Increasing Prosocial Behaviors in Multiplayer Video Games Using Persuasive Technologies

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Declaration

No portion of the work contained in this document has been submitted in support of an application for a degree or qualification of this or any other university or other institution of learning. All verbatim extracts have been distinguished by quotation marks, and all sources of information have been specifically acknowledged.

Signed: *Minmin Chen*

Date: *28-07-2022*

Abstract

Research shows that video games including social activities have benefits on psychological aspects of players' well-being, and this is especially true for cooperative video games. We conducted a pre-study to gain insights of people's perspectives on prosocial/antisocial behaviors in multiplayer video game context. From the pre-study, we learned that many people equate unfriendly behaviors to verbal insults and offensive messages, while friendly behaviors are allocated both to the gameplay aspect (such as helping with game tasks) and the communication aspect.

Both academia and industry have long been fighting with toxic behaviors in multiplayer video games and see many successful attempts. On the other hand, studies of encouraging prosocial behaviors in game are scarce. We study the potentials of using persuasive technologies to increase players' willingness to cooperate in game tasks, which is shown by our pre-study as one important prosocial behavior in multiplayer video game context. We are also curious if we can enhance players' mental well-being by encouraging cooperation in game, rather than banning toxic behaviors, which is a relatively new approach. Behavior change interventions have long been practised in health and clinical realm, thus we think it is possible to adapt them to meet our goal of promoting prosocial behaviors in game.

To test the effectiveness of persuasive techniques in enhancing players' cooperative behavior, we make a custom version of Public Goods Game and implement three persuasive techniques (reduction, self-monitoring, and priming). The game is split into four versions (one control version without any persuasive technique implemented, and three versions each with one persuasive technique), and we have each of 60 participants play one version of the game. Participants in treatment groups show higher cooperation level than the control group, but no significant difference is found between treatment groups, which implies similar effectiveness of different persuasive techniques.

Participants in treatment groups report lower level of "being able to make up my own mind about things", while the overall well-being scores are not significantly different to the control group. This suggests us to still be careful when using persuasive techniques in games as they might decrease players' perceived freedom in play.

To conclude, this study explores the possibility of using persuasive technologies to increase prosocial behaviors in multiplayer video games, and its influence on players' well-being. However, the scope of our study is limited and we hope it can inspire future works to further study the strengths and drawbacks of this approach.

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I wish to acknowledge the help provided by Utrecht University, who offered access to all the literature resources and data analysing software used during the project. I would similarly express my appreciation to Epic Games, who developed great Unreal Engine 5 and made it free for use, and the artists put their passion in creating all the game assets used in my game prototype.

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Chapter 1

Introduction

1.1 Context and topic

The video game industry is growing rapidly and shows no sign of slowing down. While there were almost two billion video gamers across the world in 2015, this figure is expected to rise to over three billion by 2023 (Statista, 2020). It is estimated that the global gaming market will amount to 268.8 billion U.S. dollars annually in 2025, up from 178 billion U.S. dollars in 2021 (Statista, 2021). The number of types and platforms of video games has also increased dramatically (Entertainment Software Association, 2021), reaching a much wider population than assumed. Researchers have found various benefits of playing video games, such as getting faster and more accurate attention (Bavelier et al., 2012), enhancing engagement over long-term goals (Dweck and Molden, 2005), increasing positive emotion (Russoniello et al., 2009), and acquiring prosocial skills (Ewoldsen et al., 2012).

As a commonly used tool for mood alternation (Colwell, 2007) and building real-life like friendships (Yee, 2006), multiplayer video games have long been nourishing toxic behaviors, which drive some players away and as a result, exclude them from these possible benefits of playing (Bergström and Ericsson, 2020).

While both academia and industry are actively researching effective ways to reduce toxic behaviors in multiplayer video games (Boinodiris, 2020), under the help of latest computing technologies such as neural networks (Stoop et al., 2021), few studies have been conducted on the topic of enhancing player experience or promoting well-being by means of increasing in-game prosocial behaviors. This leads to our study of improving players' well-being by increasing prosocial behaviors in multiplayer video games using persuasive technologies.

1.2 Research questions and contributions

In this study, we investigate three main research questions and five subquestions.

RQ1: What are people's perspectives of prosocial behaviors in multiplayer video games?

RQ1A: What kind of behaviors are regarded as prosocial behaviors in multiplayer video games?

RQ1B: What factors influence the occurrence and type of these prosocial behaviors?

RQ2: How can we design multiplayer video games to increase prosocial behaviors?

RQ2A: What persuasive techniques can we use in game design to increase these behaviors?

RQ2B: What is the effectiveness of these persuasive techniques in increasing prosocial behaviors?

RQ2C: How do players' personality and demographics affect their susceptibility to different persuasive techniques?

RQ3: How do prosocial behaviors in multiplayer video games affect players' well-being?

The main contributions of this thesis are the design of in-game persuasive techniques and the analysis of their effectiveness in increasing prosocial behaviors and players' well-being. As most research at the moment focuses on detecting and fighting toxic behaviors in multiplayer video games and few are working on the opposite side of encouraging prosocial behaviors, this study will explore the possibility of creating better gaming experience and thus enhancing players' well-being by means of making players more friendly when playing games.

1.3 Scope and focus

We conduct a pre-study to gather information about what kind of behaviors are regarded as friendly/unfriendly in multiplayer video games, followed by an actual investigation on the possibility of using persuasive techniques to increase the occurrence of these friendly behaviors.

In the main study, a game prototype is specifically made for our study purpose. To eliminate the influence of real-life relationships and in-person social activities, we scale our study to only investigating the context in which players do not know each other, and play with each other remotely.

Due to the limitation of time and resources, we focus on only a selection of persuasive strategies in game design, including reduction and self-monitoring, inspired by Fogg (2003a), and priming, inspired by Lin (2013). The generalization of our results remains a subject to future work.

1.4 Structure overview

This thesis is structured as below. Chapter 2 introduces background knowledge and related work in topics of video games, well-being, and behavior change techniques in general. Chapter 3 elaborates our pre-study on people's perspectives of friendly/unfriendly behaviors in multiplayer video games and the possible triggers of them. Chapter 4 presents our main experiment on in-game persuasive technologies and how do they influence players' cooperativeness and mental well-being. The results of our pre-study and main experiment are further discussed in Chapter 5. Finally, we conclude and summarize the study in Chapter 6.

Chapter 2

Background

We give a overview of our study in Chapter 1, and in this chapter, we give a review of the literature in topics of the relationship between video games and well-being, multiplayer video games and social behaviors, in-game toxic behaviors and the approaches to tackle the problem, and a general introduction of behavior change techniques. Based on these previous research and studies, we propose our methodology in Chapter 3 and Chapter 4.

2.1 Video game and well-being

Just like other forms of media, video games have long been a subject of argument between leading professionals. Often these bouts of criticism come from the usage of debated topics such as virtual sex, violent and gory scenes, partial or full nudity, drug use, portrayal of criminal behavior or other provocative and objectionable materials (Heng et al., 2011). Video games have been studied for relation to addiction and aggression. There have been a multitude of studies linking violent video game play with increased aggression (Prescott et al., 2018). Excessive use of video games is associated with lower levels of life satisfaction and elevated levels of anxiety and depression, but not associated with reported amount of physical exercise (Mentzoni et al., 2011). A meta analysis of studies from both eastern and western countries yields evidences that strongly suggest the exposure to violent video games is a causal risk factor for increased aggressive behavior, aggressive cognition, and aggressive affect and for decreased empathy and prosocial behavior (Anderson et al., 2010).

On February 3, 1994, Joseph Lieberman introduced the Video Game Ratings Act of 1994, which sought to establish a federal commission to create an industry-wide standard for game ratings (www.GovTrack.us, 1994). Although the utility of such ratings has been called into question by studies that publish findings that parents seldom check the ratings before allowing their children to rent or buy video games (Walsh, 2008), it is still the common practice for a wide range of countries.

Despite many negative opinions on video games, moderate video game playing is found to bring about positive emotions (Allahverdipour et al., 2010), emotional stability (Przybylski et al., 2012) and reducing emotional disturbances (Hull, 2009). Children and adolescents choose video games deliberately, as a means of mood alternation when they have problems with their friends or parents (Colwell, 2007), whilst non-gaming puts children at even higher risk of emotional disturbance than excessively playing, in particular among boys (Kutner and Olson, 2008). Players report higher levels of self-esteem and self-concept, and benefit from increased family closeness,

less risky friendship networks, and better attachment to school (Durkin and Barber, 2002). Active video games, or video games including physical activities, do qualify as and can contribute to the recommended dose of moderate-to-vigorous physical activity for weight management in young adults (Howe et al., 2014).

Many efforts have been put on investigating adolescent boys and their gaming habits (Bijvank et al., 2012), but it is undeniable that the affected population is prevalent. We can see from Table 2.1 that in spite of the differences between demographic groups, video game is a source of entertainment for the wide population and has varied effects on well-being.

Table 2.1: US gamer demographics 2021, Source: Entertainment Software Association (2021)]

Age	Male	Female
18-34	75% play on a **console** 51% most often play **action games** 68% prefer playing **with friends** 70% say games help them **stay connected** with family and friends	77% play on a **smartphone** 46% most often play **casual games** 48% prefer playing **with friends** 55% say games help them **stay connected** with family and friends
35-54	70% play on a **console** 38% most often play **action games** 44% prefer playing **with friends** 83% say games help them **relax**	78% play on a **smartphone** 67% most often play **casual games** 58% prefer playing **with friends** 77% say games help them **relax**
55-64	56% play on a **smartphone** 48% most often play **casual games** 42% prefer playing **with friends** 87% say games **provide mental stimulation**	63% play on a **smartphone** 74% most often play **casual games** 37% prefer playing **with friends** 82% say games **provide mental stimulation**
65+	68% play on a **PC** 58% most often play **card games** 77% prefer playing **alone** 46% have been playing games for **10 years or less**	60% play on a **PC** 76% most often play **card games** 81% prefer playing **alone** 63% have been playing games for **10 years or less**

Video games allow players to express themselves in ways they may not feel comfortable in real life because of their appearance, gender, sexuality, and/or age (Cole and Griffiths, 2007). The anonymity can free players from their real life identity and social situation, allowing them to be more like the person they wish to be. They use virtual characters to display their desirable qualities and imagine themselves as different, at the same time, emulating the character's better traits (Bessière et al., 2007), which increases their feelings of self-confidence and self worth (McKenna and Bargh, 1998).

2.2 Well-being measures

Health is more than absence of diseases; it is a resource that allows people to realize their aspirations, satisfy their needs and cope with the environment in order to live a long, productive, and fruitful life (Organization, 1986). Individual resources for health can include: physical activity, healthful diet, social ties, resiliency, positive emotions, and autonomy (Organization, 2004).

A commonly used scale on mental well-being is the Warwick–Edinburgh Mental Wellbeing Scale (WEMWBS) (Tennant et al., 2007). Other popular scales include the Personal Wellbeing Index (PWI) (Cummins et al., 2003), the Positive Affect Negative Affect Schedule (PANAS) (Watson et al., 1988), General Health Questionnaire-12 (GHQ-12) (Goldberg and D.P.M., 1988), and

WHO-5 (Topp et al., 2015). The scales vary on whether they asked about a specific time period or for a global evaluation of a respondent's life. Most scales use subjective evaluation measure, asking respondents to make a personal evaluation of Subjective Wellbeing (SWB), and some use alternative measures such as daily function, loneliness, sleep quality, and social support. Kearns and Whitley (2019) investigate SWB in online context, but there is in general a gap in the literature of a standardized, widely accepted, validated well-being scale regarding online or video game context. This leaves us to adapt currently common-practised scales to our study of in-game prosocial behaviors and individual mental well-being.

2.3 Multiplayer video games and social well-being

Social gaming involves playing video games with others, and can be categorized as either cooperative or competitive. In cooperative games, two or more players engage in the game on the same team with the same or similar goals, whereas in competitive games, two or more players play against each other in a competitive manner (Entertainment Software Association, 2021). Video games including social activities have been shown to have benefits on psychological aspects of well-being (Herodotou et al., 2014), and this is even more true for cooperative games (Ewoldsen et al., 2012).

The passion for multiplayer video games can be divided into two subdimensions, namely harmonious passion and obsessive passion. The influences of harmonious and obsessive passion on players' addiction to these games differ significantly. Obsessive passion may lead to addiction, and is negatively related to self-realization and unrelated to life satisfaction, while harmonious passion normally does not (Lafrenière et al., 2009). This demonstrates that the inclusion of social activity is context-related and we cannot define it as solely "good" or "bad".

Moderate playing provides a healthy source of socialization, relaxation, and combating stress (Snodgrass et al., 2011). Players are found using massive multiplayer online (MMO) games to extend real-life relationships, meet new people, form relationships of varied strengths, or use others merely as listeners of their personal problems (Williams et al., 2006). They feel the friendships formed online are comparable or even better than their real life friendships (Yee, 2006). Cole and Griffiths (2007) find that social interaction in online gaming is a considerable element in the enjoyment of playing, with a high percentage of players making life-long friends and partners through it. The same study shows that 40% participants discuss sensitive issues with their online gaming friends that they do not discuss with real life friends, and female players are more likely to do so; 40% participants have met online friends in real life, suggesting that online gaming is a social activity or facilitates social activity.

Multiplayer video games can as well positively affect prosocial behavior. Children and adolescents who play prosocial video games tend to maintain positive affective relationships, cooperation and sharing as well as empathy outside games (Harrington and O'Connell, 2016). These online social games might thus be a possible alternative social outlet, serving a similar function to in-person contact for players, for those in remote locations, with psychological difficulties, or with other factors that can inhibit in-person interaction (Odrowska and Massar, 2014). While online video game play is believed to lead to losses in offline sociability, it holds the potential to satisfy needs for the avoidantly attached people (Kowert and Oldmeadow, 2015), who disregard

their own struggles and needs in order to maintain peace and keep their friends close by. This again shows the multifaceted nature of social gaming.

2.4 In-game toxic behaviors

In-game toxic behaviors are generally seen as detrimental to player experience and social well-being. Kou (2020) identifies five primary types of toxic behaviors, including communicative aggression, cheating, hostage holding, mediocritizing, and sabotaging. Communicative aggression happens in various communication channels where communicated content is perceived as offensive to the receivers. Cheating refers to gaining an unfair advantage in playing. Hostage holding describes a behavior to purposefully keep others in an unpleasant situation, such as preventing the game from ending, or a surrender vote. Mediocritizing refers to gameplay actions that do not maximize the winning chance, but the players still desire to win. Sabotaging is to play poorly with the intention to lose the game.

The same paper also categorizes the triggers of toxic behaviors into five primary contextual factors, including competitiveness, in-team conflict, perceived loss, powerlessness, and toxic behavior. Competitiveness refers to the intense competition as inherent to the team-based competitive gaming context. In-team conflicts are interpersonal disagreements over individual choice as well as team goal. Perceived loss refers to the situation where players perceive a loss or a greater chance to lose in an ongoing match. Powerlessness describes how experiences of loss of control might engender toxic behaviors, when players experience enormous frustrations because of little control over ongoing matches. Lastly, toxic behavior itself could become a trigger of more toxic behaviors.

While both male and female players experience toxicity and feel toxicity is an issue in multiplayer video games, there is a major difference on how they experience it (Bergström and Ericsson, 2020). The majority of males experience toxicity mostly towards their performance in game, but females are affected in more ways, mostly due to their gender. Their research shows that almost twice the amount of females do not want to continue playing when affected by toxicity.

2.5 Efforts in reducing in-game toxic behavior in gaming industry

As in-game toxic behaviors are considered a major problem, technology firms make extra efforts on eliminating them, but it is a challenge to balance free playing and banning toxic behaviors (Boinodiris, 2020). The most common method is automatic chat monitoring (Märtens et al., 2015; Stoop et al., 2019; Canossa et al., 2021).

Riot Games, the developer of League of Legends, takes advantage of their massive player community to experiment on different approaches to reduce toxicity in games (Lin, 2013). They notice that many games seem toxic because at least one non-toxic player is having their bad day, rather than involving toxic players. Following this finding, they conducted four experiments on preventing players from losing their temper when playing.

- Cross-team chat experiment: making cross-team chat as an opt-in process resulted in 32.7% decrease of negative chat, while overall cross-team chat proportion did not change.
- Tribunal experiment: warning or banning the toxic players, depending on the severity of toxicity, to engage community to manage their own behavior. Players getting banned showed

higher toxicity incidence after returning to the game again, which was an undesirable outcome.

- Feedback loop experiment: due to the unsuccessful attempt in the tribunal experiment, they decided to show banned players exactly why they are banned in the reform card emails, which tell players what kind of behaviors are acceptable and what are not. In comparison to the tribunal experiment, players getting customized reform cards showed lower rate of toxicity incidence regardless the severity of punishment.

- Optimus experiment: using priming techniques to shape online behaviors by displaying different tips in different colors at various places, such as on the loading screen, or in game. While the causal relation between tip texts and toxic behavior occurrence is yet to be explored, it shows that the color of tips do have a significant influence on players' behavior. In one of their experiment, they showed "Teammates perform worse if you harass them after a mistake." in red on the loading screen, which decreased negative attitude by 8.34%, verbal abuse by 6.22%, and offensive language by 11.00%. And in another experiment, they showed "Who will be the most sportsmanlike player in the game?" in red on the loading screen, which increased negative attitude, verbal abuse, offensive language by 14.86%, 8.64%, and 15.15%, respectively. This result surprised the experiment team because they thought encouraging sportsmanship was a way to reduce toxic behaviors in games.

We see developers work hard fighting toxicity in games, but few have explored the opposite approach: encouraging and reinforcing prosocial behaviors, which leaves possibility to our study.

2.6 Prosocial behaviors

Prosocial behavior is "a voluntary behavior intended to benefit another" (Eisenberg et al., 2007), for example helping, sharing, donating, cooperating, and volunteering (Brief and Motowidlo, 1986). Obeying the rules and conforming to socially accepted behaviors are also regarded as prosocial behaviors (Bushman and Baumeister, 2007), because they are usually motivated by empathy and concerns about the welfare and rights of others (Sanstock, 2007), egoistic or practical concerns (such as one's social status or reputation), hope for direct or indirect reciprocity, or adherence to one's perceived system of fairness (Eisenberg et al., 2007).

Research suggests that prosocial behaviors are central to the well-being of social groups across different contexts. Prosocial behaviors in classrooms can have a significant impact on students' motivation for learning and their willingness to contribute to the class or even larger community (Helliwell and Putnam, 2004). In the workplace, prosocial behavior can have a significant impact on team psychological safety, and positive indirect effects on employee's helping behaviors and task performance (Frazier and Tupper, 2016).

Prosocial behaviors can also foster positive traits which are beneficial for society. They are often associated with developing desirable traits in children (Eisenberg and Mussen, 1989), but later literature includes adult as well (University of Notre Dame, 2009). Evolutionary psychologists use theories such as kin-selection and inclusive fitness as an explanation for the passing-down tendencies of prosocial behaviors between generations (Barrett et al., 2002).

2.7 Behavior change techniques

Behavior change intervention frameworks such as Behavior Change Wheel (BCW) are long been practised in health and clinical realm (Michie et al., 2014). As shown in Figure 2.1, the BCW consists of three layers. The hub identifies the source of the behavior that could prove fruitful targets for intervention. It uses the COM-B ("capability", "opportunity", "motivation" and "behavior") model. This model recognizes behavior as part of an interacting system involving all these components. Interventions need to change one or more of them in such a way as to put the system into a new configuration and minimize the risk of it reverting.

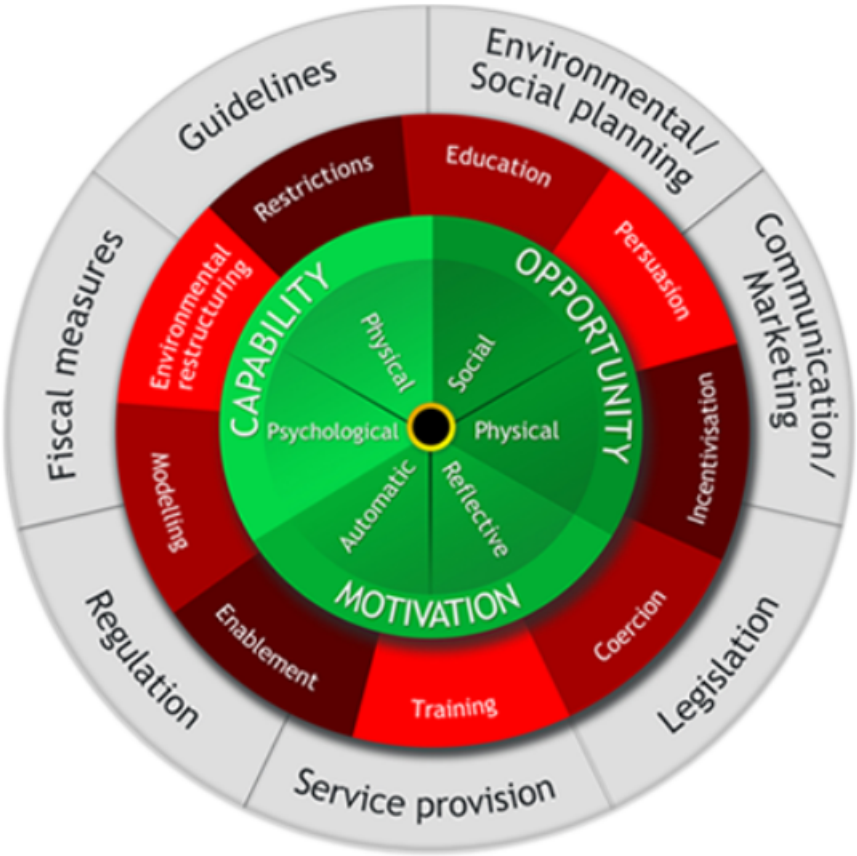

Figure 2.1: The Behavior Change Wheel, Image from *The Behavior Change Wheel: A Guide to Designing Interventions (Silverback Publishing, 2014), 18*
(usage permission granted by the author)

Surrounding the hub is a layer of nine intervention functions to choose from based on the particular COM-B analysis one has undertaken.

The outer layer, the rim of the wheel, identifies seven policy categories that can support the delivery of these intervention functions.

The BCW provides a systematic way of identifying relevant intervention functions and policy categories based on what is understood about the target behavior. General intervention functions can be translated into specific techniques for changing behavior.

In our study, we focus on the persuasion intervention function to increase prosocial behavior in multiplayer video games. Fogg (2003b) states the possibility to use computer as a persuasive tool, which is designed to change attitudes or behaviors or both by making a desired outcome easier

to achieve. The author identifies seven types of persuasive technology tools and his definitions for these technologies are listed below (Fogg, 2003a):

1. Reduction technology: reducing complex behavior to simple tasks increases the benefit/cost ratio of the behavior and influences users to perform the behavior.

2. Tunneling technology: guiding users through a process or experience provides opportunities to persuade along the way.

3. Tailoring technology: information will be more persuasive if it is tailored to the individual's needs, interests, personality, usage context, or other factors relevant to the individual.

4. Suggestion technology: a computing technology will have greater persuasive power if it offers suggestions at opportune moments.

5. Self-monitoring technology: eliminating the tedium of tracking performance or status helps people to achieve predetermined goals or outcomes.

6. Surveillance technology: observing others' behavior increases the likelihood of achieving a desired outcome.

7. Conditioning technology: use positive reinforcement to shape complex behavior or transform existing behaviors into habits.

Another common persuasive technique is subliminal priming, which occurs when an individual is exposed to stimuli below the threshold of perception (Elgendi et al., 2018). It is proved to be able to influence people's decision (Caraban et al., 2017), but certain conditions need to be met to enhance persuasion (Strahan et al., 2002).

In many cases effective persuasion requires more than one tool or strategy. We will keep this in mind while designing persuasive function to encourage prosocial behaviors in games.

2.8 Personalized persuasive technologies

Psychology research has shown that personalized information is more effective than generic information in changing attitudes and behaviors. Much of the research has taken place in the area of health interventions, in which information has been tailored to match people's education level, type and stage of disease, attitude toward the disease, and other factors (Strecher et al., 1994; Skinner et al., 1994; Campbell et al., 1994).

When social influence is used in behavior change, the effectiveness varies between different genders and age groups (Oyibo et al., 2017a). Males are more susceptible than females with respect to Competition, and younger people are more susceptible than older people with respect to Competition, Social Comparison and Social Learning. The differences are more significant in collectivist cultures than individualist cultures.

Other studies focus on the effectiveness of persuasive technologies regarding personality. The Big Five model (John et al., 1991) is commonly used to categorize people's personality. Conscientious people tend to be motivated by goal setting, simulation, self-monitoring and feedback; people who are more open to experience are more likely to be demotivated by rewards, competition, comparison, and cooperation (Orji et al., 2017). People of different personalities also

show varying levels of susceptibility to Cialdini's six persuasive principles (Oyibo et al., 2017b). Similarity-attraction paradigm is confirmed in people's evaluations of persuasive systems, but not in the system's persuasiveness (Ruijten, 2021). In video game context, Bartle taxonomy of player types (Bartle, 1996) classifies players according to their preferred actions within the game. Later works include BrainHex (Busch et al., 2016), which combines several then commonly used player personality typologies and splits players into seven categories, based on their motivation to play.

This chapter concludes all the literature in interest and short introductions about their results. In next chapter, we will go through our pre-study on people's perspectives of friendly/unfriendly behaviors in multiplayer video game context.

Chapter 3

People's perspective of friendliness in video game context

We compile through the related studies and literature in last chapter. In this chapter, we will go over the setup and results of our pre-study.

To answer our research quesion *RQ1A* (What kind of behaviors are regarded as prosocial behaviors in multiplayer video games?) and corresponding subquestion *RQ1B* (What factors influence the occurrence and type of these prosocial behaviors?), we conduct a pre-study to ask people what kind behaviors are regarded as friendly/unfriendly in multiplayer video games, and what are the possible triggers of them. The pre-study consists of two parts: a questionnaire aiming for the general population, and interviews with 8 players individually. The two methods compensate each other as the questionnaire is supposed to reach more people but may only gather brief answers, while the interviews generate deeper and more detailed information.

Prosocial behavior is a social behavior that benefits other people or society as a whole, such as helping, sharing, donating, co-operating, and volunteering (Brief and Motowidlo, 1986). We use the word "friendly" instead of "prosocial" in our pre-studies because some participants have difficulties understanding it, and "friendly" is a more familiar word to them. From the results we show in Table 3.1 and Table 3.2, we argue that all the results that we get from participants fall in the definition of prosocial behavior, so that our results in the pre-studies are still valid.

3.1 Study 1: questionnaire

We collect 48 answers with an online questionnaire, and 28 of the answer sheets are valid. By valid, we mean at least one open ended question has non-blank input. A full list of the questions is included in Appendix B.2.

The age of the 28 participants ranges from 20 to 35 years, with an average of 27.1 years. 14 participants have master level of education, and 7 have bachelor level of education. 22 of the participants are Chinese. 16 participants are male and 9 are female.

As for gaming behavior, 16 participants played at daily frequency and only 2 of them reported playing less than once a month, so the participants can serve as a good sample of gaming population. 19 participants played multiplayer video games with people they did not know in real life.

Entertainment Software Association (2021) categorizes multiplayer video games as either cooperative or competitive. In cooperative games, two or more players engage in a video game on

the same team with the same or similar goals, whereas in competitive games, two or more players play against each other in a competitive manner. Due to the diversity of video games, we further split them into two more categories of "hybrid" and "alternative". "Hybrid" games are those games where a player competes with one or a group of players, but at the same time, cooperates with another one or group of players. "Alternative" games are those games where the game mechanism does not ask players to compete or cooperate explicitly, and it remains to the player to decide whether they want to compete or cooperate with other players. As shown in Figure 3.1, among the 19 participants who have played with strangers, 11 report playing competitive games, 12 play cooperative games, 16 play hybrid and 10 play alternative. From the responses, we can see the two extended categories manage to catch a good proportion of gaming behaviors of the participants.

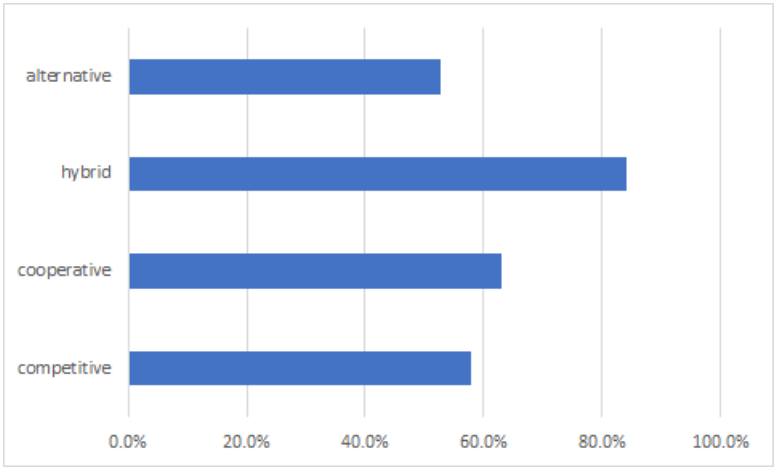

Figure 3.1: The proportion of respondents playing different types of multiplayer video games

As shown in Figure 3.2, 17 participants report that they have thoughts of conducting friendly behaviors to others, and 15 report thoughts of conducting unfriendly behaviors. Instead of being on either side of friendly or unfriendly, we find most players (14 out of 18) active in social interactions have both friendly and unfriendly impulses. This confirms the results of Lin (2013) that players conducting toxic behaviors in games are not necessarily always toxic, which means we can aim for the general gaming population instead of a small group of very toxic players.

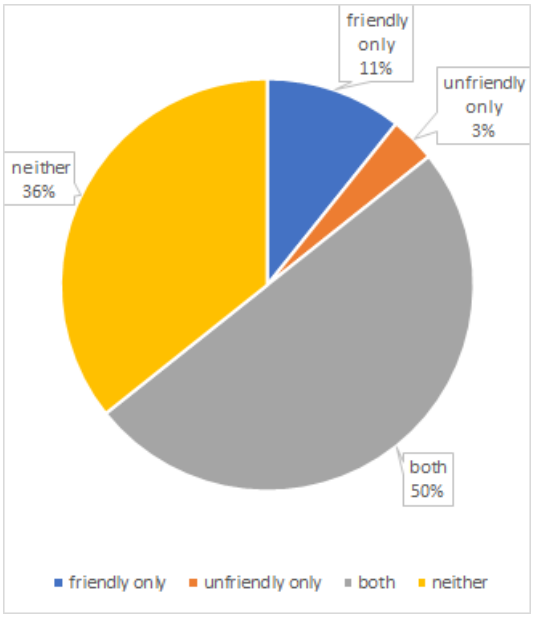

Figure 3.2: The proportion of respondents having thoughts of conducting different social behaviors in multiplayer video games

As for the mood before playing games, 2 report a lot influence on their tendency to be friendly/unfriendly during the game, 5 report moderate influence, 11 report little influence, and only 1 reports the mood before game does not have impact at all (shown in Figure 3.3). From the results, we can see that most players have both friendly and unfriendly thoughts towards other players, and their mood before play has somewhat influence on the tendency. This leaves us large possibility to change their behaviors towards the more friendly side by in-game intervention with persuasive technologies.

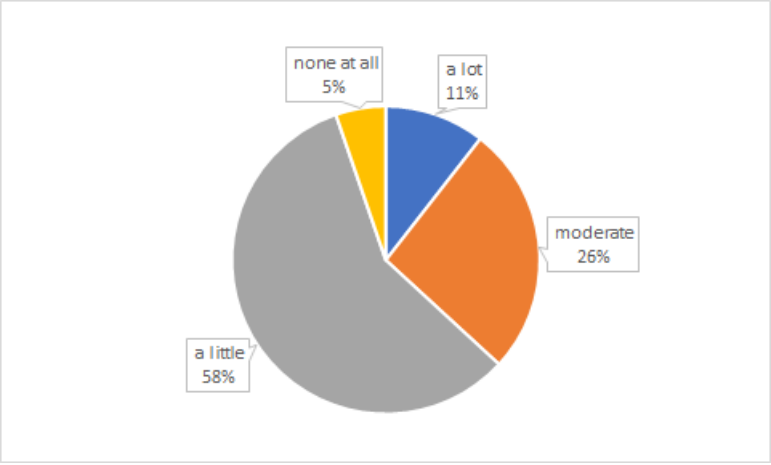

Figure 3.3: The proportion of respondents with different levels of mood influence in multiplayer video games

We ask the 19 players who play with strangers for both friendly/unfriendly behaviors they want to conduct and their thoughts of other possible behaviors falling into these two categories. For those participants who never play with strangers, we only ask for their thoughts of

friendly/unfriendly behaviors that could happen. The answers are categorized into 4 groups correspondingly. The types and their occurrence are shown in Table 3.1.

Category	Friendly behavior	Unfriendly behavior
Within chat	friendly communication, e.g. greetings before match (10) encouraging (7) compliments (3) share knowledge (1) keep silent (1) show gratitude (1)	insults (18) provoking (2) scoff (1) blaming others for losing (1)
Within match	help each other (10) take winning seriously (1)	inconsiderate behaviors, e.g. expose the location of their team (4) passive gaming (3)
Within game	friending (2) gifting (1)	blocking / blacklisting (1)
Outside game		hurt another player in real life (2) speak ill of another player, e.g. on the forum (1) expose another player's identity in real life (1)

Table 3.1: Types of friendly and unfriendly behaviors

While most friendly/unfriendly behaviors remain a relatively short time period (e.g. within a single match), some can be carried outside the game and have further impact on a player's real life. 4 participants mention unfriendly behaviors outside game but all the friendly behaviors remain in game context. Interestingly, none of the 4 participants mentioning unfriendly behaviors outside game play multiplayer video games with people they do not know in real life. The causal relation is unclear (whether negative thoughts keep them away from gaming with strangers, or lack of gaming experience biased their thoughts to the negative side). Both friendly and unfriendly behaviors can be as simple as greeting other players before a match, or shouting some insulting words in the voice chat, which makes it relatively easy for us to monitor.

We ask the 19 players who play with strangers for the actual triggers of their thoughts and possible triggers they could think of, while for other participants, we only ask for their thoughts of the possible triggers of aforementioned friendly/unfriendly behaviors. The answers are categorized into 4 groups correspondingly. Some examples and their occurrence are shown in Table 3.2.

We can see a big proportion of triggers to friendly behaviors are goal-related, which means a player tries to be friendly to others, in order to achieve a common goal, no matter it is to win or to create a enjoyable gaming environment. Triggers to unfriendly behaviors are more related to gaming experience, which means a player tends to behave unfriendly when they do not enjoy the game as expected.

Speaking of triggers outside game context, participants prize a player's own personality for being friendly, and blame their negative mood before playing for being unfriendly. This shows that people believe friendly behaviors have a more consistent source, while unfriendly behaviors are likely to happen sporadically. Our findings show that unfriendly behavior of one player can trigger more unfriendly behaviors, but friendly behaviors are less mentioned to be like so. This partially

Category	Friendly behavior trigger	Unfriendly behavior trigger
Outside game context	player's own personality (5) real-life relationship (3)	negative mood in real life (5) different perspective on acceptable behaviors (1) player's own personality (1) dislike of other players (1)
Goal related	to win / get reward (4) to make the game more enjoyable (4) to achieve better cooperation (4) uncompetitive nature of the game (1)	competitive nature of the game (2) incompatible playing goals (1)
Game experience related	player's own team having good performance (2) enjoy playing (2) hope for reciprocity (1)	player's own team having bad performance (7) bad cooperation with team (4) losing a match (2)
Other players' behavior	other players being friendly (2) opponents playing unfairly (1)	other players being unfriendly (9) opponents cheating in game (1)

Table 3.2: Triggers of friendly and unfriendly behaviors

explains why occasionally occurring unfriendly behaviors in games can be hazardous to gaming experience, which leads to our main study of increasing prosocial behaviors in games. Although it might not trigger much friendly behaviors of other players, it still shows potentials in promoting players' well-being by reducing the influence of negative gaming experience.

3.2 Study 2: interview

We conduct one-on-one interviews with 8 participants, 7 males and 1 female, aged from 28 to 35 years. All of them play video games more than once a week and do not participate in the questionnaire study. These interviews give us a broader and deeper understanding of friendly/unfriendly behaviors in multiplayer video games, as well as the triggers of them.

One interview takes roughly 10-30 minutes, depending on the participant's responding speed and the amount of information they want to share. All the interviews are conducted with text messages via WeChat and follow the procedures below:

1. A brief introduction about our study is sent to the participant with the invitation message, and we give them the chance to ask anything still unclear to them.

2. We send the informed consent form to them and ask them to reply whether they consent or not with text message. Demographic information is not collected during the interview but from the principal researcher's knowledge as all the participants are friends and their personal information are already known.

3. We ask four broad questions to them (listed in Appendix B.1). The principal researcher might ask a participant to clarify or further elaborate their point of view if anything is not clear.

4. The chat history is compiled into plain document files and sent to corresponding participant for their confirmation of the contents.

We do not hold in-person interviews as the study happens during the lockdown period and the participants think it is a more relaxed way for them to reply with texts. We might fail to catch

some minor information because participants are able to rephrase their words before sending to the principal researcher, but we think the most important information they want to convey has been collected by our side.

Except for the stereotype toxic behaviors, our interviewees come up with more diverse types of unfriendly behaviors in multiplayer video games. As for the unfriendly behaviors they come across in games, they mention cheating, quitting game when a teammate does not perform well, showing off on winning or when being in dominance. One participant mentions unfriendly behaviors conducted by strangers in a game has smaller impact than those in real life, because "they are just poor kids who can't control their temper". As for the unfriendly behaviors they have thoughts to conduct, they mention acting as a spy because "they are like true heroes when destroying a group with hundreds of players with a single man's power", doing the same unfriendly behavior on another random player (because they are not likely to be matched to the same player who did the unfriendly behavior to them). One participant concedes a tendency to blame themselves for losing, and two participants think one should not take games too seriously to harm players in real world.

Regarding friendly behaviors, participants mention sharing in-game resources, sharing game skills, completing a quest together, and greeting others before a match, which are all covered by the responses from Study 1. On the other hand, they give more ideas on the triggers of being friendly, such as to attract more players to stay in the game so "it doesn't become a dead game", the game encouraging friendliness and "the developers want you to be friendly", seeing another player from the same country when playing on a foreign server, and feeling the player to be an interesting person on seeing their ID or avatar.

Besides the intended questions on friendly/unfriendly behaviors in games, the participants also share some thoughts on the problem of multiplayer video games and social well-being. They hold quite different points of view towards video games. One of them thinks multiplayer video games are a part of social life, thus other players should be treated as seriously as someone you meet in real life, while another feels games are just for fun and should never be treated seriously. Incompatible playing goals is mentioned in our questionnaire study as one of the triggers of unfriendly behaviors, and this kind of difference can lead to bad cooperation within team, which is another trigger of unfriendly behaviors. Developers sometimes limit what a player can do in the game, on intention to eliminate possible toxic behaviors, but 2 of our participants mentioned they are upset by this kind of design because it also eliminate the possibility of developing deeper friendship with other players.

Participants tend to blame the game itself rather than a toxic player for the occurrence of unfriendly behaviors, because "it's encouraged by the game", or "it's a lame game if it gives you the thoughts of cyberbullying others". This leaves new possibility to our main study, that we might be able to increase prosocial behaviors by showing players that it is intended by game design, even under a competitive setting.

Combining the results of questionnaire and interviews, we try to answer our research question *RQ1* (What are people's perspectives of prosocial behaviors in multiplayer video games?).

To answer subquestion *RQ1A* (What kind of behaviors are regarded as prosocial behaviors in

multiplayer video games?), we get a wide range of answers from both pre-studies. In the questionnaire, the most frequently mentioned prosocial behavior is friendly communications, which can be as simply as saying "hi" before the match. Other common prosocial behaviors include encouraging each other in the game, and helping each other with in-game tasks. In the interviews, participants also focus on helping with in-game tasks, but give more explanatory answers that if a friending/gifting request is sent after the match, they will feel even more connected with that person. Unlike unfriendly behaviors, prosocial interactions are usually not carried outside the game context. No one among our participants has mentioned outside-game prosocial behaviors unless they are already friends in real life before playing. One participant in the interview mentions that he wants to be friendly to other players, but at the same time, feels a bit awkward exchanging tedious greetings with strangers. We think this kind of players are good targets of this study. They are by nature motivated to be friendly, so if we offer them the chance, it is more likely to increase their prosociality in game.

To answer subquestion *RQ1B* (What factors influence the occurrence and type of these prosocial behaviors?), we get some perceived/assumed answers from our participants. In the questionnaire, most participants mention creating a harmonious environment within the team is a critical factor for winning, this however, does not hold for competitive games. Other frequently mentioned triggers are the player's own personality, and real life relationships. Since we scope our study to prosocial behaviors between strangers only, we do not look into the factor of real life relationships. But the personality can be a good independent variable in our main study since it is relatively easy to measure. In the interviews, participants come up with more diverse answers regarding the triggers of prosocial behaviors. They mention things like the passion of building a game community, seeking for friendship, or the other player sharing some similarities with oneself (such as belonging to the same culture, using a funny avatar, etc.). These factors are very game/player specific and need careful manipulation during experiments, so we think they do not fit in the relatively small scale of this study.

This chapter concludes our pre-study on people's perspectives of friendly/unfriendly behaviors and their triggers in multiplayer video games. In next chapter, we will introduce our main study on the effectiveness of different persuasive techniques in increasing players' prosociality and well-being.

Chapter 4

Increasing in-game prosocial behaviors with persuasive technologies

In last chapter, we go over our pre-study on people's perspectives of friendly/unfriendly behaviors and their triggers in multiplayer video games. We will then introduce our main study in this chapter, from experiment design and setup, to conducting and results.

We prototype a game specifically designed for this study in order to learn about the effectiveness of different persuasive techniques in increasing prosocial behaviors, players' susceptibility to them regarding their personality, as well as the influence of in-game social behaviors to players' well-being, which correspond to our research question RQ2 and its sub-questions.

4.1 Prototype design

In our pre-study, we find that "friendly communication" within chat and "helping each other" in game context are the two most mentioned friendly behaviors for multiplayer video games. As in-game chats is already a popular research subject engaging experts in game industry, natural language processing, and machine learning experts, we choose to focus on the latter to measure the effectiveness of our implementations.

The game prototype is tested by the principal researcher and a small pilot group and further polished according to their feedback before conducting the formal experiments.

4.1.1 Public Goods Game

For the game prototype, we use a modified version of Public Goods Game (Hauert, 2005), which is widely used in behavioral economics experiments and works well in predicting cooperation level.

In the original version of the game, N players are allocated a same amount of private token. One can then decide how many of their private tokens will be put into a public pot, without letting others know the exact amount. The tokens in this pot are multiplied by a factor (greater than one and less than N) and evenly divided among the N players. Each player also keeps the tokens they do not contribute.

The group's total payoff is maximized when everyone contributes all of their tokens to the public pool. However, the Nash equilibrium (Nash, 1950) in this game is zero contributions by all, and the most rational agents would do their best by contributing nothing regardless of the amount anyone else contributes.

However, Nash equilibrium is rarely seen in real experiments and people do tend to add at least something into the pot. The actual level of contribution varies widely under different settings

(Janssen and Ahn, 2003), typically depends on the multiplication factor (Anna et al., 2007).

Depending on the experimental design, those who contribute below average or nothing are called "defectors" or "free riders", as opposed to the contributors or above-average contributors, who are called "cooperators". We regard the amount of contribution as a good scale of measuring a player's cooperation level.

"Repeat-play" public goods games involve the same group of subjects playing the basic game over a series of rounds. The typical result is a declining proportion of public contribution. When trusting contributors see that not everyone is giving up as much as they do, they tend to reduce the amount they share in the next round (McGinty and Milam, 2013). If this is again repeated, the same thing happens but from a lower base, so that the amount contributed to the pot is reduced again. However, the amount contributed to the pool rarely drops to zero when rounds of the game are iterated, because there tends to remain some hard-core "givers".

One explanation for the dropping level of contribution is inequity aversion. During repeated games, players learn their co-players inequality aversion in previous rounds, on which future beliefs can be based. If players receive a bigger share for a smaller contribution, the sharing members react against the perceived injustice, even though the identity of the "free riders" are unknown, and it is only a game (Fehr and Schmidt, 1999). Those who contribute nothing in one round rarely contribute something in later rounds, even after discovering that others are.

4.1.2 Customization

In our customized version of Public Goods Game, potatoes are used as the game tokens to remove possible influences when players map virtual tokens to real money.

In the game, a player will be asked to play with two preprogrammed virtual players, without knowing they are not humans. We use virtual players for the sake of controllability, in that way we can measure participants' performance under the same condition, which makes it possible to compare their cooperativeness under different implementations. Despite the setup, we are not telling our participants that they are playing with virtual players, so that our results resemble situations in real-world multiplayer video games. We choose to use only two virtual players because we are interested in players' strategy under different implementations rather than complicated social interactions, and two is the least amount to keep the planting number of a single player unknown to others. To fake the virtual players, we set 5 seconds of delay before the game starts, displaying "Waiting for other players to join..." on the screen, as shown in Figure 4.1. And each planting phase is set to 20 seconds so that the player cannot perceived when the virtual players make their decisions. The length of waiting time and planting decision time are tested within the pilot group and we pick the most favorable one.

Figure 4.1: The loading screen of the game

The two virtual players are programmed as one defector and one cooperator. The defector plants 0 in the first round, and in the later rounds, one less potato than the average amount of the previous round. For example, it will plant 2 potatoes in round 3 if the average planting number is 3 in round 2. If the average number is less than 0.5 in previous round, the defector will plant 0 because the planting number cannot be negative. On the contrary, the cooperator plants 5 in the first round (which is the maximum amount), and in the later rounds, one more potato than the average amount of the previous round. For example, it will plant 2 potatoes in round 3 if the average planting number is 1 in round 2. If the average number is more than or equal to 4.5 in previous round, the cooperator will plant 5 because the planting number cannot exceed the initial allocation. With this setup, we expect the player to always have the feeling of other players mimicking their action in previous round, which creates a simple yet plausible social interaction. Moreover, this setup makes sure that the player always ends up in the second place, which removes possible influence of winning or losing on their reported well-being after playing the game.

The game lasts for 10 rounds. At the beginning of one round, each player is allocated 5 potatoes, and they can decide the number of potatoes they want to plant in the public field. A player needs to type in the exact number and click the "plant" button to confirm their decision. We do not use a scroll bar because larger numbers are further away from the initial position, which requires more time and labour to choose, and could influence the recorded decision time. Figure 4.2 shows the game interface of the control version.

Figure 4.2: A screenshot of the game (control version)

We use 10 iterations because we see the planting number converges after 10 rounds during the pilot test within a small group of players. By converge, we mean players keep planting the same number of potatoes over a few rounds. Since the virtual players mimic the behavior of the human player, they do not change their strategy if the human player keeps planting the same amount. The game then reaches a balanced status and the dynamics does not change anymore. We do not allow for more than 10 rounds since there is a higher chance of participants quitting the game when they get bored by playing for too many rounds.

A player is allocated 5 potatoes at the beginning of each round, as we learn from the pilot group that 5 is big enough to tell apart players with different strategies, yet it is not too big a number to add unnecessary mental burden when doing calculations or picking an exact number from a lot of options.

The potatoes planted in the public field double after a round and all the harvest are evenly distributed to each player, no matter how many potatoes they have "donated" to the public field, and the number of potatoes each player planted is kept anonymous. Those unplanted potatoes do not double and are counted as a player's own possession, together with those potatoes harvested from the public field and distributed to them. A player should aim for as many potatoes as possible at the end of the game.

We simply use a multiplication factor of two, as it is the only integer number between 1 and 3 (the number of players). We think a non-integer number would require better mental calculation skill and might lead to more errors in players' strategy. The remaining setups are the same as the original version of Public Goods Game.

To achieve highest possible outcome, a player should keep all the allocated potatoes with themselves, while other players donate all the potatoes they have. However, a player is informed of the total number of potatoes harvested from the public field, thus they can have a rough guess of how many potatoes other players have planted. When the total harvest number is low, players are

expected to plant less potatoes in next round, which sets up a dilemma of whether one should plant more potatoes in the public field if they are aiming for highest gain. Therefore, we can note down the number of potatoes a player plants in the public field as a quantified metric of cooperativeness.

4.1.3 Persuasive techniques

Based on the control version of the game, we further change some in-game designs to see how they influence players' planting numbers. Three different persuasive techniques are tested in our game, which are:

1. Reduction (reduce complex behavior to simple tasks): using a "plant all" button other than having players enter the actual number of potatoes to plant, as shown in figure 4.3.

Figure 4.3: Game interface of the reduction version

2. Self-monitoring (eliminate the tedium of tracking performance or status): always displaying the total number of potatoes a player has planted on the screen, as shown in figure 4.4.

Figure 4.4: Game interface of the self-monitoring version

3. Priming (expose an individual to stimuli below the threshold of perception): displaying an encouraging message of "Generous is rewarded with generous" at the end of game tutorials, as shown in figure 4.5.

Figure 4.5: Game interface of the priming version

We refer to Fogg (2003a) when picking persuasive techniques to be integrated in our game, as it focuses on persuading using computers, rather than human communications (Braet, 1992). This work is based on nine years of research in "Captology" (an acronym for computers as persuasive technologies) in the Persuasive Technology Lab at Stanford University, and has now been practiced and proved in various fields such as technology design, marketing, and researching.

Two out of the seven techniques (refer to section 2.7 for detailed description) are implemented. We pick reduction and self-monitoring since they can be easily implemented and fit well in our game without changing the game mechanics too much. We think tunneling and conditioning techniques are too deliberate and can possibly hinder a player's sense of free play, while tailoring and suggestion need extra information from the players to be effective. Surveillance technique is not applicable for most multiplayer video games (many players tend to play alone without anyone watching). Therefore, all the other five persuasive techniques are not suitable for our games.

Another persuasive technique of priming is used, inspired by Riot Games' attempts in reducing toxicity in League of Legends. The other approaches they are using are specified for their cross-team chatting feature and are not applicable for our game, but we think it is possible to adapt the priming technique in our game prototype to increase prosocial behaviors. This technique has been tested on the massive player population of League of Legends and is proved to be effective in influencing players' toxicity level (not necessarily reducing though, the toxicity level increases in some cases).

4.2 Participants

60 volunteer participants (30 male and 27 female) are recruited for the experiment. Table 4.1 and Table 4.2 show the gender and ethnics distributions of all the groups. Most of them are between 19 and 33 years old except for two participants aged 59 and 60. All participants have basic knowledge of operating a computer and can understand the English texts in game. They have all signed an informed consent form in advance of the first survey of their personalities. An example of the consent form and information sheet is included in Appendix A.2.

	control	reduction	self-monitoring	priming	3 treatment groups	total
male	9	9	5	7	21	30
female	6	4	10	7	21	27
non-binary	0	2	0	1	3	3

Table 4.1: Gender distribution of different groups

	control	reduction	self-monitoring	priming	3 treatment groups	total
Asian	4	7	8	10	25	29
European	10	7	7	4	18	28
others	1	1	0	1	2	3

Table 4.2: Ethnics distribution of different groups

4.3 Independent variables

Independent variables are the variables not seen as depending on any other variable(s) in the scope of the experiment.

4.3.1 Version ID

We make four versions of our game, which are the control version and three treatment versions, each of which features one persuasive technique. A participant has access to only one version out

of the four. Version ID 1-4 correspond to the control version, reduction version, self-monitoring version, and priming version, respectively.

4.3.2 Player personality

A subject's personality might both impact their strategy used in the game and their susceptibility to certain persuasive techniques. To measure the personality of a subject, we use Ten Item Personality Measure (TIPI) (Gosling et al., 2003) as its briefness suits well into our game prototype, yet yielding reliable results.

4.3.3 Demographics

We pick age, gender, country of origin as independent variables since these factors can affect a player's cooperation level as well as their susceptibility to certain persuasive techniques.

4.4 Dependent variables

Dependent variables are the variables in the experiment whose values are studied under the supposition or demand that they depend, by some law or rule (such as by a mathematical function), on the values of other variables.

4.4.1 Decision time

We record the decision time for each of the 10 planting phase of a subject. A decreasing in decision time is expected according to McGinty and Milam (2013). A very low average decision time can also imply that the player is not careful with their decisions, and these results should be excluded from the analyzing process.

4.4.2 Number of planted potatoes

The number of planted potatoes in each of the 10 planting phase are recorded as the measure of a player's cooperation level throughout the game. The planting number in the first round is regarded to be only influenced by a player's personal factors (such as personality), while the planting numbers in the second till tenth rounds are accumulated results of interaction with other players. We expect a drop in planting number in the last phase, because there is no more expectation of reciprocity from others.

4.4.3 Well-being score

Studies show that autonomous motivation for helping yields benefits for both helper and recipient (Weinstein and Ryan, 2010), and well-being will in turn promote prosocial behaviors (Hui, 2022). However this is only true when one has the feeling of choice, instead of being obligated to act prosocially (Rinner et al., 2022). We are interested in whether increasing cooperativeness with persuasive techniques leads to better well-being to the helpers themselves. We pick the Warwick-Edinburgh Mental Wellbeing Scales (WEMWBS) as our well-being measurement scale due to its briefness and universality. A player is asked to finish the well-being questionnaire after playing the game.

4.5 Experiment design

We ask the participants to play the game on a Windows computer. If a participant does not have access to a Window device, they can as well play remotely through Microsoft Teams. The whole experiment includes four steps: 1) signing the consent form, 2) filling in TIPI questionnaire, 3)

playing the game, 4) filling in WEMWBS and reporting demographic information. All the four steps are integrated into one single application, so that a participant does not need to make extra efforts when switching between tasks. Figure 4.6 shows the TIPI questionnaire which is integrated in our game.

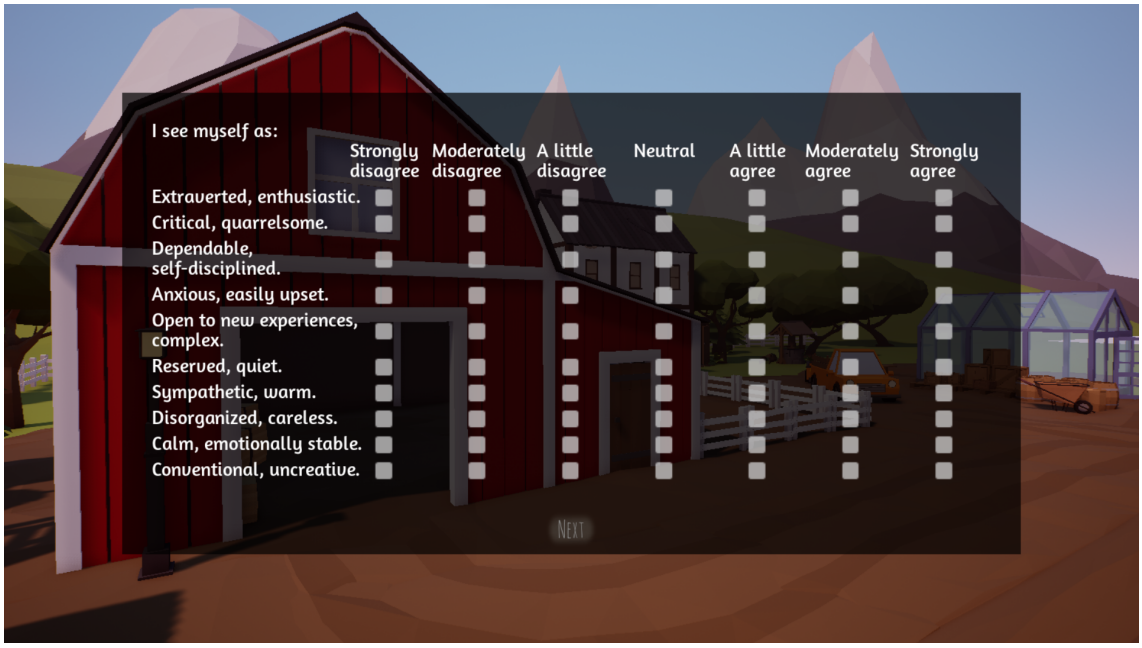

Figure 4.6: TIPI questionnaire integrated in the game

To minimize the anticipated reduction of effects due to habituation, each participant is randomly assigned to one out of the four versions of the game using a unique player ID, and is allowed to play the game only once. They can pause the game and ask questions to the principal researcher whenever they want to.

With 60 participants, we can measure each of the condition with 15 volunteers. And we ensure the conditions are equally distributed among all the participants.

4.6 Results

We analyze whether the decision time and planting number of each round are different between control group and treatment groups. The influences of persuasive techniques on different personality and demographic groups are analyzed as well. We present all the results and findings in this section.

4.6.1 Decision time

As shown in Figure 4.7, the decision times of all groups converge starting from the fourth round. We think this is because we do not offer a trial session, and participants need to get familiar with the game rules.

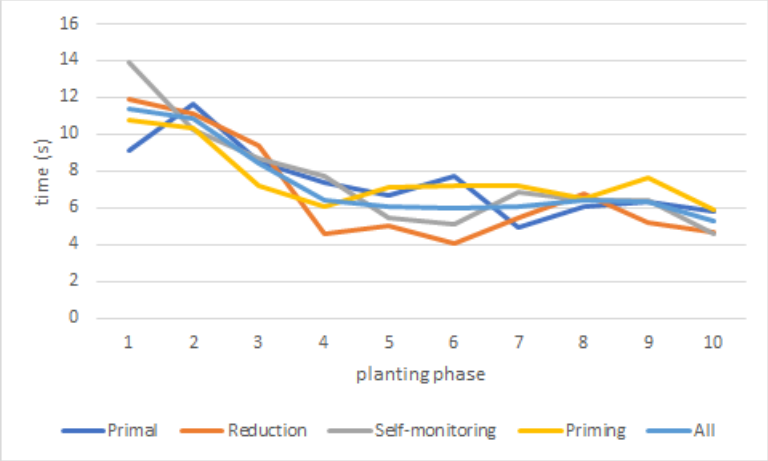

Figure 4.7: Decision time per phase for all groups

To compare the mean decision time of groups playing the game with/without persuasive techniques, we run an independent-samples t-test. We find significant difference (p = .034) in first round decision time between treatment groups (mean = 12.3 seconds) and control group (mean = 9.1 seconds). Participants use more time on deciding their strategies in the first planting phase when a persuasive technique is implemented, but no significant difference is found in later rounds. Figure 4.8 shows the decision time of all four groups over the 10 rounds.

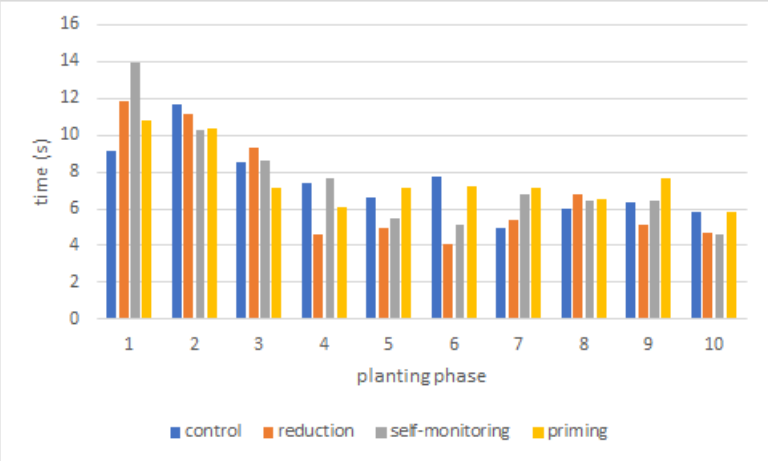

Figure 4.8: Decision time of all four groups

We think the time difference is caused by players using more time to process extra information. But after they have settled their strategy, the implementation does not influence them anymore.

To compare the decision time of different personality groups, we run a One-way analysis of variance (ANOVA) test. Participants with high extroversion score use more decision time (mean = 7.6 seconds) in the fourth phase than those with medium/low extroversion scores (mean = 5.3 and 5.6 seconds) (p = .038). No significant difference is found in decision time between other personality groups. Figure 4.9 shows the decision time of different personality groups over the 10 rounds.

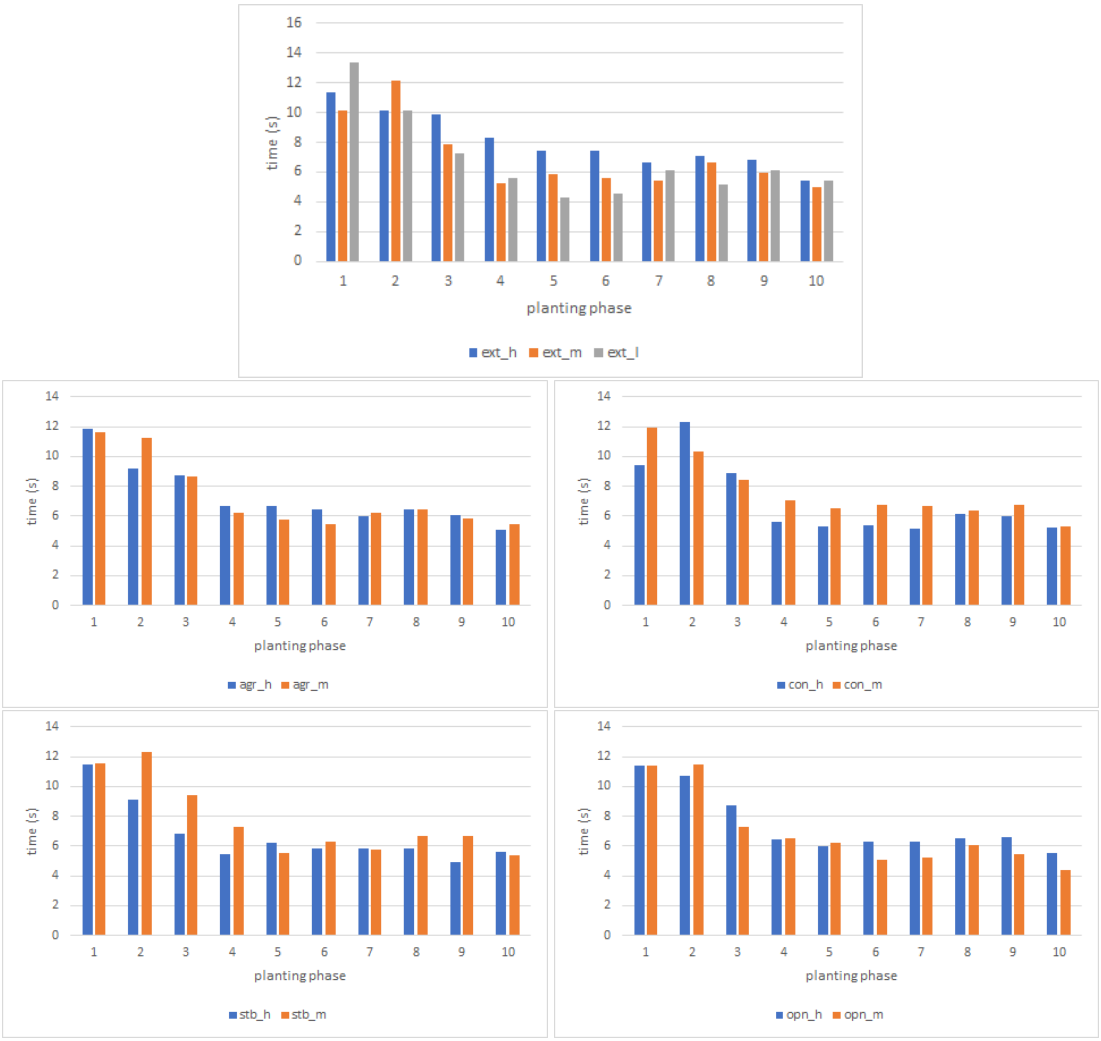

Figure 4.9: Decision time of different personality groups

Female participants use more time when making decision (mean = 7.0 seconds) in the fourth round than male participants (mean = 5.7 seconds) ($p = .034$). As we regard the first three rounds as the learning phase, a longer decision time in the fourth round might imply that females have a longer learning phase than males. The actual reasons to this is not clear due to the limited independent variables we are measuring, and we guess this could be the result of females spending less time playing video games in general (Griffiths and McLean, 2013) so they have longer learning phase, or females are more careful with their game strategies so their decision time converge slower. Asian participants use more decision time in the seventh and the ninth phases (mean = 8.3 and 7.9 seconds) than European participants (mean = 4.0 and 4.8 seconds) ($p < .001$). Figure 4.10 shows the decision time of different demographic groups over the 10 rounds.

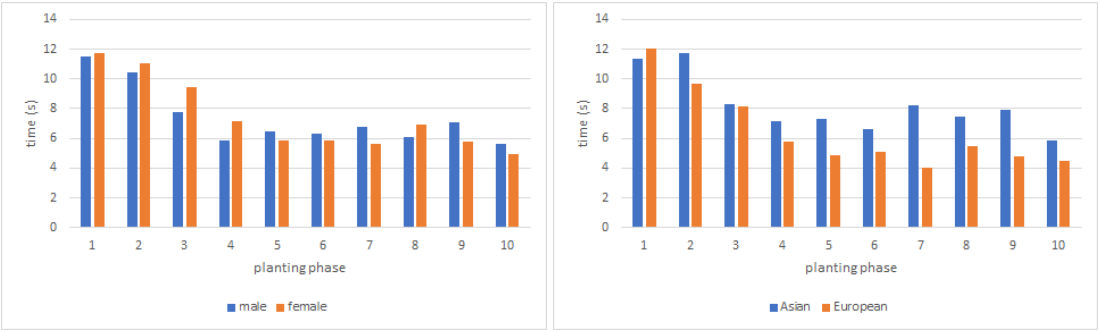

Figure 4.10: Decision time of different demographics

4.6.2 Number of planted potatoes

As shown in Figure 4.11, the planting number is decreasing gradually throughout the whole game session. This aligns with the results of the original Public Goods Game experiment. We can also see big drops during the last two planting phase, which might be a result of participants expecting less reciprocity from other players when the game is approaching to the end.

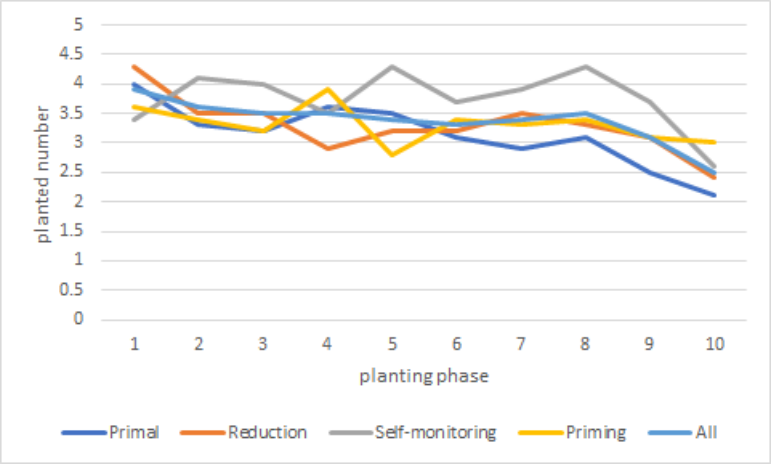

Figure 4.11: Planting number per phase for all groups

Figure 4.12 shows how decision time and planting number change over the 10 rounds together.

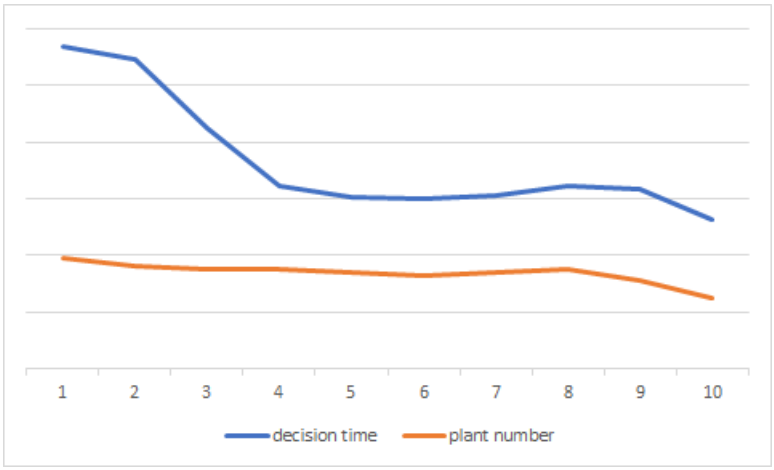

Figure 4.12: Decision time and plant number over the ten planting phases

We run tests over planting number per round with the same setup as we do with the decision times. We find significant difference (p = .018) in first round planting number between treatment groups (mean = 3.8) and control group (mean = 4.0). Participants plant less potatoes in the first planting phase when a persuasive technique is implemented, but no significant difference is found in the second till tenth rounds.

However, when we look into the average planting number from the fourth to tenth round (skipping the learning phase of first three rounds), we find significant difference between groups with/without persuasive techniques (p = .011). Participants in treatment groups plant 3.3 potatoes on average and those in control group plant 3.0 on average, which shows our implementations do have impacts on participants' planting number of potatoes, but only after their learning phase. Figure 4.13 shows the planting number of all four groups over the 10 rounds.

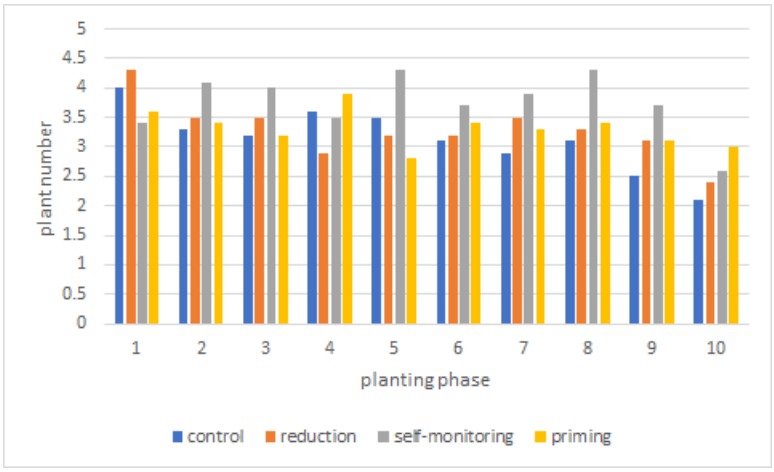

Figure 4.13: Plant number of all four groups

Although participants in different personality groups differ in their decision time, we do not find any significant difference regarding the number of potatoes they plant throughout the game. Figure 4.14 shows the planting number of different personality groups over the 10 rounds.

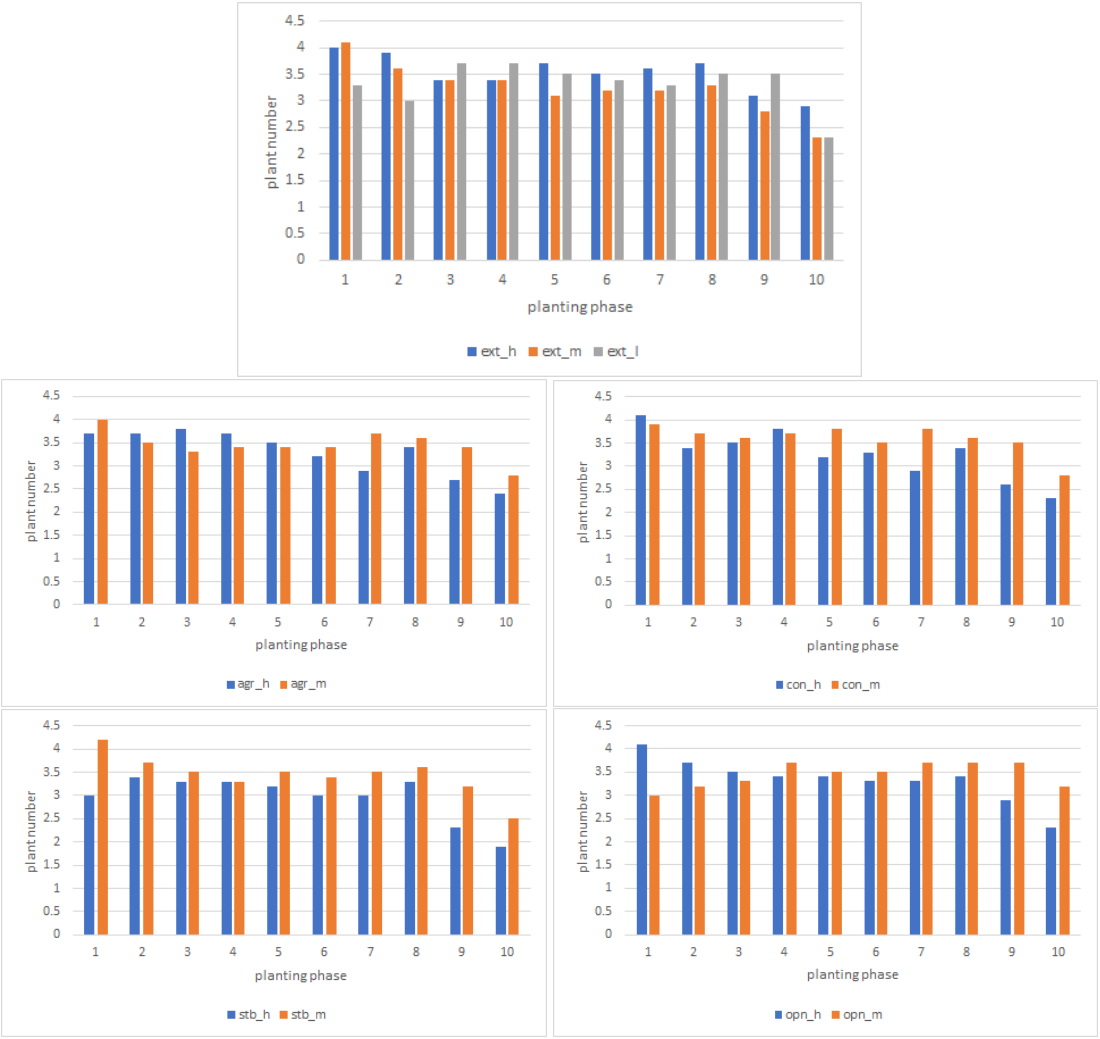

Figure 4.14: Plant number of different personality groups

No significant difference is found between genders. Asian participants plant less potatoes (mean = 3.0) in the eighth planting phase than European participants (mean = 3.9) ($p = .004$). Figure 4.15 shows the planting number of different demographic groups over the 10 rounds.

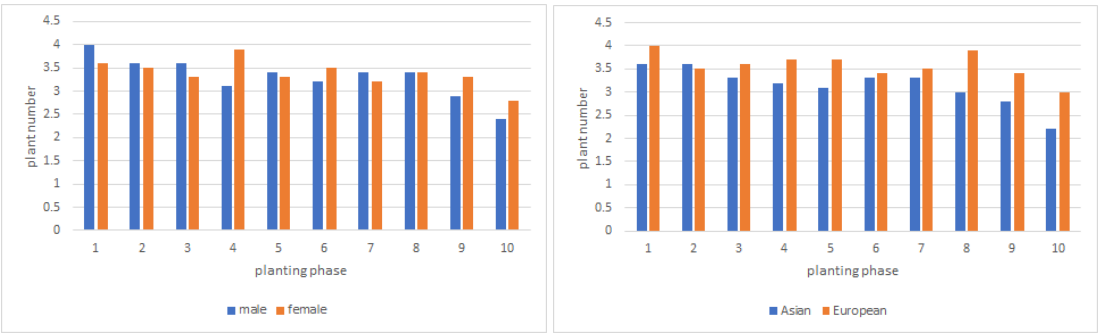

Figure 4.15: Plant number of different demographics

4.6.3 Well-being score

No significant difference is found in overall well-being scores between different implementations, but participants in the reduction group or the priming group report lower scores in the item of "I've

been able to make up my own mind about things", scoring 2.8 and 2.1 on average, in comparison of 3.3 and 3.2 in control group and self-monitoring group (p = .001). Figure 4.16 shows the 7-item well-being score of all four groups.

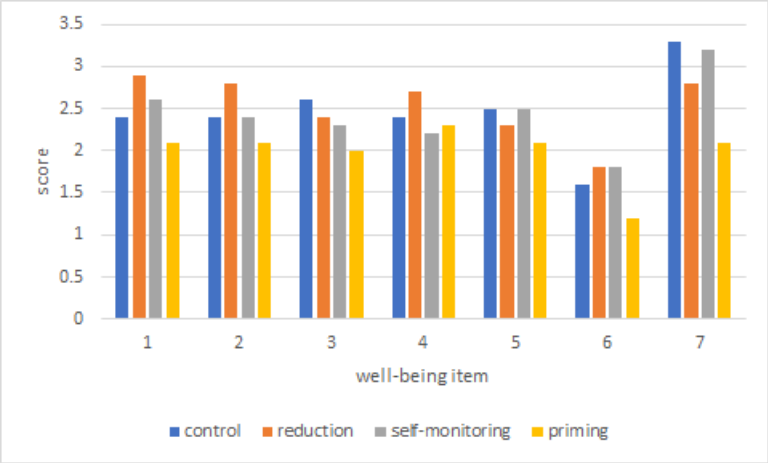

Figure 4.16: WEMWBS score of all four groups

Participants with high openness scores report lower well-being (mean = 2.3) in the item of "I've been dealing with problems well" than those with medium openness scores (mean = 2.6) (p = .049). We do not have enough participants in low openness group so the results are not reported here. No significant difference is found in other well-being items between different personality groups. Figure 4.17 shows the 7-item well-being score of different personality groups.

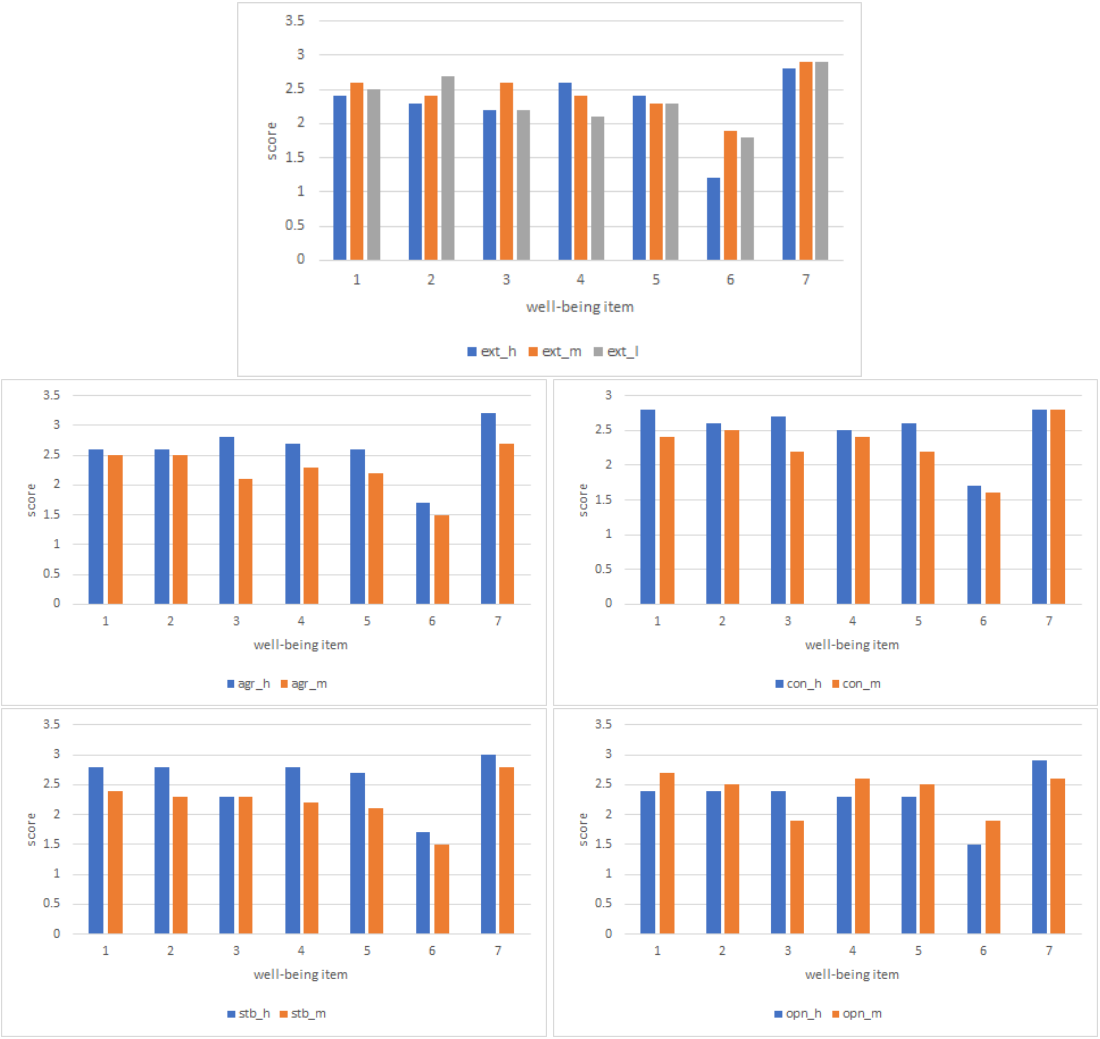

Figure 4.17: WEMWBS score of different personality groups

No significant difference is found between genders or ethnic groups. Figure 4.18 shows the 7-item well-being score of different demographic groups.

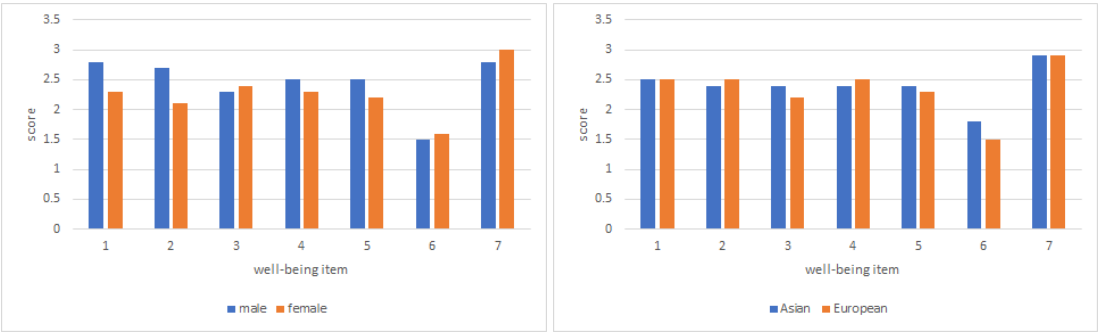

Figure 4.18: WEMWBS score of different demographics

No significant difference is found between defector group (planting less than 1.5 potatoes on average) and cooperator group (planting more than 3.5 potatoes on average). Figure 4.19 shows the 7-item well-being score of the defector group and the cooperator group.

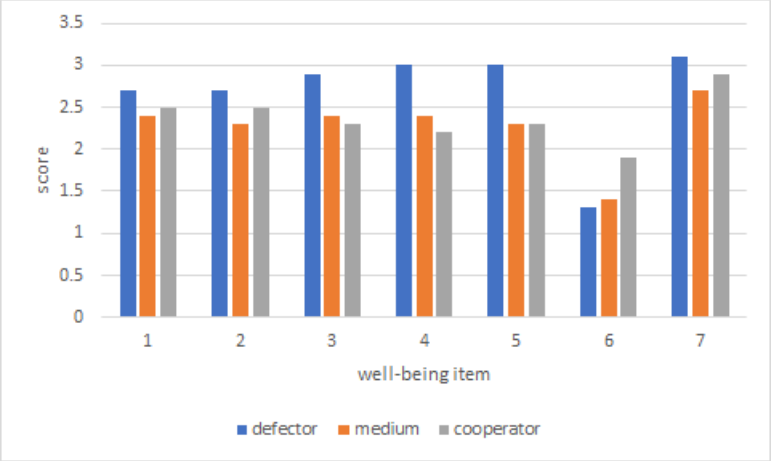

Figure 4.19: WEMWBS score of different cooperativeness groups

We introduce our main study in this chapter and we get many interesting results from the experiment. In next chapter, we are going to interpret the results of both the pre-study and the main study and have a discussion over our findings.

Chapter 5

Discussion

We have shown the readers our setups and results in the main study in last chapter. This chapter gives our interpretations of the results we get from both the pre-study and the main study.

Our study tries to explore the possibility of increasing prosocial behaviors in multiplayer video games, with the help of persuasive technologies. We attempt to answer following research questions:

RQ1: What are people's perspectives of prosocial behaviors in multiplayer video games?

RQ1A: What kind of behaviors are regarded as prosocial behaviors in multiplayer video games?

RQ1B: What factors influence the occurrence and type of these prosocial behaviors?

Although people's perspectives of friendly/unfriendly behaviors in multiplayer video games mostly overlap with each other, they can still vary from person to person. For example, words regarded as "just joking" by one can be toxic to another, and a player can feel frustrated when their teammates do not take the game seriously, while another may think "it is just a game". Therefore, it is also important for developers to be open-minded and take various needs into consideration, in order to create a more inclusive and harmonious gaming environment.

When addressing the triggers of others being unfriendly in multiplayer video games, people tend to blame one's personality or game mechanics, which has nothing to do with social factors. However, when addressing the reasons of themselves being unfriendly in games, more people attribute them to other players being unfriendly towards them first. This aligns with the observations of Lin (2013) that a typical toxic player only have sporadic impulses to act unfriendly and they do not expect themselves to be unfriendly to others when not playing.

RQ2: How can we design multiplayer video games to increase prosocial behaviors?

RQ2A: What persuasive techniques can we use in game design to increase these behaviors?

RQ2B: What is the effectiveness of these persuasive techniques in increasing prosocial behaviors?

RQ2C: How do players' personality and demographics affect their susceptibility to different persuasive techniques?

According to our experiment, we regard using persuasive techniques as a possible approach to change players' behaviors in game, but the effectiveness of different techniques do not differ much, as well as their influence on different personality types or demographic groups. Therefore, we suggest the game designers to go for the persuasive techniques which best suit their games.

In the first round which is not affected by social interactions yet, participants hesitate more

if a persuasive technique is present. We think that even the participants cannot notice our implementation consciously, they need more time to decide their strategy due to the extra information.

RQ3: How do prosocial behaviors in multiplayer video games affect players' well-being?

We find players' sense of making decisions on their own can lower due to the implementation of persuasive techniques. This suggests us to be careful when integrating these techniques into games, which can be harmful to players' well-being on the contrary of our expectations, if we overuse them.

We use WEMWBS scores as the well-being metric. It is a measurement of general well-being and not specifically designed for video game players. And we think as the game sessions are relatively short (about 5 minutes) so they do not have strong enough influences on players' well-being. Another guess is that the player only plays the game once and cannot test whether they have a higher chance of winning when they act cooperatively, which is usually the case in real multiplayer games (teams with good cooperation have higher chance to win).

We also have some interesting findings outside the scope of our research question, which are reported here for completeness.

Even when tutorials are present, players might need practice to grasp the game mechanics. We see participants' decision time converge after the fourth round, which means they are sticking to their decided strategy.

We find culture difference in strategy making in our game. Asians use more decision time even in the later phases of the game and they also tend to plant less potatoes overall. We think this as a result of Asian countries' large population and high concentration in a few areas, which leads to a performant and competitive culture as they need to compete for the limited resources available. Another cause might be the continuation of social hierarchy that largely come from Confucianist ideals but still pervades much of East Asia. While European cultures strongly emphasize egalitarianism, Asian cultures tend to maintain implicit hierarchies. These factors urge Asians to take winning more seriously and might furthermore prompt utilitarianism even when playing games.

5.1 Limitation

From the data collected in our main experiment, we find that participants have a learning phase of three rounds on average, which might influence the interpretation of our results. We suggest to have a trial session before the actual experiment so that the participants can feel comfortable with the game rules.

We do not record "plant all" button clicking event in the reduction version of the game, which might bias the decision times.

Gaming frequency and previous gaming experience are missing in demographic data, which can be an interesting factor of influence. We regard our results as still reliable since participants are assigned to different experiment groups randomly and the distribution of different gaming experience level is expected to be even.

Some participants play the game remotely as they do not have a Windows device, which may influence the recorded decision times.

Due to the limited time and labour available for this study, we only pick three persuasive

techniques in interest, leaving out lots of possibility in other persuasive techniques and different genre of games. The custom version of Public Goods Game uses variables values that are convenient for this study, the variations of which can have influence on players' in-game behaviors as well. For example, we use three players, multiplication factor of 2, and 5 private tokens per round, which can all be changed for future study purpose.

We use virtual players for better controllability, but they do not necessarily act as human players. They are also preprogrammed as one defector and one cooperator on purpose, and different setups can have influence on the results.

Both pre-study and main study are conducted within a relatively small group with limited demographic range, which means the generalization of our results remains to be answered.

We discuss our findings and interpret the results in this chapter, and we will conclude this study in next chapter.

Chapter 6

Conclusion

We discuss our interpretation to the experiment results and limitations in last chapter, and this chapter concludes our findings and future works.

Researches show that video games including social activities have benefits on psychological aspects of well-being (Herodotou et al., 2014), especially for cooperative games (Ewoldsen et al., 2012). We learn in our pre-study that while many players equivalent unfriendly behaviors to verbal insults, friendly behaviors are more often connected to in-game aspects (such as helping with game tasks).

Both academia and industry have long been fighting toxic behaviors in multiplayer video games and see many successful attempts (Märtens et al., 2015; Stoop et al., 2019; Canossa et al., 2021). We try to learn the potentials of increasing player well-being by encouraging prosocial behaviors in game, rather than banning toxic behaviors, which is a relative new approach and few have studied on it. Behavior change interventions are practised in health and clinical realm (Michie et al., 2014) thus we think it is possible to adapt them to multiplayer video game context.

6.1 Contribution and key findings

We collect opinions towards friendly/unfriendly behaviors in multiplayer video games and triggers of them, from people with varied gaming experience and preferences. We find them often relate unfriendly behaviors to verbal insulting through in-game communication channel, while friendly behaviors are more diverse, consisting of both friendly communications and good willingness in cooperation. They also come up with lots of triggers of these behaviors, from a player's own personality or emotional status, to game mechanics and gaming experiences.

We implement a custom version of Public Goods Game (Hauert, 2005) and integrate three persuasive techniques into it (reduction, self-monitoring, and priming). We find participants planting more potatoes after learning phase in treatment groups, which implies higher willingness to cooperate. However, we do not see significant difference in the effectiveness of the three persuasive techniques.

Participants with high extroversion score use more decision time in the fourth round than those with medium extroversion scores. Yet their planting numbers do not differ significantly.

Female participants use more time to make decision in the fourth round than male participants but the overall planting number is the same. Asian participants use more decision time in later game rounds (seventh and ninth) and their planting numbers converge earlier in the eighth round, in comparison to European participants in the ninth round.

We do not find significant difference in participants' susceptibility to certain persuasive technique between different personality or demographic groups.

Participants in treatment groups report lower level of "being able to make up my own mind about things", while the overall well-being scores are the same with the control group.

As increasing prosocial behaviors in multiplayer video games is a relatively new field, the strengths and drawbacks of using persuasive technologies to achieve it is yet to be explored. By conducting this study, we think it can serve as an inspiration for both academia and industry on this topic.

6.2 Future work

We have mentioned several limitations of this study in Section 5.1, which leave potentials to future work. The game prototype can be more polished to reduce possible variances, for example we can have a few trial rounds for players to get used to the game. It can also be used in other studies and adapt to different experiment purpose after modification.

We use WEMWBS to measure players' well-being, which is subjective and not necessarily reflect their actual mental status. It will be interesting to use some other measurements such as brain activities.

Besides the limitations of our game prototype, the study of the effectiveness of other persuasive techniques, or the generalization in other game genre, are also interesting research directions. For general studies of players' social interactions, the variables in our game, as well as the strategy of the two virtual players, can be changed to see how they influence players' in-game behaviors accordingly.

Another variance of the original Public Goods Game is the Open Public Goods Game, where past choices and payoffs of group members are transparent and thus affect future choices, which is also a research topic of interest. Studies show individuals in groups can be influenced by the group leaders, whether formal or informal, to conform or defect. When players are informed of individual payoffs of each member of the group it can lead to a dynamic of players adopting the strategy of the player who benefited the most (contributed the least) in the group. This can lead to a drop in cooperation through subsequent iterations of the game (Fiala and Suetens, 2017).

Enhancing players' well-being by increasing prosocial activities in game is a relatively new field. We pioneer our ideas of using persuasive techniques, but many options are out there to be explored. Our study can for example be extended to what kinds of game design grant more sense of freedom, and thus work better in increasing players' well-being.

Appendix A

Ethical considerations and materials

Ethical approval was obtained from participants in our pre-study questionnaire or main study experiment. We provide examples of our consent forms.

A.1 Consent form: online questionnaire and interviews

Welcome to the research study!

We are interested in understanding the triggers of friendly/unfriendly behaviors in multiplayer video games. For this study, you will be asked to answer some questions about it. Your responses will be kept completely confidential.

The study should take you around 5-15 minutes to complete. Your participation in this research is voluntary. You have the right to withdraw at any point during the study. The Principal Investigator of this study can be contacted at m.chen1@students.uu.nl.

By clicking the button below, you acknowledge:

- The research project has been explained and you have the opportunity to ask questions about the project to have satisfactory answers.
- Your contributed material can be used to generate insights for the research project.
- Your participation in the study is voluntary.
- You are aware that you may choose to terminate your participation at any time without providing a reason.
- You are 18 years of age or over.
- The fully anonymous data can be used for future publications and other scholarly means of disseminating the findings from the research project.
- The information/data acquired will be securely stored by researchers, but that appropriately anonymous data may in future be made available to others for research purposes.
- Utrecht University may publish appropriately anonymous data in its research repository for verification purposes and to make it accessible to researchers and other research users.

☐ I consent, begin the study

☐ I do not consent, I do not wish to participate

A.2 Consent form: potato game experiment

Welcome to the research study!

We are interested in testing our game design on real players. For this study, you will be asked to answer some questions about your player type and then play a game. After that, you will be asked to fill in another questionnaire about your feeling at the moment and some additional demographic information. Your responses will be kept completely confidential.

The study should take you around 15 minutes to complete. Your participation in this research is voluntary. You have the right to withdraw at any point during the study. The Principal Investigator of this study can be contacted at m.chen1@students.uu.nl.

By clicking the button below, you acknowledge:

- The research project has been explained and you have the opportunity to ask questions about the project to have satisfactory answers.
- Your contributed material can be used to generate insights for the research project.
- Your participation in the study is voluntary.
- You are aware that you may choose to terminate your participation at any time without providing a reason.
- You are 18 years of age or over.
- The fully anonymous data can be used for future publications and other scholarly means of disseminating the findings from the research project.
- The information/data acquired will be securely stored by researchers, but that appropriately anonymous data may in future be made available to others for research purposes.
- Utrecht University may publish appropriately anonymous data in its research repository for verification purposes and to make it accessible to researchers and other research users.

☐ I consent, begin the study

Appendix B

Study materials

B.1 Interview questions

1. Have you ever experienced any unfriendly behaviors in multiplayer video games? If so, what do you think are the triggers of the behavior? (Speaking of unfriendly behaviors, we mean any behavior of conducting intended negative emotions to others.)

2. Have you ever experienced any friendly behaviors from other players in multiplayer video games? If so, what do you think are the triggers of the behavior?

3. Have you ever conducted or had thoughts of conducting unfriendly behaviors to other players in multiplayer video games? If so, what do you think are the triggers?

4. Have you ever conducted or had thoughts of conducting friendly behaviors to other players in multiplayer video games? If so, what do you think are the triggers?

B.2 Pre-study questionnaire

1. How often do you play video games in the last three months?

    - 4+ times a week
    - 2-3 times a week
    - once a week
    - once every 2-3 weeks
    - once a month
    - less than once a month

2. Do you play multiplayer video games with players you don't know?

    - Yes
    - No

3. What kinds of multiplayer video games do you play? (multiple choice)

    - ☐ Competitive (e.g. deathmatch)
    - ☐ Cooperative (e.g. PvE)
    - ☐ Hybrid (e.g. PvP with more than 1 player on each side)

- □ Alternative (a player can decide whether to compete or cooperate)

4. Have you ever had thoughts of conducting a friendly behavior to other players?
   - ○ Yes
   - ○ No
5. What kind of friendly behaviors do you want to conduct?
6. What do you think are the triggers of your thoughts of being friendly? Or when do you feel like to conduct a friendly behavior to other players?
7. Can you think of any other kind of friendly behaviors in multiplayer video game context?
8. Can you think of any other triggers of friendly behaviors in multiplayer video game context?
9. Can you think of any kind of friendly behaviors in multiplayer video game context?
10. Can you think of any triggers of friendly behaviors in multiplayer video game context?
11. Have you ever had thoughts of conducting an unfriendly behavior to other players?
    - ○ Yes
    - ○ No
12. What kind of unfriendly behaviors do you want to conduct?
13. What do you think are the triggers of your thoughts of being unfriendly? Or when do you feel like to conduct an unfriendly behavior to other players?
14. Can you think of any other kind of unfriendly behaviors in multiplayer video game context?
15. Can you think of any other triggers of unfriendly behaviors in multiplayer video game context?
16. Can you think of any kind of unfriendly behaviors in multiplayer video game context?
17. Can you think of any triggers of unfriendly behaviors in multiplayer video game context?
18. How much does your mood before starting a game affect your friendliness towards others during the game?
    - ○ None at all
    - ○ A little
    - ○ A moderate amount
    - ○ A lot
    - ○ A great deal
19. Can you think of any kind of friendly behaviors in multiplayer video game context?

20. Can you think of any triggers of friendly behaviors in multiplayer video game context?
21. Can you think of any kind of unfriendly behaviors in multiplayer video game context?
22. Can you think of any triggers of unfriendly behaviors in multiplayer video game context?
23. What is your year of birth?
24. What is the highest level of school you have completed or the highest degree you have received?
    - Less than high school degree
    - High school graduate (high school diploma or equivalent including GED)
    - Some college but no degree
    - Associate degree in college (2-year)
    - Bachelor's degree in college (4-year)
    - Master's degree
    - Doctoral degree
    - Professional degree (JD, MD)
25. What's your country of origin?
26. How do you identify your gender?
    - Male
    - Female
    - Non-binary / third gender
    - Prefer not to say

B.3 Personality questionnaire

I see myself as:

1. Extroverted, enthusiastic.
    - Strongly agree
    - Moderately agree
    - A little agree
    - Neutral
    - A little disagree
    - Moderately disagree
    - Strongly disagree
2. Critical, quarrelsome.

- Strongly agree
- Moderately agree
- A little agree
- Neutral
- A little disagree
- Moderately disagree
- Strongly disagree

3. Dependable, self-disciplined.

- Strongly agree
- Moderately agree
- A little agree
- Neutral
- A little disagree
- Moderately disagree
- Strongly disagree

4. Anxious, easily upset.

- Strongly agree
- Moderately agree
- A little agree
- Neutral
- A little disagree
- Moderately disagree
- Strongly disagree

5. Open to new experiences, complex.

- Strongly agree
- Moderately agree
- A little agree
- Neutral
- A little disagree
- Moderately disagree
- Strongly disagree

6. Reserved, quiet.

- Strongly agree

- Moderately agree
- A little agree
- Neutral
- A little disagree
- Moderately disagree
- Strongly disagree

7. Sympathetic, warm.
   - Strongly agree
   - Moderately agree
   - A little agree
   - Neutral
   - A little disagree
   - Moderately disagree
   - Strongly disagree
8. Disorganized, careless.
   - Strongly agree
   - Moderately agree
   - A little agree
   - Neutral
   - A little disagree
   - Moderately disagree
   - Strongly disagree
9. Calm, emotionally stable.
   - Strongly agree
   - Moderately agree
   - A little agree
   - Neutral
   - A little disagree
   - Moderately disagree
   - Strongly disagree
10. Conventional, uncreative.
    - Strongly agree
    - Moderately agree

- A little agree
- Neutral
- A little disagree
- Moderately disagree
- Strongly disagree

B.4 Well-being questionnaire

- I've been feeling optimistic about the future.
  - Strongly agree
  - Agree
  - Neutral
  - Disagree
  - Strongly disagree
- I've been feeling useful.
  - Strongly agree
  - Agree
  - Neutral
  - Disagree
  - Strongly disagree
- I've been feeling relaxed.
  - Strongly agree
  - Agree
  - Neutral
  - Disagree
  - Strongly disagree
- I've been dealing with problems well.
  - Strongly agree
  - Agree
  - Neutral
  - Disagree
  - Strongly disagree
- I've been thinking clearly.
  - Strongly agree

  - Agree
  - Neutral
  - Disagree
  - Strongly disagree

- I've been feeling close to other players.
  - Strongly agree
  - Agree
  - Neutral
  - Disagree
  - Strongly disagree

- I've been able to make up my own mind about things.
  - Strongly agree
  - Agree
  - Neutral
  - Disagree
  - Strongly disagree

B.5 Demographics form

- What is your year of birth?
- What is your country of origin?
- How do you identify your gender?
  - Male
  - Female
  - Non-binary / third gender
  - Prefer not to say

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