# MASTER THESIS

# The Exploration of a Gaming Interface Design's Effect on Perceived Littering Behavior

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Abstract

**Objective:** Littering is an issue that negatively affects our environment and it can also have a negative effect on our lives. There have been many studies that explore what causes littering behavior (i.e. social, situational, personal factors) and studies that discuss ways to mitigate littering behavior. This study attempted to seek another approach to mitigate littering. Thus, in this study, it was explored whether social norms (i.e. injunctive, descriptive) and an agent element on a mock-up gaming interface design could have direct or indirect effects on people's attitude and behavioral intention towards littering. Furthermore, it was investigated whether social norm cues and the agent element could elicit feelings of autonomy, competence, enjoyment, and appreciation.

**Method:** For this research, a between-subjects experimental design was created. The two mediators were the feeling of autonomy and competence, and enjoyment and appreciation. The moderator was prior environmental attitude. The respondents ($N$ = 424) were presented with one of the eight conditional gaming interface designs (based on the three stimuli) within the framework of an online survey. These were mock-up designs only created for this study to simulate an interface for a game concept, which could be developed in the future. Based on one of the interface designs respondents saw, they had to answer various statements on how the interface would affect their feeling of autonomy, competence, enjoyment, appreciation, attitude and littering behavioral intentions if it were an actual game.

**Results:** The results showed no significant direct effects between the social norms and attitude and intention towards littering behavior. Furthermore, the social norms had partial effects on the feeling of autonomy and competence: the injunctive norm had a significant effect on competence and the descriptive norm had a significant effect on autonomy. The agent element did not elicit enjoyment nor eudaimonic appreciation and thus, they did not mediate the relationship between the agent and attitude and littering behavioral intention. Lastly, prior environmental attitude did not moderate the relationship between the social norms and attitude and intention towards littering. However, it did show a significant effect on attitude and intention towards littering.

**Conclusions:** This research aimed to further explore social norms' influential effect on littering behaviors to get a broader picture on social norms' persuasive nature in a different context for the littering issue. Based on a quantitative analysis of attitudes and intentions towards littering behavior in response to a gaming interface design, it can be concluded that this specific mock-up interface design with the stimuli elements on it (i.e. social norms and agent) did not influence respondents' attitudes and intentions towards littering. This research helped to get a broader overview on how social norms work in a different environment, in a gaming interface design. Future studies could build on this research concept to create not only an interface but an actual game, which would have a littering behavior changing effect.

*Keywords: littering behavior, social norms, gamification, self-determination theory*

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# Introduction

Littering is a social problem, which is the improper disposal of a piece of garbage. People litter according to their social, situational or individual norms, which can differ culturally (Cialdini, Reno, & Kallgren, 1990). For instance, people tend to litter more in an already littered environment than in a clean environment. The presence of litter can trigger people that if it is something that other people do, they will act similarly, or they might think that littering is acceptable due to the accumulated amount of litter in their surroundings. On the other hand, in a clean environment where there is no trace of any kind of litter, individuals tend to litter less or not litter at all. These examples are contextual motivators for a littering behavior (Schultz, Bator, Large, Bruni, & Tabanico, 2013). Furthermore, one's age and gender can also influence littering behavior, however, there is little consistent proof on these demographic attributes within research (Schultz et al., 2013).

Littering does not only pollute the environment, but excessive garbage can have negative effects on the human health (e.g. infections, chronic diseases, respiratory diseases) (Ecube Labs, 2016; El-Fadel, Findikakis, & Leckie, 1997; Schultz et al., 2013; Thompson, Moore, Saal, & Swan, 2009). Various options are available to mitigate littering, such as to place more trash receptacles out, to implement new laws, or to place conspicuous signs out. As a consequence, the most effective solution could be the change of people's general littering behavior. Although littering does not seem to be as serious as for instance the air pollution issue, it is still a problem, and it can have a major impact on the environment and on the economy (Conserve Energy Future, 2020; El-Fadel et al., 1997; Thompson et al., 2009). Hence, to be able to help preserve the environment, at first, one has to make changes internally within the self. In other words, individuals would need to change their mindset and attitude about littering, which could benefit the environment in the long run. By looking at the bigger picture, this might seem as an insignificant step, however, these psychological changes could serve as the foundation.

As littering is an ongoing issue, there have been various studies on observing littering behavior and on possible ways to influence it. For instance, several studies used social norms– which are the "shared understandings about actions that are obligatory, permitted, or forbidden" (Ostrom, 2000, pp. 143-144)– in different ways, which was found to be highly effective in influencing behavior (e.g. Bergquist, Nilsson, & Schultz, 2019; Cialdini et al., 1990). These studies applied social norm cues as a persuasive design of trash cans (de Kort, McCalley, & Midden, 2008), as performing interventions with the help of an actor in a given setting (Reno, Cialdini, & Kallgren, 1993), in the form of information campaigns or in the form of signages (Cialdini, 2003).

However, these studies about littering behavior influence were studies within similar contexts and environments. To be able to better understand, and therefore, to have an extensive influence on littering behavioral intention, other contexts need to be explored to gain a broader insight. Thus, this study takes into account the aforementioned approaches and builds upon the effectiveness of the social norms by using an alternative approach to investigate the littering issue. This alternative is based on a more technological approach, where the social norm cues are transferred into a gamified setting. Therefore, this study proposes to fill in a gap within the

littering behavior research by placing social norm cues and their potential effects on the littering behavior intention into an interface design of a gamified system.

In general, people become highly motivated to carry out certain tasks if it either benefits them in some sort of ways or if it involves gratification. One form of gratification is the feeling of enjoyment. Enjoyment is something that people are actively looking for in their day-to-day lives, which is "associated with decidedly positive affective reactions or reactions related to thrills and excitement" (Oliver & Bartsch, 2010, p. 58). In other words, if people are not looking forward to do something, but gratification is an added value to it, people are more inclined to comply. Furthermore, Ryan, Rigby, and Przybylski (2006) suggested that fulfilling one's basic psychological needs (i.e. autonomy, competence, and relatedness) can contribute to enjoyment, and therefore, it can lead to motivation. Hence, this research attempts to explore the possible effects of this interpretation on one's littering behavior intention through an interface design of a gamified system.

Thus, the aim of this study is to identify the extent social norm cues with an agent element in a gaming interface design could elicit feelings of autonomy and competence, and influence attitudes and intentions towards littering by following the line of thought of the self-determination theory and motivation. Similarly to Orji, Vassileva, and Mandryk's (2014) research, this study will use a gaming interface design rather than an actual game to validate the design concept first before considering other factors. Orji et al. (2014) reasoned their choice of instrument as follows: storyboards serve as a visual language that people with different cultural backgrounds can comprehend; to validate the persuasiveness of the model it is easier to gather a large amount of data with storyboards; and storyboards "allow us to show in an 'ideal' form the essence of persuasive interaction" (p. 464). Hence, getting feedback at the earliest stage about this prototype can provide information on whether the desired effects are met.

For this reason, the research question is:

*"To what extent could social norm cues and an agent element in a gaming interface design elicit feelings of autonomy and competence, and influence attitudes and intentions towards littering behavior?"*

The relevance of this research is to explore an alternative way to influence littering behavior intention. It is an attempt to positively impact the environment and to raise people's awareness to be more environmentally conscious and responsible. By designing a prototype and by testing the perceived effectiveness of the gaming interface based on the theories, one could gain a better insight whether this idea proposition could be actually feasible.

# Theoretical Framework

In the upcoming section, first, people's general littering behavior and some littering mitigating techniques are discussed. Then, the two types of social norms and their persuasive effects are explored. Thereafter, the concept of gamification and its influence on behavior are explained. Then, self-determination theory and the concepts of hedonic enjoyment and eudaimonic appreciation are discussed in regard to motivation and game studies. Lastly, the effects of an agent element within games are described.

## 1.1 Litter and littering behavior

Littering is one of the environmental issues that our planet faces. Schultz, Bator, Large, Bruni, and Tabanico (2013) define litter as "items that are discarded by an individual, but it can include any item that is in an unacceptable location, regardless of the origin" (p. 36). People litter consciously or unconsciously depending on a particular situation. When an individual takes his/her hand out of their pocket or purse, any item can accidentally fall out. On the other hand, they can consciously throw away cigarette butts, plastic bags, or glass bottles, simply, because they do not care about their environment. Furthermore, Schultz et al. (2013) posit that there are many social, environmental and aesthetic consequences of littering. In the environmental context, littering leads to contamination; in the social context, litter can be a source of fire hazards, human health hazards, safety hazards and other indirect health hazards from bacteria, roaches etc.; in the aesthetic context, littering causes an unpleasant view that can negatively impact communal areas, sales of properties, and property value.

Consequently, Schultz et al. (2013) focused on the causes and possible preventions for littering behavior. Their research confirmed that there are individual-level variables (i.e. age, gender, attitudes, motivation) and contextual variables (i.e. existing litter being present, the distance of trash receptacles) that cause littering behavior. They explored that most of the littering happened with intention, however, they pointed out that it is difficult to differentiate between intentional and unintentional littering. Furthermore, 85% of the littering was due to the aforementioned individual-level variables. With this information in mind, it would be interesting to discover other initiatives that could affect people's littering behavior and to discover whether these initiatives could be effective tools to mitigate littering behaviors.

For preventive techniques, Burgess, Clark, and Hendee (1971) performed an experimental analysis for anti-littering procedures. They noted that there are three traditional approaches in order to control public littering: changing people's attitudes through persuasive communication and advertising campaigns; laws and regulations; and surveys to find out the social and personality characteristics of 'litter bugs'. However, Burgess et al. (1971) posit that these approaches are not very effective: first, advertising campaigns show little effect on littering behaviors due to the still existing litter issues and second, in spite of the laws, it seems unlikely to trace back the litter to the source. Thus, individuals who are being forced to follow the laws and rules, are more likely to resist them and legal sanctions (e.g. fines) will have a small effect if not a counterproductive effect on changing behavior (Gneezy & Rustichini, 2000). Lastly, there have been only a few studies on the demographic and personal characteristics of 'litter bugs', and most of them did not find any notable demographic predictors (Burgess, Clark, & Hendee, 1971; Schultz et al., 2013).

Overall, the above-mentioned studies demonstrated the various possibilities to reduce littering intentions. As Schultz et al. (2013) observed, the issue can be found within the self, within individuals' attitude, and hence, in one's motivation. Furthermore, the aforementioned techniques to influence behavior were an attempt for extrinsic motivation to affect individuals rather than approaching individuals from their intrinsic motivation. Hence, this study attempts to explore whether individuals could be influenced by their *intrinsic values,* focusing on social norm behaviors.

## 1.2 Social norms' effect on the attitude and intention towards littering behavior

The results of the following studies on littering behavior showed that with the use of social norm cues, human behaviors can be influenced. A norm is "a principle of right action binding upon the members of a group and serving to guide, control, or regulate proper and acceptable behavior" (Merriam-Webster, n.d.b). Deutsch and Gerard (1955) identified two types of social norms: the normative [injunctive] social norm and the informational [descriptive] social norm. Reno, Cialdini, and Kallgren (1993) describe injunctive norms as "what people *approve and disapprove* within the culture and motivate action by promising social sanctions for normative or counter normative conduct" (p. 104) and descriptive norms as "*what most people do* in a particular situation, and they motivate action by informing people of what is generally seen as effective or adaptive behavior there" (p. 104).

Many studies indicate that both social norms can motivate people's action: individuals do what is socially accepted and they do what is popular. Hence, Cialdini (2003) states that to successfully communicate environmental messages, the alignment of both norms in persuasive messages are necessary. He further explains that one has to be careful with the formulation of descriptive normative messages. In order to succeed, the message should refer to the desired environmental behavior instead of pointing out to the environmentally harmful behaviors (also in Cialdini, Demaine, Sagarin, Barrett, Rhoads, & Winter, 2006). To test the effectiveness of the combined social norm messages, Cialdini (2003) and his colleagues performed an experiment to increase recycling. Their results showed that their campaign messages were successful because they also included informative and humorous elements besides the norm-related messages. Moreover, the results demonstrated that the recycling intention was successfully influenced by both the norm-related and the non-normative elements (Cialdini, 2003).

Furthermore, Kallgren, Reno, and Cialdini's (2000) research showed that social norms are persuasive if they are consciously present during the behavioral act. However, Kallgren et al. (2000) posited that norms are not always in force. In spite that they are embedded in culture and in people, situational factors and dispositional factors can affect norm focus. This explains why people behave differently in the same society. Consequently, people have to be reminded of these social norms to perform a certain behavior. For this reason, this study will present the social norm cues on the display as one of the stimuli materials to explore its potential effect in a gamified environment.

Overall, social norms can influence people's behavior, more specifically littering behaviors, and it can motivate people's actions. Therefore, it is hypothesized that social norm cues will have a direct effect on the attitude and intention towards littering behavior.

Furthermore, the combination of the two type of norm messages together can have a stronger impact on one's behavior. Thus, the following hypotheses were formulated:

H1: *The injunctive norm cue has a positive effect on the attitude and intention towards littering behavior.*
H2: *The descriptive norm cue has a positive effect on the attitude and intention towards littering behavior.*
H3: *The injunctive and descriptive norm cues together have a stronger positive effect on the attitude and intention towards littering than displaying them separately.*

## 1.3 Gamification and persuasion

To be better acquainted with the study, one has to understand what gamification, serious games, and persuasive games are. Serious games are "any form of interactive computer-based game software for one or multiple players to be used on any platform and that has been developed with the intention to be more than entertainment" (Ritterfeld, Cody, & Vorderer, 2009, p. 6, as cited in Deterding, Dixon, Khaled, & Nacke, 2011, p. 10). In this sense, the phrase 'more than entertainment' can refer to education or persuasion. These games, of course, can be enjoyable and entertaining, but the main focus lays in the higher purpose (Jacobs, 2018).

According to Jacobs (2018), "persuasive games are a subset of serious games that are created with the primary intention of changing or reinforcing certain attitudes" (p. 231). Furthermore, previous persuasive game studies demonstrated that interactivity, enjoyment, and fulfilling the need for competence can affect the level of persuasiveness, thus leading to increased attitude change (Jacobs, 2018; Peng, Lee, & Heeter, 2010; van't Riet, Meeuwes, van der Voorden, & Jansz, 2018). Moreover, van't Riet, Meeuwes, van der Voorden, and Jansz, (2018) noted that persuasive digital games have the power to positively affect and bring change to society.

Deterding, Dixon, Khaled, and Nacke (2011) define gamification as "the use of game design elements in non-game contexts" (p. 10). Deterding et al. (2011) differentiated between gamification and serious games based on the elements they include. They posit that while serious games are actual games with non-entertainment purposes, gamified applications are the incorporation of certain game elements. However, they note that the line between the two is often blurred. Deterding et al. (2011) state that this boundary between serious games and gamified applications is subjective, practical, and depends on agreement and on one's focus. This remark is important with the scope of this study, as the proposed 'game' is in borderline with the definition of gamification and serious games/persuasive games. Consequently, the proposed game design's main purpose is education and its potential influence on attitudes and behavioral intentions by using gamified elements, which theoretically, could affect users simultaneously while using the game.

Gamification is a rather complex concept; therefore, for one to better understand its effect, it is in need for some further explanation. According to Deterding et al. (2011), the term 'gamification' was first used in 2008, however, it was not officially adopted until 2010. There have been many parallel terms within game studies, but gamification has not been specified beforehand, which could be due to the complexity of its gamefulness, gameful interaction, and

gameful design (Deterding et al. 2011). However, there are some other understandings of the concept gamification. Robson, Plangger, Kietzmann, McCarthy, and Pitt (2015) define gamification as "the application of lessons from the gaming domain to change behaviors in non-game situations" (p. 412). Sailer, Hense, Mayr, and Mandl (2017) explained that its main objective is taking the core elements of games and applying them in a real-world context, sometimes, with the aim to motivate concrete behaviors in a particular situation. For this reason, these sorts of games have the ability to raise awareness of environmental problems, and hence, they could influence people's behaviors to become more environmentally directed (Agusdinata & Lukosch, 2019).

Opposed to Detering et al. (2011), Werbach (as cited in Sailer, Hense, Mayr, & Mandl, 2017) approached gamification differently by taking into consideration user experience. He defined gamification as "the *process* of making activities more game-like" (p. 372). According to Sailer et al. (2017), this process includes selecting, applying, implementing, and integrating the game design elements instead of just using them. This understanding makes the gamification process more feasible.

Furthermore, Robson et al. (2015) and Sailer et al. (2017) state that gamification is broadly used in different fields such as in healthcare, education, transportation, environmental protection, sustainability and in many other fields. In regard to this, Sailer et al. (2017) posit that the start or maintenance of a goal-directed behavior (i.e. littering behavior) can be stimulated with gamification. In other words, with gamification factors people become aware of their attitude, which can lead to a change in their behavior. Thus, the proposed game could bring awareness in people's everyday life, which could affect their attitudes. Moreover, Robson et al. (2015) discussed that gamification is effective in motivating individuals in changing behavior because of its reinforcements and emotions. Accordingly, they elaborate on how negative-positive and external-internal reinforcements equally can motivate repetitive behaviors. Overall, Robson et al. (2015) note that "gamification can produce desired behavior change through the formation of habits by reinforcing the reward and emotional response of the individuals participating in the experience, thus requiring fewer cognitive resources each time the desired activity is reproduced" (p. 413). In short, through games and gamification factors, it is possible to raise awareness and to influence behavior in non-game contexts because of reinforcements and emotions.

Additionally, in regard to the information within a game (i.e. social norm cue about littering behavior), van't Riet et al. (2018) posit that persuasive information within digital games can be more relatable, hence, they can be more effective than presenting persuasion information though traditional channels.

Overall, the aforementioned findings confirm the possible persuasive effects of the proposed game design, which could potentially lead to one's attitude change and even intention change of behavior. Furthermore, gamification factors can influence behavior through the reinforcements of rewards and emotional responses, which leads up to the emergence of habits that eventually will be requiring less and less cognitive thinking.

## 1.4 Self-determination theory, hedonic enjoyment, and eudaimonic appreciation within game studies

Oliver and Bartsch (2010) noted that entertainment psychology theories became more focused on the process of enjoyment and on the responses to it. Entertainment, enjoyment, appreciation, or fun are relative terms, they can be looked at from several angles and can be interpreted in various ways and depths. Some concepts that are relevant in the scope of this study and with the interpretation of the above-mentioned terms are hedonism and eudaimonia (Daneels, Vandebosch, & Walrave, 2020). Hedonism is the simple "pursuit of pleasure and amusement" (Oliver & Raney, 2011, p. 985), which is more *outcome* oriented in regard to pleasure or to happiness (Ryan, Huta, & Deci, 2008). Meanwhile, the concept eudaimonia is more related to "meaningful, moving, and thought-provoking experiences" (Daneels et al., 2020, p. 1), which is more *process* oriented (Ryan et al., 2008).

Waterman (1993) researched whether hedonic enjoyment and eudaimonia (i.e. personal expressiveness) can be differentiated from each other. The results showed that these two types of happiness are indeed distinguishable. Furthermore, the experimental study of Oliver and Raney (2011) demonstrated that users can experience both hedonism (e.g. pleasure) and eudaimonia (e.g. meaningfulness) during media entertainment. These findings provided an opportunity to better understand users' entertainment motivations (Oliver & Raney, 2011). As a consequence, the mindset that games can elicit meaningfulness and purpose gives a novel viewpoint within entertainment gratification (Oliver & Bartsch, 2010).

In their study, Ryan, Huta, and Deci (2008) aimed to develop a general framework for eudaimonia and to propose a model based on the self-determination theory, mainly because these two concepts share similar aspects (e.g. intrinsic motivation). The self-determination theory (SDT) posits that the basic psychological need satisfaction for autonomy, competence, and relatedness can promote well-being (Ryan et al., 2008). Furthermore, they define that the need for autonomy "refers to a sense of choice and volition in the regulation of behavior"; "the need for competence concerns the sense of efficacy one has with respect to both internal and external environments"; and "the need for relatedness refers to feeling connected to and cared about by others" (Ryan et al., 2008, p. 153). In other words, autonomy is high when one behaves out of own interest and personal value (Ryan, Rigby, & Przybylski, 2006). Moreover, it has been observed that freedom of choice, the usage of rewards as feedback, and the control-free instructions led to the feeling of autonomy, and therefore, to intrinsic motivation (Ryan et al., 2006). Additionally, as competence is the "need for challenge and feelings of effectance", new challenges, the development of abilities and skills, or positive feedback can lead to the feeling of competence, and consequently, to intrinsic motivation (Ryan et al., 2006, p. 349).

Similarly, Tamborini, Bowman, Eden, Grizzard, and Organ (2010) established a model for enjoyment derived from the SDT, which also contained the satisfaction of the three basic psychological needs. However, they used video games as the context, where they manipulated elements of video games in regard to autonomy, competence, and relatedness to observe what effects they have on enjoyment. In other words, Tamborini et al. (2010) examined if there is an effect between game elements, the three basic needs, and enjoyment to provide a wider insight about the concept enjoyment. They posit that when one fulfills these intrinsic motivations, heightened activity engagement, enjoyment, and satisfaction (e.g. playing video games) can be observed. The results of their study showed that autonomy, competence, and

relatedness indeed predicted enjoyment within media entertainment. Based on Tamborini et al.'s (2008) findings, Oliver and Raney (2011) note that media entertainment enjoyment can be comprehended as the fulfillment of both lower-order (i.e. hedonic enjoyment) and higher-order needs (e.g. autonomy), where the latter is essentially equivalent to eudaimonic appreciation. Furthermore, Ryan et al.'s (2006) study on SDT's effects on motivation in game play showed that psychological need satisfaction contributed to the enjoyment of the game, and to future game play intentions.

Daneels, Vandebosch, and Walrave (2020) posit that one can have a better understanding of why games can elicit eudaimonic experiences with the help of certain game elements (e.g. narratives). Digital games are interactive platforms, where users can develop identification through the game characters/agents/avatars (e.g. customization), develop relationship with other players, and in certain games make moral choices, which can lead to eudaimonic experiences (Daneels et al., 2020). Furthermore, they pointed out that game mechanics (e.g. rules, interface) and social interactions (e.g. with both humans and NPCs) can also contribute to eudaimonic game experiences. With digital games offering the option to play with other players, they have the opportunity to connect and make friends. Hence, it also gains a competitive aspect, which with the aforementioned can fulfill players' relatedness needs that can induce enjoyment, therefore, it can enhance eudaimonic experiences (Daneels et al., 2020). The results of their study showed that the realistic aspect and the learning aspect of games, which can reflect on current societal issues (e.g. environmental problems), were all identified as eudaimonic.

Similarly, Sailer et al. (2017) researched how gamification motivates by examining which game design elements can motivate and fulfill the need for autonomy, competence, and relatedness. They argued that "gamification is not effective per se, but that specific game design elements have specific psychological effects" (Sailer et al., 2017, p. 371). The game design elements they used were based on their visibility aspect as they are recognizable on the interface for users, and therefore, they can be manipulated more easily. They posited that "enriching the environment with game design elements, as gamification does by definition, directly modifies that environment, thereby potentially affecting motivational and psychological user experiences" (Sailer et al., 2017, p. 374). The results of Sailer et al.'s (2017) study demonstrated that two game design element groups had a positive influence on need satisfaction. The group consisted of leaderboards, performance graphs, and badges influenced the need for competence, and the group consisted of teammates, avatars, and meaningful stories influenced the need for social relatedness.

Additionally, in relation to this, Oliver et al. (2018) noted that there are other conceptualizations of media experiences, which are related to the SDT and to intrinsic need fulfillment. For instance, a model of entertainment motivation by Vorderer, builds upon the fulfillment of hedonic enjoyment in relation to pleasure and comprehension, whereas in his understanding of appreciation, entertainment is the source to fulfill basic psychological needs.

Overall, these studies were the determinants of which game design element this current study would use, as they were found to have a positive effect on the basic psychological needs, which led to motivation. Based on the findings of the aforementioned studies, it is proven that certain game elements can affect one's psychological need satisfaction, which can enhance gratification. Therefore, certain social norm messages (e.g. which say what people approve and

what most people do) as game design elements have an information sharing or educational aspect about littering, which with the other interface design elements could influence people's feeling of autonomy and competence. However, the studies above tested the game elements in an actual experiment, where participants were exposed to actual games for a longer period of time. Meanwhile, this research is testing a mock-up interface design of a game rather than a game itself to explore whether a simple interface design could have the same impact on people. Thus, a chain effect is introduced: Social norm elements can influence people's feeling of autonomy and competence. One's psychological need satisfaction can enhance gratification (i.e. collective phrase for enjoyment and appreciation). Overall, this can lead to intrinsic motivation, which can affect people's attitudes and intentions towards littering. Furthermore, as it was described in section 1.2, the combination of both social norm messages together can have a stronger impact on one's behavior. For these reasons, the following hypotheses were formulated:

H4: *The injunctive norm cue positively affects feelings of autonomy and competence.*

H5: *The descriptive norm cue positively affects feelings of autonomy and competence.*

H6: *The interaction of the injunctive norm cue and the descriptive norm cue have a stronger positive effect on predicting feelings of autonomy and competence than their effect separately.*

H7: *Feelings of autonomy and competence, and feelings of enjoyment and appreciation both mediate the influence of norm cues on attitude and intention towards littering behavior.*

## 1.5 The importance of characters within games

Anthropomorphism is a relevant concept within games, it is "the ascription of human characteristics to nonhuman entities" (Caporael, p. 215). Anthropomorphic characters in a game can increase users' engagement, further, users become more excited and interested in the game, especially, when the character differs from what is ordinary (i.e. unusual) (Nowak & Biocca, 2003). Furthermore, Nowak and Biocca's (2003) study demonstrated that users acknowledged these characters – either "human or nonhuman like" – similarly to when they were acknowledging humans (p. 490; Nowak, Hamilton, & Hammond, 2009). In other words, Krcmar and Eden (2019) explained that as soon as users start playing a game, they think about it as their reality, and they look at the avatars and agents in a social way. Moreover, the results showed that users became more engaged and immersed in the fictious setting when they were having a visible character in the game they could interact with, compared to the times without a visible character (Nowak & Biocca, 2003)

Before going any further, it is important to distinguish *agents* and *avatars*. This study uses an agent "whose actions are controlled by the computer itself", meanwhile, an avatar's "actions are controlled by a human in real time" (Nowak & Biocca, 2003, p. 483). The agent within this study is the means to interact with the user and share relevant information, therefore, the user cannot control it.

Overall, it was demonstrated that a character within a game can create more engagement, interest, and excitement, which can lead to gratification (i.e. enjoyment and appreciation). Furthermore, as it was mentioned before, gratification can lead to motivation,

which can then influence people's attitudes and intentions towards littering. Therefore, the following hypotheses were formulated:

H8: *The agent element has a positive effect on enjoyment and appreciation.*

H9: *Predicted feelings of enjoyment and appreciation mediate the effect of the agent element on attitude and intention towards littering behavior.*

The aforementioned studies confirm the effectiveness of social norm elements and the agent element in enhancing engagement and in changing behavior. Hence, this study indicates that incorporating the social norm cues with the agent element in a gamified environment, the results could be more effective. Additionally, other design elements such as non-normative factors (Cialdini, 2003) are being part of the basic interface design to strengthen its realism aspect.

H10: *The agent element strengthens the effect of the norm cues resulting in a greater effect of predicting feelings of autonomy and competence.*

Additionally, Cialdini's (2003) research demonstrated that 'prior attitude toward recycling' (i.e. environmental concern) has an effect on the intention to recycle besides norm-based messages. This means, that participants will base their answers on how environmentally conscious and aware they are in general. Hence, it can moderate the effect outcome. Thus, the study hypothesizes that:

H11: *The effect of both social norm cues on attitude and intention towards littering behavior is moderated by prior environmental attitude.*

Based on the 11 hypotheses, a conceptual model was created to visualize the hypothesized effects, which can be seen in Figure 1.

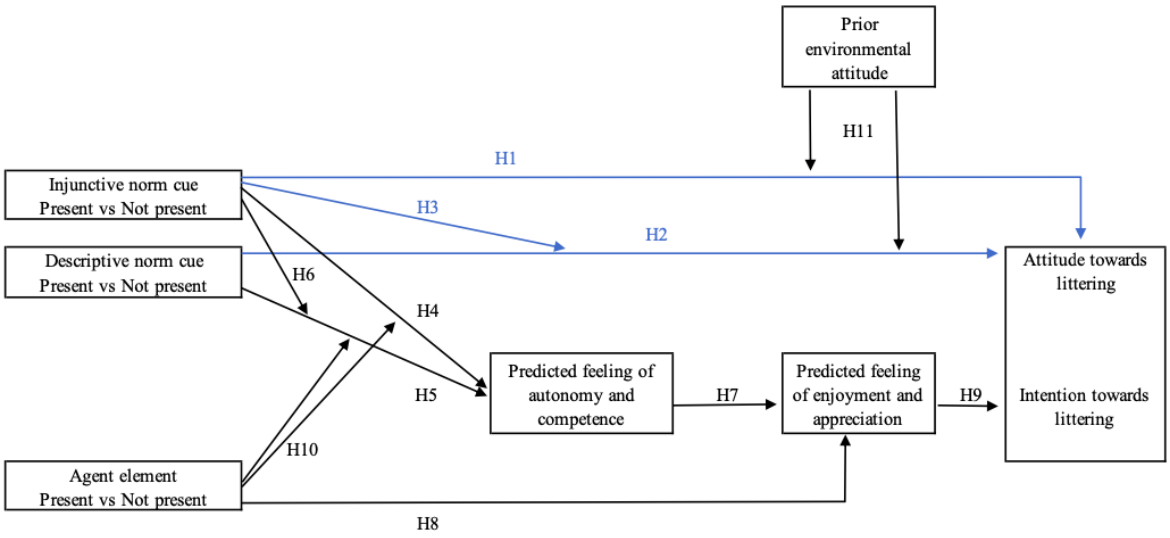


*Figure 1.* Conceptual model.

# Methodology

In the following section the design of the study, the procedure, the participants, the stimulus materials, and the measurements with the factor analysis and reliability tests are explained.

## 2.1 Design

For this research, a 2x2x2 between-subjects experimental design was created. The three independent variables include the injunctive norm cue (present versus not present), the descriptive norm cue (present versus not present), and the agent element (present versus not present). The dependent variables contain attitude and intention towards littering behavior. Consequently, based on the 2x2x2 framework, eight conditions were created (see Table 1). These conditions were represented on eight different gaming interface designs that were randomly assigned to the participants.

Furthermore, two mediators and a moderator were proposed between the independent and dependent variables. The two predicted mediators were the *feeling of autonomy and competence*, and *the feeling of enjoyment and appreciation*. The predicted moderator was the *prior environmental attitude*, with other words, the environmental concern. Therefore, besides the direct effects between the two independent variables (i.e. social norm cues) and the dependent variables, it was measured whether the feeling of autonomy and competence, and enjoyment and appreciation would have a mediating effect, and whether prior environmental attitude would have a moderating effect. The eight conditions with the sample distributions are represented in Table 1.

Table 1

*The Eight Conditions with the Sample Distributions, N = 315*

| | Injunctive norm cue | | | |
|---|---|---|---|---|
| | Present | | Not present | |
| | Descriptive norm cue | | Descriptive norm cue | |
| Agent | Present | Not present | Present | Not present |
| Present | *N* = 41 | *N* = 38 | *N* = 38 | *N* = 40 |
| Not present | *N* = 43 | *N* = 37 | *N* = 38 | *N* = 40 |

## 2.2 Procedure

For this experimental study, a survey was designed with Qualtrics, which was created in English and was translated into Hungarian as well to reach a wider audience. In this way, respondents who could not speak English were also able to fill out the survey. The online data collection approximately took one week according to the response rate. The survey began with an informed consent form, with a short introduction about the study and with some demographic questions about gender, age, educational background and then some questions about participants' attitude in regard to prior environmental concerns. Following the preliminary section, the main survey began. First, participants had to read a briefing about the

proposed game (see in Appendix A) to understand the context and on the same page one of the eight different conditions (i.e. the visual interface designs) were randomly presented to them. After they read the information and looked at the interface design, they were able to click to the next page. Here, the various statements were presented, and the participants had to rate them, based on how they felt after looking at the interface, on a 7-point Likert scale. At first, statements about the feeling of autonomy and competence were presented. Then, statements about enjoyment and eudaimonic appreciation were shown. It was then followed by statements about the participants attitude and intention towards littering. At the end, a manipulation check was performed, where the participants had to choose whether there was an agent on the interface they saw, and which statement appeared on the interface design.

## 2.3 Participants

For the survey, a snowball sampling method was used. A minimum of 30 participants were needed for each condition. An overall of $N = 424$ responses were captured. From the $N = 424$ only $N = 315$ were usable for the analysis as 109 responses were incompletely answered, and hence, they did not contain valuable answers for the study. The target group were people who owned a smartphone as they were more likely to be familiar with games that were designed for smartphones. As it was mentioned before, the participants were able to choose the language of the survey based on their preference. The survey was distributed through social media channels (e.g. Facebook, Messenger, WhatsApp, Instagram, LinkedIn).

In Table 2, one can see the respondents' demographic characteristics. More than half of the respondents filled out the survey in English. Most respondents were between the age of 15-25, which is not a surprise as the researcher had a greater network among this age group. Furthermore, most respondents were female, and the majority of the respondents have obtained a Bachelor's degree. Moreover, age and gender were roughly equally distributed within the eight conditions and an ANOVA test confirmed that the distributions among the conditions were not significantly different ($p = .67$; $p = .79$).

Table 2

*Respondent's Demographic Characteristics (N = 315)*

| Demographics | | *n* | *%* |
|---|---|---|---|
| *Language* | | | |
| | English | 182 | 57.8 |
| | Hungarian | 133 | 42.2 |
| *Age* | | | |
| | 15-25 | 198 | 62.9 |
| | 26-35 | 54 | 17.1 |
| | 36-45 | 13 | 4.1 |
| | 46-55 | 35 | 11.1 |
| | 56-65 | 13 | 4.1 |
| | 66-75 | 2 | 0.6 |
| *Gender* | | | |
| | Male | 91 | 28.9 |

| | | |
|---|---|---|
| Female | 223 | 70.8 |
| Other | 1 | 0.3 |
| *Education* | | |
| Less than a high school diploma | 6 | 1.9 |
| High school diploma or equivalent | 73 | 23.2 |
| Associate's degree (e.g. MBO) | 35 | 11.1 |
| Bachelor's Degree (e.g. HBO, WO) | 141 | 44.8 |
| Master's Degree (or specialization after Bachelor's) | 57 | 18.1 |
| Doctorate (e.g. PhD, EdD) | 3 | 1 |
| *Total* | 315 | 100% |

## 2.4 Stimulus material

Based on the conditions, the stimulus materials were presented on eight gaming interface designs. The study included three stimulus materials: an injunctive norm cue, a descriptive norm cue, and an agent element. At first, to test the validity of the stimulus materials, a pre-test was performed in the framework of an interview. For this, a total of eight interviews were conducted. Out of the eight interviews, six interviews took place in English and two interviews took place both in English and in Hungarian. In the interviews, the respondents were asked about the stimulus materials and about whether the measurement items were understandable or not. Some questions were directed towards the agent element to ask which 3D figure the participant found most likeable and suitable for the proposed gaming interface. Furthermore, these figures were animated and performed various movements to enhance their realness. Then, some questions were directed towards the formulation and comprehensibility of the social norm cues and of the measurement items. Consequently, based on the answers, both the stimuli materials and the measurement items were refined in English and in Hungarian.

### 2.4.1 Pre-test results

As it was mentioned earlier, a pre-test was conducted to refine the stimulus materials and the measurement items. For each of the social norm cue stimuli, the interviewees could choose between two differently worded variations. They had to choose one, which they found more understandable and which they thought would best fit the game's purpose. For the injunctive norm cue the two options were: "People think that littering is wrong" and "People disapprove of littering". For the descriptive norm cue the two options were: "Most people properly throw their garbage away" and "Most people use the trash cans for their garbage". Lastly, for the agent element, the interviewees had the same task, they had to choose one 3D figure out of the five options that they found best fitting for the game (e.g. a puppy, a cat, a grown-up dog, a wizard, and a person-like pear figure).

Most interviewees chose the first option for the injunctive norm cue, which said that "People think littering is wrong". Their reasoning was that it sounded more as something that people would use in their everyday language as it was clearer and simpler. For the descriptive norm cue, the votes were equal, therefore, based on the feedback, it was decided to use second option and adding the word 'properly' to it: "Most people properly use the trash cans for their garbage". The reason behind choosing this one was that the interviewees had a stronger

reasoning about the content for the second option. Based on the two interviewees' answers, who were asked both in English and in Hungarian, the Hungarian versions were slightly modified as well. Furthermore, most interviewees chose the 3D puppy figure from the agent options, as they perceived it the most likeable and suitable for the game's purpose. They explained that the innocence of the puppy could have a positive effect on people to not litter in order to keep its environment clean; the puppy figure was more engaging with its movements (as it was a .gif file); and it fit the best within the background of the interface design.

Consequently, based on the pre-test, eight interface prototypes representing the eight conditions were created (in the actual survey these were used as animated .gif files, which is "a type of computer file that contains a still or moving image" [Cambridge Dictionary, n.d.]). Two examples are presented in Figure 2 (for all eight prototypes see Appendix B):

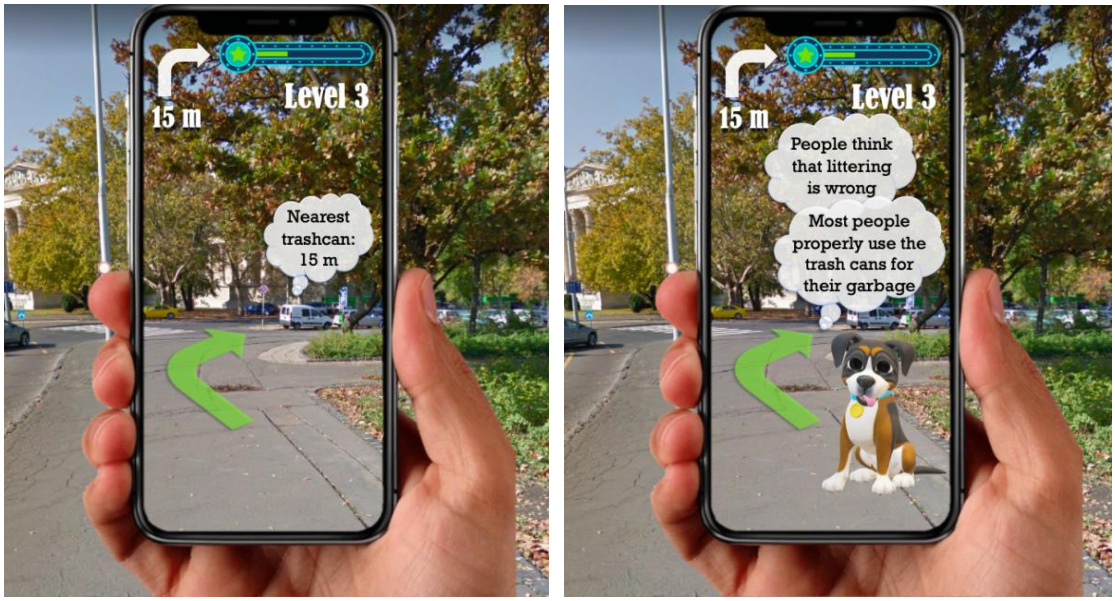


*Figure 2.* An example of the mock-up interfaces representing the control condition without any of the stimuli materials (left) and the condition with all three stimuli materials (right).

## 2.5 Measurements

### 2.5.1 Factor analysis and reliability analysis

To test the validity of the constructs and to identify how well the measured variables represent the number of constructs, a confirmatory factor analysis (CFA) was performed. Furthermore, a principle component factor analysis method and a varimax rotation method was used. The Kaiser-Meyer-Olkin measure of sampling adequacy was .88, and the Bartlett's test of sphericity was significant ($\chi 2$ (820) = 5822.79, $p < .001$), thus, all 34 items were suited for a factor analysis. The test took place by grouping together the same type of constructs (i.e. moderators, mediators, dependent variables) and carried out the test in these groupings separately. In the moderator group, the prior environmental attitude construct was used; in the mediator group the autonomy, competence, enjoyment, and appreciation constructs were placed; and lastly, in the dependent variables group the attitude and intention constructs were placed. The CFA test results can be seen in Table 3.

Accordingly, in the CFA test for the moderator group one factor was extracted. The prior environmental attitude construct originally consisted of 12 items. However, six items needed to be eliminated as they failed to meet the minimum criteria to have a primary factor loading of .60, which indicated the variance of the items explained by other factors. In the CFA test for the mediator group, four factors were extracted (i.e. autonomy, competence, enjoyment, appreciation). With the autonomy construct, there were multiple issues. Originally, it consisted of seven items, however, four items had to be removed as they failed to meet the minimum criteria for the primary factor loadings and the items did not contribute to a simple factor structure. Consequently, after the elimination of the four items, the remaining three items fell under one factor with factor loadings above .60. For competence, the five items showed high loadings above the cut-off point of .60, although one item out of the five had to be eliminated as it negatively affected an item from the appreciation construct. The enjoyment construct originally consisted of five items, which showed the strongest factor loadings under one factor, however, one of the items negatively influenced an item from the appreciation construct, therefore, it had to be removed. The appreciation construct consisted of four items. However, two of its items were influenced by one-one items from the competence and enjoyment dimensions. After the elimination of those two items from the competence and enjoyment dimensions, only one item within the appreciation construct seemed to be explained by multiple factors. Thus, this one item needed to be removed from the appreciation dimension in order to each item fall under one factor. After the elimination of the items within the mediator group, another CFA test was carried out with the remaining 14 items using varimax rotation, where four factors explained 69% of variance. All 14 items were explained under the four separate factors with primary factor loadings above .60, respectively.

In the CFA test for the dependent variables group, two factors were extracted. The attitude and intention constructs originally had four-four items. However, one item from the intention construct had to be removed as the item seemed to be explained by another factor. Furthermore, two items had to be eliminated from the attitude construct. At first, only one item was removed as it did not contribute to a simple factor structure, however, the reliability test showed that an additional item needed to be removed in order to get a Cronbach's Alpha value above .70. Hence, this left the attitude construct with two items. After the elimination of the three items within the dependable variables group, another CFA test was carried out with the remaining five items using a varimax rotation. The two factors explained 77% of variance. The CFA table can be seen in Table 3.

After the factor analysis, a reliability test was performed to determine internal consistency between the items. Furthermore, the results of the reliability test helped to determine whether the changes that were made within the factor analysis were right or not. For the constructs to be reliable, the Cronbach's Alpha value needed to be above the threshold of .70. After the reliability test, only one item needed to be removed from the attitude construct for the value to be above .70 and to improve internal consistency. For the rest of the constructs, no additional item removal was needed. As one can see in Table 3, the expectations were met with the exception of autonomy. As mentioned earlier, the autonomy construct did not perform as expected, which could be due the formulation of the items. However, it was decided to include the construct for the rest of the data analyses with these results in mind.

Table 3

*Factor Loadings for Confirmatory Factor Analysis with Varimax Rotation*

| | Factor | | | | | | |
|---|---|---|---|---|---|---|---|
| Statements | Prior environmental attitude | Feeling of autonomy | Feeling of competence | Enjoyment | Eudaimonic appreciation | Attitude towards littering | Intention towards littering |
| Env_concer_1- Mankind is severely abusing the environment. | .67 | | | | | | |
| Env_concer_2- I would be willing to make personal sacrifices for the sake of slowing down pollution even though the immediate results may not seem significant. | .68 | | | | | | |
| Env_concer_3- The benefits of modern consumer products are more important than the pollution that results from their production and use. | .61 | | | | | | |
| Env_concer_4- The so-called "ecological crisis" facing humankind has been greatly exaggerated. | .71 | | | | | | |
| Env_concer_5 - I find it hard to get too concerned about environmental issues. | .72 | | | | | | |
| Env_concer_6 - I don't care about environmental problems. | .71 | | | | | | |
| Env_concer_7- It makes me sad to see natural environments destroyed. | .64 | | | | | | |
| AUT_1- I believe I would have some choice whether to throw my trash out properly. | | .73 | | | | | |
| AUT_2- I wouldn't really have a choice about throwing my trash out properly. | | .75 | | | | | |
| AUT_3- I would throw my trash out properly because I have to. | | .67 | | | | | |
| COMP_1- I think I would be pretty good at this game. | | | .81 | | | | |
| COMP_2- I think I would do pretty well at this game, compared to others. | | | .80 | | | | |
| COMP_3- I would be satisfied with my game performance. | | | .72 | | | | |
| COMP_4- This would be a game that I could not do very well. | | | .68 | | | | |
| ENJ_1-I would enjoy playing this game very much. | | | | .85 | | | |
| ENJ_2- This game would be fun to play. | | | | .89 | | | |
| ENJ_3- I think this would be a boring game. | | | | .85 | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ENJ_4- I think this game would be quite enjoyable. | | | | .86 | | | |
| APPREC_1- I would learn something new by playing this game. | | | | | .84 | | |
| APPREC_2- I would like learning about this topic by playing this game. | | | | | .77 | | |
| APPREC_3 - I like how the topic is presented in this game. | | | | | .68 | | |
| ATTID_1 - I find throwing away my trash properly satisfying. | | | | | | .86 | |
| ATTID_2- I find throwing away my trash properly beneficial. | | | | | | .89 | |
| INT_1 - I would probably throw my trash out properly while playing this game. | | | | | | | .81 |
| INT_2 - I would most certainly throw my trash away properly after playing this game. | | | | | | | .84 |
| INT_3- After playing this game, I would be encouraged to litter less. | | | | | | | .83 |
| Cronbach's Alpha | .79 | **.52** | .76 | .94 | .81 | .77 | .81 |
| Explained Variance | 45.96% | 11.46% | 17.40% | 24.93% | 15.41% | 34.37% | 42.57% |
| Eigenvalue | 3.22 | 0.91 | 2.07 | 5.23 | 1.47 | 0.98 | 2.87 |

### 2.5.2 Measurement scales

In this research, seven constructs were used with a total of 34 items. However, after the factor analysis and the reliability tests, the items were refined into 25 items. The items were measured on a 7-point Likert scale altering from ‘strongly disagree’ to ‘strongly agree’. The Intrinsic Motivation Inventory (IMI) scale by Ryan (1982) was adopted to measure autonomy, competence, and enjoyment. Choosing the IMI scale was evident as this scale fit the best with the study’s purpose to measure feelings of autonomy, competence, and enjoyment in response to the social norm cues and agent on the interface design. An example item of the autonomy scale include “I believe I would have some choice whether to throw my trash out properly”; an example item of the competence scale include “I think I would be pretty good at this game”; and an example item of the enjoyment scale include “I would enjoy playing this game very much”. To measure respondents’ meaningful experiences in relation to one’s intrinsic needs and in response to the stimuli materials on the interface design, the eudaimonic appreciation scale was adopted from Jacobs (2017). An example item of the eudaimonic appreciation scale include “I would learn something new by playing this game”. Additionally, to measure attitude, intention, and prior environmental attitude, the scales were retrieved from a *Marketing Scales Handbook* (Bruner, Hensel, & James, 2005).

To observe whether respondents’ prior environmental attitudes (i.e. concern for the environment) would influence social norms’ effect on their attitudes and intentions towards littering, measurement scale items by Weigel and Weigel (1978); by Dunlap and Van Liere (1978); by Stern, Dietz, and Kalof (1993); by Dunlap, Van Liere, Mertig, & Jones (2000); and by Thompson and Barton (1994) were adapted. Example items of the scale include “I don't

care about environmental problems" and "It makes me sad to see natural environments destroyed". For the measurement of one's attitude towards littering behavior, scale items by Ajzen and Fishbein (1980), and by Oliver and Bearden (1985) were used (e.g. 'harmful/beneficial' to evaluate engaging in an activity). An example item of the scale is "I find throwing away my trash properly satisfying". For littering behavioral intention, the scale items were originated from Ajzen and Fishbein (1980) (e.g. 'unlikely/likely' to perform a certain behavior). An example item of the scale is "I would probably throw my trash out properly while playing this game". Furthermore, all items used in this study were slightly modified to fit this research's context. The list of all scale items with their Cronbach's alpha scores can be seen in Table 4.

Table 4

*The Refined Measurement Scale with the Cronbach's Alpha Values*

| Construct | Item |
|---|---|
| Feeling of autonomy ($\alpha$ = .52) | I believe I would have some choice whether to throw my trash out properly. |
| | I wouldn't really have a choice about throwing my trash out properly. (R) |
| | I would throw my trash out properly because I have to. (R) |
| Feeling of competence ($\alpha$ = .76) | I think I would be pretty good at this game. |
| | I think I would do pretty well at this game, compared to others. |
| | I would be satisfied with my game performance. |
| | This would be a game that I could not do very well. (R) |
| Enjoyment ($\alpha$ = .94) | I would enjoy playing this game very much. |
| | This game would be fun to play. |
| | I think this would be a boring game. (R) |
| | I think this game would be quite enjoyable. |
| Eudaimonic appreciation ($\alpha$ = .81) | I would learn something new by playing this game. |
| | I would like learning about this topic by playing this game. |
| | I like how the topic is presented in this game. |
| Attitude towards littering ($\alpha$ = .77) | I find throwing away my trash properly satisfying. |
| | I find throwing away my trash properly beneficial. |
| Intention towards littering ($\alpha$ = .81) | I would probably throw my trash out properly while playing this game. |
| | I would most certainly throw my trash away properly after playing this game. |
| | After playing this game, I would be encouraged to litter less. |
| Prior environmental attitude (i.e. environmental concern) ($\alpha$ = .79) | Mankind is severely abusing the environment. |
| | I would be willing to make personal sacrifices for the sake of slowing down pollution even though the immediate results may not seem significant. |
| | The benefits of modern consumer products are more important than the pollution that results from their production and use. (R) |
| | The so-called "ecological crisis" facing humankind has been greatly exaggerated. (R) |
| | I find it hard to get too concerned about environmental issues. (R) |
| | I don't care about environmental problems. (R) |
| | It makes me sad to see natural environments destroyed. |

# Results

In this section, first, the results of the manipulation check within the main survey are described, followed by the results of the hypotheses testing, then the results of the mediation and moderation tests are described, and lastly some additionally analyses are explained.

## 3.1 Manipulation checks

To test the manipulations of the research, a logistic regression model and a chi-square test were performed. For the agent manipulation, a one-predictor logistic model was fitted to the data. The goodness-of-fit test yielded a $\chi_2(1, N = 314) = 102.59$, $p < .001$, which is an indicator that the model fit the data significantly better than the null-model without predictors. Based on the interface the respondents saw, the overall classification accuracy where respondents correctly chose whether they saw the agent or not, and hence, correctly predicted to fall into their respective groups, was 75.5%. Furthermore, a positive coefficient for the agent indicated that with an increasing score on the agent variable there is an increased likelihood that respondents recognize the agent on the interface and choose the correct answer whether they saw it or not ($b = 2.907$, $\chi_2(1) = 68.20$, $p < .001$). Hence, there is a positive predictor relationship between agent and the likelihood of falling into the target group. The contingency table for the agent demonstrated that out of the $N = 314$ respondents 212 of them remembered correctly and 102 respondents did not remember correctly whether there was an agent on the interface or not. Moreover, when respondents received any of the interfaces without the agent ($N = 157$), only 66 of the them remembered correctly that no agent was shown and 91 of them did not remember correctly. In comparison, when the respondents received any of the interfaces with the agent on it ($N = 157$), 146 of them remembered correctly that there was an agent on the interface and only 11 of them did not remember correctly. The reason for this could have been the formulation of the question. The question (i.e. "On the interface design, there was 3D puppy figure") itself might have negatively influenced the respondents' answers by implying what they should have seen or not seen. Those respondents who received an interface with the agent on it should have answered the above-mentioned statement with a *yes*, and those who received an interface without the agent should have answered with a *no*. Therefore, respondents who received an interface without the agent might have thought that they missed the figure and that is why they chose the third option *"I don't remember"*.

For the social norms' manipulations, the logistic regression test indicated that the model fit the data significantly better than the null model without predictors ($\chi_2[2, N= 310] = 38.54$, $p < .001$). Furthermore, the Hosmer and Lemeshow test also indicated a good fit of the model for the data ($\chi_2(2) = 3.53$, $p = .17$). Moreover, a negative coefficient for both social norms indicated that with an increasing scores on these two variables, there is a decreasing likelihood of an individual falling into the target group ($b = -.937$, $\chi_2(1) = 14.83$, $p < .001$ and $b = -1.131$, $\chi_2(1) = 21.56$, $p < .001$). Hence, there is a negative predictor relationship between the social norms and the likelihood of falling into the target group. The contingency table for social norms demonstrated that out of the $N = 310$ respondents 164 of them remembered correctly and 146 did not remember which social norm cues they saw on the interface. Furthermore, out of the 73 respondents who received an interface with only the injunctive norm cue on it, 37 of them remembered correctly that they saw the injunctive norm cue. Out of the 74 respondents who

received an interface with only the descriptive norm cue on it, 34 of them remembered correctly that they saw the descriptive norm cue. Out of the 83 respondents who received an interface with both the injunctive and descriptive norm cue on it, 28 of them remembered correctly that they saw both norm cues. Lastly, out of the 80 respondents who received an interface without any norm cues on it, 65 of them remembered correctly that none of the norm cues were present. This indicates that most people, who received any of the social norms' conditions on the interface, did choose the correct answer. However, a small mistake was discovered with the formulation of one of the answers for the manipulation question (i.e. "On the gaming interface, there was a statement saying…"). The respondents could choose from five answers based on which social norms messages appeared to them on the interface. One of the answers referred to the conditions without any of the social norm cues and stated "Nearest trashcan: 15m". This formulation of the statement might have influenced the respondents negatively as on all of the interface designs there was a separate element that referred to this "15m distance". Thus, some respondents might have remembered this element and that could have been the reason that they choose the wrong answer.

## 3.2 Hypotheses testing

To test the social norms' direct effect on attitude and intention towards littering, a MANOVA test was performed. Here, both the injunctive norm and the descriptive norm were used as the fixed factors, and attitude and intention towards littering were used as the dependent variables. Furthermore, an alpha level of .05 for all statistical tests were used. The results showed no significant differences between the groups of the injunctive norm, of the descriptive norm, and of the interaction between the injunctive and descriptive norms with *p*-values above .05 ($F$[2, 310] = 1.77, $p$ = .17, Wilk's $\Lambda$ = .99; $F$[2, 310] = 0.11, $p$ = .90, Wilk's $\Lambda$ = .99; $F$[2, 310] = 0.70, $p$ = .50, Wilk's $\Lambda$ = .99). Furthermore, Table 5 shows that neither the different levels of the injunctive norm nor the different levels of the descriptive norm had a significant difference on their effect on attitude and on intention towards littering, and there was no interaction effect as all *p*-values were above .05. However, the injunctive norm's value on intention towards littering was the closest to be statistically significant compare to the rest of the *p*-values. Based on these results, H1, H2, and H3 are rejected.

Table 5

*Test of Between Subject Effects for Social Norms and Dependent Variables (N = 315)*

| Source | | $F(1, 311)$ | $p$ |
|---|---|---|---|
| Injunctive norm | Attitude towards littering | 0.33 | .57 |
| | Intention towards littering | 3.42 | .07 |
| Descriptive norm | Attitude towards littering | 0.12 | .73 |
| | Intention towards littering | 0.19 | .67 |
| Injunctive norm* Descriptive norm | Attitude towards littering | 0.24 | .63 |
| | Intention towards littering | 1.40 | .24 |

To test the social norms' direct effect on autonomy and competence, a MANOVA test was performed. Here, both the injunctive norm and the descriptive norm were used as the fixed factors, and autonomy and competence were used as the dependent variables. The results

indicated no significant differences between groups for the injunctive norm ($F$[2, 310] = 1.98, $p$ = .14, Wilk's Λ = .99) and for the interaction between the injunctive and descriptive norms with ($F$[2, 310] = 1.28, $p$ = .28, Wilk's Λ = .99). However, the descriptive norm showed significance between groups with $F$(2, 310) = 3.08, $p$ = .047, Wilk's Λ = .98. Furthermore, Table 6 shows that there was a significant difference in effect between groups of the injunctive norm on competence with $F$(1, 311) = 3.92, $p$ = .049 and with a $\eta_{p2}$ = .012, which indicates a small effect size. The mean scores for competence were higher in conditions without the injunctive norm ($M$ = 5.6, $SD$ = 0.9) compare to the conditions when the injunctive norm was present ($M$ = 5.4, $SD$ = 0.8). Additionally, there was a significant difference in effect between groups of the descriptive norm on autonomy with $F$(1, 311) = 4.19, $p$ = .042 and with a $\eta_{p2}$ = .013, which also indicates a small effect size. The mean scores for autonomy were higher in conditions without the descriptive norm ($M$ = 5.4, $SD$ = 1.1) compare to the conditions with the descriptive norm present ($M$ = 5.2, $SD$ = 1.1). However, there was no interaction effect between the two norms. It was hypothesized that both the injunctive and descriptive norm cues would have a positive effect both on the feelings of autonomy and competence. However, the injunctive norm cue had a significant effect on competence and the descriptive norm cue had a significant effect on autonomy. For this reason, H4 and H5 can be partially accepted and H6 has to be rejected. Table 6 presents a more detailed overview of the data.

Table 6
*Test of Between Subject Effects for Social Norms and Autonomy, Competence (N=315)*

| Source | | $F$(1, 311) | $p$ |
|---|---|---|---|
| Injunctive norm | Autonomy | 0.01 | .91 |
| | Competence | 3.92 | .049 |
| Descriptive norm | Autonomy | 4.19 | .042 |
| | Competence | 1.08 | .30 |
| Injunctive norm* Descriptive norm | Autonomy | 0.53 | .47 |
| | Competence | 2.35 | .13 |

To test the agent element's direct effect on enjoyment and appreciation, a MANOVA test was performed. Here, the agent was used as the fixed factor, and the enjoyment and appreciation were used as the dependent variables. The results showed that there was no significant difference between the groups of the agent with $F$(2, 312) = 1.10, $p$ = .34, Wilk's Λ = .99. Furthermore, there was no significant differences in effect between groups of the agent neither on enjoyment ($F$[1, 313] = 2.21, $p$ = .14) nor on appreciation ($F$[1, 313] = 0.94, $p$ = .33). Therefore, H8 was rejected.

Additionally, to test the agent element's interaction effect with the norm cues on autonomy and competence, a MANOVA test was carried out. Two sets of analyses were performed. In the first analysis, the agent and the injunctive norm were used as the fixed factors, and the autonomy and competence were used as the dependent variables. In the second analysis, the injunctive norm was replaced with the descriptive norm. In the first and second analysis, the results indicated that there was no significant interaction effect between the injunctive norm and the agent with $F$(2, 310) = 0.76, $p$ = .47, Wilk's Λ = .99, and there was no interaction effect between the descriptive norm and the agent with $F$(2, 310) = 0.61, $p$ = .54,

Wilk's $\Lambda = .99$. With the absence of the interaction effect between the injunctive norm and the agent, and the descriptive norm and the agent, the results showed no between subject effects on autonomy ($F[1, 311] = 1.42$, $p = .23$; $F[1, 311] = 0.76$, $p = .39$) or on competence ($F[1, 311] = 0.28$, $p = .60$; $F[1, 311] = 0.69$, $p = .41$). This is indicated by the non-significant $p$-values, which are above the statistically significant threshold of $p = .05$. Hence, H10 was rejected.

## 3.3 Mediation and moderation effects

### 3.3.1 Mediation

As there was no main effect between the social norms and attitude and intention towards littering behavior, there was no mediation effect either. Therefore, H7 was rejected.

To test the mediation effect of enjoyment and appreciation on the relationship between agent and attitude and intention, a mediation test was performed with Process v3.5. Here, agent was used as the x-variable, attitude and intention were used as the y-variable, enjoyment and appreciation were used as the mediator variables. The results showed the total effect model (i.e. the effect between agent and attitude and intention without mediation), the direct effect model (i.e. the effect between agent and attitude and intention with mediation), and the indirect effect model (i.e. the mediation effect). The results indicted no statistically significant mediation effect of enjoyment and appreciation between the agent and attitude nor between the agent and intention towards littering.

The total effect model between agent and attitude yielded a non-significant effect with an overall effect of $F(1, 313) = 1.20$, $p = .27$, $R^2 < .001$ and with a total effect of $b = -.12$, $t(313) = -1.10$, $p = .27$, 95% CI [-.32, .09]. The direct effect model between the agent and attitude showed a significant effect with the overall effect of $F(2, 312) = 8.00$, $p < .001$, $R^2 = .05$ and with the direct effect of $b = -.09$, $t(312) = -0.82$, $p = .41$, 95% CI [-.29, .12]. Here, enjoyment and appreciation showed a significant effect on attitude with $b = .17$, $t(312) = 3.84$, $p < .001$, 95% CI [.08, .26]. However, the results showed that the agent did not predict enjoyment or appreciation, therefore, there was a non-significant effect between the two with an overall effect of $F(1, 313) = 1.88$, $p = .17$, $R^2 = .01$ and with a $b = -.18$, $t(313) = -1.37$, $p = .17$, 95% CI [-.44, .08]. Furthermore, the indirect effect was tested using a non-parametric bootstrapping. This indicated a non-significant indirect effect with the effect size of -.03 and with a 95% confidence interval ranged from -.09 to 01.

The total effect model between the agent and intention yielded a non-significant effect with an overall effect of $F(1, 313) = 3.62$, $p = .06$, $R^2 = .01$ , and with a total effect of $b = -.22$, $t(313) = -1.90$, $p = .06$, 95% CI [-.45, .01]. The direct effect model between the agent and intention showed a significant effect with the overall effect of $F(2, 312) = 52.75$, $p < .001$ , $R^2 = .25$ and with the direct effect of $b = -.14$, $t(312) = -1.40$, $p = .16$, 95% CI [-.34, .06]. Here, enjoyment and appreciation showed a significant effect on intention with $b = .44$, $t(312) = 10.04$, $p < .001$, 95% CI [.35, .52]. Furthermore, the indirect effect was tested using a non-parametric bootstrapping. This indicated a non-significant indirect effect with the effect size of -.08 and with a 95% confidence interval ranged from -.19 to 04. These results demonstrated that a mediation effect of enjoyment and appreciation between the agent and attitude and intention towards littering did not occur, hence, H9 was rejected. Additionally, the average mean scores for attitude and intention towards littering were higher when conditions with the agent was presented to respondents ($M = 6.3$, $SD = 0.8$; $M = 6.0$, $SD = 0.9$) compare to when

conditions without the agent was presented to respondents ($M$ = 6.2, $SD$ = 1.1 ; $M$ = 5.8, $SD$ = 1.0).

Furthermore, these results showed that enjoyment and appreciation did have a significant effect on attitude and intention towards littering. To further analyze this, two MANOVA tests were performed. In the first test, enjoyment was used as the fixed factor, the attitude and intention were used as the dependent variables. The results indicated significant differences between groups for enjoyment with $F(48, 578) = 2.61$, $p < .001$ , Wilk's $\Lambda = .68$. Furthermore, there was a significant difference in effect between groups of enjoyment on attitude with $F(24, 290) = 1.74$, $p = .02$ and with a $\eta_{p2} = .13$, which indicates a large effect size. There was also significant difference in effect between groups of enjoyment on intention with $F(24, 290) = 3.94$, $p < .001$ and with a $\eta_{p2} = .25$, which also indicates a large effect size. Similarly, the results indicated significant differences between groups for appreciation with $F(34, 592) = 3.49$, $p < .001$ , Wilk's $\Lambda = .69$. Moreover, there was a significant difference in effect between groups of appreciation on attitude with $F(17, 297) = 2.32$, $p < .002$ , and with a $\eta_{p2} = .12$ indicating a large effect size, and on intention towards littering with $F(17, 297) = 5.91$, $p < .001$ , and with a $\eta_{p2} = .25$, which also indicates a large effect size.

### 3.3.2 Moderation

To see whether there was indeed a moderation within the study, a moderation test was performed with Process v3.5. The results showed that prior environmental attitude (PEA) was not a significant moderator between the social norms (injunctive norm and descriptive norm) and the dependent variables (attitude and intention). The test did not show a significant interaction between the injunctive norm and PEA neither on attitude $b = .03$, $t(311) = 0.24$, $p = .81$, 95% CI [-.21, .28]) nor on intention towards littering ($b = -.02$, $t(311) = -0.13$, $p = .90$ , 95% CI [-.29, .26]). Furthermore, the test did not show a significant interaction between the descriptive norm and PEA neither on attitude ($b = -.22$, $t(311) = -1.73$, $p = .09$ , 95% CI [-.46, .03]) nor on intention towards littering ($b = -.11$, $t(311) = -0.81$, $p = .42$ , 95% CI [-.39, .16]). Although, the moderation test showed a significant effect of PEA on attitude and intention towards littering, therefore, an additional MANOVA test was performed. The results indicated $F(52, 574) = 1.89$, $p < .001$, Wilk's $\Lambda = .73$ with a significant effect both on attitude ($F[26, 288] = 2.48$, $p < .001$) with a large effect size of $\eta_{p2} = .18$, and on intention ($F[26, 288] = 1.70$, $p = .02$) with a large effect size of $\eta_{p2} = .13$. However, as only a moderation effect was hypothesized, H11 had to be rejected.

## 3.4 Additional analyses

To explore effects that were not hypothesized, or which could explain some of the results, further analyses were performed. First, a relationship between social norms and enjoyment and appreciation was tested and the results indicated that there were significant differences in effect between groups of the injunctive norm on enjoyment with $F(1, 311) = 5.17$, $p = .024$, but with a small effect size of $\eta_{p2} = .02$. The mean scores for enjoyment were higher in conditions without the injunctive norm ($M$ = 4.5, $SD$ = 1.4) compare to the conditions with the injunctive present ($M$ = 4.2, $SD$ = 1.4). Secondly, the relationship between prior environmental attitude and enjoyment and appreciation was tested. The results showed significant differences in effects between groups with $F(52, 574) = 1.59$, $p = .007$, Wilk's $\Lambda = .76$. Furthermore, there

were significant differences in effect between groups of prior environmental attitude on enjoyment ($F$[26, 288] = 1.94, $p$ = .005, $\eta_{p2}$ = .15) and on appreciation ($F$[26, 288] = 1.85, $p$ = .008, $\eta_{p2}$ = .14). Thirdly, the relationship between autonomy and competence, and enjoyment and appreciation was tested. The results showed significant differences in effects between groups of competence with $F$(34, 350) = 2.01, $p$ = .001 , Wilk's $\Lambda$ = .70. Moreover, there were significant differences in effect between groups of competence on enjoyment with $F$(17, 176) = 2.67, $p$ = .001 , $\eta_{p2}$ = .21, and on appreciation with $F$(17, 176) = 2.28, $p$ = .004, $\eta_{p2}$ = .18, which indicates large effect size. Lastly, the relationship between autonomy and competence, and attitude and intention towards littering was tested. The results demonstrated that there were significant differences in effect between groups of autonomy ($F$[30, 350] = 1.55, $p$ = .035, Wilk's $\Lambda$ = .78), competence ($F$[34, 350] = 2.99, $p$ < .001 , Wilk's $\Lambda$ = .60 ), and there was an interaction effect between the two ($F$[212, 350] = 1.28, $p$ = .022, Wilk's $\Lambda$ = .32). Furthermore, there were significant differences in effect between groups of autonomy on attitude ($F$[15, 176] = 2.41, $p$ = .003 , $\eta_{p2}$ = .17), there were significant differences in effect between groups of competence on intention ($F$[17, 176] = 5.00, $p$ < .001, $\eta_{p2}$ = .33), and there were significant differences in the interaction effect between groups on intention ($F$[106, 176] = 1.56, $p$ = .005, $\eta_{p2}$ = .48).

Table 7

*Summary of the Hypotheses*

| Hypotheses | | Results | Explanation |
|---|---|---|---|
| H1 | The injunctive norm cue has a positive effect on the attitude and intention towards littering behavior. | Rejected | The results did not indicate a significant direct effect. |
| H2 | The descriptive norm cue has a positive effect on the attitude and intention towards littering behavior. | Rejected | The results did not indicate a significant direct effect. |
| H3 | The injunctive and descriptive norm cues together have a stronger positive effect on the attitude and intention towards littering than displaying them separately. | Rejected | The results did not indicate a significant interaction effect. |
| H4 | The injunctive norm cue positively affects feelings of autonomy and competence. | Partially accepted | The injunctive norm cue only showed significant effect for competence. |
| H5 | The descriptive norm cue positively affects feelings of autonomy and competence. | Partially accepted | The descriptive norm cue only showed significant effect for autonomy. |
| H6 | The interaction of the injunctive norm cue and the descriptive norm cue have a stronger positive effect on predicting feelings of autonomy and competence than their effect separately. | Rejected | The results did not indicate a significant interaction effect. |
| H7 | Feelings of autonomy and competence and feelings of enjoyment and appreciation both mediate the influence of norm cues on attitude and intention towards littering behavior. | Rejected | The results did not indicate a significant double mediation. |
| H8 | The agent element has a positive effect on enjoyment and appreciation. | Rejected | The results did not indicate a significant effect. |
| H9 | Predicted feelings of enjoyment and appreciation mediate the effect of the agent element on attitude and intention towards littering behavior. | Rejected | The results did not indicate a mediation effect between agent and the dependent variables. |
| H10 | The agent element strengthens the effect of the norm cues resulting in a greater effect of predicting feelings of autonomy and competence. | Rejected | The results did not indicate a significant interaction effect between the social norms and the agent. |
| H11 | The effect of both social norm cues on attitude and intention towards littering behavior is moderated by prior environmental attitude. | Rejected | The results did not indicate a significant moderation effect for prior environmental attitude. |

# Discussion

The purpose of this study was to examine whether social norm cues and an agent element in a gaming interface design could elicit feelings and influence one's attitudes and intentions towards littering behavior. To investigate this assumption, eleven hypotheses were formulated. The results of the study mainly showed non-significant effects. In this section, the discussion of these results, the limitations of the study, and suggestions for future research are explained.

Table 5 shows that the social norm cues in regard to littering, which were presented on the mock-up interface, did not cause changes in respondent's attitudes towards littering or on their intentions towards littering. The reason for this could be related to the interpretation of the norm cues and to the fact that the participants were asked to look at a mock-up design. The norm cues were refined based on the feedback of some interviewees during the pre-test to be simple and to be easily interpreted. However, it could be possible that these norm cues were not as strong as it was predicted, and respondents did not take these cues as seriously as they could not relate it to an actual behavior at the moment when they were filling out the survey. Previous studies on the social norms' influencing abilities (i.e. Cialdini, 2003; Cialdini et al., 2006; Kallgren, Reno, & Cialdini, 2003) demonstrated that they can successfully affect people and their littering behaviors. These studies were carried out during actual behavioral acts, where the norm cues were visible at places where people were doing their everyday errands or at locations with trash cans nearby. Furthermore, Kallgren et al. (2000) posited that social norms are persuasive if they are consciously present during the *behavioral act*. However, in this study the idea was to test whether these norms could also elicit feelings on a simple design. Thus, these norm cues were placed within a gaming interface design in a visible spot to be consciously present if a behavioral act was performed, but as it was mentioned before, respondents were not able to actually try out the game or perform a certain behavior. However, to simulate user experience of the game to some extent, the respondents were presented with a briefing before they saw the interface, which explained the game concept (see in Appendix A). Respondents were instructed to imagine that they could play this game, to consider how they would feel and how it would affect their littering behavior if they played with it. It could have happened that most respondents did not imagine this behavior, or they had a hard time to comply with. In addition, the results demonstrated that people's feeling of autonomy and competence cannot be influenced with this particular design even when it was asked to think about how they would feel. In Tamborini et al.'s (2010), Daneels et al.'s (2020), and in Sailer et al.'s (2017) study they had participants experience an actual game with certain game elements to see whether it would affect their feeling of autonomy, competence, and even their enjoyment and appreciation. This study used these research's findings to explore whether it could also work effectively without an actual gaming experience. In this study's case, it did not have the same effect on peoples' feelings of autonomy or competence as in these previous studies. The results indicated effects of the injunctive norm and the descriptive norm either on autonomy or on competence, but not on both. Hence, as the results demonstrated, social norms on this mock-up interface design did not elicit feelings both of autonomy or on competence neither did they influence attitude and intention towards littering behavior. One reason for the outcomes that involved a hypothesized relationship with autonomy could have been the

adjusted autonomy scale to fit the context of this study, which is discussed in the limitations section. Nevertheless, based on Orji et al.'s (2014) research, it can be stated that a simple interface design could successfully affect people's behavior. However, the interface that was designed for this study might was not as persuasive, but with some refinements it could be more effective in eliciting feelings and in motivating possible behavior change. Therefore, this study can be an immediate input to further gaming concepts and to interface designs, which main purpose would be to influence human behaviors, especially littering behavior. Moreover, once an effective interface design is created for instance, to the same concept this study described, a next step could be the development of a real game for smartphones. The application of this game might involve a more powerful effect on participants as it would involve an actual behavioral act and the experience of the game. Of course, for this to work, an effective interface design has to be created and tested first.

Oliver and Raney's (2011) and Tamborini et al.'s (2010) study demonstrated that the experience of certain intrinsic needs (e.g. autonomy and competence) could elicit feelings of enjoyment and eudaimonic appreciation during media entertainment. Thus, partly based on these findings, it was hypothesized that feeling of autonomy and competence could lead to gratification, and additionally it would mediate the relationship between the social norms and attitude and intention towards littering behavior. However, as no direct effect was perceived between the social norms and attitude and intention towards littering, this mediation effect did not happen either. Furthermore, as mentioned before, partial effects were observed between the social norms and autonomy and competence. This means that when respondents saw any of the social norm messages about littering, these norms did not provoke respondents to think or "act" differently, which leads back to the interpretation of the norms that was mentioned in the beginning of the discussion. Hence, these social norms did not change how they felt, and it did not influence their own choices to think or act in certain ways in regard to the littering issue, nor these norms affected how competent respondents felt with this game concept. Additionally, the results showed a positive relationship between the feeling of competence and enjoyment and appreciation, which could mean that when respondents felt competent it enhanced their enjoyment and appreciation levels. This effect did not occur with the feeling of autonomy, presumably due to the modified scale as mentioned before. Furthermore, the additional analyses revealed that respondents' level of autonomy had an effect on their attitudes about littering, and respondents' level of competence affected their intention towards littering. Moreover, a relationship between enjoyment and appreciation, and attitude and intention was found. This could mean that as respondents experienced enjoyment or appreciation, it affected their attitude and intentions towards littering. Thus, it could be that as people feel enjoyment or appreciation, which are positive emotions, it broadens their mind and awareness, hence, they are more inclined to not litter (Fredrickson, 2013). Furthermore, the respondents' environmental consciousness and general littering habits could have been also a contributing factor to all outcomes, which is explained more in detail at the end of this discussion.

Moreover, it was hypothesized that a visible agent element could elicit enjoyment and appreciation within respondents, and that enjoyment and appreciation have a mediation effect. This was partly based on Nowak and Biocca's (2003) study, which demonstrated that anthropomorphic characters in a game can increase users' engagement, further, users become more excited and interested in the game. Moreover, users became more engaged and immersed

in the fictious setting when they were having a visible character in the game they could interact with, compare to the times without a visible character. However, Nowak and Biocca's (2003) study involved a virtual environment, where participants could experience an interaction with the agent/avatar. Thus, the interface design of the present study involved an agent figure with limited movements as it was converted into a .gif file to be more relatable and engaging for respondents, which was a different approach based on Nowak and Biocca's (2003) findings. However, the results of the present study demonstrated that this approach did not create the same effects as Nowak and Biocca's (2003) research, and a visible agent did not increase respondent's enjoyment or appreciation levels. Hence, enjoyment and appreciation did not mediate the effect between the agent and attitude and intention towards littering. However, the presence of the agent figure on the interface could make a nonsignificant difference in the perception of attitude and intention towards littering behavior, which means that the agent did have some kind of impact on the respondents. Furthermore, as partial effects were observed between the social norms and autonomy and competence, the presence of the agent did not indicate a greater effect on the relationship between the social norms and the feelings of autonomy and competence. To sum up, in this study, a visible figure on the gaming interface did not lead to excitement, enjoyment, or appreciation within respondents, thus, with the absence of this relationship, feeling of enjoyment or appreciation did not act as mediators. This could be explained with the chosen figure or with the visual cohesiveness of all the elements altogether on the interface. In the latter's case, in future studies to create the most aesthetically pleasing and cohesive interface design, one could apply a human-centered design approach from the beginning of the process in order to fit people's needs and to capture their attention with the interface. Overall, this outcome helped to have a more extensive overview of a visual agent's effect through a mock-up interface and about the overall experience and appearance of all elements, which were visible on the interface.

In addition, Cialdini (2003) asserted that 'prior attitude toward recycling' (i.e. environmental concern) has an effect on the intention to recycle besides norm-based messages. Consequently, it was hypothesized that participants would answer the questions on their attitude and intention towards littering behavior based on how environmentally conscious and aware they are in general. Overall, the results showed that prior environmental attitude was not a significant moderator between relationship of the social norms and the attitude and intention towards littering behavior. In other words, whether respondents were environmentally conscious or not did not influence how they perceived the social norm cues and their effect on respondents' attitude and intention towards littering. The reason could have been that since the social norms did not influence respondent's attitude and intention towards littering in general, this moderation effect between the two could not have happened either. However, the results did indicate that respondent's prior environmental attitude influenced respondent's attitude and intention towards littering. This is self-evident, as people who care more about the environment will litter less, and those who do not care much about their environment might not care whether from time to time they do litter. Interestingly, the results indicated a relationship between prior environmental attitude and enjoyment and appreciation, which could be related to the results that showed an effect between enjoyment and appreciation on attitude and intention towards littering.

A further explanation of the outcomes could be related to the respondents' general littering habits. People were chosen randomly for this study without any specific aspects except that they had to be familiar with smartphones and with games for smartphones. Participants were not chosen based on their littering habits: whether they were frequent litterers or not. In the online survey, most respondents indicated that they do care for the environment, which causes them to be conscious about littering. This could be one reason why most hypotheses were rejected and there were no relationships between the variables. If respondents are in general environmentally conscious and do not litter, they will not find the need to use a game that this study described as they main purpose of the game is to reduce littering behaviors. Thus, social norms about littering did not influence most respondents and their perception about littering as they were already environmentally conscious.

## 4.1 Limitations and Future Research

This research was built on the social norm studies including their influencing effect on behavior, and on studies how certain game elements can influence people's basic psychological needs, feelings of enjoyment, and feelings of eudaimonic appreciation. The idea behind the design of the study was to test whether certain design and game elements on a gaming interface would be able to influence people's basic psychological needs, their gratification experience, and their attitude and behavioral intentions towards littering. However, there were a few limitations within this study including the formulation of some survey questions, the exposure time, the autonomy variable, the target group. Furthermore, the discussion section has already pointed out to some of the limitations and future research options, which will be discussed here more in detail.

One of the limitations was the formulation of the manipulation questions in the survey. The agent manipulation question ("On the interface design, there was 3D puppy figure") might have suggested that respondents should have seen an agent on the interface, and this might have influenced the choice of answer of those who received an interface without the agent. For this reason, some might have chosen the answer "I don't remember" instead of "yes" or "no". In the social norms' manipulation question, respondents could choose from five answers based on which social norm statement they saw on the interface. One of the answers referred to the conditions, where none of the social norm cues were present on the interface and only a short statement was present ("Nearest trashcan: 15m"). This answer could have negatively affected respondents as in all eight interface designs there was a design element, which showed the direction and the distance to the trashcan. Some respondents might have associated this element with the control statement incorrectly, causing them to choose the wrong statement. Even though this mistake was committed unconsciously, in future studies, one should be careful with the formulation of the survey questions and try to avoid influencing respondents in any ways.

Another limitation was the exposure time of the interface design. There was not a set exposure time for how long the respondents could look at the interface design to avoid respondents to feel forced or to take too much of their time. Everyone could look at it as long as they wanted to. This might have caused some people to rush through the design and not to look at it thoroughly as it was asked from them. As a consequence, it could have influenced how they answered the questions, and therefore, the outcomes of the study. Consequently,

future studies, which are planning on applying a similar research design within an online survey, should reconsider the exposure time. One option could be to set a short time interval, where respondents have to look at a design for a set amount of time without being able to move on to the next page of the survey until the time has passed. After this, respondents could either click on the next page manually or the survey automatically could move to the next page. In this way, the researcher can create a more effective exposure effect without forcing respondents too much.

A further limitation was the measurement scale for autonomy. The factor analysis and the reliability test demonstrated that something was not appropriate with the autonomy variable. The reliability test showed no internal consistency between the items and removing any of the items still did not make a difference. This outcome was not expected as the items that were used were based on the Intrinsic Motivation Inventory scale. However, it might have happened that as the scale items were fitted to the context of this research, it influenced its level of internal constancy. This limitation was taken into account as further analyses were carried out, but this issue could have contributed to the outcomes. As a consequence, in future research, it is advisable to do both explanatory and confirmatory factor analysis tests, and reliability tests with the modified scale items to ensure its validity and internal consistency at the earliest stage of the research.

Moreover, it is questionable whether littering behavior was a good dependent variable or not as it was difficult to measure it in a research like this. If it was measured in a longitudinal study over a longer period of time, it might have had a more accurate data about one's littering behavioral habits. Similarly, as mentioned before, the target group was not chosen based on people's littering behavioral habits, which might have also influenced the outcomes of the study as most respondents indicated that they were environmentally conscious, meaning that in general they try to avoid littering. In this sense, having respondents who care for the environment might led to the less accurate outcomes of this study in regard to the interface and this game concept, hence, this was another limitation of the study. Therefore, future studies with a similar research concept should focus on a target group who are less environmentally conscious to better explore whether a gaming interface or an actual game could affect their littering behaviors.

Lastly, as it was mentioned in the discussion, other limitations could have been the overall design of the mock-up interface with the elements on it and the formulation of the social norm cues. The general gaming elements (e.g. the indication of the level and the distance on the upper left and right corners) that were chosen for the interface were based on some game studies and on the researcher's general experience with smartphone games. In addition to these elements, the norm cues and the agent were placed within the display. However, this arrangement and design of the elements might not have been as appealing, even though it was mentioned to respondents that this was a mock-up design. Therefore, future research should also take into account which game elements and social norm statements would trigger participants best, and also which of these elements could be the most persuasive, which could lead to the participant's attitude change and to their littering behavior change. In addition to this, one could create a little more realistic mock-up interface. For this, a human-centered design process should be the most effective solution.

Additionally, future studies could carry out a similar research by applying some modifications to it. They could focus on the design perspective of the gaming interface to test and refine its elements first, rather than test how these elements could elicit feelings. For this, they could take into consideration to implement elements (e.g. incentives) that could motivate players to use this application, as intrinsic motivation was not completely enough for people to not litter. The last question within the online survey of this study was an open comment section, where respondents could leave their insights and suggestions. Those who filled it out gave some good points that future studies could also take into account. Someone suggested that this game might cause people to create more trash in order to gain more points. Someone said this game might be too time consuming as once someone needs to throw away trash, he/she would need to take the phone out and launch the application. Lastly, someone suggested that the game should include other features to make it more relatable for users, for instance, to offer rewards that could be translated into real life as some people who litter would need extrinsic motivation to not litter. These are all great remarks that would worth further examination. Once the purpose of the game is clear and the interface design is established, one could move on to create a unique playing experience and to test the actual game with people to see to what extent would it affect people's basic psychological needs, enjoyment, appreciation, and people's attitude and intention towards littering.

## Conclusion

This research aimed to further explore social norms' influential effect on littering behaviors to get a broader picture on social norms' persuasive nature in a different context for the littering issue. For this reason, the following research question was formulated: "*To what extent could social norm cues and an agent element in a gaming interface design elicit feelings of autonomy and competence, and influence attitudes and intentions towards littering behavior*". It was expected to find direct and indirect (i.e. mediation) effects of the social norms on littering behaviors as previous literature on social norms indicated their behavior changing effects. Additionally, previous studies indicated games' persuasive nature on feelings and behaviors. Based on a quantitative analysis of attitudes and intentions towards littering behavior in response to a gaming interface design, it can be concluded that this specific mock-up interface design with the stimuli elements on it (i.e. social norms and agent) did not influence respondents' attitudes and intentions towards littering. However, partial effects of social norms were found on the feelings of autonomy and competence. To better understand the implications of these results, future research could elaborate and build on this study. Future research could reconsider the target group and differentiate between participants who are environmentally conscious and who are not, to obtain results based on the true litter bugs. Furthermore, the adjusted autonomy scale could also have contributed to the outcomes, thus, future research could revise the adjusted scale.

This research helped to get a broader overview on how social norms work in a different environment, in a gaming interface design. Furthermore, future studies could build on this research concept to create not only an interface but an actual game, which would have a littering behavior changing effect. A game concept like this could not only be useful to mitigate littering, but to educate the younger generation to create a greener environment.

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# Appendix A

The example of each of the briefings that were presented to participants about the interface designs

"On this page, you see two illustrations with a gaming interface. One of them is in English and the other one is in Hungarian. Please, look at only one of the gaming interfaces based on the language you chose to fill out this survey!

On the illustration you can see an interface design of a game designed for smartphones. The purpose of this game is to mitigate littering. This is an augmented-reality game, where the game uses the camera and location functions of your smartphone. In this way, you can see your surroundings through the game. Also, the game assists you and shares relevant information about the topic the game presents.

Some other elements are included on the interface: you get directions towards the nearest trash can (by using your location) and you can see a progress bar of your current level based on your scores. You get points for every properly disposed garbage, which the game automatically recognizes by the camera and location functions. In this way you have the chance to compete with other players and to unlock further features of the game.

One of the gaming interfaces is in English and the other one is in Hungarian. The information presented on each gaming interface is the same. If you speak both in English and in Hungarian, please, look at only one of the illustrations based on the language you chose to fill out this survey!

While looking at the gaming interface imagine that you could play with this game. You can proceed to the next page as the arrow appears on the bottom of the page, so carefully look at the gaming interface. After the illustration, you will see some statements. Please consider how you would feel if you played this game."

"On this page, you see two illustrations with a gaming interface. One of them is in English and the other one is in Hungarian. Please, look at only one of the gaming interfaces based on the language you chose to fill out this survey!

On the illustration you can see an interface design of a game designed for smartphones. The purpose of this game is to mitigate littering. This is an augmented-reality game, where the game uses the camera and location functions of your smartphone, and also uses a 3D figure to assist you and to share relevant information about the topic the game presents. In this way, you can see your surroundings through the game, and you will feel like that this figure is really part of your reality.

Some other elements are included on the interface: you get directions towards the nearest trash can (by using your location) and you can see a progress bar of your current level based on your scores. You get points for every properly disposed garbage, which the game automatically recognizes by the camera and location functions. In this way you have the chance to compete with other players. On the higher levels, you are able to choose between figures, you can customize them, and you can teach them various tricks.

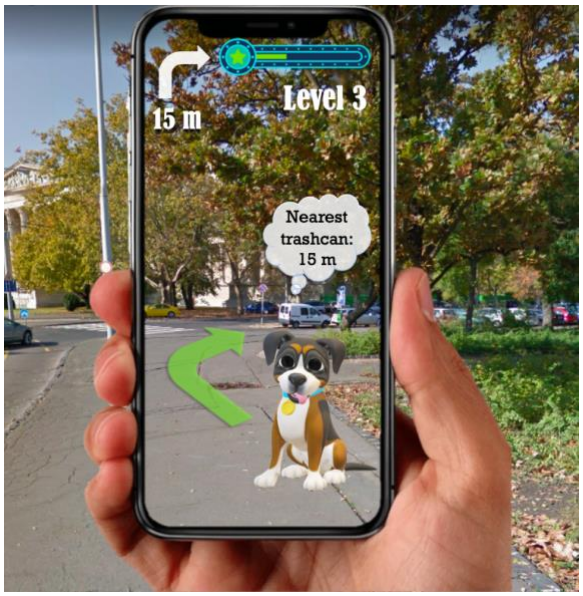
One of the gaming interfaces is in English and the other one is in Hungarian. The information presented on each gaming interface is the same. If you speak both in English and

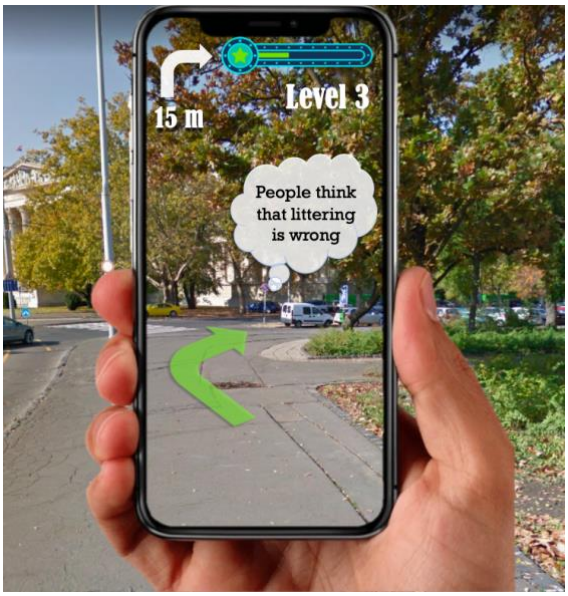
in Hungarian, please, look at only one of the illustrations based on the language you chose to fill out this survey!

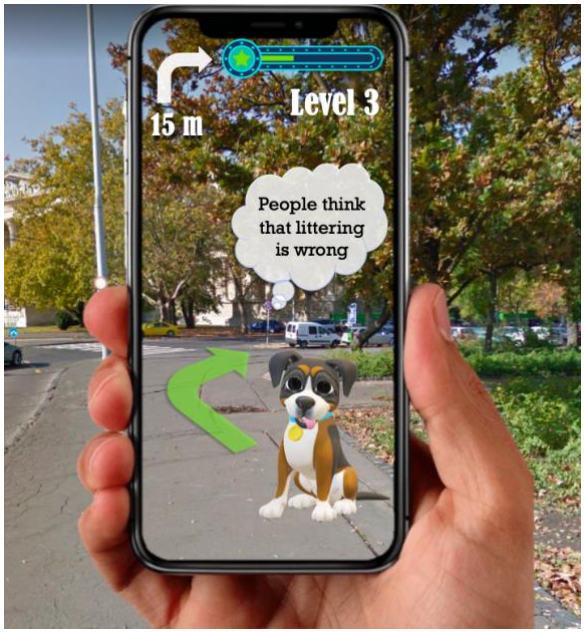
While looking at the gaming interface imagine that you could play with this game. You can proceed to the next page as the arrow appears on the bottom of the page, so carefully look at the gaming interface. After the illustration, you will see some statements. Please consider how you would feel if you played this game."

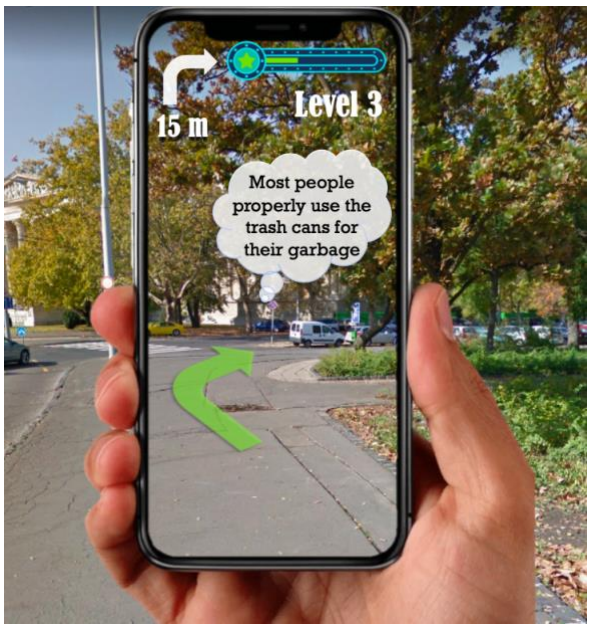
# Appendix B

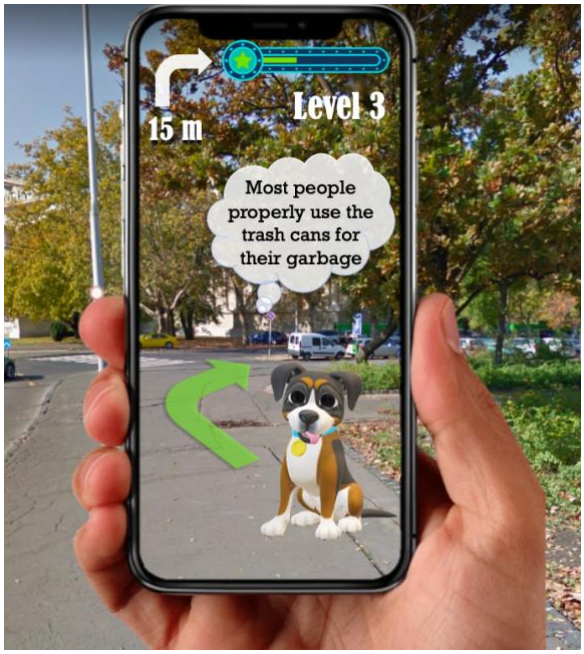
The eight mock-up interface designs that respondents saw based on the eight conditions

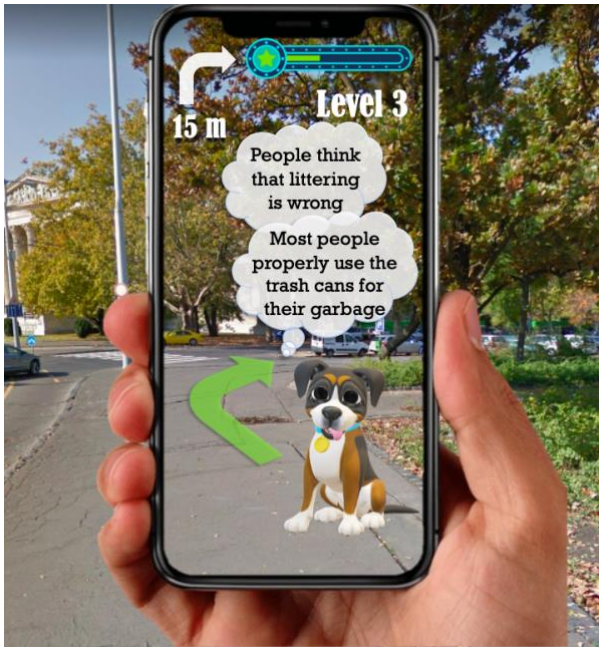


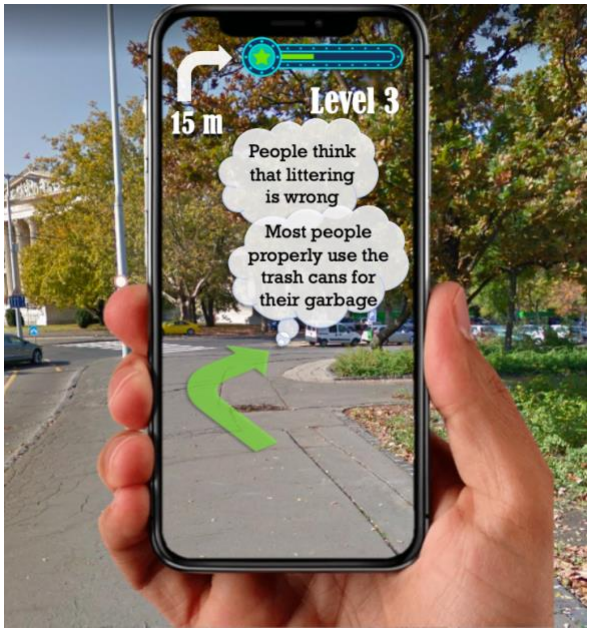



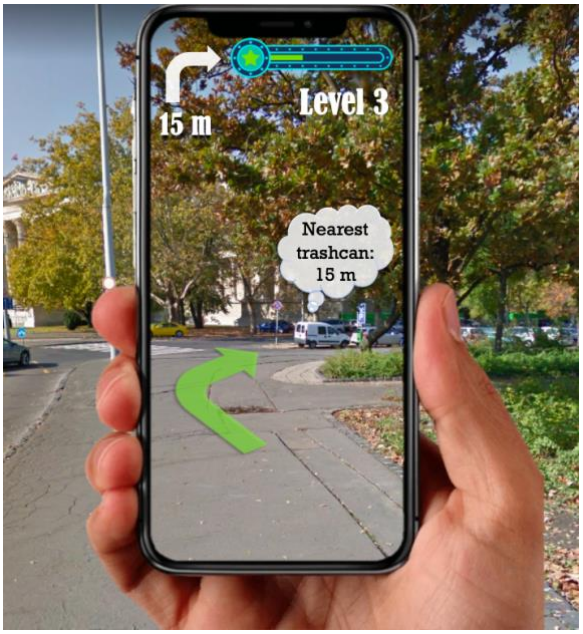




15 m
Level 3
Most people properly use the trash cans for their garbage


15 m
Level 3
People think that littering is wrong
Most people properly use the trash cans for their garbage


15 m
Level 3
People think that littering is wrong
Most people properly use the trash cans for their garbage


15 m
Level 3
Nearest trashcan: 15 m