

# Gamification for Motivation

A study to understand whether competition or cooperation leads to more motivation  
to discard litter in parks

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## ABSTRACT

Littering in public parks has become a prevalent issue, undermining the intended purpose of these spaces, and posing environmental concerns. This paper explores the use of co-experienced gamification to motivate individuals to properly discard trash in public parks. A constructive design research lab study was conducted using a physical prototype that enabled a comparison between a cooperative and competitive game mode. Findings indicate that both game modes were enjoyable, fostering laughter and fun. Whilst both game modes provided participants with feelings of competence and autonomy, participants felt more autonomy in the competitive game mode and hence it is more likely to foster intrinsic motivation according to the Self Determination Theory (SDT). These findings highlight the potential of co-experienced gamification of trash receptacles in parks, as a means to changing the mindset of park visitors to discard their trash correctly, and to mitigate the negative environmental and social consequences associated with litter.

## KEYWORDS

Littering; Gamification; Trash Disposal; Competition; Cooperation; Co-experience

## INTRODUCTION

Littering can be defined as “*waste products that have not been discarded properly*” [32]. Unfortunately, littering is a common occurrence in public parks, especially during summertime, which can reach levels where parks appear to be “*public garbage dumps*” [30]. This goes against the essence of public parks, which are meant to improve the quality of life of city dwellers [19] and which can serve as important locations for individuals to

restore psychologically as shown by Hartig & Staats [2006]. Additionally, littering also has a variety of negative side effects on the environment. Hence, it is important that people are motivated to discard their trash correctly, to prevent these.

A way in which motivation can be increased is through gamification. Gamification can be defined as follows: “*using game-based mechanics, aesthetics, and game thinking to engage people, motivate action, promote learning, and solve problems.*” [22]. As research in the education field has shown, gamification can lead to more motivation in students compared to regular courses [9] and Buckley and Doyle [2016] have shown that gamification is “*particularly effective for students who are intrinsically motivated*”. It has also been shown how gamification can lead to positive behaviour change through intrinsic motivation in initiatives such as the Bottle Bank Arcade [33].

As most research has focussed on individual experiences when it comes to the gamification of trashcans it is interesting to consider shared experiences. The theory of co-experience shows how experiencing together with a second person can increase pleasure and fun [4] which can develop intrinsic motivation that could lead to behaviour change.

Competition and cooperation are two gamification methods which can be co-experienced by users. Players either go up against each other or work together to reach a common goal. Both game styles have been shown to lead to more motivation in students [29, 8], and therefore this research aims to compare the two styles to understand which is more effective in motivating players to discard trash by answering the following research question: *In which ways does a cooperative or competitive*

*shared experience with a gamified trash receptacle influence motivation to discard litter in public parks?*

The paper will demonstrate a constructive design research lab study. Preliminary research was done in the form of a literature study and followed up by a physical prototype. The prototype made it possible to investigate a direct comparison between a cooperative game mode and a competitive game mode using the same device. In the subsequent sections of the paper, the game modes will be referred to as *CooGm* and *CompGm* respectively.

This paper will first provide insight into littering in parks, behaviour change, gamification, shared experiences, and prior investigations using gamified trash receptacles. Subsequently, the methodological framework employed in this research will be presented including the developed prototype and a description of the study's experimental setup. Finally, the gathered data will be presented, analysed, and discussed.

## **BACKGROUND RESEARCH**

The following sections will give a brief introduction to background research relevant to this study.

### **Littering in Parks**

There is a variety of issues that litter brings with it, from environmental to social ones. Litter can lead to fire hazards, human health hazards [36] and it has also been proven to increase crime such as theft in communities [23]. Several studies including Keizer et al. [2008] have also found that littering is more common where litter is already present. Additionally, the costs of having to remove litter are extremely high. In an investigation, the Dutch Association of Cleaning Directors (NVRD), found that cleaning litter in the Netherlands cost 304 million euros each year [28].

People from every social group litter. However, a study performed by Aziz et al [2019] found that students were at the top of the list for littering with just under 70% of litterers. Taking this into account, the target group for this study will be students. Additionally, according to Sibley and Lieu [2003] people are more likely to leave their litter behind after staying in one location for a longer period of time. For this reason, the study will focus on people in public parks, as students often meet there for several hours to relax. The scenarios presented to participants in this study will also consider that littering increases during summertime [26].

The reason behind littering seems to be largely intentional. Shultz et al. [2013] found that 'an estimated 81% of observed littering occurred with intent'. This can also be seen in Aziz et al, [2019] which shows that attitude was the 'main factor causing littering. Therefore, it is crucial that people's attitudes regarding littering change as this can help prevent the negative outcomes mentioned before.

### **Gamification**

As briefly mentioned in the introduction, gamification can extract a variety of beneficial behaviours from users. However, gamification needs to be designed carefully as one can easily make the big mistake of "*creating a game no one wants to play*" [24]. There are a variety of different considerations that ought to be made when gamifying something to ensure that the gamification works. The most important one is that there should be clear goals and the game should be based on a set of rules [34]. Next to that, the gamification should also confront the player(s) with a challenge [16], as beating it will make the players feel more competent. Though, it's important that the game is not too difficult as this will frustrate them [39]. Another important aspect is performance feedback. A study by Jung et al., [2010] showed that it is beneficial to include explicit performance feedback, as this can serve as a motivational factor and has also been shown to reinforce the engagement of group members to a goal [18].

Often gamification is also linked with a reward. In many cases, material rewards are used as they 'draw in more attention and people more easily'. Whilst gaining attention from users is important, it also brings the issue that often players only participate for the material reward they will receive [39]. Therefore, non-material rewards such as feeling satisfaction when winning, or completing a difficult challenge, can be better motivators for people to participate as this motivation will be intrinsic. However, when using non-material rewards, it is even more essential that the gamification is fun and enjoyable [39].

## RELATED WORKS

### Design for Behavioural Change

The Fogg Behaviour Model (FBM) is a psychological model that defines why behaviour is performed. The model states that *'for a target behaviour to happen, a person must have sufficient motivation'* [14]. People can be motivated in two ways, extrinsically or intrinsically. Extrinsic motivation usually arises when rewards are used to achieve behaviour change. The issue with extrinsic rewards is that usually when they are removed, individuals return to their previous behaviour [11]. Extrinsic rewards can come in the form of physical or social rewards, but they can also come in the form such as warnings about punishment. An initiative by Coca-Cola rewarded players who played their game about recycling bottles with a 'recycling related gift' which was 'designed to encourage the upkeep of recycling behaviours at home' [31].

Intrinsic motivation on the other hand is driven by people's interest and enjoyment of an activity [11]. Individuals that are intrinsically motivated will perform a behaviour because it is fun and for the challenge, instead of external rewards they could receive [10]. The Self Determination Theory (SDT) argues that intrinsic motivation is present in everyone and can develop if people's need for competence and autonomy are met [15]. However, it can only develop if individuals feel competence in addition to autonomy. Feeling only competence will not increase intrinsic motivation. Additionally, feeling relatedness will also aid in raising intrinsic motivation [12]. If these basic needs are met individuals are more likely to act intrinsically motivated [13].

In the section *Gamification of Trashcans*, two examples are mentioned that use intrinsic motivation to achieve positive behaviour change in the context of trash removal. Discarding trash should become an internalized process for individuals, as this will lead to less littering, hence in this study, the gamification of the trashcan will focus on rewarding players with solely intrinsic motivation.

### Gamification of Trashcans

As mentioned above, littering is a major issue and hence, there have been projects and campaigns around the world to change this behaviour. Some of these

projects have attempted this by gamifying trashcans, to achieve lasting behavioural change such as recycling more. The 'Bottle Bank Arcade' is one such project which was able to motivate people to recycle 19kg of glass bottles in one night, compared to a close by, ordinary recycling bin which was only used twice [33]. Another project called the World's Deepest Bin also used gamification aspects to increase the enjoyment of discarding trash which resulted in 41kg more trash being discarded compared to a nearby 'regular' trashcan [42]. In the project 'TetraBIN' a trashcan was gamified to explore public displays for behaviour change and whilst the project did not investigate the effectiveness of the trashcan to reduce littering, it revealed interesting interactions with the gamified trashcan and showed players enjoyment [41].

### Shared Experience

It has been proven that a user experience is amplified when the experience is shared and both co-experiencers know each other [5]. As Shteynberg [2015] showed, a larger number of cognitive resources are assigned when something is co-experienced. Co-experience is defined by Battarbee [2003a] as *'the user experience, which is created in social interaction'* and the *'seamless blend of user experience of products and social interaction'*. In other words, products create a new, fun, and pleasurable shared experience between users, which would otherwise not have been possible. Therefore, if an experience is enjoyable, this feeling could be amplified when co-experienced with a friend.

## METHODOLOGY

### Constructive Design Research

This study is based on the Constructive Design Research (CDR) methodology. It focuses on the 'Lab' methodology which describes how research can be done in a controlled environment where researchers are able to 'compare user experience' [25] and it's possible to control variables allowing them to *'focus on one thing at the time'* [25].

The 'Lab' setting is beneficial for this study as firstly, it was possible to control the number of participants and their relationship with each other. Secondly, it allowed the participants to evaluate both the cooperative and competitive modes which is beneficial as it offers a direct comparison. And thirdly, the designed prototype

requires a given amount of trash to play, which could be provided to participants ensuring that they play as intended.

### Prototype Design

An important aspect which this prototype needed to achieve was that both game modes could be played using the same prototype to ensure that participants evaluate the game modes, instead of the prototype. The final design consists of two parts described below.

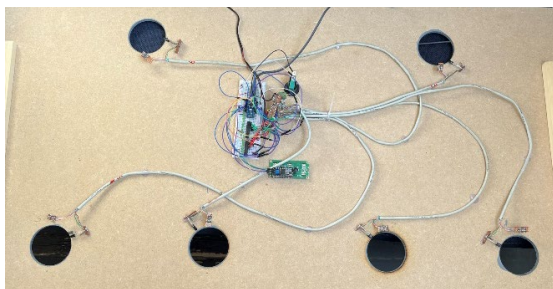
#### *Physical Prototype*

The final prototype is designed to resemble a trashcan where the top surface has six circular holes (Figures 1&2). At the centre of the top surface, a large green button is installed which serves to start the game modes but is also used as a feature in the CooGm. Additionally, an LCD display is installed to relay the player's score. Next to each hole, an individually addressable RGB LED is attached to offer instantaneous performance feedback to players.



**Figure 1&2: The Physical Prototype.**

Beneath the top surface, each hole is equipped with infrared (IR) sensors (Figure 3). When either game is started, the IR transmitters activate and, if trash is discarded into a hole, the IR receivers detect elevated values as the IR beams are reflected towards the receiver.



**Figure 3: Electronics below the prototype.**

The prototype is powered by an Arduino Nano v3 with two MCP23017 I/O expanders attached to it to address each RGB LED individually. Furthermore, the IR emitters are powered externally through a 5V power supply.

The electronics were attached to an MDF housing, which was designed to be portable and painted to emulate the appearance of a trashcan. On the top surface, a white border was drawn around the LCD display, to accentuate its presence.

Lastly, a poster outlining the rules for each game mode was attached to the wall behind the prototype which provided participants with an explanation of the game's objectives.

#### *Game Modes*

##### *Competitive Game Mode*

In the CompGm, the players play against each other. The top surface is divided and after pressing the start button, one LED on either side will turn blue. This indicates to the players where a piece of trash should be discarded. If they do so within 1.5 seconds, the LED will turn green. The quicker player each 'round' is awarded two points, whilst the slower player only receives one. This was done to encourage players to continue playing as both receive positive performance feedback to aid their feeling of competence. If they are too slow or miss the hole, the LED turns red and 1 point is subtracted. The LEDs provide instant performance feedback in case players are too focused on the game and cannot check the LCD screen. The player with the higher score after both players run out of trash is the winner.

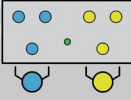
##### *Cooperative Game Mode*

Within the CooGm, players are required to collaborate to gain points. Each 'round' players switch between two roles: One player discards the trash whilst the second player 'activates' the designated hole. The fundamental mechanics are similar to the CompGm, albeit both players share the 6 holes. Each 'round' one of the holes will illuminate in blue, however, simply discarding a piece of trash correctly will not count. One of the players first needs to 'activate' the hole by pressing the green button. To illustrate, if it is player 1's turn to discard trash, player 2 must press the green button when the blue LED illuminates. Failure to do so, or if player 1 discards the trash before the hole is 'activated' results in the deduction of a point. If done correctly, two points are awarded. Both players win after running out of shared

trash by setting a 'high' score, which they can improve upon the following time. The rules presented to the participants can be seen in Figures 4 and 5.

### Can you beat your Friend?

**Basic Rules**  
Each player has 3 holes, score points by throwing a piece of trash into the hole illuminated in blue.  
The quicker player earns more points.



**How to score**

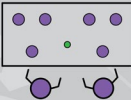
- Stand next to each other with your trash ready!
- When the game starts, throw your trash into the hole illuminated by the blue light.
- Be quicker than your friend! The first one gets 2 points, the slower player only 1.
- If you throw your trash in too late or in the wrong hole you get no points.
- Play until your trash runs out!

**How to Win**  
Very simple, score more points than your friend! **Have Fun!**

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### How many points can you score together?

**Basic Rules**  
Take turns in discarding pieces of trash and pressing the button to score points.  
Only by working together you can get a high score!



**How to score**

- Have your trash combined and be ready!
- The left player starts throwing the trash away into the hole that is illuminated in blue.
- However, you can only score if the second player, holds the green button and activates the hole. You alternate roles with each piece of trash.
- Coordinate correctly to score points!  
You get no points if you're too slow or the button is not pressed.

**How to Win**  
Set a high score as a team, that you can beat next time you play! **Have Fun!**

**Figure 4&5: Rules CompGm(Above), Rules CooGm(Below)**

## Data Collection

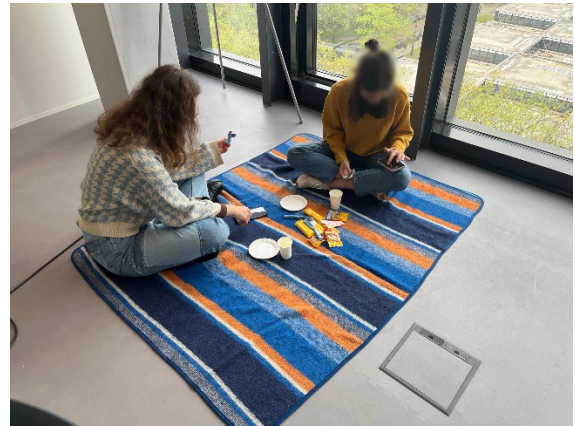
### Participants

Each session consisted of two individuals who knew each other well and were students from Eindhoven University of Technology between the ages of 18 to 27. The study was conducted with 16 participants which should allow for data saturation as most obtained data from the study is qualitative [2]. The participants were recruited using convenience sampling.

### Methods and Study Setup

A total of 8 sessions lasting approximately 35 minutes were conducted. The participants were first introduced to a scenario in which they were enjoying a picnic in a park during summer. Despite the sessions being performed in closed rooms, special attention was dedicated to ensuring that participants could still relate to the location depicted in the scenario. Sounds of birds and other parkgoers were played in the background, a park on a sunny day was displayed on a large TV screen in the room, and participants were initially asked to sit on a blanket, on which they could find some snacks.

Following the priming, participants were requested to complete a questionnaire to verify their conformance with the study by asking about their age group and their relationship with the second participant. Additionally, the Competitiveness Index (CI) [40] was employed to assess the degree of competitiveness of each participant.



**Figure 6: Two participants sitting on the picnic blanket.**

Subsequently, the scenario was continued, explaining that they had been sitting there for several hours and accumulated trash. Participants were then asked to gather a few pieces of trash laying around while also being provided with 'pre-collected' trash, with which they proceeded to the prototype to play the first game mode. It should be noted that to avoid data bias, four sessions started with the CompGm, and four with the CooGm. Following the interaction with the gamified trashcan, participants were presented with the emotions from the Geneva emotion wheel (GEW) [35] and prompted to select three each, which they believed were most salient during their experience. This was meant to provide insights into the emotional associations of each game.



**Figure 7&8: Participants playing the CooGm(Left) and CompGm(Right).**

The scenario was then reset, and the participants were asked to play the second game mode. Lastly, a semi-structured focus group was conducted. Questions regarding the overall experience and emotional responses were asked followed by questions to understand how the game modes fulfilled the human needs of autonomy, relatedness, and competence.

#### *Thematic Analysis*

The interview results were analysed using inductive coding based on the approach 'Thematic Analysis' [6]. Using the thematic coding software MAXQDA the raw data of the focus groups were coded and placed into themes.

## **RESULTS**

### **Qualitative Findings**

The thematic analysis revealed a total of 35 codes, which were subsequently categorized into six themes which are presented in the following sections.

#### *Autonomy*

The analysis revealed that the majority of participants experienced more autonomy during the CompGm as they were solely responsible for their actions and decisions. For instance, Participant 4 emphasized that *"You have it in your own hands"*. Moreover, most participants also felt more in control over their actions as they were unaffected by the performance of their teammate. Notably, several participants expressed initial confusion during the CooGm, mentioning challenges in understanding and coordinating with their partner at first, which influenced their perception of control.

Nonetheless, not all participants thought the same. Some participants expressed diminished pressure to achieve the goal as they were working together and therefore had more time to coordinate. This allowed them to *"focus on doing it right"*, which resulted in a heightened sense of control. Additionally, participant 17 conveyed, *"I felt more in control because I'm playing with a reliable teammate."* emphasizing the beneficial influence of a partner for individuals less proficient in competitive contexts or games.

#### *Competence*

Each game mode appears to elicit a sense of competence in distinct ways. Several participants expressed that the CompGm fostered a heightened level of enjoyment and perceived competence due to its intuitive and simple nature, allowing them to grasp the game easily and perform well. This is empathized as one participant stated, *"I also had more fun because the game mode was more clear to me"* and another remarked, *"I think the competitive game mode was just very simple to understand"*. Moreover, in general, participants exhibited limited concern regarding negative performance outcomes, *"I didn't really care I lost since it was such a short game"*.

Conversely, the CooGm, elicited a sense of competence, as it involved a *"learning curve"*, and participants generally perceived it as more challenging. Several expressed a sense of improvement and becoming better at the game as they played. Participant 14 noted, *"We didn't really understand the game in the beginning and then we started understanding it which created this nice little joy"*. Additionally, Participant 8 expressed that *"I really liked that we had to figure out a system ourselves"*.

#### *Relatedness*

The feeling of relatedness is more pronounced in the CooGm. Multiple participants mentioned a heightened sense of connection as they had to work together towards a common goal with one participant stating, *"I have more involvement in the first one (CooGm) since we needed to collaborate together"*, and another participant expressed enjoyment of having *"to coordinate to really get something done"*. Furthermore, a few participants remarked that the CompGm provided a comparatively *"isolated experience"*, as *"you have those two separate sides"*.

On the other hand, participant 14 stated that competition against friends can also engender a sense of connection. The participant explained that it allowed them to be much more aggressive as they were playing with a friend, which contributed to feeling connected with the co-player. Additionally, participant 11 mentioned that the feeling of relatedness was comparable across both game modes since *"In both of them, you have this shared experience"*.



### Emotional Responses

This section will present the emotional responses during the focus group and present the chosen emotions from the GEW.

#### Positive Emotions

Both game modes, appear to be enjoyable and fun to play. The CompGm on the one hand, generated a sense of excitement and a desire to win, evoking a feeling of being "sharp and on edge". Likewise, the CompGm was deemed more enjoyable by some participants as they quickly understood the game mechanics. Participant 14 expressed, "I was used to the whole setup ... which also made it more fun". This mode was also perceived as more suitable for locations such as parks, where individuals may prefer minimal time investment in learning the rules.

On the other hand, the CooGm appeared to elicit enjoyment and entertainment through confusion during the collaboration. One participant remarked that "the first game mode is more chaotic, which also makes it more fun though", and another mentioned finding amusement in observing the second player struggling. The feeling of enjoyment was also linked to the sense of improvement over the course of the game. While players also struggled at the beginning of the CompGm, enjoyment from improvement was only mentioned regarding the CooGm.

Two participants mentioned that they enjoyed the physical interaction the CooGm facilitated, finding satisfaction in engaging with the green button. Other participants mentioned appreciating the 'role switching' introduced by the button, although they suggested that this rotation could be emphasized further, for instance, by using a switch so participants "have to be more actively switching the mode".

The selected emotions from the GEW indicate that both game modes were mainly associated with positive emotions such as Enjoyment or Amusement but, the bar plots below show that the CooGm was perceived more positively overall.

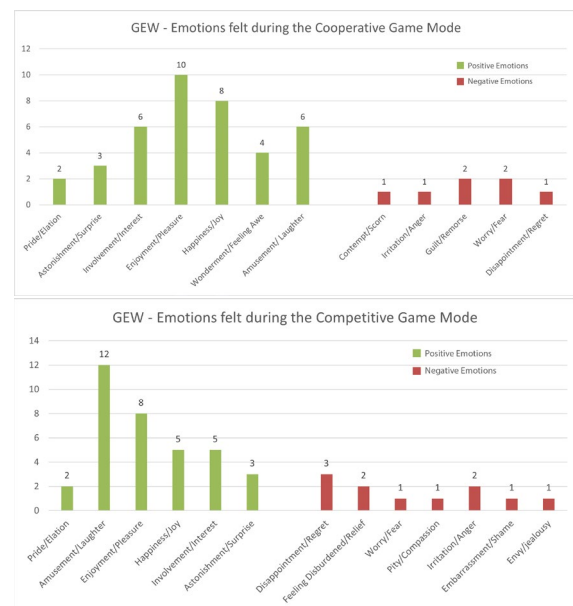
#### Negative Emotions

During the CompGm, several participants experienced frustration when their trash got stuck and did not easily fall into the holes, perceiving it as unfair because they did not want to lose due to this. Participant 1 explained that during the CompGm "I was more bothered when things

didn't feel fair" while Participant 3 mentioned that the CompGm made them feel upset about their own performance stating, "I had annoyingness towards myself after". This, however, was not supported by other participants, as mentioned earlier.

Many participants felt confusion at the beginning of the CooGm, however, this turned into enjoyment over the course of the game. Some participants also expressed that, they felt uncomfortable playing cooperatively: "It was sometimes a bit awkward". And some mentioned that even though they felt comfortable, they would have felt discomfort when playing such an involved game with a stranger: "I can imagine that for some people that would be uncomfortable if they don't know each other". Additionally, two participants mentioned experiencing a sense of guilt as they made mistakes during the CooGm perceiving their errors as hindrances to the co-player. Several participants also mentioned that their enjoyment of the game could be influenced by the performance of the second player. Participant 1 mentioned, "If I would have had a co-player in the cooperative mode who was really bad at playing. I would have gotten really frustrated".

The GEW shows that negative emotions were selected 11 times for the CompGm with disappointment being the most chosen, whilst negative emotions were selected only 7 times for the CooGm with Guilt/Remorse and Worry/Fear being the most chosen.



Graph 1&2: Bar Plots of emotions felt during the CooGm(Top) and the CompGm(Bottom).

### *Preferred Game Mode*

There is no overall consensus regarding preference for either game mode between participants. Eight of the participants expressed a preference for the CooGm, whilst seven preferred the CompGm with one participant having no clear preference.

Reasons favouring the CompGm were enjoyment from the thrill of winning against friends and the excitement of battling each other. On the other hand, participants enjoyed experiencing improvement and the collaborative nature of the CooGm. The sections above elaborate on the reasonings behind their preferences.

### *Relationship to the Second Player*

The dynamics of participant relationships were also mentioned during the focus group. In the CompGm, participants seemed to have opposing views regarding how their relationship with the second player would impact their enjoyment. Participant 3 empathized that *"Because I know who I'm playing against I really want to win"*. Although, *"If I was playing this game with someone else whom I didn't know, then I would act differently"*. Conversely, participant 5 stated that since they knew the second player, they were content with losing, however, if they were random opponents, they would want to prove their skill to prevent embarrassment. For the CooGm, the relationship with the co-player appeared to only affect the enjoyment, as participants would potentially feel uncomfortable playing with strangers.

### **Observations**

The observation of the CompGM revealed a general sense of tension and excitement between participants as most assumed an active stance to react to the lights more quickly. Whilst a few participants experienced confusion at the start of the game, most of them quickly grasped it, and only had to get used to the speed of the lights. An occurrence in all sessions was that some pieces of trash got stuck in the holes which prompted frustrated comments and body movements. An interesting observation was that after having thrown all their trash away, participant 8 decided to look around as if searching for more trash to continue playing. Regardless of winning or losing, after finishing, most participants were laughing.

The observations of the CooGm revealed that all pairs were initially confused and slightly overwhelmed, however, they all managed to figure it out before the

game ended. Interestingly, in some pairs, one player would take the lead at the beginning and give instructions but also make encouraging remarks to the other player. Over the course of the games, there seemed to be less tension and at the end of the game, all participants laughed and displayed enjoyment.

### **Competitiveness Index**

The questions from the CI consisted of true or false statements, designed to gauge the presence of a competitive mindset. The results indicate that seven participants answered at least 16 of the questions competitively. Six participants answered between 10 and 15 questions competitively. Three participants answered less than 10 questions competitively. This indicates that every participant had a somewhat competitive mindset with a little less than half of the participants being quite competitive, and the rest being between less competitively oriented to little competitively oriented.

### **DISCUSSION**

In this study, a prototype was used to understand whether a cooperative or competitive gamified co-experience with a trashcan could motivate people to discard their trash. The findings indicate that both game modes were generally enjoyed by participants who laughed and had fun regardless of the mode.

According to the SDT intrinsic motivation is fostered when autonomy is present alongside competence [15]. The results of this study demonstrate that competence was achieved in both game modes, through different ways. Most participants, however, felt more autonomous during the CompGm as the performance of the second player did not influence their own. This suggests that employing competitive gamification when discarding trash may enhance intrinsic motivation. However, the SDT also argues that the need for relatedness contributes to the development of intrinsic motivation [12]. This need appears to be more fulfilled in the CooGm where players actively engaged with each other. Nonetheless, in the CompGm, participants also appeared to have an enjoyable shared experience and felt a sense of connection, indicating that even though the CooGm leads to more relatedness, intrinsic motivation can still be further fostered in the CompGm.



Most of the pairs also expressed that they would enjoy the CooGm more if there was a shared scoreboard present in the park, showcasing the high scores set by other teams as this would make them "*care more*" about the score they achieved. Additionally, two participants highlighted that the CooGm could lose its appeal after some time, but they believe this could also be addressed with such a scoreboard. A scoreboard would turn the CooGm into an inter-team competition which has been shown to lead to the highest enjoyment and performance levels [27]. It could therefore develop even more intrinsic motivation than simply cooperation when it comes to discarding trash and should therefore also be investigated.

As mentioned above, previous research has suggested that user experience is amplified when shared with another person [5]. Participants perceived the co-experience as enjoyable in both game modes. Losing or performing poorly did not affect their perception negatively and therefore, only their enjoyment appears amplified. Thus, associating trash disposal with shared enjoyment could lead to a greater development of intrinsic motivation compared to an individual gamified experience. The results also indicate that the relationship with the second participant could play a role in the enjoyment of the game. Further investigation is warranted to explore how exactly this relationship influences game enjoyment as it could provide insights into other potential contexts where co-experienced gamification could be valuable.

The findings also revealed that there was no overall preferred game mode. This suggests that both game modes are equally enjoyable, and no inherent bias exists towards either mode. The quantitative approach employed in this study was valuable as it revealed the reasons behind participants' actions and emotions. However, conducting a follow-up study in an actual park setting would be important to investigate whether either game mode actually leads to long-term behaviour change through increased intrinsic motivation, or if it merely results in a temporary decrease in littering due to the novelty factor. A field study with quantitative measures would also allow the possibility to generalize these results to a broader population, which is not feasible with the current study. Validated questionnaires such as the Intrinsic Motivation Inventory (IMI) [20] could then be employed to assess which game mode enhances intrinsic motivation more.

When comparing the results of the CI with the preferred game modes reported by participants in the focus group, it appears that participants' competitive mindset had no apparent effect on their game mode preference. Contrary to expectations, some participants with a competitive mindset preferred the cooperative game mode and vice versa. One extreme example is Participant 11, who answered only 6 questions on the CI competitively but chose the CompGm as "*there you have a very clear winner*". This suggests that a high score alone may not be a sufficiently compelling goal for some players, which might have influenced the preferred game mode selection of some participants.

Finally, the findings demonstrate that both game modes elicit enjoyment and fun. However, it is observable that negative emotions such as frustration and irritation, were more frequently reported during the CompGm. Participants expressed frustrations when their individual performance was impeded by the prototype. This highlights a limitation of the study, as players' feeling of enjoyment was influenced which could have affected their perceived autonomy as well as their game mode preference. Nonetheless, this finding further supports the earlier argument that the competitive game mode is more likely to foster intrinsic motivation, as participants would have experienced a heightened sense of autonomy in the CompGm if the prototype did not have issues.

## CONCLUSION

This study investigates whether university students co-experiencing a competitive or cooperative gamified trashcan would lead to more intrinsic motivation to properly discard trash in public parks. Guided by the theoretical framework of the SDT, the findings of the study indicate that both game modes are perceived as enjoyable and engaging by participants. Each game mode provides a sense of competence to players albeit in distinct ways. Notably, participants report a higher degree of autonomy in the competitive game mode, where solely their individual actions influence the game outcome. Thus, according to the SDT, the competitive game mode is more likely to enhance intrinsic motivation, potentially fostering long-term behavioural change.

These findings highlight the potential of co-experienced gamification of trash receptacles in parks, as a means to change the mindset of park visitors to discard their trash correctly, and to mitigate the negative environmental and social consequences associated with litter. However, while this study demonstrates the potential to change behaviour via intrinsic motivation, future research is necessary to validate the effectiveness through a long-term field study.

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## REFERENCES

- [1] Aziz, N.A.A. et al. 2019. Public Perception to Littering in Greenspaces: A Case Study in Bintulu, Sarawak, Malaysia. *Journal of Physics*. (Nov. 2019). DOI:<https://doi.org/10.1088/1742-6596/1358/1/012031>.
- [2] Baker, S.E. and Edwards, R. 2012. How many qualitative interviews is enough. NCRM, University of Southampton. (Mar. 2012).
- [3] Battarbee, K. 2003a. Co-experience: the social user experience - Human factors in computing systems. CHI'03. (2003), 730-731.
- [4] Battarbee, K. 2003b. Defining co-experience. In Proceedings of the 2003 international conference on Designing pleasurable products and interfaces.
- [5] Boothby, E.J. et al. 2016. Psychological Distance Moderates the Amplification of Shared Experience. *Personality and Social Psychology Bulletin*. 42, 10 (Aug. 2016), 1431-1444. DOI:<https://doi.org/10.1177/0146167216662869>.
- [6] Braun, V. and Clarke, V. 2006. Using thematic analysis in psychology. *Qualitative Research in Psychology*. 3, 2 (Jan. 2006), 77-101. DOI:<https://doi.org/10.1191/1478088706qp063oa>.
- [7] Buckley, P.J. and Doyle, E. 2014. Gamification and student motivation. *Interactive Learning Environments*. 24, 6 (Oct. 2014), 1162-1175. DOI:<https://doi.org/10.1080/10494820.2014.964263>.
- [8] Burguillo, J.C. 2010. Using game theory and Competition-based Learning to stimulate student motivation and performance. *Computers & Education*. 55, 2 (Sep. 2010), 566-575. DOI:<https://doi.org/10.1016/j.compedu.2010.02.018>.
- [9] Chapman, J. and Rich, P.R. 2018. Does educational gamification improve students' motivation? If so, which game elements work best? *Journal of Education for Business*. 93, 7 (Sep. 2018), 315-322. DOI:<https://doi.org/10.1080/08832323.2018.1490687>.
- [10] Dahlström, C. 2012. Impacts of gamification on intrinsic motivation. *Education and Humanities Research*. Norwegian University of Science and Technology. (2012), 1-11.
- [11] Deci, E.L. et al. 1999. A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. *Psychological Bulletin*. 125, 6 (Jan. 1999), 627-668. DOI:<https://doi.org/10.1037/0033-2909.125.6.627>.
- [12] Deci, E.L. and Ryan, R.M. 1985. *Intrinsic Motivation and Self-Determination in Human Behavior*.
- [13] Flannery, M. 2017. Self-Determination Theory: Intrinsic Motivation and Behavioral Change. *Oncology Nursing Forum*. (Mar. 2017), 155-156. DOI:<https://doi.org/10.1188/17.onf.155-156>.
- [14] Fogg, B.J. 2009. A behavior model for persuasive design. In Proceedings of the 4th international Conference on Persuasive Technology.
- [15] Gagné, M. and Deci, E.L. 2005. Self-determination theory and work motivation. *Journal of Organizational Behavior*. 26, 4 (Apr. 2005), 331-362. DOI:<https://doi.org/10.1002/job.322>.
- [16] Groh, F. 2012. Gamification: State of the art definition and utilization. *Institute of Media Informatics Ulm University*. 39, 31 (2012).
- [17] Hartig, T. and Staats, H. 2006. The need for psychological restoration as a determinant of environmental preferences. *Journal of Environmental Psychology*. 26, 3 (Sep. 2006), 215-226. DOI:<https://doi.org/10.1016/j.jenvp.2006.07.007>.
- [18] Hollenbeck, J. et al. 1989. An empirical examination of the antecedents of commitment to difficult goals. *Journal of Applied Psychology*. 74, 1 (1989).
- [19] Hussain, G. et al. 2010. IMPACT OF PUBLIC PARKS ON HUMAN LIFE: A CASE STUDY. *Pakistan Journal of Agricultural Sciences*. 47, 3 (Jan. 2010), 225-230.
- [20] Intrinsic Motivation Inventory (IMI): <https://selfdeterminationtheory.org/intrinsic-motivation-inventory/>
- [21] Jung, J.E. et al. 2010. Enhancing the Motivational Affordance of Information Systems: The Effects of Real-Time Performance Feedback and Goal Setting in Group Collaboration Environments. *Management Science*. 56, 4 (Apr. 2010), 724-742. DOI:<https://doi.org/10.1287/mnsc.1090.1129>.
- [22] Kapp, K.M. 2012. *The Gamification of Learning and Instruction: Game-based Methods and Strategies for Training and Education*.
- [23] Keizer, K. et al. 2008. The Spreading of Disorder. *Science*. 322, 5908 (Dec. 2008), 1681-1685. DOI:<https://doi.org/10.1126/science.1161405>.
- [24] Kleinberg, A. 2012. Brands that failed with gamification. *iMedia Connection*. (Jul. 2012).
- [25] Koskinen, I. et al. 2013. Design Research Through Practice: From the Lab, Field, and Showroom. *IEEE Transactions on Professional Communication*. 56, 3 (Sep. 2013), 262-263. DOI:<https://doi.org/10.1109/tpc.2013.2274109>.
- [26] Moraz, N. 2020. Psychologische Massnahmen zur Reduktion des Litterings in einem urbanen Park. *Philosophischen Fakultät Der Universität Zürich Universität Zürich*. (Jun. 2020).
- [27] Morschheuser, B. et al. 2019. Cooperation or competition – When do people contribute more? A field experiment on gamification of crowdsourcing. *International Journal of Human-computer Studies*. 127, (Jul. 2019), 7-24. DOI:<https://doi.org/10.1016/j.ijhcs.2018.10.001>.

- [28] Nederlandse Vereniging van Reinigings Directeuren (NVRD): (2023). <https://l8.nu/rKNc>
- [29] Nichols, J.D. and Miller, R. 1994. Cooperative Learning and Student Motivation. *Contemporary Educational Psychology*. 19, 2 (Apr. 1994), 167-178. DOI:<https://doi.org/10.1006/ceps.1994.1015>.
- [30] NOS 2015. Mooi weer = vieze parken. NOS.
- [31] Qureshi, W. 2015. Coca-Cola encourages rugby fans to recycle. *Packaging News*. [packagingnews.co.uk](http://packagingnews.co.uk).
- [32] raleighnc.gov 2023. Tips To Help Prevent Litter. [Raleighnc.gov](http://Raleighnc.gov).
- [33] Rolighetsteorin 2009. Bottle Bank Arcade - TheFunTheory.com - Rolighetsteorin.se. YouTube.
- [34] Salen, K. and Zimmerman, E.I. 2003. *Rules of Play: Game Design Fundamentals*.
- [35] Scherer, K. et al. 2013. The GRID meets the Wheel: Assessing emotional feeling via self-report. *Components of Emotional Meaning: A Sourcebook*. Oxford: Oxford University Press. (2013).
- [36] Schultz, P.H. et al. 2013. Littering in Context. *Environment and Behavior*. 45, 1 (Jan. 2013), 35-59. DOI:<https://doi.org/10.1177/0013916511412179>.
- [37] Shteynberg, G. 2015. Shared attention. *Perspectives on Psychological Science*. 10, 5 (2015), 579-590.
- [38] Sibley, C.G. and Liu, J.K. 2003. Differentiating Active and Passive Littering. *Environment and Behavior*. 35, 3 (May 2003), 415-433. DOI:<https://doi.org/10.1177/0013916503035003006>.
- [39] Sitar, N. et al. 2014. *Gamification: Changing People's Behavior with Fun*. Worcester Polytechnic Institute. (2014).
- [40] Smither, R.K. and Houston, J.P. 1992. The Nature of Competitiveness: The Development and Validation of the Competitiveness Index. *Educational and Psychological Measurement*. 52, 2 (Jun. 1992), 407-418. DOI:<https://doi.org/10.1177/0013164492052002016>.
- [41] Tomitsch, M. 2014. Towards the real-time city: An investigation of public displays for behaviour change and sustainable living. *Making Cities Livable Conference*. 7, (2014).
- [42] Volkswagen 2009. *The Fun Theory 2 - an initiative of Volkswagen: The World's Deepest Bin*. YouTube.

# **APPENDIX**

# Ethical Review Form

(Version 1.6)

This Ethical Review Form should be completed for every research study that involves human participants or personally identifiable personal data and should be submitted to [ethics@tue.nl](mailto:ethics@tue.nl). For more information about how this process works please click [here](#).

## Part 1: General Study Information

<b>1</b>	Project title	Which (aspects) do users prefer when undergoing a competitive and a cooperative co-experience in the context of trash disposal?
<b>2</b>	Name of the researcher/student	Lucas Licht Pradillo,
<b>3</b>	Email of the researcher/student	<a href="mailto:l.g.w.licht.pradillo@student.tue.nl">l.g.w.licht.pradillo@student.tue.nl</a>
<b>4</b>	Supervisor(s) name(s)	Daniel Tetteroo
<b>5</b>	Supervisor(s) email address(es)	D.Tetteroo@tue.nl
<b>6</b>	Department	Industrial Design
<b>7</b>	Are you a student and is this application for educational purposes?	<input type="checkbox"/> Yes, Bachelor. Course: <input checked="" type="checkbox"/> Yes, Master. Course: <input type="checkbox"/> No
<b>8</b>	Research location	TU/e campus
<b>9</b>	Start date data collection	April/2023
<b>10</b>	End date data collection	June/2023
<b>11</b>	Does your project receive external funding (e.g., NWO, relevant for special regulations from funders)?	<input type="checkbox"/> Yes. Name Funder: <input checked="" type="checkbox"/> No
<b>12</b>	Which internal and external parties are involved in the study? Think about sharing data or information between TU/e and other universities, commercial companies, hospitals, etc.	<p><b>Participants of the Study</b> The participants of the study will be students of the TU/e. They will be between 18 and 27 years old.</p> <p><b>Researcher</b> I am the sole researcher of this project and will therefore handle the data by myself. No sensitive data will be acquired from the participants, and they will be anonymized.</p>
<b>13</b>	Have any special agreements already been made with an external party, such as a Non-Disclosure Agreement (NDA) or a data sharing agreement?	<input type="checkbox"/> Yes, namely: <input checked="" type="checkbox"/> No
<b>14</b>	Has your proposal already been approved by an external Ethical Review Board or Medical Ethical Review Board?  <i>Additional explanation: For example, when you are collaborating with another university and the project has been approved by their Ethical Review Board, or when you received a WMO-waiver from a Medical Ethical Review Board.</i>	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
<b>15</b>	If yes: Please provide the name, date of approval and contact details of the ERB. Please also include the registered number for your project approval. Additionally, please send in the Ethical Review Form upon which ethical approval was granted together with this form.	

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16	<p>Have you already performed a Data Protection Impact Assessment (DPIA) for this or a very similar project?</p> <p><i>Please read the information below: a DPIA is not the same as a regular privacy impact assessment. More detailed questions on privacy will follow in the section below.</i></p>	<p><input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p>If yes: Please provide details about the DPIA here and send in the DPIA documentation together with this form.</p>
<h3>Part 2: Medical study</h3>		
1	<p>Does the study have a medical scientific research question or claim?</p>	<p><input type="checkbox"/> Yes* <input checked="" type="checkbox"/> No</p> <p>*If yes or in doubt, please contact Susan Hommerson via <a href="mailto:s.m.hommerson@tue.nl">s.m.hommerson@tue.nl</a></p>
<h3>Part 3: Use of (medical) devices in the study</h3>		
1	<p>Does your research include a device?</p>	<p><input type="checkbox"/> Yes, not self-made <input checked="" type="checkbox"/> Yes, self-made <input type="checkbox"/> No</p>
2	<p>Please describe your device or link to an online description of the device</p>	<p>The device will be a rectangular box with several small holes on the top. In front of each of the holes a multicolor LED is attached with will light randomly over the course of the game to indicate to the user where to discard a piece of the trash. Underneath each of the holes, an infrared sensor is attached to determine whether the trash was discarded in the right hole and on time. All LEDs and sensors will be controlled using an Arduino attached safely to the inside of the box.</p> <p>The device will be able to accommodate two game modes. The first one will be competitive meaning two players will play against each other to achieve a higher score than the other. The second game mode is a cooperative one where the two players have to work together to achieve a high score by collaborating and communicating with one another.</p> <p>For both game modes, the individual or combined score will be displayed using an Arduino LCD display at the back of the device so it's easily visible.</p>
3	<p>Will you use a device that is 'CE' certified for <b>unintended use</b> (meaning you will use existing CE certified devices for other things than they were originally intended for) or use a device that is not 'CE' certified?</p>	<p><input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p>



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4	<p>If yes: Do you use a device or software that has a medical purpose such as diagnosis, prevention, monitoring, prediction, prognosis, treatment or alleviation of disease or injury?</p>	<p><input type="checkbox"/> Yes, my device or software currently has a medical purpose  <input type="checkbox"/> Yes, my device or software could have a medical purpose in the near future  <input type="checkbox"/> No  <input type="checkbox"/> I'm not sure</p>
<p><b>Part 4: Information about the study</b></p>		
1	<p>What are your main research questions?  <i>Additional explanation: You need to provide at least one clear research question.</i></p>	<p>Research question:          - Which (aspects) do users prefer when undergoing a competitive and a cooperative co-experience in the context of trash disposal?</p>
2	<p>Description of the research method  <i>Additional explanation: For example, interview, survey, experiment, user-test, Randomized Experiment, focus groups, pilot study, observation, etc.</i></p>	<p>The study will involve quantitative and qualitative research methods.</p> <p><u>Research-through design</u>          The device will be deployed in a lab setting for testing. This will allow me to control different variables which would make gaining research hard otherwise. For example, will I be able to control the number of people interacting with the trashcan at the same time and also how many pieces of trash each player has to play with.</p> <p><u>Introductory Questionnaire:</u>          Before starting the testing I will ask users to fill out a couple of questions regarding their relationship with the second participant and to see whether they are competitive by nature.</p> <p><u>Geneva Emotion Wheel</u>          After playing either game mode, the participants will be asked to fill out a Geneva emotion wheel. They will be asked to choose the three emotions they felt the most during the game and to indicate to what extent they felt them. I will elaborate on these emotions in the interview afterwards.</p> <p><u>Observation</u>          Additionally, whilst the participants are playing, I will be observing their facial expressions and comments. I will also note who won the competitive game mode and who performed better overall to understand whether that has an impact on their preference.</p> <p><u>Semi-Structured Interview</u>          After the testing, the players will be asked to take part in a short interview. In this interview, I will ask them to elaborate on the emotions they felt whilst playing the games, and I will relate the questions to the 3 human needs that make up the self determination theory (Competence, Autonomy and Relatedness), to see which aspects motivate participant to play the game modes more.</p>

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<b>3</b>	<p><b>Description of the research population, in- and exclusion criteria</b></p> <p><i>Additional explanation: Please describe which persons are eligible for your study. What criteria are used to select participants in your study, and what criteria are used to exclude possible participants?</i>  <i>For example: We will randomly select participants from the JSF participant database with good vision and older than 18 years.</i></p>	<p><b>Inclusion Criteria:</b></p> <ul style="list-style-type: none"> <li>- Healthy adult participants between 18-27 years old</li> <li>- Students of the TU/e</li> </ul> <p><b>Exclusion Criteria:</b></p> <ul style="list-style-type: none"> <li>- Physical or mental impairments limiting participation in the studies, or their understanding of the consent form and procedures.</li> <li>- Children under the age of 18 years old</li> </ul>
<b>4</b>	<p><b>Description of the measurements and/or stimuli/treatments</b></p> <p><i>Additional explanation: Think about your outcome measures and the variables you will be collecting and describe them in a way such that another person understands what the participant will experience.</i>  <i>For example: Participants will perform task A and see pictures from database B, and we measure validated Scale 1.</i></p>	<p><b>Introductory Interview:</b>  Measuring of relationship with participants, and standardized competitiveness questionnaire</p> <p><b>Observation</b>  Observing the participants comments and facial expressions, and denoting the winner and overall better performer.</p> <p><b>Emotion</b>  Geneva emotion wheel, and semi structured interview followup questions.</p>
<b>5</b>	<p><b>Describe and justify the number of participants you need for this study. Also justify the number of observations you need, taking into account the risks and benefits.</b></p> <p><i>Additional explanation: Think about if you need 3 or 30 participants for example, and why? Do they need to provide their input once, or several times, and why?</i></p>	<p>For the study, 10-15 pairs (20 – 30 participants) will be asked to participate.</p> <p>As this study uses both qualitative and quantitative data, these amount of participants should give enough insights to determine preferred parts of either game modes.</p>
<b>6</b>	<p><b>Explain why your research is societally important. What benefits and harm to society may result from the study?</b></p> <p><i>Additional explanation: What benefit will the results of your study have to society in general?</i></p>	<p>The research is societally important as it investigates how users could be motivated to use a gamified trash can. One could assume that this in turn would then lead to motivation in participants to litter less. Litter is a huge problem in today's society. Specifically, on hot summer days, parks are left completely littered which not only affects communities around the parks but also the overall city environment.</p> <p>One way to increase motivation in users is to use gamification. Specifically, the aspects of cooperation and competition have been shown to increase motivation in other fields and therefore it would be interesting to understand if there are certain aspects in either game mode which could be proposed to future designers, in order to design a gamified trashcan. This research can then be expanded on and a fully functional device could be researched in the field.</p>
<b>7</b>	<p><b>Describe the way participants will be recruited</b></p> <p><i>Additional explanation: How will you recruit participants for your study? For example, by using flyers, personal network, panels, etc.</i></p>	<p>The participants will be found and contacted by scoping the university. Ideally, pairs of friends will be asked to participate.</p> <p>They will be contacted via the researcher's own personal network.</p>

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<b>8</b>	<p>Provide a brief statement of the risks you expect for the participants or others involved in the study and explain. Also take into consideration any personal data you may gather and associated privacy issues.</p> <p><i>Additional explanation: Risks for the participants can be anything from risk of data breach to risk of safety or well-being. Describe these possible risks and describe the way these risks are mitigated.</i></p>	<p>This study involves minimal risks for the participants. Participants will not be exploited, and the research plan will be fully revealed before the start of the study. The researchers will have access to this data only with prior consent from the participants, who can decline to share their results at any moment. No individual results will be published, as conclusions will be made from the entire cohort's data.</p> <p>Risks of the Research Methods:</p> <ul style="list-style-type: none"> <li>- <u>Interviews/observations/usability testing</u> conducted within the research-through-design approach will be focused exclusively on the usage and experience of using the prototypes.</li> <li>- <u>Data collection</u>, including self-reported data, will be kept on a password-protected academic online platform at the Eindhoven University of Technology. All the personal data collected during the study will be processed confidentially and test subjects will never be recognisable in publications, academic material, or any other means.</li> </ul>
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### Part 5: Self-assessment checklist

<i>Note: answers in the blue boxes indicate that your research is eligible for fast-track approval</i>		Yes	No
<b>1a</b>	Does the study involve human material? (e.g., surgery waste material derived from non-commercial organizations such as hospitals)		x
<b>1b</b>	Will blood or other (bio)samples be obtained from participants? (e.g., hair, sweat, urine or other bodily fluids or secretions, also external imaging of the body)		x
<b>2</b>	Will the participants give their consent – on a voluntary basis – either digitally or on paper? Or have they given consent in the past for the purpose of education or for re-use in line with the current research question?	x	
<b>3</b>	Are the participants, outside the context of the research, in a dependent or subordinate position to the investigator?		x
<b>4</b>	Does the study involve participants who are particularly vulnerable or unable to give informed consent? (e.g., children (<16 years of age), people with learning difficulties, patients, people receiving counselling, people living in care or nursing homes, people recruited through self-help groups)		x
<b>5</b>	Will participating in the research be burdensome? (e.g., requiring participants to wear a device 24/7 for several weeks, to fill in questionnaires for hours, to travel long distances to a research location, to be interviewed multiple times)?		x
<b>6</b>	May the research procedure cause harm or discomfort to the participant in any way? (e.g., causing pain or more than mild discomfort, stress, anxiety or by administering drinks, foods, drugs, or showing explicit visual material)		x
<b>7</b>	Will financial inducement (other than reasonable expenses and compensation for time) be offered to participants?		x
<b>8a</b>	Will it be necessary for participants to take part in the study without their knowledge and consent at the time? (e.g., covert observation of people)		x
<b>8b</b>	If yes: Will you be observing people without their knowledge in public space? (e.g. on the street, at a bus-stop)		x

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<b>9</b>	Will the study involve actively deceiving the participants? (e.g., will participants be deliberately falsely informed, will information be withheld from them, or will they be misled in such a way that they are likely to object or show unease when debriefed about the study)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<b>10</b>	Will participants be asked to discuss or report sexual experiences, religion, alcohol or drug use, suicidal thoughts, or other topics that are highly personal or intimate?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<b>11</b>	Elaborate on all boxes answered outside of the blue boxes in part 5. Describe how you safeguard any potential risk for the research participant.		

### Part 6: Self-assessment on privacy

The following questions (1-10) concern privacy issues, as laid down in the General Data Protection Regulation (GDPR). The Data Stewards and – if necessary – privacy team of TU/e will assess these questions. In some cases, more information is required to assess the privacy risks. If this is the case, you will be notified that the Data Stewards team will contact you.

The GDPR defines ‘personal data’ as any information relating to an identified or identifiable natural person (‘data subject’). Personal data also includes data that indirectly reveals something about a natural person. Personal data can lead to the physical, physiological, genetic, mental, economic, cultural or social identity of a natural person. There are two main categories of personal data: regular personal data and special category personal data.

If you are not sure whether some of these questions below should be answered with a Yes or No, please contact a Data Steward first through [rdmsupport@tue.nl](mailto:rdmsupport@tue.nl).

*Note: answers in the blue boxes indicate that your research is eligible for fast-track approval*

		Yes	No
<b>1</b>	Will the study involve discussion/collection/processing of <b>regular</b> personal data, or will you collect and (temporarily) store video or voice recordings for the purpose of conducting interviews?  <i>Additional explanation: For example, name, address, phone number, email address, IP address, gender, age, video or interview recordings? If you are not sure whether your data contains personal data, please contact the Data Stewards Team (<a href="mailto:rdmsupport@tue.nl">rdmsupport@tue.nl</a>).</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<b>1A</b>	If yes: Please describe which regular personal data you will collect in this study?	I will be video and audio recording the testing of the device. If an image of the testing is used in the report users will be made unidentifiable.	
<b>2</b>	Will the study involve discussion/collection/processing of <b>special category</b> personal data or other <b>sensitive data</b> ?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<b>2A</b>	If yes: Please describe which special-category personal data and/or sensitive data you will collect in this study?		
<i>If you answered yes to either question 1 or 2, please answer the questions below. If you answered no to both questions, you can skip this part and continue onto part 6. Also, if an answer to any of the following questions is ‘yes’, please contact a Data Steward at <a href="mailto:rdmsupport@tue.nl">rdmsupport@tue.nl</a></i>			
		Yes	No
<b>3</b>	Will your project involve the processing of personal data on a <b>large scale</b> ?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<b>4</b>	Does this processing activity involve the use of new or innovative technologies?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<b>5</b>	Does your study involve systematic (c.q. automated) monitoring of persons?	<input type="checkbox"/>	<input checked="" type="checkbox"/>

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<b>6</b>	Does the study involve collaborations (with third parties) in which data are shared or exchanged in order to link or combine data?		X
<b>7</b>	Will the study include data processing activities that prevent data subjects from exercising their rights or using a service or contract?		X
<b>8</b>	Will the study process personal data to score, rank or profile persons?		X
<b>8</b>	Does your data processing include activities that involves composing “ <b>blacklists</b> ” – and, in particular, in relation to sensitive or special category data, such as communication data, financial records or credit scores, genetic data, biometric data, health data, camera surveillance data, location/GPS data, internet-of-things data, employee monitoring, observing or influencing behaviour, etc.		X
<b>9</b>	Will personal data be transferred or shared outside the EU/EEA? EU data protection rules apply to the European Economic Area (EEA), which includes all EU countries and non-EU countries Iceland, Liechtenstein and Norway.		X
<b>10</b>	Will any raw or anonymized personal data or any other sensitive data or research results from the project possibly be transferred to a high-risk country*?  <i>*High risk countries: China, Russia, Iran, Turkey, and North Korea. If personal data or other potentially sensitive data is exchanged with one of these countries, or if part of the data processing takes place in one of these countries: <b>an advice from the Data Protection Officer, the kennisveiligheidsteam (Knowledge Security team), and the CISO (Chief Information Security Officer) is ALWAYS required.</b></i>		X

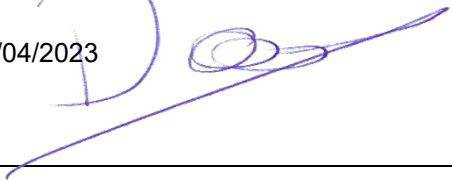
### Part 7: Data processing, storing and archiving

<b>1a</b>	Is consent your legal basis for processing the personal data in your study?  <i>Additional explanation: What is a legal basis? One of main principles in the GDPR is to ensure that personal data is processed lawfully, fairly, and transparently. To comply with this principle, the processing of personal data also requires that you have a valid legal basis for the personal data processing activity. In research projects, the legal basis is often but not always consent. However, it is possible that it is not clear or not possible to establish whether to use consent as a legal basis. Some examples where consent may not be applicable as legal basis are covert research, data collection in public spaces, secondary data analysis of existing data, data that are transferred to you by a third party, consent is not possible or would require disproportionate effort, etc. In that case, please indicate which legal basis you think that applies or (preferably) contact a data steward first.</i>	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
<b>1b</b>	If yes: Please briefly explain how you will obtain consent from participants and send in your draft of the information letter and consent statement together with this form. You can download a suitable template <a href="#">here</a> .	Before starting the study participants will be given a consent form informing them about their participation, how their data will be stored and handled, and what their rights are. The study will only begin once the consent form has been signed by both.
<b>1c</b>	If no: Please briefly explain on which legal basis - other than consent - you will process the personal data in your study.	
<b>2</b>	In which way will you collect and process the (personal) data?  <i>Additional explanation: Please describe which software (e.g., LimeSurvey, Atlas Ti, Qualtrics), tools (electronic lab journals, information management systems, etc.), technologies, apps or devices (Internet-of-Things, Fitbit, etc.), techniques (monitoring, interview, survey), special data environments (e.g., Living Lab), etc. you will use to collect or process data?</i>	The video recording of the testing will be done on a video camera. The recording of the audio will be done using a Dictaphone.  The interview will be transcribed using the transcribe function from Microsoft word.  Additionally, observations will also be noted on Microsoft word.

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3	Where will the data and in particular the personal data be stored during and after completion of the study? If you have already uploaded your Data Management Plan, you can refer to your Data Management Plan.	All data will be stored on Microsoft OneDrive.
4	Which security measures are applied?	<p>Visual and audio data will be collected on devices not connected to the internet and will be directly transferred to the cloud after completion of the testing.</p> <p>The collected data will be coded and detached from the personal data (participants' names) by assigning a randomized number to each data set provided by the participants.</p> <p>The coded data will be kept on a password-protected academic online platform at the Eindhoven University of Technology. All the personal data collected during the study will be processed confidentially and test subjects will never be recognizable in publications, academic material, or any other means.</p> <p>Only the researcher and supervisor will have access to the data.</p>

### Part 8: Closures and Signatures

1	<p>Enclosures (tick if applicable):</p> <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Informed consent form;</li> <li><input type="checkbox"/> Informed consent form for other agencies when the research is conducted at a location (such as a school);</li> <li><input type="checkbox"/> Text used for ads (to find participants);</li> <li><input type="checkbox"/> Text used for debriefings;</li> <li><input type="checkbox"/> Approval other research ethics committee;</li> <li><input type="checkbox"/> The survey the participants need to complete, or a description of other measurements;</li> <li><input type="checkbox"/> Any other information which might be relevant for decision making by ERB;</li> <li><input type="checkbox"/> Data Protection Impact Assessment checked by the privacy officer</li> <li><input type="checkbox"/> Data Management Plan checked by a data steward</li> </ul>	
2	<p>Signature(s)</p> <p>Signature(s) of researcher(s) Date:</p> <p>Signature research supervisor (if applicable) Date:</p>	<p>Lucas Licht Pradillo</p> <p><i>Lucas Licht Pradillo</i> 19/04/2023</p> <p>20/04/2023 </p>



## Ethical Review Form

Appendix: Consent Form that will be provided to participants before starting the testing

# Subject information for participation in scientific research

### Introduction

Dear Sir/Madam,

You are asked to take part in a scientific study.

Participation is voluntary. Participation requires your written consent. Before you decide whether you want to participate in this study, you will be given an explanation about what the study involves. Please read this information carefully and ask the investigator for an explanation if you have any questions. You may also discuss it with your partner, friends or family.

### 1. General information

Situation	Example passage
- Industry-initiated	Lucas Licht Pradillo

### 2. Purpose of the study

*Littering is an extremely common practice, especially in parks during warm summer afternoons. This study aims to understand which aspects of cooperative and competitive game modes participants prefer when interacting with gamified trashcans.*

### 3. What participation involves

During the study, the following will happen:

Firstly, you will be asked to fill out a short questionnaire. Afterwards, you will be introduced to the setting the testing will take place in. Following this, you will be asked to play a competitive and cooperative game mode with a gamified trashcan. After playing each game mode, you will be asked to note down the top 3 emotions you felt whilst playing the game mode. Lastly, a semi-structured interview will be done with both participants at the same time, elaborating on the emotions that were felt during the game modes but also about other aspects of the game modes.

### 4. What is expected of you

In order to carry out the study properly it is important that you follow the study instructions.

### 5. If you do not want to participate or you want to stop participating in the study

It is up to you to decide whether or not to participate in the study. Participation is voluntary.

If you do participate in the study, you can always change your mind and decide to stop, at any time during the study.

You do not have to say why you are stopping, but you do need to tell the investigator immediately.

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The data collected until that time will still be used for the study.

If there is any new information about the study that is important for you, the investigator will let you know. You will then be asked whether you still want to continue your participation.

### **6. End of the study**

Your participation in the study stops when

- you choose to stop
- the end of the entire study has been reached
- the investigator considers it best for you to stop
- The government or Ethical Review Board, decides to stop the study.

The study is concluded once all the participants have completed the study.

### **7. Usage and storage of your data**

Your personal data will be collected, used and stored for this study. This concerns data such as your name, address, date of birth and data about your health. The collection, use and storage of your data is required to answer the questions asked in this study and to publish the results. We ask your permission for the use of your data.

#### **Confidentiality of your data**

To protect your privacy, your data will be given a code. Your name and other information that can directly identify you, will be omitted. Data can only be traced back to you with the encryption key. The encryption key remains safely stored in the local research institute. The data that is sent to the sponsor will only contain the code, not your name or other data with which you can be identified. The data cannot be traced back to you in reports and publications about the study.

#### **Access to your data for verification**

Some people can access all your data at the research location. Including the data without a code. This is necessary to check whether the study is being conducted in a good and reliable manner. Persons who have access to your data for review are the committee that monitors the safety of the study. They will keep your data confidential. We ask you to consent to this access.

#### **Retention period of your data**

Your data must be kept for 12 weeks at the University.

#### **Withdrawing consent**

You can withdraw your consent to the use of your personal data at any time. This applies to this study and also to storage and use for future research. The study data collected until the moment you withdraw your consent will still be used in the study.

#### **More information about your rights when processing data**

## Ethical Review Form

For general information about your rights when processing your personal data, you can consult the website of the Dutch Data Protection Authority.

If you have questions about your rights, please contact the person responsible for the processing of your personal data. For this study, that is:

*TU/e:* See Appendix A for contact details, and website.

If you have questions or complaints about the processing of your personal data, we advise you to first contact the research location. You can also contact the Data Protection Officer of the institution or the Dutch Data Protection Authority.

### **8. Any questions?**

If you have any questions, please contact the researcher.

If you have any complaints about the study, you can discuss this with the investigator. If you prefer not to do this, you may contact the committee at your institution. All the relevant details can be found in Appendix A: Contact details.

### **9. Signing the consent form**

When you have had sufficient time for reflection, you will be asked to decide on participation in this study. If you give permission, we will ask you to confirm this in writing on the appended consent form. By your written permission you indicate that you have understood the information and consent to participation in the study. The signature sheet is kept by the investigator.

Thank you for your attention.

## Ethical Review Form

### 16. Appendices to this information

- A. Contact details TU/e
- B. Overview/description of study procedures

#### Appendix A: contact details for researchers and TU/e

##### Lucas Licht Pradillo

Department of Industrial Design, Eindhoven University of Technology, l.g.w.licht.pradillo@student.tue.nl

Complaints: **Daniel Tetteroo**, D.Tetteroo@tue.nl

Data Protection Officer of the institution:

For more information about your rights: [Ethics@tue.nl](mailto:Ethics@tue.nl)

## Ethical Review Form

### Appendix B: Subject Consent Form

#### Exploring how competition or cooperation affect motivation to litter less.

- I have read the subject information form. I was also able to ask questions. My questions have been answered to my satisfaction. I had enough time to decide whether to participate.
- I know that participation is voluntary. I know that I may decide at any time not to participate after all or to withdraw from the study. I do not need to give a reason for this.
- I give permission for the collection and use of my data to answer the research question in this study.
- I know that some people may have access to all my data to verify the study. These people are listed in this information sheet. I consent to the inspection by them.
  - I  **do**  
 **do not**  
consent to keeping my personal data longer and to use it for future research.
  - I  **do**  
 **do not**  
consent to being contacted again after this study for a follow-up study.
  - I want to participate in this study.

Name of study subject:

Signature: \_\_\_\_\_

Date: \_\_ / \_\_ / \_\_

I hereby declare that I have fully informed this study subject about this study.

If information comes to light during the course of the study that could affect the study subject's consent, I will inform him/her of this in a timely fashion.

Name of investigator :

Signature: \_\_\_\_\_

Date: \_\_ / \_\_ / \_\_