

How to sustain the sustainable? A mixed-methods study of digital pro-environmental behavior change interventions in organizational contexts

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Abstract

Over the years, organizations have been looking for digital behavioral change interventions that create awareness among employees and make their behavior on the work floor more pro-environmental. Employee pro-environmental behavior (PEB) impacts the organization's performance, but there is not much research about the effectiveness of these interventions in sustaining behavioral change over time. Therefore, this study aims to determine how enablers and barriers influence the effectiveness of the intervention in sustaining PEB after the intervention. This research used a mixed method approach with qualitative data from 18 semi-structured interviews and quantitative data about the organizational performance and the intervention. This data is used to perform a cross-case analysis and a thematic analysis. The cross-case analysis found that organizational support, the intervention type, and the intervention focus are important aspects that determine which behavioral change interventions are effective. The thematic analysis helped to identify several barriers and enablers for the PEB of individuals and organizations. Those outcomes were used to make an adapted version of the theory of planned behavior for pro-environmental behavioral change interventions. The conceptual figure showed that the game design elements related to the self-determination theory influence the intention to behave pro-environmental through subjective norms, environmental attitudes, and perceived behavioral control. Moreover, environmental self-identity is an additional factor influencing this intention to behave pro-environmental, which can be strengthened by participating in PEB. The last part of the conceptual model focuses on habit creation. If the behavioral change occurs, it can be sustained over time when it becomes a pro-environmental habit. Habit creation can be achieved by having environmental cues in place after the intervention and alignment between the game and work practices of participants.

Keywords: Behavioral change intervention, Gamification, Pro-environmental behavior, Theory of planned behavior, Self-determination theory, Habits

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1. Introduction

The long-term survival of ecosystems is becoming increasingly threatened by the fast and increasing exhaustion of resources, increasing emissions, and loss of biodiversity brought on by human behaviors, particularly economic ones like industrial manufacturing, production of electricity, transportation, and agriculture (Zacher et al., 2023). The institutional setting of an organization influences its environmental impact, although employee behavior is critical to achieving the company's long-term objectives (Unsworth et al., 2021). Without employee performance and commitment, organizations' environmental sustainability initiatives would fail (Zacher et al., 2023). According to Jahanshahi et al. (2019), companies should enhance employee environmental consciousness to optimize their pro-environmental behavior (PEB) and accomplish environmentally oriented objectives. The definition of employee PEB in the workplace context is all types of activities undertaken by individuals at work that aim to protect the planet or improve business procedures in this domain (D. Yang et al., 2023). However, despite the widespread recognition of the need to embrace more sustainable ways of life, progress has been gradual, and novel techniques to change PEB are urgently required to make sure that environmental sustainability is achievable (Elf et al., 2020).

To promote the PEB of employees, a company could use several behavioral change interventions. Some examples of such interventions are goal setting, social norms, nudges, gamification, virtual reality, and more. Overall, there are many interventions to choose from. Still, the research of Grilli and Curtis (2021) reveals that more needs to be understood about whether behavior change interventions accomplish actual sustained pro-environmental behavioral change. Therefore, the motivation of this study is to define which behavioral change interventions are the most effective in sustaining actual PEB. Follow-up studies will be essential to future interventions to check if a modified behavior could become embedded in a person's lifestyle and, therefore, be sustained long after the intervention has finished (Rau et al., 2022). A follow-up period of several months in research is crucial because it may offer desperately needed insights into whether treatments should be continued over time with the same individuals or if a single treatment is sufficient to generate sustained increases in PEBs (Elf et al., 2020). However, a research gap about sustaining PEB exists because assessing the long-term consequences of interventions is challenging, and follow-up evaluations are rarely considered (Grilli & Curtis, 2021). An intervention cannot be effective if PEB returns to its base level after it ends (Burns & Savan, 2018). Therefore, in this research, a pro-

environmental behavior change intervention is effective when it accomplishes long-term behavioral change. The development of habits creates long-term behavior preservation, so PEB is performed multiple times during the intervention (Ro et al., 2017). To find an answer to the issues mentioned above, the following research question is stated: *How do enablers and barriers influence the effectiveness of digital behavioral change intervention in sustaining actual pro-environmental behavior of employees after the intervention?*

By addressing the above research question, this research makes a theoretical contribution to the existing literature on employees' PEB by adding several barriers and enablers. By considering the individual level, this research also adds to the notion of the theory of planned behavior, which was then used for the PEB concept. Furthermore, this research extends knowledge about factors that stimulate habit creation after a behavioral change intervention focusing on individuals' PEB. However, most research on PEB seldom considers habits (Linder et al., 2022). This research also has practical implications because it gives organizations an overview of essential enablers and barriers to consider when accommodating a behavioral change intervention. Additionally, the outcomes of this research are helpful for organizations that want to use interventions and consultancy companies that provide interventions by showing them the importance of having follow-up data that is both objective and subjective to determine the effectiveness of the intervention.

2. Theoretical framework

2.1. The comparison of behavior change theories for pro-environmental behavior

The theory of planned behavior (TPB) was developed by Ajzen in 1991, who mentions that attitudes, subjective norms, and perceived behavioral control influence individuals' intentions and, eventually, their behavior (Ajzen, 1991). The attitude toward the behavior is based on easily obtainable assumptions about the expected outcomes of the behavior or behavioral beliefs (Ajzen, 2020). The subjective norms refer to the supposed societal pressure to engage in the behavior or avoid people from doing so (Ajzen, 1991). Perceived behavioral control means the degree to which people think they have control over their behavior (Johe & Bhullar, 2016). TPB is regarded as being among the best models for creating pro-environmental behavioral interventions (Yuriev et al., 2020). Interventions that employ the TPB as a theoretical framework seek to alter behavior, norms, and control attitudes, which results in the motivation to execute the desired behavior (Steinmetz et al., 2016). The TPB has already been applied to comprehend a variety of PEB, including ecotourism, energy

efficiency, waste consumption, and water usage (Lizin et al., 2017; Yuriev et al., 2020). TPB demonstrates that the relationship between attitudes and behavior is highest when the surrounding circumstances are neutral; hence, when the organizational influences are either highly positive or strongly negative, attitudes appear to have little predictive value for behavior (Nye & Hargreaves, 2009).

Another relevant behavior change theory is the norm activation model (NAM). Within the norm activation model, the ascription responsibility, the awareness of consequences, and the subjective norms make up the personal norms, which determine the behavior (Hallaj et al., 2021). The value-belief norm (VBN) theory is a more extended form of the norm activation model because it is specifically created to analyze environmentally friendly behavior (Han, 2015). Awais et al. (2022) state that it is the most well-known and often applied theory for clarifying such PEB. The VBN theory distinguishes three forms of value orientation: egoistic, altruistic, and biospheric value (Chen, 2015). The belief values of the VBN model exist of the new ecological perspective (NEP), awareness of consequences, and ascription of responsibility, and the norm values are based on the social obligation to adopt pro-environmental policies (Chen, 2015). These beliefs produce a moral responsibility or personal norm, which is the best indicator of the PEB (Ture & Ganesh, 2018).

According to goal-setting theory, people establish personal goals (such as pro-environmental behavior) in response to their demands and attitudes and the simplicity of connectedness towards such goals (Wong et al., 2020). These are several goals, including normative goals that focus on behaving responsibly in light of what one believes is appropriate, gain goals that concentrate on finding methods to safeguard and develop one's resources, and hedonic goals to improve one's feelings in a particular scenario (Staples et al., 2020). Steg et al. (2014) research suggests that normative goals are more important than gain and hedonic goals when encouraging PEB. The study of Iyagba and Olufunto (2022) shows that goal setting, in combination with a genuine commitment by individuals, had a substantial favorable impact on PEB, such as recycling. Individuals may have several goals simultaneously; for example, an individual's environmentally friendly behavior, like using public transportation to work, may be connected to a sustainable objective and to health or financial goals (Unsworth et al., 2013).

The protective motivation theory (PMT) can assist in identifying both barriers and motivations for adopting the PEB (Shafiei & Maleksaeidi, 2020). A distinctive feature of the

protective motivation theory is that when deciding whether to engage in behavior, individuals weigh both their present behavior and their expectations of novel behavior regarding their associated costs and benefits (Shafiei & Maleksaeidi, 2020). Individuals' protection motivation decision is divided into two cognitive processes: the threat appraisal and the coping appraisal (Bockarjova & Steg, 2014). The threat appraisal outlined how a person evaluates the intensity and anticipated sensitivity of danger, whereas the coping appraisal element weighs the perceived capacity to decrease or avoid risks against the expected costs of protective measures (Keshavarz & Karami, 2016). Overall, a person is more likely to act in a way that will safeguard them from danger when the threat's intensity, sensitivity, self-efficacy, and response efficacy are great. Still, the expense and likelihood of getting an unfavorable outcome are minimal (Kothe et al., 2020).

Noguera-Méndez et al. (2016) mention that the social learning theory is still not sufficiently considered in environmental programs as it is costly in terms of the duration of the intervention but has the potential to bring about long-lasting changes. Social learning theories argue that people acquire behavior from others within the contextual setting which appears to have crucial significance for the environmental education (Heimlich & Ardoin, 2008). Hence, according to the idea of social learning, an employee can reproduce the responsible leader's beliefs concerning the environment via the engagement process of responsible leadership (Huang et al., 2021). When employees have greater levels of green self-efficacy, environmental leadership is more successful in fostering the PEB (Faraz et al., 2021). Transformational leadership has already proven effective in promoting environmental concern in the workplace (Li et al., 2020). Robertson and Carleton (2017) discovered that the indirect impacts of environmentally specific transformational leadership on workers' PEB behavior are moderated by internal environmental locus of control. Individuals with a more significant internal environmental locus of control are much more inclined to act ecologically responsibly because they believe their behavior can contribute to the environment (Cleveland & Kalamas, 2015). Trivedi et al. (2015) found that an environmental locus of control positively impacts individuals' PEB.

Generally, the TPB and VBN focused both on norms, such as individual norms of employees, and social norms in an organizational context where employees work together. These two theories are often used for pro-environmental behavior change interventions (Rau et al., 2022). Also, the goal-setting theory is an important basis for the goal-setting interventions. Overall, several theories could be used as the basis for the development of pro-environmental

behavior change interventions. These interventions are described in the next part of this chapter. The PMT and the social learning theory do not focus on a specific intervention but help determine enablers that are important for PEB in an individual and organizational context. These enablers are described in Chapter 2.3. Additionally, looking at factors that inhibit PEB on the work floor is useful. These barriers are described in Chapter 2.4.

2.2. The comparison of pro-environmental behavior change interventions

By looking at existing academic literature, several interventions that focus on PEB are found. The non-digital behavioral change interventions are selected from research on PEB that has been proven in recent years. However, some of the interventions are used in a digital environment, which is relatively new. Therefore, the research on digital behavioral change interventions is collected from relatively few relevant academic articles. An overview of the different interventions can be found in Table 1.

Non-digital behavioral change interventions for PEB	Digital behavioral change interventions
Social norms	Digital game-based learning (DGBL)
Goal setting	Digital gamification
Eco-feedback	Virtual reality (VR)
Nudging	Augmented reality (AR)
Gamification	Metaverse

Table 1: Overview of interventions

In the research of Farrow et al. (2017), numerous forms of social norm interventions positively impact PEB. These interventions are based on the concept of several theories mentioned above, such as the VBN model or the TPB. Social norm interventions are more powerful than other sorts of persuasive messaging in altering the PEB (Russell et al., 2016). These interventions successfully stimulate significant behavioral changes, and descriptive norms appear to have especially persistent benefits. However, Steg et al. (2014) research indicates that normative objectives were more crucial than hedonic and profit-oriented goals when promoting PEB. According to De Groot et al. (2021), using these interventions is appealing since they are seen as a practical, inexpensive, and simple approach to delivering behavioral change initiatives.

Do Canto et al. (2022) conclude that the goal-setting theory has significant potential for understanding PEB and designing behavioral interventions. The goal-setting theory is already mentioned in chapter 2.1. According to Steg et al. (2014), interventions that aim at making PEB more enjoyable are likely to be more successful when hedonic goals are prioritized,

whereas communicating which behaviors people can adopt to reduce their environmental footprint is likely to be effective when normative goals are prioritized. When co-developing such goals together with employees, behavior and work performance can be favorably affected (Groen, Wilderom, et al., 2017). Once employees are engaged in formulating performance goals, managers reflect the measures to have higher quality and use them more frequently (Groen, Wouters, et al., 2017). The effectiveness of interventions like goal-setting will increase when combined with feedback (Karlin et al., 2015). Eco-feedback gives information about the supply of a household's energy consumption statistics, as well as past usage and information on neighbors' energy usage, and has been shown to help lower energy consumption (Shen et al., 2020). The main objective is to raise an understanding of the environmental impact of consumer utilization to encourage PEB (Bao et al., 2021).

Another intervention to encourage PEB is nudging (Lehner et al., 2016). Pro-environmentalists are starting to see the nudging technique as a way to promote and inspire people to act in a pro-environmental manner (Wee et al., 2021). A typical 'green' nudge is to make the preferred decision more accessible or to make it the default option (Grilli & Curtis, 2021). Such a default option is also known as a habit, which contributes to a long-term tendency to behave in a specific way (Heimlich & Ardoin, 2008). Understanding habits is essential to comprehend why individuals do not behave in a way that supports their pro-environmental views (Mazar et al., 2022). Sustainability interventions that take advantage of the propensity to rely on the instinctive, impulsive mechanism can be beneficial for encouraging specific PEB (Linder et al., 2022). The literature on nudges used such a viewpoint. According to Lehner et al. (2016), nudges do not attempt to modify one's set of morals or boost information sharing; instead, they focus on facilitating behavior and personal decisions that are favorable to society. A nudge that reminds individuals of what they are sacrificing, their surroundings, and their quality of life is more successful than a nudge that focuses merely on pollution reduction (Bimonte et al., 2019).

Digital game-based learning (DGBL) interventions can deliver cognitive knowledge while emotionally involving individuals by allowing them to experiment with new behavior and immediately observe the results. The learning process in DGBL is significantly influenced by game mechanics or elements, which may encourage PEB (Janakiraman et al., 2021). Games and gamified applications have already shown potential as an intervention for encouraging sustainable behavior among individuals (Douglas & Brauer, 2021) and have shown to be a successful method of teaching people about sustainability (Zawieska et al., 2022).

Gamification promotes habit-building by encouraging people to engage in environmentally friendly action frequently (Albrecht et al., 2021). Deterding (2011) defines this concept of gamification as “the use of game design elements in non-game contexts.” Points, ranks, leaderboards, awards, and badges are all elements of this gaming approach (Larson, 2019). Gamification removes barriers to individuals’ everyday social engagement, making them less accountable for their choices and behaviors, giving them the impression of freedom, and increasing their drive to innovate (Boncu et al., 2022). The primary goal is to foster enjoyment, considerable incentive, improve user experience, participation, and prospects for continuous involvement (Lu & Ho, 2020). Digital gamification is organized uniquely where several dynamics and mechanics are integrated, such as levels, gradual increase in complexity, operations, hurdles, and feedback that permit enhanced involvement through pleasure, thus from intrinsic motivation (Suganthi, 2019). Games often engage players by presenting tasks appropriate for their skill level, giving them chances to feel positive emotions like success or expertise that sustain them to play for extended periods (Morschheuser et al., 2018).

A key component of gamification is making incremental steps of progress noticeable and becoming more significant (Korn & Schmidt, 2015). Unlike other behavioral change interventions, such as nudging, gamification resulted in longer-term emotional involvement (Douglas & Brauer, 2021). Another important gamification component is competition between teams, which may boost players' motivation to participate (Cao et al., 2022). Competition within gamification causes interpersonal assessment, which either reinforces the game performance of individuals positively in the case of high results or negatively in the case of poor scores (van der Heijden et al., 2020). Conversely, Cao et al. (2022) discovered that gamified collaboration succeeded more than competitive interactions in increasing users' pro-environmental activities. Also, the broad view of the users in the research of Oppong-Tawiah et al. (2020) is that environmental conservation is a cooperative endeavor that should not be competitive. Gamification can extrinsically inspire a new behavior but cannot ensure that participants will be intrinsically motivated to maintain the new behavior (Yen et al., 2019). A game-based intervention most likely results in behavior change if it allows for group norms within a team that stay together for the length of the intervention (Ro et al., 2017). Research by Berger (2019) shows that people who use a combination of game-design elements and descriptive social norms make more environmentally friendly decisions than those who only use game-based elements. In line with this finding, the literature review of

Rau et al. (2022) shows that combining a variety of interventions is the most effective treatment and presents the most substantial evidence to improve durable commitment (e.g., specific information to increase consciousness and encourage participation and ongoing feedback to strengthen long-term commitment).

Several digital pro-environmental behavior change interventions show promising results but are only tested in a laboratory setting, for example, approaches based on immersive technologies. Zhang and Song (2022) reviewed existing literature on sensory stimuli and immersion. They propose that potential interactions between multiple sensory elements (visual, audio, and haptic) in sustainable applications may lead to PEB and sustainable decision-making. Such immersive technologies include virtual reality and augmented reality (Suh & Prophet, 2018). According to Plechata et al. (2022), virtual reality (VR) interventions are already used in laboratory settings to promote PEB. For example, in the paper of Nelson et al. (2021), the virtual reality environment experiment leads to higher intentions to purchase recyclable materials compared to the control group. The virtual reality world allows users to experience a variety of scenarios that are not conceivable in real life and demonstrates to users that they have the power to influence the world via their actions (Plechata et al., 2022). Besides virtual reality, one could also use augmented reality. The research of Dunn et al. (2021) focuses on the use of augmented reality (AR) technology in a game environment concentrating on biodiversity that encourages players to go outdoors and investigate their local areas, yet permitting them to engage themselves in the digital game. The research of Dunn et al. (2021) suggests that the use of augmented reality increases awareness about the environment, but behavioral action to donate did not occur. However, according to Arjoranta et al. (2020), another game that uses AR called Pokémon GO establishes behavioral change among its users, who are more socially interactive and exhibit self-improvement. Still, this research did not focus on PEB.

Another intervention called Metaverse has been identified as one of today's most promising technologies (Hwang & Chien, 2022). Metaverse is built on the merging of virtual reality technology (VR) and augmented reality (AR) that allow holistic engagements with virtual worlds, digital items, and humans (Mystakidis, 2022). Jin et al. (2022) discovered that PEB through avatars in the metaverse diminishes future pro-environmental motivations in the real world due to the licensing effect. However, Plechata et al. (2022) suggest that based on their research, the initiatives aimed at encouraging people to utilize more PEB in the metaverse

may positively impact their everyday behavior. The researchers by Plechatá et al. (2022) and Jin et al. (2022) are both conducted in laboratory settings.

2.3. Enablers for pro-environmental behavior change in the workplace linked to behavioral change theories

The most effective intervention programs build their techniques for promoting PEB by considering individual values and contextual circumstances (Steg & Vlek, 2009). These circumstances can enable PEB based on several theories, as shown in Table 2. According to Keyworth et al. (2020), some contextual enablers of a company are that individuals have enough time to provide interventions, a favorable environment for providing interventions, such as having access to necessary resources and assistance from co-workers, as well as an organizational mechanism to facilitate intervention delivery. Research by Borg et al. (2022) uncovers that the most common enabler of their plastic reduction intervention is the fundamental level of community and business support. Based on the social exchange theory, when employees feel supported by their company, they are much more dedicated, happy, and inclined to participate in environmental behavior (Paillé & Boiral, 2013). Therefore, to accomplish pro-environmental behavior change, senior management commitment and active participation of middle managers are critical components of the business culture (Sawyer et al., 2021). The business 'green' culture is an essential organizational enabler in promoting PEBs because it contributes to developing employees' visions to promote pro-environmental issues in the organization (Azhar & Yang, 2021). The presence of corporate social responsibility (CSR) within an organization positively affects the PEB of employees and the environmental performance of the company (Ahmad et al., 2021). Another essential aspect to emphasize environmental concerns at the office is the existence of the transformational leadership (Li et al., 2020). Transformational leaders transform a follower's perspective beyond their immediate self-interests; they do so through charismatic appeal, motivation, intellectual challenge, or individualized consideration (Eisenbach et al., 1999). By displaying a regular pattern of PEB, leaders communicate to employees that pro-environmental activities are appreciated and desired at work (Robertson & Barling, 2013). A transformational leadership style where leadership behavior promotes engagement of employees in green practices is called green transformational leadership (Chen & Chang, 2012). Green transformational leadership (GTL) is a leadership approach that empowers staff members and employees to fulfill their personal needs and aspirations to meet the overall organizational sustainability objectives (Farrukh et al., 2022).

Employees are more inclined to engage in pro-environmental practices if they are notified about their organization's environmental goals, the development of green activities, and their concerns about the firm's influence on the environment are addressed (Albrecht et al., 2021). The degree to which an organization supports the environment with important resources like practical help, feedback, motivation, and time supply strongly influences the behavior of its employees (Paillé & Meija-Morelos, 2019). Also, when the equipment and resources that support green behavior are seen as simple to use, employees tend to behave more environmentally responsible (Yuriev et al., 2018). Understanding environmental issues and the effects of personal actions are prerequisites for adopting PEB (Ones et al., 2015). Furthermore, norms may also play a role in employees' PEB. Wesselink et al. (2017) research states that the higher the level of subjective norms in the organization, the higher the level of actual PEB displayed by employees. Additionally, the findings by Blok et al. (2015) demonstrate that environmental knowledge and personal norms of individuals have a considerable influence on the desire to behave in a manner that is ecologically friendly and indirectly have a favorable effect on PEB in the workplace. Research by van der Werff et al. (2013) implies that people with a strong environmental self-identify not only feel a more outstanding moral obligation to behave in an ecologically beneficial way but are more likely to participate in PEB. To sustain this PEB over time, it must be internalized with high levels of self-determination (Steinhorst & Klöckner, 2017). For example, the research of van der Linden (2015) suggests that people who behave pro-environmentally since they feel it is the right thing to do (warm glow) are more likely to sustain PEB over time.

Additionally, interventions can use both non-monetary and monetary rewards to motivate people to engage in specific behavior, but monetary incentives are more likely to be counterproductive in the context of environmental conservation (Michalek et al., 2019). Techniques that induce internal change, personal norms like commitment, or perceived social norms should produce sustainable change more effectively than incentives (Burns & Savan, 2018). Research by De Leeuw et al. (2015) suggests that interventions focusing on the benefits of acting in an environmentally friendly way are less likely to yield results than those focusing on perceived behavioral control. Heinz and Koessler (2021) mention that successful interventions must meet several conditions, such as increasing awareness of adverse effects on others, triggering other-regarding preferences, arousing emotional concern, or enlarging our moral compass. It has been established that user engagement with mobile applications is another crucial prerequisite for the effectiveness of digital behavior change interventions

(D'Addario et al., 2020). Moreover, the degree to which managers are conscious of individuals' psychological preferences and requirements ultimately determines how willing employees are to engage in the intervention (van der Heijden et al., 2020). Research by El-Hilly et al. (2016) found three enablers for user engagement. First, they mention that the intervention needs a purpose that is made apparent and evident to the user if one wants to encourage behavior change. However, this purpose must align with the participant's personal goal (also known as "user alignment"). The last crucial element they mention is functional usefulness, or the sensitivity of the intervention's capacity to meet participant objectives and address issues.

Besides looking at the enablers, it is also essential to consider the barriers that may hinder the occurrence of PEB on the organizational or individual level. This is described in chapter 2.4.

Level	Enablers of pro-environmental behavior	Theories
Organizational level	Organizational support	Social exchange theory
	Green transformational leadership	Social learning theory
Individual level	Personal and subjective norms	Norm activation model (NAM) Value-belief-norm (VBN)
	Perceived behavioral control (Internal locus of control)	Theory of planned behavior (TPB)
	User engagement	Protective motivation theory (PMT) Goal-setting theory

Table 2: Enablers connected to theory

2.4. Barriers to pro-environmental behavior change in the workplace linked to behavioral change theories

In this part, several barriers on the organizational and individual level are discussed. These barriers can hinder PEB on the work floor and are based on several theories which can be found in Table 3. Firstly, on the organizational level, corporate values can act as a barrier when there is not a green culture in organizations, and therefore environmental aims remain unestablished (Yuriev et al., 2018). Also, employees' feelings to create environmental motivation in their workplace may decline due to their lack of faith in their present organization, which will weaken the strength of the association between green culture and PEBs (Azhar & Yang, 2021). The research of Yuriev et al. (2018), found that the lack of support from colleagues and managers is another organizational barrier to PEB. Employees are far less inclined to display an interest in environmental concerns at work if they have limited chances to see leaders perform environmentally favorable actions (Li et al., 2020).

Additionally, both a lack of a corporate environmental perspective and a lack of effective communication about the environmental vision and values, are seen as organizational barriers (Uusi-Rauva & Heikkurinen, 2013).

According to Azhar and Yang (2021), there are three categories of individual barriers for pro-environmental barriers. (1) Individuality: Concerns of personal attitudes like as lack of concern or laziness; (2) Responsibility: Individuals don't perceive any need to perform PEBs because they may believe other people, institutions, or authorities are accountable for ecological problems; and (3) Practicality: Including obstacles that encompass people's daily-life concerns, such as a lack of time, knowledge, money, support, or environmentally friendly facilities. This individuality barrier greatly impacts those with low environmental concerns and is related to a person's attitude and behavior (Takshe et al., 2023). Additionally, as many of the effects of environmental issues are seen as occurring in the future, individuals may decide that it is acceptable to prioritize fulfilling their immediate needs and avoid taking any pro-environmental action for the time being (Tam & Chan, 2017). According to Kollmuss and Agyeman (2010), those with an external locus of control believe that only individuals in positions of power can effect change and that their efforts are meaningless. They state that these individuals are far less inclined to act in an environmentally friendly behavior. This aligns with the responsibility category of Azhar and Yang (2021). Furthermore, Wynveen and Sutton (2016) findings imply that a low amount of awareness about the climate change phenomena is an inhibitor of a person's pro-environmental activities. Additionally, Gifford (2011) considers that adopting pro-environmental practices may be hindered by perceptions of societal judgment. Social norms have a double-edged sword as they can promote PEB, but they also may prevent people from changing to being more pro-environmental if they are hesitant to object to actions that harm the environment (Perry et al., 2021).

Overall, several behavioral change theories could help design pro-environmental behavioral change interventions. These theories also describe the barriers and enablers for PEB. However, it is still unclear if behavioral change interventions create PEB that is sustained over time and which enablers and barriers are necessary to consider for an intervention to be effective in terms of long-term change. Therefore, this research wants to determine which factors help or hinder a digital behavioral change intervention's effectiveness in sustaining pro-environmental behavioral change after the intervention.

Level	Barriers to pro-environmental behavior	Theories
Organizational level	Lack of organizational support	Social exchange theory
	Limited leadership example behavior	Social learning theory
Individual level	Personal attitude	Theory of planned behavior (TPB)
	Perceived behavioral control (External locus of control)	Theory of planned behavior (TPB)
	Social norms	Norm activation model (NAM) Value-belief-norm (VBN)

Table 3: Barriers connected to theory

3. Methodology

3.1. Research design

A mixed-method research design was adopted to understand if digital behavioral change interventions are successful in sustaining employees' actual PEB after the intervention. This means that qualitative and quantitative data were used to capture data (McKim, 2016). This research focused on gamification or digital interventions because the other digital interventions were only tested in laboratory settings (e.g., VR, AR, and Metaverse). The function of gamification in influencing pro-environmental behavior change is a quite new subject (Ouariachi et al., 2020). Therefore, semi-structured interview questions helped us to understand how employees experience behavioral change interventions (McIntosh & Morse, 2015) and if their PEB caused by these interventions were sustained over time. The interview data of employees from the same case were compared with each other. Also, the data of the five organizations were then compared with each other to create an introductory narrative for the setting of organizations and the interventions they participated in. An inductive approach was used to analyze the subjective data in combination with grounded theory, as will be elaborated upon in the data analysis section. The grounded theory is an inductive method of research that is especially useful for predicting and explaining behavior (Saunders et al., 2007) that is gathered during the interviews.

Secondly, besides asking interview questions, objective data relating to the sustainable objectives of the organizations was also compared over time. Young et al. (2013) proposed that evaluations of behavior change interventions should include not just self-reported behavior improvements but also environmental performance indicators (EPIs) (e.g., recycling rates) because aspects in the organization's strategy or structure may offset changes in an employee's behavior and result in mitigating efforts. The objective data about environmental performance indicators was collected from year reports and was compared to the performance before and after the intervention. The data about the behavioral change intervention was

composed of reports made by an external organization, which was used to check how many people participated and what they had learned compared to before the intervention. This research used objective data on the organization's environmental performance and the intervention. The objective data was compared to the subjective interview data of the employees to see if the intervention was effective.

3.2. Sampling strategy

In this research, the purposive sampling approach was used. The objective of purposive sampling is to have participants who will offer the most relevant and sufficient data concerning the chosen topic of study (Yin, 2016). Before doing the interview, a company needed to meet several criteria. The first criterion was that public and private organizations were included to get a clear picture of the impact of interventions in these types of organizations. As habitual pro-environmental actions were established as significant predictors of the PEB (Steg & Vlek, 2009), these companies should have finished a behavior change intervention that focused on improving the PEB of their employees more than two months ago. The intervention should have been conducted in at least one organizational department. The range of two months was chosen because, with a range of 18 to 254 days, the median amount of time to create automatic behavior or a habit is 66 days (Lally et al., 2010). Another criterion was that objective data on the company's performance during the intervention and their current performance related to their environmental impact was available. In total, five companies were interviewed using semi-structured interview questions. Eisenhardt (1991) asserts that the number of cases relies on how much new knowledge each case can add and how much is already known. When data saturation was not reached, additional interviews could be included. Data saturation was identified both during data collection and the data analysis process, where it is characterized as the absence of new codes (Braun & Clarke, 2019). However, data saturation was reached with a total of five organizations.

Within the companies, four employees were selected, depending on the availability and size of the organization. The total amount of interviews was eighteen. The employees of the selected organizations needed to meet several criteria. It is possible to gather information using heterogeneous sampling, which is part of purposive sampling, to identify and analyze the main aspects that may be identified (Saunders et al., 2007). Sustainability advocates and skeptical employees were questioned to remove a possible inclusion bias. Additionally, to lower the sampling bias, one or two persons were selected from middle management and

three employees from the lower level of the organization. Middle managers were seen as mediators between top management and lower-level employees of the organization (Wooldridge et al., 2008). Top management could not be included due to their low availability. Therefore, employees were asked questions about organizational support and leadership style to get an indication. One of the criteria for all the employees was that they at least participated in the behavioral change intervention. However, skeptics were expected to be harder to include in the interviews as participation in the pro-environmental intervention was voluntary. To include them in the research, credibility needs to be created (Williams & Miller, 2002). Credibility was established by being transparent about the outcomes of the theoretical field and showing how it is connected to practical outcomes (Chong & Bourgoin, 2020). Unfortunately, it was only possible to include two skeptics as most did not participate in the behavioral change intervention. An overview of the five organizations and the interviewees can be found in Table 4. This table included the firm size to see if this influences the PEB, the intervention type, the follow-up period after the intervention, and the number of employees with their function title to show that at least one manager was interviewed.

Organization	Firm size	Intervention	Follow-up period	Number of interviewees
Organization A (Public)	Large	Digital gamification	20 months	4 Interviews - Manager sustainability - Senior advisor strategy and environment - Advisor purchasing policy and strategy - Advisor water quality
Organization B (Public)	Large	Digital gamification	12 months	4 Interviews - Manager sustainability - Policy officer crisis management - Financial advisor - Employee practice and education
Organization C (Private)	Large	Digital gamification	15 months	4 Interviews - Commercial regional manager - Assistant branch manager - Sustainability coordinator - Receptionist
Organization D (Private)	Small	Digital gamification	10 months	2 Interviews - Project team leader - Project team member

Organization E (Private)	Large	Digital gamification	3 months	4 Interviews - Transport & customs manager - Supply chain planning expert - Transport team leader - MES developer
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Table 4: Overview of organizations

The interviewees who participated in this study got valuable insights about the behavioral change interventions performed in their organization regarding the sustained effect. Also, they gained insights into which factors helped sustain PEB in their organization or which enablers needed to be introduced or supported more to make it easier to display PEB. Additionally, the organizations that participated got an objective overview of their employee's experience with the behavioral change intervention.

3.3. Data collection

3.3.1. Ethical approval and interview structure

Before gathering data, ethical approval was granted by the Ethics Committee of Behavioral, Management, and Social Science at the University of Twente, number 230114. First, two pilot interviews were conducted before doing the actual interviews. Piloting helped to improve the interview guide and interview skills (Majid et al., 2017). Conducting a pilot study of the qualitative research is a technique to make certain that validity is reached (Dikko, 2016). After the pilot study, some alterations were made to the interview guide, and the actual semi-structured in-depth interviews were performed. Semi-structured means that questions are asked to each respondent in an identical style and the same sequence, although they are semi-structured in the sense that the interviewer was permitted to deviate somewhat from the interview framework (McIntosh & Morse, 2015).

3.3.2. Research biases

The most common kind of researcher bias, called anticipation bias, occurs when a concept is imprinted in the researcher's mind, and they tend to verify it in their study (Wadams & Park, 2018). To prevent directing interviewees in directions that confirm the researchers' presumptions about the phenomena under investigation, the interview questions used were open-ended and non-leading (Koch et al., 2013). Another way to deal with the anticipation bias was to focus on and be aware of the reflexivity (Wadams & Park, 2018). Research reflexivity is the notion that a researcher's prejudgments and biases may impact choices and behavior throughout qualitative research activities and is a crucial component of rigor in the research (Johnson et al., 2020). Value presumptions or biases are often only seen as harmful

in qualitative research whenever the researcher is ignorant or unable to clarify how their prejudgements have affected their work (Probst & Berenson, 2013).

3.3.3. The interview guide

The interview guide used to collect data consisted of open-ended questions, which can be found in Appendix A. Before starting the interview, the researcher gave a short introduction about themselves and the research purpose. To limit the social desirability bias at the start of the in-depth interview, the interviewees were reassured that their ideas were valid and were asked to talk freely while also fully outlining the privacy and anonymity protocols of the research to try to capture their own more observable, objective behavior. The interviewees were asked for oral consent before participating in the interview. The first two questions of the interview guide were part of an introduction to get to know the interviewee and make them feel comfortable. Next, questions were asked about why the organization started working with the intervention and what the employee's motives were to participate. So, within the first part of the interview, the type of intervention was determined which could be connected to certain behavioral change theories. Also, employees' motives for joining the intervention were questioned to check if they joined because of personal norms or because there was social pressure. Then, questions were asked about positive and negative experiences with the intervention. After, a question was asked about increased environmental awareness after the intervention. These questions were asked to check their level of awareness about the environment before the intervention and to determine if the effect of the intervention helped to change the behavior of employees or even made it part of their daily routine. These questions were connected to the theory that stated that environmental knowledge and personal norms of people have a significant impact on the willingness to act in an environmentally responsible way (Blok et al., 2015) and habit creation theory. The eleventh question was used to determine if the behavioral change lasted over time or not and what some underlying reasons were for this to occur. Currently, there is little known about the effects of pro-environmental behavior change interventions over time. The last questions focused even more on reasons for increased or decreased PEB within an organization. These questions were related to the existing enablers in an organization and the possible improvement the organization could make to stimulate PEB. These questions were based on the theory discussed in the enablers section of Chapter 2.3. where it was made clear that organizational support, leadership, and social norms are important enablers.

3.3.4. Comparison of subjective and objective data

The subjective interview data that was gathered, was compared to the available objective data from organizations. This was done to check if the interviewees did not only provide socially desirable answers and if the changed behavior of employees influenced the organizations. The research of Wheeler et al. (2019) showed that socially desirable answers were given in a situation where providing an honest response about one's environmental behavior would go against societal norms or expectations. The objective data about performance measurements of the organization was collected from annual reports that were available on their website. Data on the performance measurements of the organization before the intervention were compared with data on the current performance of the organization. This provided information about the possible effectiveness of an intervention on the participant's behavior and the entire organization. However, in most cases, data about the year after the intervention was not available. Furthermore, objective data about the intervention was gathered when available. This data was collected right after the intervention by external firms that organized the intervention within the organizations. This data provided insights into the number of participants, the adapted green practices, and the number of emissions saved by participating in the game. Furthermore, in two cases survey data provided insights that employees still find it difficult to translate their new knowledge to their work processes and prefer to have more periodic sessions to talk about sustainability initiatives.

3.4. Data analysis

All the interviews were recorded, transcribed, and then analyzed with ATLAS.ti software. Thematic analysis was used: a technique for finding, analyzing, and exposing patterns among data (Braun & Clarke, 2006). Thematic analysis was used as it allows data to result in the creation of themes (Yin, 2016). Six stages make up the analysis: familiarizing oneself with the data, generating initial codes, looking for themes and reviewing them, defining and naming the themes, and finally producing a report (Braun & Clarke, 2006). After the themes were established, the Gioia method was used for the second-order analysis that focuses on the theoretical area, asking whether the developed themes offer ideas that may support the description or clarification of the things one has observed (Gioia et al., 2012). The Gioia method is based on the grounded theory and shows how a solid data structure becomes a dynamic inductive model (Gioia et al., 2012). The Gioia technique and thematic analysis were utilized in combination to make sure that the interview responses resulted in a similar understanding of the themes (Yong et al., 2021). To increase the reliability of the data

	Sector	Organizational structure	Intervention focus	Intervention type	Effectiveness of sustained PEB
Organization A	Public	Rigid structure with silos	Organization	Customized	Not effective*
Organization B	Public	Rigid structure with silos with bottom-up initiatives	Organization	Partly customized	Not effective
Organization C	Private	Top-down and bottom-up	Private life	General	Partly effective
Organization D	Private	Flat structure, bottom-up	Organization	General	Effective
Organization E	Private	Top-down and bottom-up	Private life	General	Effective*

Table 5: Overview of the cross-case analysis

** Based on qualitative data only*

analysis and the coding process a second coder was used. This was done by highlighting the important data sections the researcher found and letting the second coder code the same parts using their own expertise (O'Connor & Joffe, 2020).

After this process, a case study was conducted. Case studies were chosen because they help to create a new theory (Eisenhardt, 1989). First, the data of employees within one organization were compared using a within-case analysis. This data was used to get a better understanding of individual experiences with the PEB intervention. To summarize the data of a single case a detailed write-up was made that is considered to be an assessment (Barratt et al., 2011). Afterward, the statements of employees of different companies were compared using cross-case analysis to gain insight and discover patterns of organizational and intervention factors. The cross-case analysis allowed the research to go beyond first perceptions and increased the likelihood of identifying any unique conclusions that could be present in the data (Perotti et al., 2012). This analysis provided an introductory narrative of the situation before looking at the thematic analysis. To avoid jumping to conclusions, the researchers chose two examples at a time, compared them while noting the variations and parallels, and repeated this process until all cases had been contemplated (Barratt et al., 2011). First, the two public organizations were compared with each other. Afterward, the two larger private firms were compared with each other, and later they were paralleled with the smaller private firms. Finally, the public and private firms were compared.

Lastly, the subjective outcomes that were gathered during the interviews were compared to objective data that related to the performance measures for the sustainability factors of the

organization and the objective data about the behavioral change intervention. This process is called triangulation, which involves employing two separate methodologies for different data collection techniques (Heale & Forbes, 2013). Triangulation helped to answer the question of whether the behavioral change intervention effectively sustained PEB over time.

4. Results

4.1. Introductory narratives of the organizational setting, context of the intervention, and effectiveness of the intervention

In this section, the five different cases are introduced in terms of the organizational context, the type of behavioral change intervention, and the effectiveness of the intervention. An overview of the five organizations can be found in Table 5. These introductory narratives are included because they provide a clear overview of the situations at hand in which the barriers and enablers occur that are discussed in Chapter 5. A more detailed within-case analysis of the organizations can be found in Appendix B.

4.1.1. The organizational structure and sector

This section focuses on the organizational structure and sector to determine if these two factors influence participation in the game and the adoption of PEB. Within the organizations with a larger firm size (A, B, C, E), one can see a more rigid organizational structure with a top-down management approach. Within the two public sector organizations (A and B), there are also silos, which makes the communication between departments sometimes difficult. One person from Organization A mentioned, *“I feel that everyone just stays within their own department, and not much is shared with other departments or regions.”* However, in organization B, a new director is working on a more bottom-up approach to gather employee suggestions. The combination of top-down with bottom-up is seen in organizations B, C, and E. Organization B mentioned: *“Currently, we are also doing a leadership track where we are moving much more ownership and responsibility down to other layers in the organization. So, by having a track with the real manager and making the employees part of this track, we try to move that responsibility down and break down a bit of the hierarchy.”* Organization D is very small compared to the others and has a flat structure with a fast decision-making process. Organizations with flatter structures or bottom-up approaches are privately held firms.

In all five organizations, sustainability was also part of their strategy. However, in both public organizations, interviewees talk about a moral obligation to be as sustainable as possible. Within the private organizations, there are also reasons to respond to market

requests or attract new employees. For example, an employee of the private firm organization D stated: *“When an application for a new sports area then goes to a municipal department, it must go through the city council. The moment there is a sustainable aspect to the application, you get the approval quicker.”* Overall, public organizations have a more outstanding moral obligation and more rigid organizational structures. The private firms have organizational structures that are both bottom-up and top-down and focus more on sustainability to gain new business.

4.1.2. The digital behavioral change interventions focus and type

When looking at all the digital interventions, three of them were general and the other two were at least partly customized. Furthermore, for some interventions, there was a focus on private lives instead of people’s work. Therefore, this section wants to determine the characteristics of effective behavioral change interventions. In all five organizations, the digital game was played for six weeks, with a different challenge or topic every week. When looking at why individuals participated in the game, the main reason in organizations A, B, C, and D was to learn more about sustainability. Interviewees mentioned: *“We started playing the game to get the idea across the workplace of okay, everyone can do something about sustainability, and you learn from that.”* and *“What I liked about the game is that it helped a little bit in looking at yourself. A mirror is held up to you, and with a different theme each week, you also learn a lot; for example, what I wasn't aware of is that producing clothes has quite an impact on the environment.”* Within organization E, the main reason interviewees participated was because of an invitation from another colleague. The second most given reason was getting to know colleagues, which was mentioned in organizations B and C.

In three organizations (A, B, and D), the digital game was focused on both the private and work life of the participants. However, in companies C and E, the focus was on the private sphere. As the game was focused on the private lives of participants, they only adopted a little PEB at work. Furthermore, some people who mentioned that they were actively involved in environmental practices in their private lives mentioned this was also due to the money they saved with it. For example, an interviewee of organization C said, *“But I have to say very honestly, and I also mentioned this internally during the intervention, that a lot of my actions are also motivated because it just saves money.”* Another person mentioned: *“We have had solar panels for a while now. Everybody has installed them in the last couple of years, but it's more for the sake of the wallet and the high bills. Yes, well, it is also an excellent incentive if*

that works then.” Therefore, individuals may have different motives because they are behaving more pro-environmental. Hence, if an organization wants to achieve a behavioral change at work, there must be a game where the focus is on how to positively impact the environment on the work floor and less focus on participants' private lives. Besides, in two of the five organizations (A and B), the games were fully or partly customized specially for the organization. Having customized interventions makes it easier for employees to recognize and implement sustainability practices at work during the digital game. However, according to objective and subjective data, the employees within organizations A and B are still unsure how to use their newly gained knowledge and translate it into something they can make part of their work process. The other three organizations (C, D, and E) played games that were not custom-made and very general.

To conclude, the focus of the intervention must be on the organization rather than on employees' private lives as it did not help them to behave more pro-environmental on the work floor. Also, customized games make it easier for employees to recognize sustainability practices in the organization but do not show them how to incorporate them into their work processes.

4.1.3. Effectiveness of the digital intervention in sustaining pro-environmental behavior

As awareness is a first step before behavioral change, it is important to check whether interventions help to increase awareness and if this eventually results in a pro-environmental behavioral change that can be sustained. Based on the qualitative data, sixteen of the eighteen interviewees mentioned an increase in awareness due to participation in the intervention. An interviewee of organization B said, *“Yes, certainly my awareness of sustainability has increased, and what I also see within the company is that there are now more electric cars, scooters, electric bicycles, everything is much more widely included within the organization.”* Furthermore, an interviewee of organization C stated *“I did find it very much confronting how much our consumption can be at the expense of nature. Yes, so that was kind of an important eye-opener for me.”* Therefore, the goals that the organizations made before the intervention to increase the environmental awareness of their employees were all reached as far as it was possible to determine this with the subjective data. The goals of the intervention were not connected to the strategic organizational goals.

In most cases, the people who became more aware also started to behave more pro-environmental. When looking at the behavioral changes, one can see, based on qualitative

data, that in organizations A, B, D, and E, a majority changed their behavior. In organization C, two interviewees changed their behavior and the other two did not. Examples of behavioral changes are buying more local products, using their car less, picking up trash, or washing their clothes at a lower degree. However, in organizations A and B, the behavioral changes decreased over time. People stated: *“But I have to say when you asked that question now, I think I kind of let sustainability fall to the background, as it, unfortunately, goes with some things.”* or *“Yes, I do notice that now, when I am not working on sustainability anymore, then you continue in your old pattern.”* For organization C, the effect was sustained for two of the three participants who changed their behavior right after participating in the game. Therefore, the game was partly effective. However, within organizations D and E, all the participants who changed their behavior because of the intervention sustained it over time. A primary reason that was given for the sustained behavior over time was that it became part of individuals' daily routines, or they stated it became a habit. One of the interviewees of organization E stated, *“To be honest, it's not really that I'm thinking about sustainable options anymore because during the intervention, I had to think about it, and then I adapted. I did it for six weeks. Then, it just became a habit.”* Therefore, the interventions of organizations D and E seem effective at first glance. However, in Organization D, the objective data shows an increase in several CO₂ categories. In Organization E, three of the four employees who were interviewed were invited by one of their colleagues to participate in the intervention, which may have created bias. So, in organizations A and B, the behavior did not sustain over time; for organization C, the intervention was partly effective; and for organizations D and E, the interventions seem effective, but the effects are questionable. Based on subjective data, most of the employees' environmental awareness increased, and behavioral change occurred. However, from these behavioral changes, the effect decreased over time within most organizations as employees do not know how to make it part of their work practices.

Furthermore, when looking at the organizations' objective data, one can see that most of the organizations report on their CO₂ emission in terms of energy use, fuel, and travel. The business or air travel increased in 2022 for three of the five organizations. This might have occurred because of the end of COVID-19. The other two categories focus on CO₂ emissions for fuel and energy; there is a decrease for four (A, B, C, and E) of the five organizations. CO₂ is the only subject they report on in organizations B and D. For the other three organizations, there are also measurements for recycled products, office waste, and turnover

of environmentally sustainable activities. Most organizations generally have a good starting point for further optimizing their environmental performance. However, there has yet to be data available for 2023, while three organizations (B, C, and D) participated in the interventions in 2022. Organization E even played the game in 2023. This makes it hard to see if the organizations improved at these factors after participating in a behavioral change intervention focusing on PEB. Also, organizations C and E's games focused on participants' private lives, which probably does not influence the organizational sustainability measurements. However, the data can be used to support certain statements.

5. Thematic analysis

5.1. Enablers of pro-environmental behavior

This part describes the enablers and barriers of PEB of the behavioral change intervention. An outline of all the enablers and barriers can be found in Figure 1. The illustrative quotes that make up the first-order concepts are displayed in Table 6.

5.1.1. Environmental self-identity

When comparing the different organizations, one can see various factors that hinder or stimulate the PEB of individuals. When looking at the enablers, several interviewees mentioned that they find sustainability essential, care about the environment, and have a positive attitude toward sustainability. These individuals stated that they were already quite aware of sustainability but wanted to learn even more **and increase their knowledge**. They participated in the intervention because of their **intrinsic motivation** to embrace sustainability. For example, one interviewee stated, *“Basically, it's motivation from within me to embrace sustainability, both personally and at work.”* Other interviewees participated because of **personal norms**. For example, in public organizations, individuals revealed it is their moral obligation. Another reason someone from a private organization gave was that she wanted to learn about sustainability because they felt guilty and did not know much about sustainability. She said, *“I raised a certain guilt because compared to the Netherlands, my country is way less green, and I do not like to be the foreigner who is bringing a lower quality to that level.”* Overall, they have shown a positive mindset by **implementing environmentally friendly practices** in their private life, like buying second-hand clothes, using a bike instead of a car, or installing solar panels.

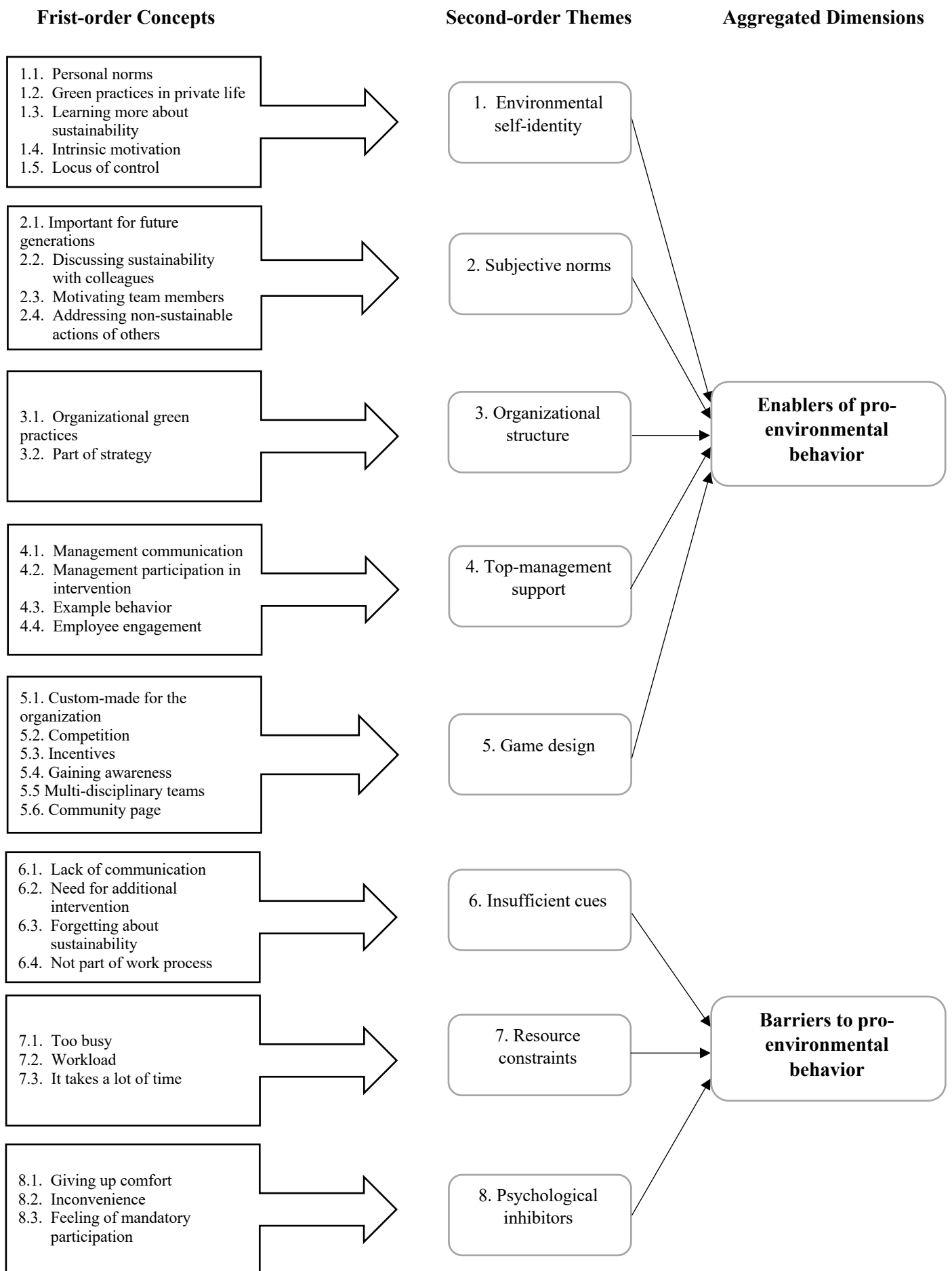


Figure 1: Data structure

First-order Concept	Quote
1.1. Personal norm	<i>"I raised a certain guilt because compared to the Netherlands my country is way less green and I do not like to be the foreigner who is bringing a lower quality to that level."</i>
1.2. Green practices in private life	<i>"I regularly choose public transportation even if I have a car standing outside the door." "I work very hard on sustainability, even privately. I make sure that we eat primarily vegetarian food."</i>
1.3. Learning more about sustainability	<i>"I wanted to learn more about sustainability in a playful way." "I learned many facets of sustainability and what you can do about it yourself, through different choices."</i>
1.4. Intrinsic motivation	<i>"Basically, it's motivation from within myself to embrace sustainability, both personally and at work." "But, I think the sustainable behavior has persisted because of my intrinsic motivation."</i>
1.5. Locus of control	<i>"One of the things that came up there was, to monitor your power usage very carefully by making sure that you don't leave equipment on standby but turn it off. With that, I felt I could have an impact." "I wash at 30 degrees and make sure that my lights are off, those are just tiny bits that do help."</i>
2.1. Important for future generations	<i>"Yes, of course, you also want to create a good future for your children." "I also have children and I think if they see the good example of how to respect the earth and act sustainably. That's only a good thing."</i>
2.2. Discussing sustainability with colleagues	<i>"It was because of documentaries I started watching that were recommended by an international group of colleagues I worked with, and they were talking about it over lunch."</i>
2.3. Motivating team members	<i>"For example, if someone wasn't there, I would email those questions to someone afterward to see if anyone had any input so that you could do all kinds of actions on the communication page and to keep motivating the team."</i>
2.4. Addressing the non-sustainable actions of others	<i>"We are behind a large glass window and at one point a colleague of mine wants to open the window. Then I said well it is winter, and it is fine to open the windows, but did you check that the heating is not on."</i>
3.1. Organizational green practices	<i>"I would say that from the first day I worked in this company, I noticed the selective waste collection in the office, not only for conventional paper and plastic but also for batteries." "We recently implemented a bike plan for electric bikes so it's easier to bike to work."</i>
3.2. Part of strategy	<i>"Last year sustainability was explicitly mentioned in it and now it has become part of our social mission." "I think that that knowledge and expertise about sustainability is still very limited in the market of building materials. I think is a good thing, that this is a first step for us to become leaders in the field of sustainability."</i>
4.1. Management communication	<i>"Yes, because I know the sustainability coordinator talked to our executive team the other day and then they really embraced that and then you also notice that that is reflected also in the new communication pieces."</i>
4.2. Management participation in intervention	<i>"We had that from some regions because the executive team participated, that a lot of other people were like oh, I'm going to participate too."</i>
4.3. Example behavior	<i>"That's just a certain mentality that our director has, and he sets a good example, which is of course the most important thing."</i>
4.4. Employee engagement	<i>"There is a group of employees who were involved in the sustainability program, because from our side we can then also suggest whether things are feasible or not."</i>
5.1. Custom-made for the organization	<i>"We used a game, and we really turned it around, so to speak, for the organization. So, it was really custom-made"</i>

5.2. Competition	<i>"It was a very fun competition to participate in." "If you had done all the tasks, you got a number of points and eventually whoever had the most points as a team won."</i>
5.3. Incentives	<i>"There were three prizes at the end including an electric bicycle. That was quite a nice incentive to participate."</i>
5.4. Gaining awareness	<i>"When we start our sustainability journey, we introduced the game to work at least on awareness and to look from there, what can we do further."</i>
5.5. Multi-disciplinary teams	<i>"The sustainability program team now comes from different departments. In the beginning there was a lot of pushing and pulling within that team to get those people moving. Now, that runs better and better now we do have our ambassadors on sustainability within different teams."</i>
5.6. Community page	<i>"There was also this community page that looked like a Facebook page, but only for the intervention participants. So, you could post what are you doing, how you completed each challenge, or what kind of tips you have for the others."</i>
6.1. Lack of communication	<i>"I don't know if it's specifically about sustainability then. No, I can't name an example that they communicate clearly what's going on."</i>
6.2. Need for an additional intervention	<i>"Even if you were to do some additional kind of project, once every quarter or even if it's just small reminders so you are at least alerted to it like, we are working on sustainable, you can participate in that."</i>
6.3. Forgetting about sustainability	<i>"But I have to say when you asked that question now, I think I kind of let sustainability fall to the background, as it unfortunately goes with some things." "Yes, I do notice that now, when I am not working on sustainability anymore, then you continue in your old pattern."</i>
6.4. Not part of the work process	<i>"The interface with the position that I have and sustainability that is also somewhat less obvious, let me put it that way. It doesn't really emerge that much in the processes of my work, which makes it regress."</i>
7.1. Too busy	<i>"One colleague did not participate at all because he was too busy."</i>
7.2. Workload	<i>"So, I know that there were some people who maybe enter because they've they found it interesting and then they saw the amount of work and did not complete the game."</i>
7.3. It takes a lot of time	<i>"I do think it's an objection for many people that playing the game takes so much time." "So, some had a barrier of time. They said, I don't have time for it, so I'm not participating."</i>
8.1. Giving up comfort	<i>"There are electric scooters within our organization, but then it turns out that people do almost always choose the car. I think it is mainly because of the comfort and what they are used to."</i>
8.2. Inconvenience	<i>"There are also some in my personal life that I could do more sustainably, but then out of inconvenience I don't. For example, I am still using shampoo from a plastic bottle. There are other options as well, but then I am still attached to my own brand."</i>
8.3. Feeling of mandatory participation	<i>"Yes, at first it seemed to come across as if it was voluntary, but we were just enrolled by team, so it didn't feel voluntary."</i>

Table 6: Illustrative quotes for the first-order concepts

Most of these individuals believed that their green practices positively impacted the environment, and it made a difference. This can be seen as **a locus of control**. Several Individuals made comments that all small initiatives help and make an impact. For example, *“One of the things that came up there was to monitor your power usage very carefully by making sure that you don't leave equipment on standby but turn it off. With that, I felt I could have an impact.”* All these characteristics are part of an environmental self-identity. Most people with an environmental self-identity became even more aware after the behavioral change intervention and adopted small pro-environmental proposals from the game.

5.1.2. Subjective norms

When looking at the quote above, one can see the recurring subject is subjective norms. Individuals discussed the importance of leaving a better world for **future generations** like kids or grandkids. Additionally, several people only participated because they got an invitation from a colleague they knew well or a manager who stimulated them to join. Also, when team members were not participating during the intervention, they were motivated by the other members. For example: *“We talked to each other because you can also look at other teams, and when they had filled out everything, you could see that they had answered fewer questions correctly. Then you could say, okay, guys, we must try to get over that score by answering more questions correctly. That way, we kept motivating each other.”* During the game, participants shared ideas with each other and talked about the game and sustainability with other **colleagues**. After the game, the participants still talked about the intervention and, in some cases, even **pointed out non-sustainable behavior to others**. *“Imagine that a colleague now takes plastic cups from home and throws them away every day. Then I would say sorry, but you know that's not right.”* Another person said: *“We are behind a large glass window, and at one point, a colleague of mine wants to open the window. Then I said well, it is winter, and it is fine to open the windows, but did you check that the heating is not on.”* The subjective norms helped people to motivate each other during and after the game to behave more environmentally friendly.

5.1.3. Organizational structure

The organizational culture can be seen as an enabler in organizations, where topics like **environmental green practices** and sustainability are kept alive and communicated about. Additionally, the environmental goals are included in the **strategy** or strategic goals of the organization. The strategic goals were not aligned with the goals of the behavioral change intervention. However, it is noteworthy that in most organizations, several initiatives try to

stimulate PEB, not only one digital game. Five interviewees stated that they think the effect comes not only from one intervention but from multiple green aspects. Statements were made like: *“But I can't say that because of the game, it went from zero to hundred. I have always been into sustainability and being environmentally conscious. I also took an external course on circular procurement and other courses that deal with sustainability.”* And, *“You never know if it is only because of the game, but I had planned a trip to Paris for our family, and I was like, I'll take the train instead of the car. But I don't think it was just the game because there was also another colleague who had said that it would be very easy to go there by train.”* Overall, organizations implemented several environmentally green practices, which made participants question if their behavioral change occurred only because of the game. Furthermore, the organization's strategies included environmental goals, which were not aligned with the intervention goals.

5.1.4. Top-management support

Another enabler is the top-management support. In the organizations' strategies, the top management is involved in creating a strategy with several goals focused on environmentally friendly practices. According to one employee, it helps them to embrace sustainability. He stated: *“The board of directors and the business unit managers, so the ones with final responsibility for the regions, are very closely involved in strategy formation. From there, it was initiated, so the upper layer thinks it's important and is talking about it.”* Top management showed their support by **communicating** to the employees that they find sustainability a very important topic and the importance of participating in the game. For example, during meetings, they tried to encourage employees to participate in the online digital game. In some cases, the managers have shown that they find it essential by **participate themselves** in the digital game with the executive team. Also, interviewees made comments about management **giving the right example** by using only electric cars, initiating the making of buildings more sustainable, or participating in the game themselves. One interviewee mentioned: *“I just noticed from our director that he indeed considers things important in terms of an office with solar panels and waste separation. He enforces it quite strictly; for example, when throwing away food, he makes comments like what a shame to throw it away.”* Also, management support inspired people to participate in the intervention, but employees also followed their example and behaved more pro-environmental. However, sometimes the top management also needs help to be reminded: *“I know that the sustainability coordinator recently spoke with our management team, and they really*

embraced it. Then you also notice that this is also reflected in the new communication pieces, and there is attention to it again.” Also, **employees were engaged** in meetings and gave suggestions to the high-level management about sustainability and other subjects. However, in every organization, it is mentioned that most employees did not participate in the intervention focused on sustainability.

5.1.5. The game design

When looking at the digital game design, a few things are noticeable. First, fourteen out of eighteen interviewees mentioned they liked the game's **competitive component**. Because of this competition, participants wanted to gain as many points as possible and become the winning team or individual. The winning teams gained some recognition and a price, but there was also a reward for the individual with the highest number of points. The points and rewards were **incentives** that kept players motivated. Also, interviewees mentioned they the competition kept them motivated to play. Furthermore, the games were easy to understand and very approachable. Also, some interviewees made comments about it being animated and interactive. One participant said: *“I liked that idea, and it was very interactive. I think If it was just a series of lectures or webinars, I was maybe not so self-involved, and it would not be so motivating.”* Furthermore, in this research, the game is mainly played with **multi-disciplinary teams** with members from different departments. Interviewees mentioned they liked the social interaction and meeting new people after COVID-19. Some of the participants are sometimes made sustainability ambassadors during the game and have functions throughout the entire organization. For example, one person said, *“Ambassadors were, of course, appointed to promote the game to get as many participants signed up as possible, so every effort was made to get things moving.”* Furthermore, there was a **community platform** where individuals could share ideas, tips, or solutions to challenges. *“Yes, the actions you did were shared on the community page through the app, and that's how people responded to each other.”* Lastly, a **custom-made game** made it easier for individuals to recognize sustainable initiatives at their work. According to one of the managers, a custom-made game helps: *“A customized game does help because it allows you to recognize examples of your own organization. With a customized game, you can bring it a little closer to the people.”* The customized game made it easier for people to recognize pro-environmental initiatives the organization was already doing. However, it is still challenging to implement pro-environmental practices on the work floor. Overall, the game is one of the many factors influencing PEB.

5.2. Barriers to pro-environmental behavior

5.2.1. Insufficient cues

A barrier that several interviewees mention after experiencing a small behavioral change is that there were insufficient cues about sustainability after the intervention. The participants started a behavioral change during the game, but after a while, they **forgot about sustainability**. They stated that the lack of reminders may be a reason the effect is decreasing over time. In total, seven interviewees mentioned they would like to have an additional intervention, mention sustainability more during meetings, or have the organization send them reminders about sustainability. Also, interviewees mention that there needs to be more **communication**, as it currently requires more work to stay up-to-date about what their organization is doing. However, several firms have an intranet page where employees can voluntarily subscribe themselves to the topic of sustainability. Therefore, only some people who participated see the sustainability topics on their intranet page. Additionally, some interviewees mentioned that sustainability is separate from **their work process** and, therefore, need to be reminded about it on a daily basis. One interviewee quantified: *If it is not part of a standard process, it does not become part of everyone's work. Then, it remains dependent on the sustainability department or managers, and nobody does it anymore.* Another person stated that their behavioral change decreased over time because: *"The interface with the position that I have, and sustainability is a little less obvious. Let me put it this way: if you're in a project and you're going to make something, one could immediately see the link with sustainability, and that is not really the case for the processes of my job."* Overall, this is coded as insufficient cues about sustainability.

5.2.2. Resource constraints

Another often-named barrier is people's time limit, which they disliked about the intervention and suggested making the interventions less than six weeks. Also, two managers stated that some employees did not participate in the digital game because they were **too busy** and needed more time. One manager described a situation with a colleague: *"A colleague said I don't have time for games. He said work is serious and you cannot play games there. While we had presented it as if it is also fun to do something together and work should also be fun."* In some organizations, it is more difficult to be engaged with sustainability. One individual said: *"There is a lot of pressure on some assignments. It must be done quickly and within cost. Then I quickly notice that if a question comes up asking whether it is sustainable, they say, I do not have time for that now; it just must go on."* Another comment that was made relatively

often was about the **workload**. People played the digital game besides their everyday work. However, one interviewee who really liked the intervention played it in her personal time. Sometimes, people even suggested making the game period shorter because they felt it took a **lot of time**. *“A round of the game really shouldn't take more than twenty minutes to half an hour, and otherwise, you should indeed start skipping things, like that personal post, for example, at the end.”* Another individual said: *“I would just do it in four weeks, so you just have it full attention in a short time. Because you end up having to do the intervention in addition to your regular work. In the beginning, it is fun, and after a week or 4, you think I already improved everything.”* These resource constraints created by the high workload or insufficient time create a barrier to PEB.

5.2.3. Psychological inhibitors

Furthermore, several other reasons were given as to why the effect of the intervention was not sustained over time. Six interviewees mentioned that they did not like **giving up comfort**. For example, people stated they did not like to give up their old products even though they knew they were not environmentally friendly. Comments made are: *“There are electric scooters within our organization, but then it turns out that people do almost always choose the car. I think it is mainly because of the comfort and what they are used to.”* or *“There are also some in my personal life that I could do more sustainably, but then out of convenience I do not. For example, I am still using shampoo from a plastic bottle. There are other options as well, but then I am still attached to my own brand.”* Such statements are coded as **convenience** and giving up comfort and can be seen as personal costs. Additionally, in one of the cases, a person felt that she was forced to participate in the intervention and had no personal freedom to choose. She stated that her awareness did not increase, and there was no behavioral change, as there was no intrinsic motivation. Therefore, the **feeling of mandatory participation** could be a barrier to PEB. To summarize, giving up comfort, convenience, and the feeling of mandatory participation can be seen as psychological inhibitors that obstruct PEB.

6. Discussion

6.1. Theoretical contribution

This paper contributes to the literature by using the game design theory and expanding the theory of planned behavior to show how several barriers and enablers influence the effect of the behavioral change intervention and how the effect may be sustained due to the creation of habits. How these factors influence PEB is displayed in Figure 2.

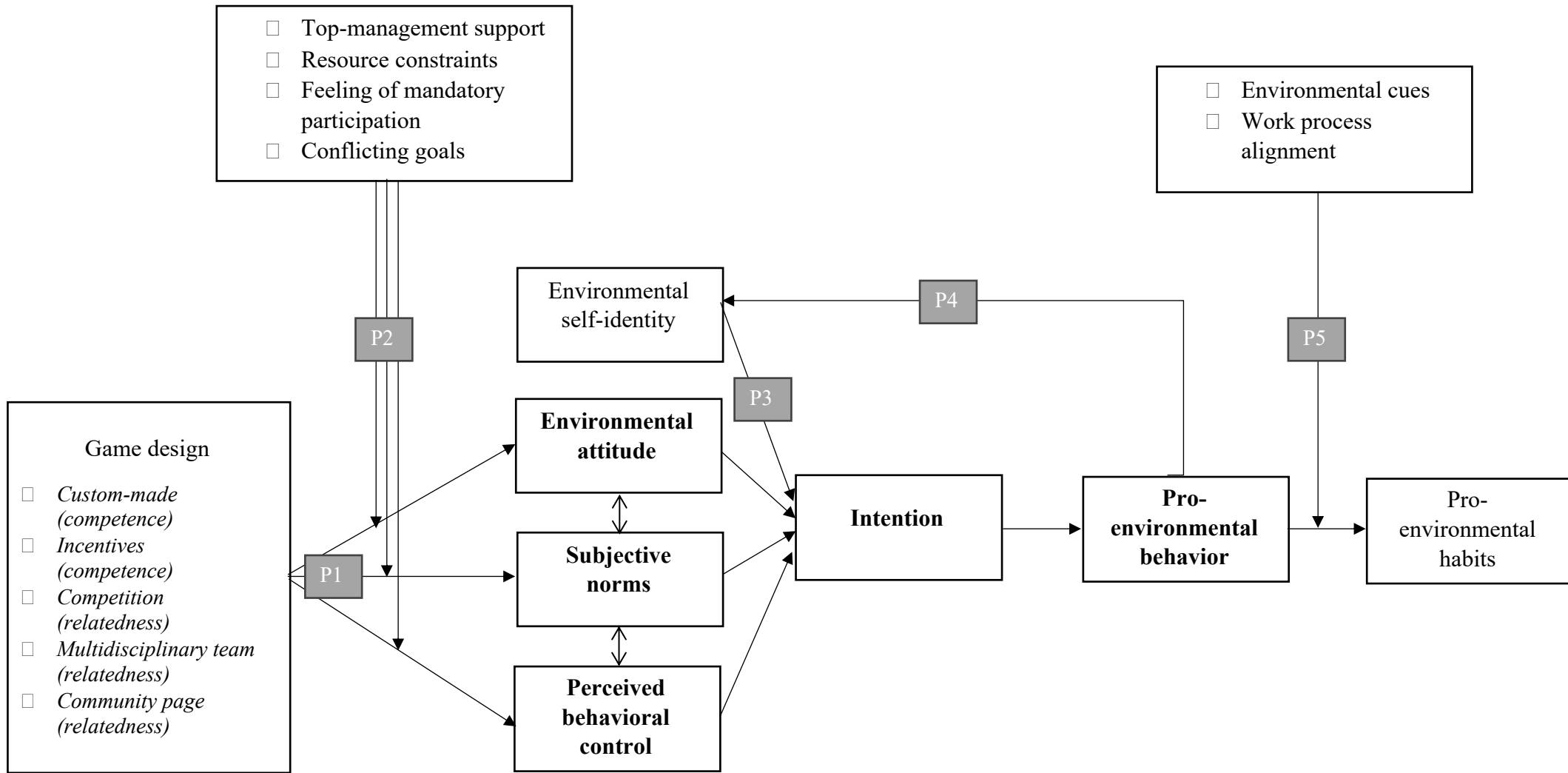


Figure 2: Theory of planned behavior adapted for pro-environmental behavior

In this research, the intervention's game design helps create a higher amount of awareness and behavioral change among the game participants. Conway (2014) claims that because users are presumed to behave consistently, gamification designs that concentrate on extrinsic reward systems while ignoring the users' psychological demands are deemed ineffective. Also, individuals' behavioral intentions and attitudes toward utilizing digital platforms are influenced by their intrinsic motivation (Huang, 2016). When reviewing the literature on game design, several researchers use the self-determination theory (i.e., autonomy, competence, and relatedness) when looking at autonomous motivation during games (Groening & Binnewies, 2021; Sailer et al., 2017; Wee & Choong, 2019). Furthermore, previous research stated that the fundamental psychological demands of autonomy, competence, and relatedness have a significant indirect influence on intention through the attitudinal antecedents (attitude, subjective norm, and perceived behavioral control) of the theory of planned behavior (Al-Jubari, 2019; Al-Jubari et al., 2018; Hagger & Chatzisarantis, 2016). Wee and Choong (2019) found that it is essential that the game design for energy conservation consists of two elements, a personal profile and a non-fixed structure, which helps users satisfy their demand for autonomy. Their research states that a non-fixed structure means that users can choose their tasks and customize their user profiles. In this research, there was not much autonomy as the topics of the challenges were fixed for every team, most of the games were quite general, and participants did not have the option to personalize the profiles. The low autonomy may have created a lower intrinsic motivation to participate in the game and lowered the creation of environmental attitudes, subjective norms, and perceived behavioral control that create the intention to behave more pro-environmental.

Moreover, the second factor of the self-determination theory is competence. A sense of competence can be created by designing complex game challenges that still seem doable and by including feedback systems that tell participants about their advancement toward positively obtained competencies rather than giving them critical feedback (van Roy & Zaman, 2017). The competence level of participants can be made visible by including game design elements, such as badges, points, and awards (Huang & Yeh, 2017). During the interviews, no comments were made about the difficulty of the tasks or receiving direct feedback about the amount of newly obtained capabilities. However, participants started implementing their newly learned sustainability skills into practice and were given points and rewards for their efforts during the intervention. When games were custom-made for the organization, employees found it easier to recognize and implement sustainable practices during the game.

This could have created a sense of competence. To the best of the researcher's knowledge, custom-made games for organizations were not connected to competence before.

Besides, the third element is relatedness. The ability to interact with others in a gamified setting satisfies a fundamental psychological desire for relatedness (Nikou & Economides, 2017). According to Wee and Choong (2019), three game design elements facilitate players' relatedness needs: competition, collaboration, and chat-based social networks. Almost all the games reviewed in this research worked with multidisciplinary teams as participants enjoyed social interaction and meeting new colleagues after COVID-19. There were also subjective norms with teams as team members reminded each other to finish challenges and pointed out others' non-sustainable behavior. So, there was collaboration with team members and competition among the different teams. H. Yang et al. (2023) found that competition is a helpful gamification design element because it motivates users to keep playing the game if they exceed others or perform worse. Furthermore, four of the games included in this research had a community platform where participants could share ideas, tips, or actions they performed during the game with other teams. Consequently, the relatedness in the games was relatively high.

In this research, the elements of competence and relatedness, which are part of the game design, influence the intention to behave pro-environmental through the three factors of the theory of planned behavior. This is in line with previous research. However, autonomy within the game design was not found in this study. Nevertheless, without autonomy in the game, behavioral change still occurred in most cases. *Therefore, proposition 1 (P1) is that a game design with competence and relatedness elements has a positive relationship with the intention to behave pro-environmental through the three factors of the theory of planned behavior.*

However, an environmental attitude, social norms, and perceived behavioral control do not automatically make people behave more pro-environment. This research found that several situational factors moderate how the game design influences these factors. In line with Sawyer et al. (2021), an important organizational factor is that top management supports sustainability within the organizations and that middle managers are active. However, this research found it is important to have several ambassadors throughout the organization who are engaged with sustainability and can engage people to participate in interventions about sustainability. This means that it is vital that the organization does not have one sustainability department with people who are trying to stimulate employees to participate. Furthermore,

this study found that some individuals even began to follow leaders' environmentally friendly examples and were motivated to make small changes to their behavior. These managers also communicated clearly about the importance of behaving pro-environmentally. Hence, the example behavior of managers and how they communicate about it are important factors that influence the PEB of individuals on the work floor. This example behavior aligns with the social learning theory (Heimlich & Ardoin, 2008; Huang et al., 2021). In this case, the top-management support can influence if people participate in the game, which in turn influences the creation of an environmental attitude, subjective norms, and perceived behavioral control.

Additionally, this study found that when the organization does not provide enough resources to participate in the intervention, it hinders employees from participating in the game and performing PEB. This is in line with the research of Keyworth et al. (2020). An example of this is when organizations place pressure to reach non-sustainable organizational goals within a certain period, and employees do not have enough time to play the game due to the hustle and bustle of the day. When an organization does not provide enough time-resources to employees, this may be due to the lack of alignment between the behavioral change intervention goals and the organization's strategic goals. This is already established by Von Thiele Schwarz and Hasson (2013) who found that health interventions were longer considered time-limited initiatives when they aligned with an organization's strategic objectives. Additionally, people's perceptions of resources and barriers influence how much control they have over their behavior and how strongly they intend to engage in specific actions (Hardin-Fanning & Ricks, 2017). Ru et al. (2018) state that some external considerations, including time constraints, may be outside one's control and can influence one's desire to engage in a particular activity because people will have a higher desire to carry out a particular activity if they exercise greater control over themselves. In line with perceived behavioral control, people who do not have a feeling of control because of certain constraints are less likely to behave environmentally friendly. Overall, the resource constraints lower the perceived behavioral control and, indirectly, the intention to behave pro-environmental.

When looking at the psychological inhibitors, people who have the feeling that they are forced to participate in an intervention may also feel as if they have no control over themselves. The feeling of mandatory participation lowers the intention to participate actively in the intervention, which decreases the development of attitudes, subjective norms, and perceived behavioral control. Furthermore, the other psychological inhibitors found in this research, like giving up comfort and inconvenience, are seen as barriers to PEB. A person could be

motivated by environmental issues but also be inclined to other factors, such as comfort and convenience, creating a dispute between their goals (Geng et al., 2017). The relationship between attitudes and behavior is likely to weaken in challenging circumstances where people have conflicting goals and aspirations with concern for the environment (Mancha & Yoder, 2015). This may also be the case for the interviewees who made comments about saving money and being environmentally friendly at the same time. For example, if energy prices go down, these individuals may put on the heating, which harms the environment. So, when these conflicting goals exist, they negatively influence the relationship between game design and an individual's environmental attitude. To conclude, four situational factors (top-management support, resource constraints, conflicting goals, and the feeling of mandatory participation) are found in this research that influence game participants. *Consequently, proposition 2 (P2) is that the situational factors moderate the relationship between the game design functions and the three factors of the theory of planned behavior.*

When looking at environmental self-identity, this research found that environmental self-identity is an additional factor influencing the intention to behave pro-environmental for individuals who participated in the game. This is in line with the research of van der Werff et al. (2013), who states that people with a strong environmental self-identity are more likely to engage in PEB. Many participants who already had environmental self-identity mentioned that they wanted to learn more about sustainability initiatives and aspired to increase their awareness. By participating in the game, these individuals strengthened their environmental self-identity even further. However, in the case of the skeptics, this research found that an environmental self-identification could be created by participating in the game as they started implementing sustainable practices from the intervention. Some of the skeptics even acted pro-environmental after the game had finished. So, in this research, an environmental self-identity could be strengthened further, or it can be created by participating in a behavioral change intervention for PEB. *Therefore, proposition 3 (P3) reads as follows: An environmental self-identity is an additional factor that stimulates the intention to behave pro-environmental. Moreover, proposition 4 (P4) is that participants can develop an environmental self-identity by performing pro-environmental behavior during the behavioral change intervention.*

Furthermore, reviewing the sustained PEB of the interviewees, the individuals who stated that their behavior was sustained over time mentioned that it became part of their daily routine or a habit. However, in some cases, the PEB did not become a habit. This research found that

without environmental cues, individuals relapse into their old behavior. It is, therefore, very important that the organization that hosts the game also gives employees additional environmental cues about the importance of sustainability after the game. Therefore, one single intervention is not always enough to sustain a behavioral change over time. This is in line with the research of Rau et al. (2022), which showed that combining a variety of interventions presented the most substantial evidence to improve long-term commitment. Therefore, implementing multiple interventions, like giving additional cues about PEB, helps to create habits. Furthermore, this research contributed to the habit theory by establishing that to stimulate the creation of habits after the intervention, the practices discussed during the digital game must be aligned with the initiatives in the workplace. This makes it straightforward for individuals to make the initiatives part of their work processes. Currently, this is missed in organizations where the behavioral change effect of individuals decreases after a while. According to studies on habit formation, behavior is more likely to become rooted when practiced regularly in a particular setting (Ouellette & Wood, 1998). Also, given that intrinsic motivation changes over time, PEB habits require a stable organizational setting that encourages consistent PEB (Linder et al., 2022). Overall, this research found that when the effect of the behavioral change intervention needs to become a habit, there must be environmental cues and alignment to the work processes in place. *Therefore, proposition 5 (P5) is: The creation of habits helps to sustain the effect of the pro-environmental behavioral change intervention over time.*

To conclude, the game design of the intervention influences the factors of the theory of planned behavior. However, top-management support, resource constraints, conflicting goals, and the feeling of mandatory participation are situational factors that moderate this relationship. Furthermore, an environmental self-identity is an additional factor that influences the intention to act pro-environmental and is strengthened when behaving pro-environmental. Lately, it is essential to have environmental cues in place and an alignment between organizational practices and the intervention. These factors stimulate habits that effectively sustain the PEB over time.

6.2. Practical recommendations

This research also found some important practical contributions for organizations when initiating a digital behavioral change intervention that focuses on the PEB of employees. First, when an organization wants to change the behavior of employees on the work floor, the intervention must be mainly focused on initiatives within the organization, as the games

focused on private lives only sometimes have a spillover effect on the workplace. Also, it is odd to introduce interventions based on employees' personal lives in an organizational environment. Furthermore, before conducting the intervention, it must be evident that participation is voluntary. When individuals feel coerced or obligated to hold views regarding the environment, undesirable reactions to these environmental messages may occur. In the research of Ma et al. (2018), this reaction was one of the causes of the observed negative impacts on the environmental statements about global warming. After playing the game, most individuals became more aware of the consequences, or if they were already aware, their level of awareness increased. Therefore, the game helps create awareness even for already conscious people.

A practical recommendation for the game design would be to align the practices mentioned in the PEB change intervention with the work processes of individuals. Hence, it is easier for them to recognize and implement sustainable proposals. So, it would be helpful to customize the game design even further to the organization's processes and sustain the behavioral change over time. Also, autonomy options should be included when looking for a digital behavioral change intervention, as this was missed in all the games. When autonomy is part of the game design, it may be possible that even more people sustain their behavioral change as high levels of self-determination help to achieve this (Steinhorst & Klöckner, 2017). Autonomy in gamification can be created by giving players significant control over tasks and goals, giving feedback, and allowing for flexibility (Botte et al., 2020).

Moreover, there must be environmental cues in place. Cues, like text messages or group meetings, help people confront hurdles and encourage them to act (Kwan et al., 2020). These prompts are very helpful to include as an additional small intervention as the behavioral change may decrease less or even become a habit. Some organizations in this research already have an intranet page, but individuals must subscribe themselves to the sustainability page. Connecting the participation to a pro-environmental behavioral change intervention to a subscription to the intranet page could also help to remind the participants. According to Russell et al. (2016), reminders are a beneficial tool for reminding people of new job duties until they develop into routines, which can assist in sustaining the habits altogether. Therefore, a practical recommendation would be to use multiple organizational interventions, like gamification and environmental cues, to create habits and sustain behavioral change over time.

Additionally, the individuals must have sufficient time to participate in the digital intervention. This can be established by aligning the intervention's goals with the organization's strategic goals, which is currently missing in the intervention included in this research. When there are resource constraints, people do not prioritize the intervention or PEB and do not participate in the game regularly. As a result, they may not develop an intention to behave pro-environmental. Therefore, it is a recommendation to gain sufficient time resources for the individuals who participate in the intervention. Also, having well-defined objectives may draw participants in and boost their self-assurance in reaching them, which can impact their actions and promote active engagement in the digital intervention (Che et al., 2023). Hence, it is recommended to have alignment between the goals of the intervention and the strategic goals of the organization to overcome resource constraints and promote active participation.

Furthermore, it is crucial to develop top-management support, which can be shown by communicating about the importance of sustainability and leadership example behavior by participating in the intervention to promote PEB. Leadership participation has a positive relationship with subjective norms and perceived behavioral control, establishing that employees are more likely to participate in the intervention and gain awareness (Hu et al., 2012). Besides, when sustainability is embedded in various levels of the organization, employees are confronted with the topic more often. Moreover, establishing an independent sustainability department runs the danger that responsibility for sustainability is restricted to that department rather than being an enterprise-wide obligation (van Bommel, 2018). Therefore, it is recommended to have sustainability ambassadors throughout the entire organization during and after the intervention.

Lastly, objective data must be available right after the game and after a certain period of at least two months to determine if behavior became a habit (Lally et al., 2010). In two of the five cases, there was no objective data available, and the data that was available was from right after the game. One can argue how important organizations find these sustainable interventions if they do not even bother to gain reports of the results. The quantitative data is important for managers to have as it gives a clear overview of whether the intervention effectively reached their goals like gaining awareness. Furthermore, the longitudinal data provides managers with an overview to check if the effect of the intervention is sustained over time. So, it gives clarity on whether organizing such a pro-environmental behavioral change game was worth their money.

7. Limitations and future research

Despite the contributions, this research also has some limitations that can be a guide for future research. First, the study aimed to include both advocates and skeptics of sustainability within an organization. In three of the five cases, it was impossible to include skeptics due to availability issues or because they did not participate in the intervention. This issue lowered the amount of objectivity in the research. For future research, it would be helpful to focus on skeptics. One could research why they choose not to participate and what would motivate them to change their behavior. Furthermore, a limitation of this research is that the initiators of the game within the organizations were only sometimes interviewed. It would be helpful to talk to the initiator of the digital behavioral change intervention as it clarifies the game's original intention. This is important as sometimes it was unclear why certain functions were included in the game and why the goals of the interventions were not connected to strategic organizational goals. Therefore, future research should include them in their studies.

Additionally, a criterion to participate in the research was that the intervention was concluded at least two months ago based on habit theory. However, most of the interventions were done in 2022, and no objective data about their sustainable performance in 2023 is available. Also, in some cases, no data was available on the digital behavioral change intervention. This makes it almost impossible to see if the behavioral change intervention effectively reached the organizational objectives for the game. For future research, it is essential to add a criterion that the data about the organizational performance the year after the intervention and a report of the intervention itself should be available. Also, it is highly recommended that future research includes a longitudinal data collection to see if the effect is sustained over time to determine if a behavioral change intervention is worth the time and money of the organizations.

Furthermore, in most organizations, there are multiple initiatives besides the digital game to create awareness or support sustainability within the company. One can think of mandatory courses about sustainability or conferences employees attend. Therefore, future research should check how much these initiatives influence the behavior of employees before the game and if they may have stimulated them to participate in the pro-environmental behavior change intervention eventually. Also, aspects like COVID-19 played an essential role in this research as employees wanted to socialize with their colleagues and, therefore, participated in the game. However, COVID-19 also negatively impacted the organization's sustainable reporting numbers like business travel. For future research, one could investigate additional situational

factors between participation in behavioral change interventions and the PEB of employees within the organization. Next, this research was conducted in private and public firms based in the Netherlands due to availability issues. Also, all the interviewees lived in the Netherlands and had the function of an employee or middle manager. Even though three individuals with international backgrounds were included. Two of them mentioned that sustainability is not a topic that is talked about in their home country, and they had little knowledge of how to behave more pro-environmental. Therefore, it would be helpful to find out how cultural values may influence the PEB of employees, as already suggested by other research (De Salas et al., 2022; Han, 2015; Steg et al., 2014; D. Yang et al., 2023). Finally, this research included interventions focused on individuals' private lives and the organizational context due to availability issues. Future research about PEB on the work floor should only include behavioral change interventions where the focus is on organizational sustainable behavior.

8. Conclusion

This research aimed to discover how enablers and barriers influence the effectiveness of a digital behavioral change intervention. The intervention was effective if the behavioral change of employees that occurred after the intervention was sustained over time. The qualitative findings showed that three of the five organizations effectively sustained PEB after the digital intervention. The quantitative data provided little meaningful insights as data from the year after the game or the behavioral change intervention was unavailable. Furthermore, the semi-structured interview data was used for a cross-case and thematic analysis. The cross-case analysis found several characteristics of effective games for PEB. Through the thematic analysis, several barriers and enablers of PEB were found. After the two analyses, the theory of planned behavior was expanded with several factors for behaving pro-environmental. The game design influenced participants' intentions through the theory of planned behavior. However, it was moderated by several situational factors like management support, resource constraints, conflicting goals, and the feeling of mandatory participation. Participating in the intervention stimulated the creation of an environmental self-identity that influences the intention to behave in an environmentally friendly way. To conclude, one must create a habit if the effect of the behavioral change intervention needs to be sustained over time. This can be achieved by having environmental cues after the intervention and aligning the game design practices and employees' work processes.

9. Resources

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10. Appendices

Appendix A: Interview guide

Thank you for participating in this research. My name is Camilla, and I am a master student in Business Administration at the University of Twente. My research is about the effect of interventions on pro-environmental behavior. Pro-environmental behavior is described as behavior that tries to lower the harmful effects of humans on the environment. Today, I will ask some questions regarding your experience with the intervention in which you participated. I would like to inform you that your data will be entirely anonymous, and the data will be stored on a secured server at the University of Twente. During the interview, you can withdraw at any moment without giving an explanation, and you can refuse to answer a question. Before starting the actual interview, I would like to ask your consent to record this session.

Introduction and company description

1. Can you please introduce yourself and explain your function within the company?
2. What is your opinion of pro-environmental behavior and/or sustainability?
3. In general, what is your company doing to support your pro-environmental behavior with the company?
4. What type of leadership style does top management have within the organization?
5. What is the company's strategy?
6. How are pro-environmental goals included in the strategy?

Intervention

7. Can you please describe what intervention X entails?
8. What were the reasons for the company to introduce intervention X to the organization?
9. What were your reasons for (voluntarily) participating in intervention X?
10. What did you like about the intervention X?
11. What did you dislike about the intervention X?
12. Could you elaborate upon a situation that helped you adopt pro-environmental behavior when participating in the intervention?
 - a. What type of behavior did you display during this positive experience?
 - b. Who was involved in this experience?
13. Could you elaborate upon a situation that did not help you adopt pro-environmental behavior when participating in the intervention?
 - a. What type of behavior did you display during this negative experience?
 - b. Who was involved in this experience?
14. How did intervention X influence your awareness of the importance of pro-environmental behavior at work?

15. Could you please describe your pro-environmental behavior right before the intervention and how it was influenced after the intervention?
16. In your opinion, how long did the effect of the behavioral change intervention last?
 1. If the effect decreased over time, what were the reasons for this to occur?
 2. If the effect was sustained over time, what were the reasons for this to occur?
17. What are aspects that need to be changed in intervention X to ensure that the effect will last over a more extended period?
18. What was the opinion of your colleagues about the behavior change intervention X?
19. What other actions should company X take to support pro-environmental behavior within the company?
20. What are some newer interventions the company is currently using to improve pro-environmental behavior? (Top management)
 - a. Why have you introduced these new interventions? (Top management)
21. What are (other) points you still would like to share regarding the topic of this interview?

Thank you for participating in my interview. I will send you the transcript so you can check if you agree with it and if it accurately reflects our conversation. If you are interested in the research results, I can send you the final paper when everything is complete.

Appendix B: Within-case analysis

1. Organization A

1.1. Organizational context

Organization A is an organization that is part of the government consisting of several different regions in the Netherlands. It has a large firm size with more than 10.000 employees.

Therefore, their organizational structure is quite hierarchical, with many different departments. Two of the four interviewees even talked about the silos within the organization. One person stated, *"I feel that everyone just stays within their own department, and not much is shared with other departments or regions."* There is some participation from the bottom up, but most decisions are made and implemented from the top. Overall, top management supports sustainability within the organization. For example, one person talked about the support and said: *"I know that the sustainability coordinator recently spoke to our senior team, and they really embraced sustainability. Afterward, you notice this is also reflected in the new communication pieces"*. Also, managers try to motivate people to participate in the digital intervention during department meetings. In some regions, even the management team gave the right example and joined the game. The strategy of organization A is made at a national level, and all regions should contribute. It consists of a CO₂ management plan,

working with a CO₂ performance ladder, sustainability subjects in their internal education programs, and reporting about their sustainability per year. Their ambition is to be climate-neutral and have a circular operation by 2023.

Additionally, they have connected the sustainable development goals to the main subjects. Also, employees receive a contribution if they want to purchase a bike or solar panels for their house. During the interviews, participants from different regions were questioned. Also, they had different organizational functions, like manager sustainability, senior advisor strategy and environment, advisor purchasing policy and strategy, and advisor water quality. Within organization A, there is a team for sustainability that arranges everything surrounding this subject and facilitates the digital intervention for the participants. This is not the same for every region.

1.2. Description of the intervention

Organization A played a digital game for six weeks in January 2022 that focused on gaining awareness about environmental impact. However, one of the sustainability managers mentioned: *“We did not set goals for the intervention because causality between this online game and our broader sustainability goals cannot be made.”* The interviewees all took part in the first edition of the sustainable game. One person, the manager of sustainability, is interviewed, who arranged and facilitated the game within the organization; this person also took part in the first edition. Additionally, three different individuals were interviewed about their experience with the game. They mentioned they participated in the game because they wanted to learn more about sustainability, were interested in sustainability, and because of their motivation from within to embrace sustainability. One person participated because his entire team joined. The game focused on the private lives of employees and their behavior on the work floor. The entire organization could voluntarily participate in the gamified intervention. The organization has already done a fourth edition of its sustainability game, but it has not implemented other interventions for sustainability. The game was custom-made for the organization and was designed with and managed by people from the organization. However, two of the four interviewees stated that they liked being more focused on their own department and how they could apply sustainable initiatives to their work. For example, *“I think ultimately, I would have liked to get more out of it about how to put it away and translate it within the organization. So, it was mainly an assistance of where you can find something, but that didn't make it directly focused on your work process.”* Someone else mentioned, *“No, what was discussed in the game was not very applicable to my work.”* After

joining the game, participants could subscribe themselves to the newsletter or the intranet page for sustainability to receive updates. However, this was voluntary, and the two interviewees did not subscribe after playing the game. During the interviews, they stated they missed reminders or updates about sustainability within their organization.

1.3. Effects of the intervention on pro-environmental behavior

On an individual level, all four interviewees were positive about sustainability, so there were no real skeptics. One person stated that they did not become more aware because they were already quite aware and had implemented several initiatives in their private life. However, this person did adopt small initiatives from the game, like using a mug instead of cardboard cups. The other three persons stated that they became more aware of the environmental impact at their workplace and started to behave more sustainably. After playing the game, people started implementing initiatives like using fewer cardboard cups, picking up litter, and pointing it out to colleagues. For example, one person mentioned: *“I just very clearly took the attitude of no more than two paper cups a day. One for coffee and one for tea, and for water, I just bought my own plastic cup. The water bottle, I just rinse it at the end of the day, and the next day, I use it again, so there's a real change in behavior from myself there.”* However, two of the interviewees mentioned that the effect decreased over time due to the lack of reminders and being very occupied with their work. Furthermore, participants mentioned time limits of playing the game besides their work and giving up comfort. One of the four participants declared that PEB remained stable through time because of their intrinsic motivation, due to a life-changing experience, or the feeling that it is their social responsibility. She said: *“I think when you're in this field, you also have a kind of personal motivation to be involved in sustainability. However, for me, I think it has more to do with the fact that I lived and worked in Malawi, East Africa, for a while. Then you see things there, which gives you a very different perspective, how the rest of the world is paying the bill of how we live.”*

1.4. The effectiveness of the pro-environmental behavior intervention

Overall, in Organization A, the effect of the three persons who changed their behavior remained stable for one person, and for the other two, it decreased over time. Therefore, based on the qualitative data, the game is not effective in sustaining PEB after the intervention. As the game is played in 2021, the quantitative data of the years before and after the intervention are included to make comparisons. One can see decreases in CO₂ emissions and office waste. The other categories, air travel, energy use, and CO₂ emission from purchases, have increased

over the years. The increase in air travel and energy use for electricity and fuel probably increased after the COVID-19 crisis when it was possible to travel again and visit the office. Overall, based on the quantitative data the intervention had a positive impact on the PEB of participants in organization A. However, this company could not provide any quantitative data about the digital behavioral change intervention itself.

	2020	2021	2022
CO₂ emission (kton)	113	95	90
Air Travel (KM)	2.7 mln	2.1 mln	9.7 mln
Energy use electricity (TJ)	701	684	693
Energy use fuel (TJ)	649	534	666
CO₂ emissions from purchasing and (infra) projects (kton)	x	612	800
Waste office locations (Kg)	802.457	373.199	161.735
<i>Organization A: Reporting on sustainability</i>			

1.5 Conclusion

Organization A communicate to their employees about sustainability and have the support of the top management. The goal of Organization A was to increase the awareness of the environmental consequences of their employees. With their custom-made game, the participants became more aware and changed their behavior right after the intervention. However, the majority relapsed into their old behavior due to the lack of reminders about sustainability within the organization. In the quantitative data, one could also see an increase in several environmental indications like air travel, CO₂ from purchasing and energy use. However, this may be due to other factors like the COVID-19 epidemic. Overall, the custom-made intervention was effective in creating awareness, but participants needed additional cues after the game has finished for the behavior to be effectively sustained over time.

2. Organization B

2.1. Organizational context

Organization B is an entity of the government, that is created to carry out responsibilities for the public's safety and security. It is a large organization with approximately 700 employees. Within the organization, four persons were interviewed. One of these employees was a skeptic and three of them were sustainability advocates. Due to their origin, the organization has a

relatively strong hierarchy with two main departments. Most of the decision-making came from the director and the managers. However, two years ago, they hired a new director who is focusing more on the ideas of employees. According to one of the employees, *“It is nice to see that this is slowly happening, but it is also a bit of a cultural change.”* Not everyone in top management was enthusiastic about sustainability, but at least one of the four directors was concerned, according to an interviewee. Organization B also developed a sustainability team with representatives from different departments. The manager of sustainability, who is a middle manager, was part of this team and managed to inspire the skeptic person to participate in the intervention. Currently, they implemented a policy changing all paper cups for mugs to reduce the amount of office waste.

Additionally, a bicycle plan helped employees with a financial contribution to buy an electric bike instead of going to work by car. Also, the organizations provided electric cars and electrical tools, and the firefighter's outfits consisted of recycled socks. Within their strategy, there was a big focus on social responsibility. The strategy consisted of eight pillars, one of which is sustainability.

2.2. Description of the intervention

In September 2022, the organization started to play a digital game for six weeks to raise awareness about sustainability among their employees in a playful way. No strategic organizational goals were linked to the game, as the main focus was awareness and sharing knowledge. The subjects of the game were an introduction to sustainability, energy and mobility, circularity, personal impact, sustainability, and behavioral change. Fifty-eight employees, divided among ten teams, participated voluntarily in the intervention. Seventy-eight percent played the game actively, and sixty-eight percent finished all the game's challenges. This intervention was partly customized for their organization. For example, there were general questions about sustainability, but employees also had to identify products that used a lot of energy within their organization and develop solutions. Employees liked the social interaction with their colleagues from other departments and the competitiveness among teams. Two persons participated because they wanted to learn more about sustainability. The other person participated because she liked to play a game and to get to know her colleagues after COVID-19. The skeptical individual mentions he participated because the sustainability manager inspired him to do so, and at the same time, he mentioned it also helps to save him money in his private life. The players also started to share thoughts and ideas with other participants via the game's community page. There were prizes for teams

that finished in the top three, as points were granted every week after each challenge. An example of a prize was that the front-runner could win an electric bike.

2.3. Effects of the intervention on pro-environmental behavior

Three of the four interviewees, including the skeptic, declared that the game helped to increase their awareness about pro-environmental initiatives at work and stated to behave more environmentally friendly by taking the train, using less plastic and paper, and installing solar panels. For some of the interviewees, the amount of increased awareness was larger than for others who had already implemented several environmentally friendly practices. One person who was already quite aware mentioned: *“Well, you know, it's also quite difficult to come up with something new, and in the office area, we were like, we already have a lot of the obvious things. So, we've already done those sustainable things, but then we started doing very small initiatives like making fewer copies to prevent paper waste.”* Two of the four interviewees mentioned that the effect of the game on their behavior on the work floor decreased over time. One person stated they did not become more aware, and they did not experience a behavioral change. The person for whom the effect was sustained over time stated it was because of his intrinsic motivation. Two of the individuals with a decreased effect suggested incorporating small reminders or a meeting occasionally to talk about sustainability on the work floor. *“I think it would help to do some kind of project every three months or at least get a little reminder so you are made aware of the organization's sustainability initiatives, with an option to participate.”* Another suggestion was a follow-up game. Within the organization, there is a newsletter to receive updates. However, one must subscribe themselves to be updated. For one person, the effect of the intervention was sustained over time as their awareness was already very high, even in their private life. Also, this person subscribed themselves to the newsletter.

2.4. The effectiveness of the pro-environmental behavior intervention

Overall, for the three persons in Organization B who changed their behavior, it remained stable for one person, and for the other two, the effect decreased over time. Based on the qualitative data, the effect did not maintain stable so the game cannot be seen as effective in sustaining PEB after the game. When looking at the objective data, one can see an improvement in the amount of CO₂ emission for fuel and business travel in the year the game was played compared to the years before. However, the game was played in 2022, and the data for 2023 is not yet available. This makes it difficult to establish if the effect was due to the game as it was played at the end of 2022. Additionally, there was some reporting about the

intervention was done by an external company that facilitated the game. Their survey found that employees learned something new about the sustainable goals of the organization and talked about it with colleagues. However, most employees were not sure how to translate it to the work floor, which may hinder the adoption of PEB on the work floor. According to their external report, the organization saved 36.198 kg CO₂ a year by participating in the intervention. However, this is not included in the emissions scopes shown below. Overall, the intervention was not effective in sustaining behavioral change. Furthermore, Organization B had a positive development over the years by lowering CO₂ emissions. However, it is not possible to make any valuable statements about the effect of the intervention on the emission scopes of organization B as data for 2023 is not available, and the game is played in September 2022.

	2020	2021	2022
Emission type scope 1: Fuel			
Natural gas consumption	474.4	532.8	428.1
Fuel consumption of company assets - Diesel	5.0	7.4	3.7
Aspen	2.2	2.5	2.6
Fuel feet - Diesel	317.3	343.6	382.5
Fuel feet- Petrol	3.8	2.8	1.3
Fuel feet- Hydrotreated vegetable oils (HVO)	-	-	-
Total scope 1 (ton)	775.7	891.1	838.2
Emission type scope 2: Energy			
Electricity use trucks	-	-	-
Heat Supply	26.1	35.9	26.9
Total Scope 2 (ton)	26.1	35.9	26.9
Business travel scope 3: Travel			
Business travel (kilometres)	24.4	55.0	38.1
Flying km	-	-	-
Total Scope 3 (ton)	24.4	55.0	38.1
Total emission (ton)	826.2	981.9	903.2
Data collected after the intervention by external company			
Do you think it's important for the organization to support carbon reduction?			
Yes, of course! I am convinced that a change is needed in the current system, and change begins with yourself. 49%	Very important, the climate issue and transition to a circular economy are important developments, and as an organization, you should respond to that. 27%	Important, but I think that my organization should not be a frontrunner and better follow other organizations in moving toward the circular economy. 22%	I don't think it's necessary for my organization to work on carbon reduction. It makes no

			difference anyway. 2%
Were you aware of your organization's sustainability goals before this game?			
No, before this game I was not aware. 17%	Yes, but only the main lines. 67%	Yes, I knew them already, but I also learned new things. 16%	Yes, nothing was new for me. 11%
To what extent are you already working on sustainability in your daily life?			
I try to life as sustainable as possible. 28%	I am a bit concerned with sustainability in my daily life. 61%	Too little. 3%	I am not concerned with sustainability in my daily life. 8%
What do you need most to make sustainability part of the organization even more?			
I need more periodic sessions where we brainstorm on possible sustainability measures. 47%	I need someone I can turn to with my ideas to so I know something will be done with it. 16%	I'm fine with it. In the organization, we do enough on sustainability. 34%	I prefer not to be involved in topics that are about sustainability. 3%
Do you ever talk to your colleagues or collaboration partners about opportunities for sustainability?			
Yes, I take every opportunity I see. It's part of my work process. 11%	Yes, I raise the issue during strategy discussions. 20%	I sometimes talk about it in a coffee moment, but don't yet know how to really take it further in my work. 60%	No, it is not common for us to talk to each other about sustainability. 9%
<i>Organization B: Reporting on C02 emission and the intervention</i>			

2.5. Conclusion

Organization B is quite hierarchical, but the new director tries to make changes and involve employees more. The organization stated they had introduced the intervention to increase awareness in a playful manner. The participation was voluntary and the skeptic who participated was inspired by one of the middle managers. Creating awareness succeeded as most of the interviewees increased their awareness even if for some interviewees the increase in awareness was small. In total, three of the four interviewees experienced a behavioral change. However, for only one of these interviewees, the effect was sustained over time. This makes the digital behavioral change intervention ineffective. Within this organization, individuals mentioned that they lack reminders about the importance of sustainability on the work floor. When looking at their quantitative data we see a decrease in all the scopes over time, but it is difficult to establish if it was due to the game played at the end of 2022.

3. Organization C

3.1. Organizational context

Organization C is a family business that is a leading distributor and supplier of building materials, specializing in serving the construction, renovation, and woodworking sectors. They have seven locations throughout the Netherlands and more than 1000 employees. The company started with a baseline measurement for sustainability in 2020. Organization C invested in solar panels, making their buildings more sustainable, and invested in electrical machinery. The organization's management was supportive of sustainability and communicated this throughout the entire organization. The top managers develop the major decision-making and are part of the development of the strategy of Organization C. As top management was very involved with the sustainable strategy, they were very positive about it and communicated the importance of being environmentally friendly. According to one employee, they shared a lot of experiences and tried to inspire others. When there are good suggestions from the lower-level employees, the top management listens and even implements them.

Additionally, some top management visited several locations to speak to the employees about their experiences within the organization. Employees stated that they feel heard and all own shares of the company. There is one sustainability manager who is responsible for all the locations, but every unit also has a sustainability team with members in different departments. Sustainability is incorporated in several segments of the organization and part of its organizational culture. When looking at the strategy of organization C, topics like circularity, working with sustainable materials, lowering CO₂ emissions, waste, and the health and safety of their employees are mentioned. The organization states that its strategy is to build sustainably and has developed a sustainability policy. The overall strategy is translated into several sub-goals. This organization has an intranet page for employees to find information. On this page, there are messages about sustainability within the organization that every employee can access. In total, four individuals are interviewed, of which one is skeptical, and three are sustainability advocates.

3.2. Description of the intervention

The organization started playing a digital game for forty days that was focused on gaining awareness about environmental issues and as a starting point for their new sustainable strategy. Their goal was to create more awareness about sustainability and see the opinions of different employees within the organization. However, the game was focused on the private

lives of employees, and therefore, there were no organizational goals. Before playing, there was a survey to determine individuals' footprint, and afterward, they were shown their new decreased footprint. During the game, people could share initiatives through the community page. Teams gained points by playing the game, coming up with creative ideas, and inspiring others. For the winning team, there was a reward. Organization C played the game from May until the end of June 2022 with two-hundred-twenty-one participants, which is approximately twenty percent of all employees. Organization C initially hoped for twenty-five percent. Of the 221 participants, 166 individuals were active. This showed that most of the participants played actively and did not quit during the process, which is a good indication that people remained interested. The game was not custom-made for the organization and focused on general environmental topics like CO₂ emission and waste reduction. Additionally, there was a more significant focus on people's private lives than organizational factors. Participating in the digital game was voluntary as one had to subscribe. One could subscribe to a team or individually, after which one was assigned to a team. According to one interviewee, she felt it was not a choice to participate, as she was automatically assigned to a team. The other participants joined because two of them wanted to learn more about sustainability, and one of them wanted to get to know colleagues in a different setting.

3.3. Effects of the intervention on pro-environmental behavior

Two interviewees mentioned they voluntarily participated because they wanted to learn more about sustainability, and one stated she felt participating was mandatory. Another interviewee was slightly skeptical but also curious and, therefore, participated. The person who felt participating was mandatory stated she was already aware of the environment and did not feel that they learned anything or that their behavior had changed. The main things the participants enjoyed about the intervention were the competitive part and the learning experience. Three of the four interviewees increased their awareness about the importance of PEB in their private lives and the impact of PEB. However, as the game was mainly focused on their personal life, the interviewees stated that they did not change anything at work. Two of the three individuals who became more aware adopted small initiatives like buying second-hand clothes instead of new ones, buying local products, wasting less food, using their bikes more instead of a car, and eating less meat. These small behavioral changes still occur one and a half years after the intervention. One reason for this was: *"The challenges in the intervention were accessible to everyone, so that helps, but that also raises awareness about the impact of what you're doing, which makes it stick."* Another person, who was first a bit skeptical,

mentioned that the changes are now part of the system of his daily routine, and at the same time, it helps save some money while doing it. One person who implemented many sustainable friendly initiatives in her life became more aware but did not change her behavior compared with her behavior before the intervention. However, this person also mentioned that being sustainable helps her to save a lot of money. She stated: *“But I have to say very honestly, and I also mentioned this internally during the intervention, that a lot of my actions are also motivated because it just saves money.”* Additionally, the person who felt forced to participate became slightly more aware but did not change her behavior.

3.4. The effectiveness of the pro-environmental behavior intervention

Overall, in organization C, two participants changed their behavior, and this remained stable over time. Therefore, based on the qualitative data, this intervention was effective for most of the interviewees in sustaining PEB over time. The outcome of the intervention was an average reduction of their footprint of 2.994 m2. This is a total reduction of 48.2 ha annually if they keep implementing the same actions. When looking at the report on sustainability, one can see the baseline measures of 2020. However, the intervention was very focused on the private life of the employees. Therefore, it is hard to state that this intervention influenced the organizational performance. From 2020, there has been an improvement in the amount of CO₂ emissions of the company, except for scope 3. Scope 3 is the indirect emissions caused by the operations, like business travel and commuter traffic. This may also be an effect of an increase in travel after COVID-19. Additionally, the residual materials processed by partners are increasing, and at the same time, the percentage of recycled materials from the residuals is increasing. Also, the amount of waste per thousand-euro revenue is decreasing. Overall, the organization made a good improvement when comparing 2020 to 2021. However, Organization C played the game in 2022, and the data for 2023 is not yet available. Also, the game was focused on the private lives of participants and thus had little effect on the organizational sustainability objectives.

	2020	2021	2022
CO₂ emission (t CO₂ e)			
- Emission type 1 (Scope 1, Fuel)	- 1.686,6	- 1.525,9	- Not available
- Emission type 2 (Scope 2, Energy)	- 3.917,2	- 3.656,4	- Not available
	- 4.213.0	- 4.869,9	- Not available

- Business travel (Scope 3)			
Residual materials processed by partner (Mil. kg)	X	3.2	2.7
Amount of kg of waste per 1000 euros of revenue	X	7.6	6.8
Percentage of recycled material from the residual material	X	71%	73%
Data collected after the intervention by external company			
Involvement	221 participants - 166 active participants (75.1%) - 21 no active participation (9.5%) - 34 no participation (15.4%)		
Actions with the most CO₂ reduction	1. Set the heating to 15 degrees at night. 73 individuals (23.0%) 2. Eating vegetarian 1 (extra) day per week. 73 individuals (23.0%) 3. Eating vegetarian 2 (additional) days per week. 29 individuals (9.1%) 4. Eating fresh fruits and vegetables of the season. 75 individuals (23.7%) 5. Heating off in rooms where no one is there. 67 individuals (21.1%)		
<i>Organization C: Reporting on sustainability and the intervention</i>			

3.5. Conclusion

Organization C has a big focus on sustainability with support from its top management. Individuals stated it is part of their organizational culture. The organization introduced the intervention as a starting point for its new strategy that includes sustainability. However, the game was mainly focused on people's private lives and not custom-made for the organization. The game did not change much about how individuals behaved on the work floor but had a positive influence on their PEB in their private sphere. One person did not become more aware or changed their behavior. The other interviewee became more aware and changed his behavior, but the effect did not sustain over time. For the other two interviewees, the effect of the intervention was sustained over time when the behavior became a habit or part of their routine. From the four interviewees, this was the case for two participants who changed their behavior and therefore the intervention is effective based on the qualitative data. Also, several comments were made about how being environmentally conscious also helps to save money.

When one of the individuals felt forced to participate in the intervention their behavior did not change. When looking at their qualitative data we can see an increase in recycled materials and a decrease in scopes 1 and 2. This is a positive development, but it is difficult to say if it is due to the intervention as it was focused on the private lives of participants.

4. Organization D

4.1. Organizational context

Organization D is a small private advisory company with ten employees and a hired advisor. Therefore, two employees are interviewed to represent this company. One is a project team leader, and the other is a team member. The organizational structure of this organization is relatively flat because of its size. According to the interviewees, the director's management style is very much in collaboration with the employees, who tried to inspire employees to become more focused on sustainability. The organization was introduced to the game by a team leader within their organization after they started working with the CO₂ performance ladder. Before playing the game, the director of the company had already started introducing several initiatives to make the office more sustainable, like installing solar panels and purchasing electric cars for the company. The director is a huge sustainability advocate who also addresses employees' behavior when choosing a less sustainable option. Overall, according to the interviewees, he communicates clearly that he finds sustainability important.

4.2. Description of the intervention

Organization D played a general digital game for six weeks to improve awareness about the environment. Every participant played the game individually. In total, ten of the eleven employees participated in the game. Also, the director was participating in the intervention. The goal was for everyone to participate in the game and to get everyone on the same page when talking about sustainability. They started in October 2022 and finished the game in November 2022. Almost everyone in the organization played the game and supported the intervention. The total amount of players was ten. One skeptic person did not play the game during the six weeks. During the game, players could communicate via a community page and see the number of points they had gained. After the digital game, employees became more aware of what initiatives they could take to lower their environmental footprint as a company and in their private life. Both interviewees stated that they particularly liked the game's competitive component and how it looked. Both participants played the game to increase their knowledge and learn more about sustainability.

4.3. Effects of the intervention on pro-environmental behavior

The two interviewees were both positive about sustainability. The first person was also the one who introduced the game to the organization. Both interviewees stated that their awareness has increased much because of the game because they are very eco-friendly in their private lives. Yet, this person implemented small initiatives mentioned in the game, like using less paper and trying to do things more digitally. This person said: *“The effect has remained very steady over time, but thanks to the game, I am even more aware about sustainability. I now go to events that cover more topics than only CO₂ emission, and I look at how I can improve it at the office.”* However, the other interviewee stated that they were sometimes a little bit lax when it came to sustainability and doubted if it helped what we were doing in the Netherlands. This same person said: *“America is a much bigger country than the Netherlands and then I think what's the point of such a small country like the Netherlands being sustainable. However, you shouldn't think like that because every little bit helps, and if everyone thinks like that, then of course nothing at all will happen.”* Even though this interviewee talked about some doubts about the impact she may have as someone in the Netherlands, the effect of intervention remained relatively stable as the organization kept sustainability alive. This person also feels that the pro-environmental setting of their work influences the choices made in her private life. However, she suggested doing an additional game.

4.4. The effectiveness of the pro-environmental behavior intervention

Overall, within organization D, the awareness increased, and the behavioral change that occurred because of the game remained stable over time. As the PEB is sustained over time, this intervention is effective. When looking at the data, one can see an increase in the emission of fuel, emission of energy, and an increased amount of business travel. As a reason for the increased CO₂ emission, the organization stated: *“We had been told by the organization that calculated these numbers that from 2021, we also had to include our self-employed person with regard to his kilometers and energy consumption.”* So, within the objective data, one can see a contradiction when comparing it to the employees' statements. However, these increased numbers could be a reason to play the game to optimize these CO₂ levels. Nevertheless, the digital intervention was played in October 2022, and the data for 2023 is not available yet. Therefore, it might be hard to see any effect in the 2022 data, which will hopefully be shown in 2023.

In a report after the game, several results were published from a survey made by the participants. The outcomes of these questions can be found in the table below. Most employees believe it is important for the organization to support carbon reduction, and this change begins with their selves. Only a very small percentage of the employees did not think this was necessary, which may be in line with the one skeptic in the organization. Furthermore, almost everyone knew the sustainable goals of the organization even before the intervention, and every person was at least a bit concerned with sustainable practices in their lives. Also, 62 percent of the participants believed the organization already does enough for the environment, and 38 percent preferred having periodic meetings to brainstorm sustainable measures. Notably, 80 percent of all the participants talk to their colleagues about sustainability but still find it hard to implement it in their work processes. This is not entirely in line with the qualitative data, where employees mention they adapted practices that were mentioned in the game to their work. Additionally, the report included other numbers about the participants. In total, eighty percent of the participants were active, and seventy-two percent finished all the challenges in the game. Based on the report of the intervention, a total amount of 4.977 kg of CO₂ emission per year was saved by the participants compared to their CO₂ emission before the intervention. Therefore, the game itself was a practical first step in reaching awareness, but the organization still needs to translate it to the work processes of their employees.

	2020	2021	2022
C02 Emission (ton)	23.11	25.24	30.80
Total			
- Direct emission by the organization (Scope 1: Fuel)	- not available	- 22.88	- 26.2
- Indirect emission by the organization (Scope 2: Energy)	- not available	- 2.29	- 4.4
- Business travel	- not available	- 0.07	- 0.1
Data collected after the intervention by external company			
Do you think it's important for the organization to support carbon reduction?			
Yes, of course! I am convinced that a change is needed in the current system and	Very important, the climate issue and transition to a circular economy are important developments, and as an organization, you	Important, but I think that my organization should not be a frontrunner and better follow other organizations in moving	I don't think it's necessary for my organization to work on carbon reduction. It makes no

change begins with yourself. 50%	should respond to that. 38%	toward the circular economy. 0%	difference anyway. 13%
Were you aware of your organization's sustainability goals before this game?			
No, before this game I was not aware. 11%	Yes, but only the main lines. 11%	Yes, I knew them already, but I also learned new things. 33%	Yes, nothing was new for me. 44%
To what extent are you already working on sustainability in your daily life?			
I try to life as sustainable as possible. 14%	I am a bit concerned with sustainability in my daily life. 86%	Too little. 0%	I am not concerned with sustainability in my daily life. 0%
What do you need most to make sustainability part of the organization even more?			
I need more periodic sessions where we brainstorm on possible sustainability measures. 38%	I need someone I can turn to with my ideas to so I know something will be done with it. 0%	I'm fine with it. In the organization, we do enough on sustainability. 62%	I prefer not to be involved in topics that are about sustainability. 0%
Do you ever talk to your colleagues or collaboration partners about opportunities for sustainability?			
Yes, I take every opportunity I see. It's part of my work process. 20%	Yes, I raise the issue during strategy discussions. 0%	I sometimes talk about it in a coffee moment, but don't yet know how to really take it further in my work. 80%	No, it is not common for us to talk to each other about sustainability. 0%
<i>Organization D: Reporting on CO₂ emission and the intervention</i>			

4.1.4.5. Conclusion

The organization introduced the behavioral change intervention to increase awareness about sustainability when they started working with the CO₂ performance ladder. Additionally, their director finds the topic of sustainability important and communicates this to the employees. The game helped to increase their awareness and to display more PEB that sustained over time. The goal of hundred percent participation was not reached, but everyone knows the sustainability goals of the organization and a majority thinks the organization does enough for sustainability. Overall, this behavioral change intervention was effective. Improvements can be made by organizing sessions where they talk about sustainability measures or make it clearer how sustainable opportunities can be implanted at work.

5. Organization E

5.1. Organizational context

Organization E is an organization that specializes in energy management and automation solutions. The company primarily focuses on providing products, software, and services that help individuals and organizations manage and optimize their energy usage, electrical distribution, and industrial automation processes. The organization operates in different hubs like North America, Europe, India, and China and has approximately 135.000 employees worldwide. Within this large firm size organization, the four interviewees all work in the Netherlands but have different nationalities. Within the organization, there is a focus on more sustainable products and implementing a net-zero roadmap. They state that sustainability is at the core of everything they do, aligning with their purpose and strategy. Additionally, the organizations included the seventeen sustainable development goals to monitor their progress. Also, every year, a mandatory educational lesson focuses on the environment and social impact. This is done in addition to their sustainability school, which offers free online courses to employees. Also, all managers drive an electric or hybrid car. According to several interviewees, the top-management layer determines the main guidelines. For the middle management, the decision-making process is more bottom-up. One of the interviewees mentioned there are also meetings every few months that all employees are part of, even at the lowest level, where people could make suggestions or give comments. *“On the other side, employees are also involved because every day there are some daily meetings and the employees can bring ideas as well and they can bring ideas which are valued by the company.”* Overall, management supports pro-environmental ideas and communicates the importance of sustainability. However, the support is focused more on the work environment than private initiatives. One of the interviewees said, *“So, the management has given attention to promoting sustainability more and more, but this was more for the kind of initiatives related to the work environment. About things we already need to do because, as I said, sustainability is already a massive thing that we give attention to in our company.”* Also, sustainability is part of the strategy with several pro-environmental goals like keeping the CO₂ emission of transport as low as possible. Additionally, the organization tries to make sustainability visual and easy to contribute to. For example, one interviewee mentioned that within the warehouses, there are bins with clear labels for plastic or paper trash to make it easier to align with the company's sustainability rule of separating trash on the work floor.

5.2. Description of the intervention

Organization E played a digital game for six weeks, forty days, starting in May and finishing in June 2023. The game was only played in the Netherlands department. Before playing the

game, participants had to fill out a questionnaire to determine their current footprint. There were no organizational goals, as the intervention was focused on individuals' private lives. After finishing the game, they could see a decrease in their own footprint. The organization introduces the game to raise even more awareness within the company. However, one interviewee mentioned he thought the company introduced it as it is good for public relations (PR). The department in the Netherlands initiated the game, and members of the other hubs could join. Approximately 110 employees participated in the game, which is around 20 percent. The game was mainly focused on improving the awareness of sustainability in people's personal lives and a little bit on their work. During the game, there was a community page where participants were stimulated to share their ideas. One of the interviewees invited two other persons to participate in the game. Therefore, two persons mentioned one of the reasons they joined was because of this invitation. Other reasons were curiosity and gaining awareness. The other two persons mentioned they participated because they did not know much about sustainability and wanted to increase their knowledge. The intervention was not custom-made for the organization and, therefore, very general, with a focus on people's private sphere.

5.3. Effects of the intervention on pro-environmental behavior

Two interviewees mentioned that awareness about their personal lives also helped them apply it more at work. However, the other two interviewees mentioned the game was so focused on their private life they did not adopt much of it for their work. The game helped four interviewees become more aware, and three interviewees changed their behavior by implementing several small initiatives like eating less meat, biking to work, picking up trash, or wearing a sweater instead of turning on the heating. One of the interviewees mentioned that in the country she originally came from, sustainability is not a huge topic, and she was not educated about it in school. For this person, the effect of the intervention is still present. She mentioned: *"Due to the game, I cannot eat beef without thinking about how much more water I am wasting than if I would choose chicken. So, it is definitely burned into my mind."* Another person mentions their behavioral change is now a habit. He stated: *"I am not actively thinking about the intervention anymore because during that time, I had to think about sustainable alternatives a lot, and then I did it for six weeks. After, it just became a habit."* In one of the cases, the awareness increased a little bit, and this person did not adopt any PEB after the intervention. This person stated he was already quite aware and educated about the topic, but it was hard for him to make it a habit. As a reason, he stated that it is a personal

blocking point for him to create new habits, and it is probably a personality issue. Overall, for all four interviewees, their awareness increased. However, a behavioral change only occurred for three of them. Two of them stated that the effect was sustained over time because of their intrinsic motivation, and one of them mentions it had become a habit.

5.4. The effectiveness of the pro-environmental behavior intervention

Overall, in Organization E, three of the four employees changed their behavior, and all of them are sustained over time. Based on the qualitative data, this makes the digital intervention an effective tool in this situation for these employees. However, it is noteworthy that the game was played three months before the interviews, and most of the participants were invited by the same colleague who is also included in this research. This may create a selection bias. Additionally, no qualitative data about the digital behavioral change intervention regarding the user participation rate or engagement is available. This makes it very difficult to make any conclusions about the effectiveness of this intervention.

When looking at the sustainable reporting of the company before the intervention took place, they are constantly reducing the amount of greenhouse gas emissions, and they avoid the amount of CO₂ emissions increasing every year. Additionally, their total water withdrawal and atmospheric pollution are decreasing. Also, a huge part of the amount of energy they use is covered by their own green energy. Hence, they have a good starting point for further optimizing their environmental performance, although no objective information is available after the intervention. This starting point may be why the organization started playing the game. However, their intervention was mainly focused on employees' private lives, which makes it hard to determine if there is a tangible impact on the organizational level.

	2020	2021	2022
Greenhouse Gas (GHG) in TCo2E			
- Scope 1	- 142.658	- 140.936	- 119.617
- Scope 2	- 145.207	- 153.115	- 109.730
- Scope 3	- 65.931.222	- 68.901.866	- 60.952.497
Tonnes of saved and avoided Co2 emissions to the customers	265 M	347 M	440 M
Turnover of environmentally sustainable activities, taxonomy aligned (Million euro's)	X	83.6	6.934

Atmospheric pollutions (kg)	440.442	342.228	308.520
Total water withdrawals (m3)	1.928.032	2.072.263	1.921.569
Estimated coverage of energy consumption (%)	96%	95%	95%
<i>Organization E: Reporting on sustainability</i>			

5.5. Conclusion

Organization E introduces the behavioral change intervention as a voluntary course for individuals who want to learn more about sustainability. This is besides their mandatory educational lessons. Within the organization, there is a big focus on being sustainable as it is part of the daily processes of employees. The game was focused on people's private lives, but in some cases, it also helped to be more pro-environmental at work. The awareness had increased in three of the four cases, and their behavior had become more pro-environmental. The reason for this change to occur is that the behavioral change had become a habit. Overall, based on the interviewees, the game was effective, but there is no objective data about the intervention to compare it with. This makes it hard to make conclusions about the overall effectiveness of the intervention on organizational performance measurements. When looking at the qualitative data, we see a positive development in all sustainability factors. However, the game was played in 2022, and the data for 2023, after playing the game, is not available yet. Also, the game was focused on individuals' private lives. This makes it difficult to state if positive development has occurred because of the intervention.