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Article

Turning Screen Time into Movement: Location-Based Games as a Behavioural Intervention Against Physical Inactivity

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Abstract

This paper explores how Location-Based Games (LBGs), especially those with Augmented Reality (AR), can help people move more and spend less time just looking at screens. LBGs make walking or being active a part of the game, which could be useful for public health. I use three main sources: recent research, my own experience with LBGs, and informal interviews with adult players. I look at how well LBGs get people to move, what keeps them interested, and what problems they face. Results show that LBGs can increase motivation and activity at first, but people often lose interest over time. Safety and access are also issues. The paper ends with practical ideas to help LBGs work better and last longer.

Keywords: location-based games; exergaming; physical activity; hikikomori; NEET; gamification; self-determination theory; screen time

1. Introduction

1.1. Public Health Problem and Opportunity

Not moving enough causes many health problems and early death, according to the World Health Organization. About 31% of adults do not get enough physical activity, and millions of deaths each year are linked to this (WHO fact sheets; see [14]). At the same time, people spend more time on screens, often called 'screen time' or 'doomscrolling.' These habits give quick rewards and make real life feel less interesting, so it becomes harder to stay active (Twenge & Campbell; doomscrolling literature; see [12,15]). When screen time goes up and movement goes down, it creates a public health problem that is hard to solve with traditional methods.

Location-Based Games (LBGs), especially AR exergames that require physical movement for in-game progress, represent an intriguing technological strategy: instead of asking users to reduce screen time, they reframe screen time as an opportunity for movement by coupling digital rewards to real-world locomotion. Empirical evidence suggests that some LBGs (e.g., Pokémon GO) produced measurable increases in step counts and local exploration in the short term ([1,5]). However, multiple studies and commentaries also report rapid decay of engagement (the "sustainability gap") and potential safety concerns from distracted movement, indicating that LBGs are not a panacea and require careful design, evaluation, and contextualization.

1.2. Vulnerable Populations and Clinical Context

Some groups are at higher risk from social isolation and not moving enough. These include people who stay at home for long periods (hikikomori), young people who are not in work, school, or training (NEET), and those with gaming disorder. Hikikomori means avoiding social contact and staying at home. NEET youth are often disconnected from work or school and face extra risks. Gaming disorder is when gaming gets out of control and harms daily life. For these groups, interventions should be easy to start, acceptable, and digital to lower barriers.

1.3. Rationale and Significance

This study also aims to address a broad gap in public health research. Many digital tools focus on self-monitoring and feedback, but few make physical activity a required part of using the app. LBGs are different because you have to move in real life to make progress in the game. This turns everyday places into places to play. Because of this, LBGs are a new kind of tool that mixes entertainment and health. It is important to understand how they work and what their limits are, so we can design better ways to help people build lasting habits, not just short bursts of activity. the IMRAD study

Self-Determination Theory (SDT) helps explain why LBGs are interesting at first. These games meet needs for feeling skilled, playing with others, and having choices. Gamification and nudge theory show how points, leaderboards, and reminders can guide what people do. But for lasting change, people need to move from outside rewards to their own motivation, with help from others and safe, flexible game features. In this paper, I clearly state the research questions, explain the methods, present the main findings, and give practical ideas for design and policy.

1.4. Research Questions (RQs)

Based on gaps identified in the pilot materials and extant literature, the study addresses three primary research questions:

1. RQ1. To what extent do LBGs produce observable short-term increases in physical activity among previously low-active adults?
2. RQ2. What are the principal motivational and design mechanisms that explain initial uptake and subsequent drop-off (sustainability gap) in LBG engagement?
3. RQ3. Which safety, accessibility, and social-context factors mediate LBG effectiveness for vulnerable subgroups (e.g., NEET, hikikomori, socially anxious users), and what design or policy modifications could mitigate these barriers?

A second goal is to give practical recommendations that connect game design, wearables, and public health policy, in line with WHO's Global Action Plan on Physical Activity (GAPPA, 2018–2030).

2. Theoretical Background

2.1. Self-Determination Theory and Motivation in Exergames

Self-Determination Theory (SDT) provides a widely used framework for understanding how digital and real-world activities shape human motivation. SDT argues that sustained engagement requires the satisfaction of three universal psychological needs: autonomy (the sense of volition and choice), competence (the feeling of effectiveness), and relatedness (a sense of connection with others). Location-Based Games often satisfy these needs during early gameplay. Players experience a sense of competence through rapid feedback, leveling systems, and visible progress markers. Autonomy emerges because users can choose routes, quests, and activity levels at their own pace. Relatedness is fostered through cooperative features such as raids, group tasks, or shared achievements.

However, SDT emphasises that extrinsically motivated behaviours decay unless they become internalised. Early engagement in LBGs often depends on external drivers such as item collection, experience points, or novelty of AR features. When these rewards no longer provide excitement, users rarely make the transition to intrinsic motivation (e.g., walking because they enjoy it or value its health benefits). This theoretical lens explains the “burst-crash” pattern repeatedly observed in both participant accounts and prior literature, where activity rises sharply for several weeks and then declines as novelty dissipates.

2.2. Gamification and Behavioural Reinforcement

Gamification frameworks focus on how game-like elements—badges, leaderboards, reward loops, and progressive challenges—shape user behaviour. In LBGs, these mechanisms operate as behavioural reinforcements: points, collectibles, and achievements create predictable and unpredictable

reward cycles. Variable-ratio rewards (e.g., rare item spawns) are particularly effective for short-term engagement because players cannot predict when rewards appear, which creates a sense of anticipation.

Yet these systems have limitations. Gamification tends to be most powerful during early exposure; repeated use can make rewards less meaningful unless paired with new content or social scaffolding. The literature also warns that frictionless reward systems may undermine intrinsic motivation: when users rely solely on external badges or points, they may stop participating when rewards lose relevance. This pattern reflects participants' complaints about "repetitive tasks," "empty maps," and lack of personalised progress.

2.3. Nudge Theory and Behavioural Economics

Nudge theory provides another lens for understanding how LBGs promote short-term physical activity. A "nudge" is a subtle design feature that alters behaviour without restricting freedom of choice, such as visual cues, reminders, or environmental prompts. LBG mechanics inherently nudge users by placing rewards at real-world points of interest or by requiring a certain number of steps to advance. These small cues encourage walking even among individuals who are normally inactive or reluctant to leave home.

However, nudges alone rarely produce long-term behavioural change. They must be combined with internalised goals, social accountability, or meaningful routines. Participants in this study frequently noted that they "stopped noticing" nudges after several weeks, illustrating the limited duration of their effectiveness. From a behavioural economics perspective, repeated exposure reduces the salience of cues, and human attention naturally shifts away from predictable stimuli.

2.4. Clinical Context: Social Withdrawal, NEET Status, and Gaming Disorder

Understanding vulnerable populations requires a brief overview of the conditions referenced in this study. Hikikomori is characterised by prolonged social withdrawal, typically involving individuals who remain at home for months or years, avoid social interactions, and experience impaired daily functioning. People with hikikomori often struggle with anxiety, low self-esteem, and limited autonomy. Traditional physical-activity interventions are poorly suited for this group due to high psychological barriers.

Similarly, young adults classified as NEET (Not in Employment, Education, or Training) frequently experience social exclusion, unstable routines, and reduced access to community spaces. Their physical activity levels tend to be lower than those of peers, and digital engagement is typically higher. Gaming Disorder, as defined in ICD-11, involves impaired control over gaming and associated functional decline. While most LBG players do not meet clinical criteria, designers must consider the risk that gamified systems could reinforce compulsive use patterns.

Taken together, these clinical and behavioural frameworks suggest that LBGs may be uniquely suitable as low-threshold, autonomy-supportive interventions, yet they also require careful design to avoid reinforcing problematic patterns.

3. Methods

3.1. Study Design Overview

This study used a qualitative approach, combining a focused review of the literature, my own experience with LBGs, and informal interviews with adult players. This study used a qualitative approach. I combined a review of the literature, my own experience with LBGs, and informal interviews with adult players. The goal was to explore user experiences, motivation, and barriers in depth, not to get results that apply to everyone. I found participants through friends and local gaming groups. Because this was an exploratory study and for privacy reasons, the sample was small (3 to 5 people). I used pseudonyms to keep participants anonymous.

3.2. Data Sources

1. Literature synthesis. A targeted review of key empirical and conceptual sources (e.g., Althoff et al., 2016; Howe et al., 2016; Ryan & Deci, 2000; Lyons, 2021; Mayrsohn et al., 2022) provided the theoretical backbone and comparative evidence. (see [1,5,7,8,10])
2. Autoethnography. I kept notes on my own use of LBGs, tracking how much I walked, any safety incidents, and how motivated I felt over several months. These personal notes helped compare my experience with what interviewees said.
3. Informal interviews. Semi-structured conversations (15–40 minutes) focused on initial motivations, experience of increased movement, reasons for quitting or continuing, social aspects, safety concerns, and accessibility issues. Interviews were audio-summarised; no recordings or personal identifiers were retained.

3.3. Interview Protocol

Interviews followed a semi-structured format, allowing participants to elaborate freely while ensuring consistent thematic coverage. Each interview began with introductory questions about the participant's gaming habits, followed by experience-specific questions such as: "What motivated you to start playing?", "How did the game influence your walking or daily routine?", and "Which features kept you engaged or discouraged you?" Additional prompts targeted safety concerns, emotional responses, and accessibility issues. Interviews lasted between 15 and 40 minutes and were conducted in informal settings to reduce pressure and encourage open sharing. Notes were taken during or immediately after each session, and summaries were created for analysis.

3.4. Autoethnographic Tracking Procedures

The autoethnographic component was conducted over several months of intermittent gameplay. The author documented walking routes, approximate step counts (when available through wearables), duration of sessions, and subjective states such as mood, motivation, frustration, and perceived safety. Weekly reflective entries captured patterns of engagement, fall-off periods, and contextual influences such as weather or academic workload. This approach was chosen because autoethnography is well suited for exploratory, user-centred research where embodied experiences are relevant to the research questions.

3.5. Analytic Strategy and Trustworthiness

Data analysis used an inductive-deductive thematic approach. Initial coding drew on pre-established theoretical categories (e.g., autonomy, novelty, relatedness), followed by open coding to capture emergent patterns not anticipated by the theoretical framework. Codes were then grouped into broader categories, which eventually formed the main themes presented in the Results. Triangulation across interviews, autoethnographic notes, and literature helped increase credibility by cross-validating patterns. Reflexive journaling mitigated bias by documenting the researcher's assumptions and potential subjectivities. Although thematic saturation was not fully achieved due to the small sample, recurring patterns across participants suggest that the identified themes are robust enough for exploratory interpretation.

3.6. Measures and Operational Definitions

- Physical activity (PA) proxy: self-reported change in walking frequency and step counts where wearable data were available informally; no formal accelerometry was collected.
- Engagement: participant narratives about frequency/duration of gameplay and subjective interest.
- Sustainability gap: participant account of decline in motivation or cessation, typically within 4–8 weeks.
- Safety incidents: participant reports of near misses or attention-related hazards while playing.

3.7. Data Analysis

I analyzed the interview summaries and my notes by looking for common themes. At first, I used ideas from SDT and gamification, like competence, relatedness, autonomy, rewards, and leaderboards. Then I added new themes that came up, such as boredom, lack of new content, and safety. By comparing the three data sources, I made the findings more reliable. The main themes below are those that came up most often.

3.8. Ethical Considerations

Participation was voluntary, with verbal informed consent. The study avoided the collection of personal identifiers to protect privacy. Reflexive author notes acknowledged potential bias due to the autoethnographic component. The small, convenience sample limits generalizability and raises the possibility of selection bias towards more motivated or tech-savvy individuals.

3.9. Positionality Statement

As a researcher who is also an active user of location-based games, my position within the study required deliberate reflexivity. My familiarity with game mechanics and prior positive attitudes toward digital fitness tools may have influenced how I interpreted participant accounts. To mitigate this, I maintained a reflexive log documenting assumptions, expectations, and potential biases. This positionality does not undermine the findings but contextualises them, acknowledging that qualitative insights are co-constructed between researcher and participant.

3.10. Limitations of the Methods

Because this was a small, qualitative study, I cannot say how common the effects are for everyone. There may be self-report bias, memory errors, and I did not use objective measures of physical activity. Still, looking in depth and using theory gives useful ideas for future research and designing interventions. The analysis found four main themes: (1) immediate engagement from novelty and rewards; (2) a clear drop in interest over time; (3) social connection helps people start and keep playing; and (4) safety, accessibility, and context limit who can join and benefit.

4. Results

4.1. Theme 1 — Initial Engagement and Short-Term Increases in Physical Activity (Addresses RQ1)

All interviewees and the author's autoethnographic notes reported immediate increases in walking and incidental PA during the early phase of gameplay (first 2–6 weeks). Motivators included curiosity about AR features, the pleasurable feedback loop of collecting rewards, and low friction to begin (installed app → create avatar → walk). These qualitative reports mirror the quantitative short-term effects documented for large user bases (e.g., [1,5]).

Participants said they changed their behavior by taking longer routes, walking to nearby points of interest, and going out just to finish in-game tasks. Some mentioned that their step counts went up day to day, similar to what other short-term studies found, but I did not collect formal step data in this study.

Illustrative quote (pseudonym "A"): "In the first two weeks, I was walking much more — I looked forward to discovering new things on the map. I was surprised how a little reward made me change my route."

4.2. Theme 2 — The Sustainability Gap: Novelty Decay and Content Scarcity (Addresses RQ2)

Participants often said that after 4 to 8 weeks, they lost interest or stopped playing. The reasons fit into two main groups:

1. Content-related boredom: repetitive tasks, limited new objectives, and absence of procedurally generated or localised fresh content.

2. Motivational shift: external rewards (collectables, XP) initially drove behaviour but failed to internalise motivation; when novelty faded, players lacked autonomous goals (per SDT) to continue.

This pattern aligns with the sustainability gap described in the literature ([7,8]). Interviewees recommended richer content pipelines (seasonal events, localised quests) and scaffolding toward intrinsic goals (health tracking tied to personal milestones) to prolong participation.

Illustrative quote (pseudonym “B”): “After a month, it felt like the map had nothing new. If I don’t feel progress that matters to me, I stop.”

4.3. Theme 3 — Social Connectivity and Accountability (Addresses RQ2 & RQ3)

Social features like raids, team events, and leaderboards helped in two ways. They got people to start playing with friends, and they made people want to keep playing so they would not let their team down. For people who are usually isolated, these features gave a safe way to meet others, especially during organized game events.

But social features can also make some people feel left out. Competitive leaderboards or public rankings sometimes discouraged players who are socially anxious. The findings suggest that designers should balance competition with cooperative and low-pressure social options to include more people.

Illustrative quote (pseudonym “C”): “I joined because my friend dragged me to a raid — I met people. But sometimes the leaderboards are too intense; it felt stressful.”

4.4. Theme 4 — Safety, Accessibility, and Equity Constraints (Addresses RQ3)

Participants and I noticed safety concerns, like almost getting hurt while looking at the screen, feeling uncomfortable in new outdoor places, and worrying about being seen by others. Accessibility was also a problem. People with mobility issues, strong social anxiety, or who rarely leave home (hikikomori) found it hard to join outdoor activities.

Suggested mitigations included “heads-up” design (audio cues, vibration, simplified glanceable UI), mode switching (indoor starter tasks, progressive exposure), and explicit safety features (automatic pause above certain travel speeds to discourage gameplay while driving). For equity, developers should provide alternate task pathways (e.g., indoor missions, home-based AR) and localised safety mapping to reduce exposure to hazardous routes.

Illustrative quote (author’s autoethnography): “I almost had an accident crossing a street while trying to catch an in-game item — it made me realise how dangerous distracted play can be.”

4.5. Theme 5 — Transition from Play to Habit Formation

Across interviews, participants described trying to make LBG-related walking a regular habit, but often did not succeed. Some made temporary routines like ‘evening walking loops,’ but these usually stopped when the game felt less new. This suggests that LBGs, as they are now, do not help players turn short-term play into lasting habits. Participants suggested that features like forgiving missed days, flexible schedules, and personal reminders might help people build habits without feeling forced or guilty.

4.6. Additional Observations: Psychological Mechanisms and Transition Dynamics

Short-term increases in physical activity seem to come from outside rewards and the excitement of something new. These rewards help people feel skilled and connected, but only for a while. Players rarely develop their own motivation unless the game helps them set personal goals and gives them choices. Nudge and gamification work best when they feel new and interesting.

4.7. Additional Minor Themes

Environmental and Contextual Moderators

Participants highlighted several environmental factors affecting engagement. Weather was the most cited barrier; heavy rainfall, heat, and cold reduced outdoor sessions. Urban design also played a

role: those living in city centres had denser clusters of game objectives, while suburban participants described “empty spaces” or long distances between points of interest. These differences shaped both motivation and perceived fairness of the game. Safety concerns were situational as well—poorly lit streets or crowded intersections made some participants avoid evening sessions or certain locations altogether.

Emotional and Psychological Responses

Gameplay led to different emotions, not just enjoyment. Some participants felt nostalgia, especially those who played Pokémon games, which reminded them of childhood and made them more motivated for a while. Others liked that LBGs gave them a break from stress or a chance to get away. But some felt self-conscious using their phones outside or uncomfortable in crowds. This shows that emotions can help or hurt engagement depending on the situation.

Technical and Device Limitations

Participants often mentioned technical problems that made it hard to keep playing. Battery drain was a big issue because LBGs use GPS, mobile data, and keep the screen on. This sometimes made people stop playing early or not play at all. Data limits, bad GPS signals, and app crashes also made things harder. These technical problems can break the habit of being active, even if people want to keep going.

5. Discussion

5.1. Interpretation Relative to RQs and Existing Literature

RQ1 (short-term PA): Consistent with large-scale studies ([1,5]), qualitative data here indicate that LBGs can produce short-term increases in movement, particularly among previously low-active individuals. The mechanism is straightforward: in-game progress contingently requires real-world (motivation and sustainability): The results match what other studies found about the ‘sustainability gap’ ([7,8]). Outside rewards help people start moving more, but do not lead to lasting motivation. This means LBG designers should help players set personal goals, connect game tasks to things that matter to them, and make it easy to fit the game into daily life.

RQ3 (safety/accessibility): Safety, mobility, and social barriers have a big impact on how well LBGs work. For groups like NEET youth or people with hikikomori, LBGs should be easy to start and offer a gradual path, starting with home-based missions, then short safe walks, and later community events. Social features should be inclusive, with options for teamwork, private play, and different ways to take part.

5.2. Integration with Existing Health Technologies (Discussion)

Another finding is that linking LBGs with health-tracking tools like wearables and smartphone health apps could help. This could make feedback stronger by connecting game progress with real activity data. Participants wanted to see their in-game efforts show up in real-world health stats, which could make active play feel more meaningful and help people set their own goals. At the same time, any integration should protect privacy, use as little data as possible, and give users control, so it does not repeat the problems of commercial fitness apps.

5.3. Design Recommendations (Operational)

Based on thematic synthesis and theoretical framing, the following recommendations are offered for designers and public-health actors:

1. Dynamic content: Add new content often, like seasonal events and local quests, to keep the game interesting.

2. Autonomy-supportive mechanics: Let players set personalised PA goals, choose difficulty /progression, and receive meaningful, health-oriented feedback (e.g., linking in-game milestones to WHO PA metrics).
3. Cooperative social scaffolds: Prioritise team quests and accountability mechanisms that reward collective contribution over ruthless leaderboards to include socially anxious players.
4. Safety-first design: Use simple displays, audio prompts, vibration, and automatic pause when moving too fast to prevent accidents.
5. Accessibility: Offer indoor missions, options for people with low mobility, and a gradual increase in outdoor activities so more people can join.
6. Public health integration: Governments and health agencies should see LBGs as a useful tool within GAPPa frameworks. They can fund pilot programs, set up ways to measure 'active screen time' versus passive screen time, and support community events that use LBGs to make neighborhoods more walkable and safe.

5.4. Policy Implications and Economic Rationale

Physical inactivity costs a lot of money worldwide. Investing in digital tools like LBGs could be a good use of resources if they help people change their behavior for the long term. Policymakers should not see all screen time as bad. Instead, they should measure and value 'active' screen time that gets people moving and helps them connect with others. Public investment in LBG content, research on long-term use, and working together with urban planners, public health, and game developers could help more people benefit.

5.5. Research Implications and Future Directions

- Randomised controlled trials (RCTs) with objective PA measures (accelerometry) are needed to quantify medium- and long-term effects and test specific design modifications (e.g., cooperative vs. competitive modes).
- Implementation research should evaluate community deployments, cost-effectiveness, and equity implications among NEET and hikikomori populations.
- Mechanistic studies should probe the pathway from extrinsic reward to internalised motivation, exploring which game features best foster autonomy and enduring behaviour change.
- Safety evaluations should quantify the incidence of distraction-related harms and test UI mitigations (audio cues, motion detection).
- Ethical studies need to examine dependency risks: while LBGs leverage similar reward mechanics as problematic gaming, design must ensure games do not replace one problematic pattern with another.

5.6. Strengths and Limitations of This Paper

This study puts the findings into a clear structure, with research questions and practical recommendations. The main strengths are combining research, personal experience, and participant stories, and giving useful ideas for design and policy.

Limitations include the small number of interviews, using a convenience sample, no objective measurement of physical activity, and possible bias from my own experience. These findings should be seen as ideas for future research and design, not as final proof. My own and others' experiences show that these games can help people move more in the short term, thanks to novelty, rewards, and social features. But keeping people interested over time is still a big challenge. To make LBGs work for public health, especially for groups like NEET youth and people who are socially withdrawn, designers and policymakers need to work together to add new content, support personal motivation, include everyone, and make games safe. Adding LBGs to public health strategies fits with WHO's GAPPa goals and could help fight the global problem of physical inactivity. More long-term and fair research is needed to show how well this works.

5.7. Concluding Outlook

Looking ahead, combining augmented reality, wearable sensors, and adaptive gamification could help create new ways to connect screen time with public health. If these systems are designed with safety, autonomy, and inclusion in mind, LBGs could move from being short-term motivators to long-term tools that help people build healthy routines. To make this happen, developers, scientists, clinicians, and policymakers need to work together and invest in long-term research.

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