] every year when the wood anemones sprout to photograph them. Now I'm also playing there. I also go there just to spend time and take photos, but oftentimes just with my mobile phone." (P16)

"I've never been a hiker but I stay up at night. So I've gone playing during the night and have taken photos of misty fields, and forests - foggy forests, sunsets, sunrises... The birds start singing at 3 A.M. It's atmospheric." (P21)

These comments also highlight the importance of the seasonal experience, as well as the time of day for the nature experience. Some LBGs were supporting the seasonal experience via in-game events. Taking the example of Pokémon GO, the game features events that roughly correspond to real world events, such as an "Eggstravaganza" event around Easter, a "Halloween" event around Halloween and a "Lunar New Year" event at the start of the next lunar year in February. However, based on knowledge derived from the informants as well as the authors' knowledge, these in-game events were largely disconnected from events in nature. This can be explained by the large variance in seasons around the earth, and that the most popular commercial LBGs (which the interviewers also primarily talked about) are global live service games. Thus, while LBGs have potential to direct players to nature at times when interesting things happen, this potential is not currently realized in commercial LBGs.

Another aspect often brought forward in the interviews related to game mechanics and photographing in nature while playing was PoI submissions. Players submitting new PoIs to the Niantic database through the Wayfarer system were oftentimes looking for potential submission candidates when they were in a new location. Here the PoI submission criteria defined by Niantic were important in defining the focus of the players' attention. For example, natural shapes such as rocks or mountains are not acceptable candidates, but man-made structures, trail markers and playgrounds are. The way this activity directed players' attention is illustrated by the following quotes:

"I wanted to make some playing areas near my summer cottage so I was looking at bridges, signs and old wooden houses thinking "could this be a PokéStop, or could this be a PokéStop"" (P10)

"I look up locations beforehand, but you never know what's there before you actually go there (...) I once went out to create one gym, but ended up submitting various other [PoI proposals] too" (P19)

A final aspect related to players' attention while in forests was how players were switching between the 3D visualization of the forest provided by their eyes and what they see, and the 2D map visualization provided by the LBG. This back-and-forth between the bird's-eye view map interface and players' vision of the environment allowed them to view the forest from a new perspective. The map view directed players' attention to things such as terrain forms, alerted them if there was a body of water nearby (since it was oftentimes easier to see it from the map interface than in real life) and consequently, allowed them to discover new things from the forest. Through the map visualization, players could also see familiar forest areas in a new perspective.

In summary, LBGs contain several mechanisms that guide players' attention while in nature. Some features simply redirect players' attention away from the real world into the game, but others such as (1) navigation, (2) PoI submission, and (3) AR photos, redirect players' attention within the game world. Furthermore, the ability to see the forest area from a bird's-eye perspective through LBGs could be seen as an enriching experience that enabled players to re-imagine the forest area through the game.

4.2. Augmenting the experience

The second key theme emerging from the interview data was the augmentation of the nature experience. Related to this were two key phenomena: how LBGs can (1) boost engagement with the environment by bringing something extra there that can make the experience more fun; and (2) stimulate imagination by providing players with stories and ideas for activities. The concept of augmented experience was mentioned both implicitly and explicitly, and in the context of several different LBGs and across all informants. The following quotes from Pikmin Bloom players highlight how that game augments the players' forest experiences, making them more enjoyable:

"In Pikmin Bloom you can draw things on the map while walking, I think it's quite fun." (P1)

"Pikmin is like a virtual step counter. It does not really bother me, so I don't think about it. But it gives me (...) a feeling I am achieving something when I'm walking." (P8)

The second quote underscores a tension that prima facie may appear a contradiction. Namely, while P8 stated they do not actively think about the game, they also stated that it gives them a feeling of achievement when walking. This may be understood by how LBG players switch from thinking about the game to thinking about their real world environment and back. This process appeared to be typical among the informants. Several highly active players (e.g. P2, P9, P11, P15,

P17, P19) highlighted that playing had become "an automation" for them. For these players, the game had become an integral part of their daily routines. This integration between the game and the highly active players' lives is illustrated by the following quotes:

"I have the game open actually all the time, mostly at home I look at it, and while watching movies. Also while I go somewhere I have the game there." (P2)

"I play all the time. I always have the game on at home. And if I go to play specifically, typically something from 2 hours to 6 hours, the duration of an event. Unless there is an even longer event." (P9)

Despite active players stating they play all the time, they could still forget about the game at times. One example comes from the context of Pikmin Bloom. In the game, players are prompted to plant flowers. P13 recalled starting to plant flowers and then going for Nordic walking. He then forgot about the flowers at some point, focusing on the outside world and other LBGs he was playing. Only when he got back home did he remember Pikmin Bloom, and realized that he had run out of flowers. Forgetting about the LBG can be viewed as a sign of low user engagement, but it also underscores that in some instances, the augmentation provided by LBGs for forest-goers is small or even non-existent.

Related to augmenting the playing experience, it is important to discuss the camera see-through AR feature. As discussed in the previous theme, this feature could direct players' attention, but it could also augment the environment the players were in, prompting imagination. For example, players' could imagine pokémon creatures or zombies in forests depending on the game they were playing, or engage in role-playing where they were a Witcher in search of bounties in a Scandinavian-style forest. Some of the informants (P1, P10, P13) compared the augmented experience provided by LBGs to their childhood. Here the augmentation served to bring forward nostalgic experiences. The following quotes illuminate this:

"As a kid I used to capture butterflies, I could not do it now, I could not put a butterfly to a jar, but collecting is fun. (...) [In Pokemon GO] I get the same feeling, something I hadn't experienced in years!" (P13)

"It's like you pretended to be capturing pokémon as a kid, and now you're actually capturing pokémon. Sort of. (laughs)" (P10)

In summary, LBGs had two main categories of mechanisms of augmenting the players' nature experience: (1) boosting engagement; and (2) stimulating imagination. Within these mechanisms there were notable individual differences between the informants, but also differences between games. For example, the level of boosted engagement with the surrounding environment sometimes remained shallow, as also suggested by previous work (Schneider and Schaal, 2018. By contrast, in certain cases LBGs were able to tap into the players' imagination, including childhood memories, and enable players to experience enjoyable augmented experiences in forests.

4.3. Providing a social setting

The majority of contemporary commercial LBGs are multiplayer live service platform games. The role and presence of social features and other players were very pronounced in the interviews, and influenced players' behavior and actions in LBGs as well as real life. In-game social features acted as a motivational force and the presence of other human players made the players more conscious of their actions. For example, players changed their movement and actions to meet, or to avoid, other players, and they sometimes intentionally sought to build fields over enemy players or play in a way that was difficult for the enemy team members to counter. The following quotes highlight these behaviors:

"I no longer play Ingress, ever, at gyms of which I'm trying to get a golden badge. (...) It's not that anyone would hunt me, but many Ingress players also play Pokémon GO and they can take down the gyms at the same time they go for the portals." (P12)

"If in the morning I see that many of my gyms have returned, I go out right away (...). If they are still intact from yesterday I might wait until noon." (P20)

"There's the [forest name redacted] near where we live, and I go there, because I know most Cargressers [playing Ingress by car] do not go there, or it is much more difficult for them to go there" (P21)

These quotes also highlight that several LBGs feature multiplayer elements that guide players to imagine a social presence to their playing, even if they are alone. This was particularly true for Ingress Prime players, where all the players share the same playing field, and can follow each others' actions through an in-game interface. With such affordances, LBGs create a social setting in which playing as well as nature-going takes place.

As discussed briefly under the two other themes, several LBGs prompt players to take AR photos of their surroundings. These AR photos are frequently shared through social media channels such as Instagram, Facebook, WhatsApp and Telegram. The photos could display a beautiful scenery, or some clever way to match the AR content into the real world environment. Through this activity, LBGs offered a concrete activity through which nature experiences were shared. P16

explained on this topic as follows:

We go there to photograph the sunset - we photograph nature - we also photograph new photos for me for social media. (P16)

In addition to the virtual presence of others, LBGs were played in conjunction to direct social relationships. For example, some players' families were also playing (e.g. P1, P2, P12, P15), some had found new real world friends through the game (e.g. P6, P7, P11) and others enjoyed meeting new people at raids and other places. The participants brought forward several advantages of playing with others, such as being able to take down raid bosses easier or sharing car rides to distant gyms. The following quotes illustrate these behaviors.

"It's good to find a friend if I go really far. It's more fun that way, and you get the extra accounts deployed to the gym to feed more berries." (P11)

"I play with my son, and my husband. For example, we've been to [redacted forest nature areas x,y and z]. I try to select areas where there is something for me to play to get these golden badges. I've changed the area a little each time." (P15)

LBGs could also serve as a distraction from real world social relationships. This was particularly true when other members of the social party were not actively playing. Players reported various coping strategies for these situations such as using auto-play devices (P9, P16), switching between the playing activity and attending to the real world social contacts (P12, P15) and quitting playing entirely (P3, P4). As examples, P12 mentioned how he visited nature locations with his son, took down a gym and then spent time partaking in his son's hobbies and activities in the forest. P4 stated that it is oftentimes easiest to simply avoid playing not to hurt your social life, as explained in the following quote:

"During summer we sail quite a bit. I check for Pokémon when we are in a harbor but rarely there is anything. The game breaks the real world a little. Especially when I'm with my spouse. You have to be considerate. If your companion plays it's fine, otherwise playing hurts your life." (P4)

In summary, LBGs offer a social setting which influences players' actions and behaviors in forests and nature environments. The social setting was important in both (1) the multiplayer game mechanics, which directed players' behavior in-game and in the real world; and (2) players' face-to-face social interactions, which could be enhanced by the game, but LBGs could also serve as social distractions, particularly when in company of those who did not actively play. The findings from this theme underscore both cooperative and competitive social features as

powerful motivational mechanisms, but they can also make players more conscious of their actions, which subsequently influences how they behave in both the real world and the game.

5. Discussion

Our findings contribute to the literature on personal health and wellness management technologies (Chiang et al., 2014; Gao et al., 2015 by providing new knowledge on how LBGs influence players' nature experiences. We show that LBGs direct players' attention, offer new perspectives onto the location they are in, augment players' experience and provide a social setting in which players operate. In contrast to previous studies which suggest that LBGs have a close to non-existent influence on players' nature experiences (Schneider and Schaal, 2018), our findings showcase various mechanisms through which active players have experienced changed perceptions as a result of playing LBGs. This study also addresses the recent calls to continue research on LBGs' influence on nature experiences (Laato, Pynnönen, et al., 2022; Saaty, Haqq, Dooley, et al., 2021; Saaty, Haqq, Toms, et al., 2021), and provides a new methodological approach (commercial LBG player interviews) to support the workshop (Laato, Pynnönen, et al., 2022), diary studies (Saaty, Haqq, Dooley, et al., 2021; Saaty, Haqq, Toms, et al., 2021) and intervention studies (Schneider and Schaal, 2018) already conducted on this research topic.

The discovered phenomena were influenced by players' perceived in-game goals, which were dependent on the players' real life circumstances, the playing field including real world terrain, objects, etc. and in-game PoIs, the player community and the game mechanics. LBGs could augment players' nature experiences through overlaying a story-world on top of reality, and through providing a sense of social presence through the game. Overall the interview findings suggested that LBG players could well focus on the real world environment while playing, and enjoy nature as it was also without the game's influence. While past research has highlighted the lack of in-game content in some nature areas as something to be improved (Tregel et al., 2017), in light of our findings this can also be interpreted to protect players from excessive digital input. Furthermore, even if LBGs reduce some of the reported health benefits of forest-going (e.g. (Kotera et al., 2020; Lee et al., 2011; Moran, 2019; Park et al., 2010)), they still provide players motivation to go to forests.

Our work has some limitations which also offer

avenues for future research on this topic. First, the participant sampling was carried out through player chats and forums, which may have resulted in a sample of more experienced players. Alternative methods such as from-the-street recruitment may be utilized by future studies to also obtain views from newer and more casual players. Second, despite not being a requirement for interview participation, the majority of the participants ended up being Pokémon GO players. The dominance of Pokémon GO not only shows in the commercial LBG market, but also the academic LBG research. However, we encourage future research to specifically focus on other forms of AR and LBG play in nature and see how various technical designs may change players' experiences of nature. Third, we analyzed the data through a reflexive thematic analysis approach, which is a heuristic approach that maintains interpretive rigor, but has less procedural rigor than template-based approaches such as the Gioia method (Mees-Buss et al., 2022). We acknowledge that template-based analysis approaches and quantitative work are also needed in this research domain, and these approaches may offer answers to questions such as how dominant certain nature experiences are among players and players subgroups.

6. Conclusion

We studied LBGs as personal health technologies for promoting nature-going by uncovering how they alter players' perceptions of forests and nature. The findings underscored three key thematic areas: (1) directing attention; (2) augmenting the experience; and (3) providing a social setting. Within these themes pertinent was that while contemporary LBGs can act as a distraction from the real world and nature, they can also provide new ways to see nature (e.g. a map-based bird's-eye view, or a re-imagined augmented view). Such re-contextualizations offer novel ways to perceive and experience familiar space, and can serve as a foundation for enriching players' nature experiences. Overall, there is a multifaceted and bi-directional nature in how LBGs shape players' nature perceptions, and simultaneously, how nature influences and changes players' experience of the game.

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References

Balmford, A., Clegg, L., Coulson, T., & Taylor, J. (2002). Why conservationists should heed pokémon. *Science*, *295*(5564), 2367–2367.

Braun, V., & Clarke, V. (2019). Reflecting on reflexive thematic analysis. *Qualitative Research in Sport, Exercise and Health*, *11*(4), 589–597.

Chiang, J.-H., Yang, P.-C., & Tu, H. (2014). Pattern analysis in daily physical activity data for personal health management. *Pervasive and Mobile Computing*, *13*, 13–25.

Gao, Y., Li, H., & Luo, Y. (2015). An empirical study of wearable technology acceptance in healthcare. *Industrial Management & Data Systems*.

Gioia, D. A., Corley, K. G., & Hamilton, A. L. (2013). Seeking qualitative rigor in inductive research: Notes on the gioia methodology. *Organizational research methods*, *16*(1), 15–31.

Hamari, J., Koivisto, J., & Sarsa, H. (2014). Does gamification work?–a literature review of empirical studies on gamification. *2014 47th Hawaii international conference on system sciences*, 3025–3034.

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? *International Journal of Human–Computer Interaction*, *35*(9), 804–819.

Hartmann, P., & Apaolaza-Ibanez, V. (2010). Beyond savanna: An evolutionary and environmental psychology approach to behavioral effects of nature scenery in green advertising. *Journal of Environmental Psychology*, *30*(1), 119–128.

Koivisto, J., & Hamari, J. (2019). The rise of motivational information systems: A review of gamification research. *International Journal of Information Management*, *45*, 191–210.

Kotera, Y., & Rhodes, C. (2020). Commentary: Suggesting shinrin-yoku (forest bathing) for treating addiction. *Addictive Behaviors*, *111*, 106556.

Kotera, Y., Richardson, M., & Sheffield, D. (2020). Effects of shinrin-yoku (forest bathing) and nature therapy on mental health: A systematic review and meta-analysis. *International Journal of Mental Health and Addiction*, 1–25.

Laato, S., Fernández Galeote, D., Altarriba Bertran, F., & Hamari, J. (2022). Balancing the augmented experience: Design tensions in the location-based game pikmin bloom. *CHI*

Conference on Human Factors in Computing Systems Extended Abstracts, 1–7.

Laato, S., Kordyaka, B., Islam, A. N., Papangelis, K., & Hamari, J. (2022). Territorial or nomadic? geo-social determinants of location-based it use: A study in pokemon go. *Internet Research*, *32*(7), 330–353.

Laato, S., Pynnönen, S., & Kangas, A. (2022). Gamification of forest-going: Opportunities for players, landowners and the forest industry. *Proceedings of the 6th International GamiFIN Conference Tampere, Finland, April 26-29, 2022 (Organized as an online conference).*, 146–155.

Laine, T. H., & Suk, H. J. (2016). Designing mobile augmented reality exergames. *Games and culture*, *11*(5), 548–580.

Lee, J., Park, B.-J., Tsunetsugu, Y., Ohira, T., Kagawa, T., & Miyazaki, Y. (2011). Effect of forest bathing on physiological and psychological responses in young japanese male subjects. *Public health*, *125*(2), 93–100.

Leorke, D. (2019). *Location-based gaming: Play in public space*. Springer.

Markwell, N., & Gladwin, T. E. (2020). Shinrin-yoku (forest bathing) reduces stress and increases people's positive affect and well-being in comparison with its digital counterpart. *Ecopsychology*, *12*(4), 247–256.

Martens, D., Gutscher, H., & Bauer, N. (2011). Walking in "wild" and "tended" urban forests: The impact on psychological well-being. *Journal of environmental psychology*, *31*(1), 36–44.

Mees-Buss, J., Welch, C., & Piekkari, R. (2022). From templates to heuristics: How and why to move beyond the gioia methodology. *Organizational Research Methods*, *25*(2), 405–429.

Mitten, D., Overholt, J. R., Haynes, F. I., D'Amore, C. C., & Ady, J. C. (2018). Hiking: A low-cost, accessible intervention to promote health benefits. *American journal of lifestyle medicine*, *12*(4), 302–310.

Moran, D. (2019). Back to nature? attention restoration theory and the restorative effects of nature contact in prison. *Health & Place*, *57*, 35–43.

Ohly, H., White, M. P., Wheeler, B. W., Bethel, A., Ukoumunne, O. C., Nikolaou, V., & Garside, R. (2016). Attention restoration theory: A systematic review of the attention restoration potential of exposure to natural environments. *Journal of Toxicology and Environmental Health, Part B*, *19*(7), 305–343.

Park, B. J., Tsunetsugu, Y., Kasetani, T., Kagawa, T., & Miyazaki, Y. (2010). The physiological effects of shinrin-yoku (taking in the forest atmosphere or forest bathing): Evidence from field experiments in 24 forests across japan. *Environmental health and preventive medicine*, *15*(1), 18–26.

Saaty, M., Haqq, D., Dooley, S., Manalel, J., Pentakalos, S., Roshan, S., Toms, D., & McCrickard, D. S. (2021). Exergames and nature. *Proceedings of the NatureHCI 2021 workshop, co-located with the CHItaly 2021 conference*, 8–15.

Saaty, M., Haqq, D., Toms, D. B., Eltahir, I., & McCrickard, D. S. (2021). A study on pokémon go: Exploring the potential of location-based mobile exergames in connecting players with nature. *Extended Abstracts of the 2021 Annual Symposium on Computer-Human Interaction in Play*, 128–132.

Schaal, S. (2020). Location-based games for geography and environmental education. In *Geography education in the digital world* (pp. 168–178). Routledge.

Schneider, J., & Schaal, S. (2018). Location-based smartphone games in the context of environmental education and education for sustainable development: Fostering connectedness to nature with geogames. *Environmental Education Research*, *24*(11), 1597–1610.

Song, C., Ikei, H., Park, B.-J., Lee, J., Kagawa, T., & Miyazaki, Y. (2018). Psychological benefits of walking through forest areas. *International journal of environmental research and public health*, *15*(12), 2804.

Talukder, M. S., Laato, S., Islam, A. N., & Bao, Y. (2021). Continued use intention of wearable health technologies among the elderly: An enablers and inhibitors perspective. *Internet Research*.

Tregel, T., Raymann, L., Göbel, S., & Steinmetz, R. (2017). Geodata classification for automatic content creation in location-based games. *Joint International Conference on Serious Games*, 212–223.

Ulrich, R. S., Simons, R. F., Losito, B. D., Fiorito, E., Miles, M. A., & Zelson, M. (1991). Stress recovery during exposure to natural and urban environments. *Journal of environmental psychology*, *11*(3), 201–230.

Wilson, E. O. (1984). *Biophilia*. Harvard University Press.