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The Gamification of Well-Being

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by

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Abstract

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The rise of the digital era has caused digital domains to become increasingly prevalent and impactful in people's lives. This thesis explores the threats, as well as possible benefits of one type of digital system: a gamified app. It examines how gamification can impact people and society in positive and negative ways. An experimental model was tested to examine the potential impacts of such apps. The project also considered the ethical implications of gamified systems and suggests that if ethical frameworks are created, gamified systems can have a positive effect on people's lives and be tools for positive social change.

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Signature Page for Leadership Studies Honors Thesis

The Gamification of Well-Being

Thesis presented

by

Matthew Barnes

This is to certify that the thesis prepared by Matthew Barnes has been approved by his/her committee as satisfactory completion of the thesis requirement to earn honors in leadership studies.

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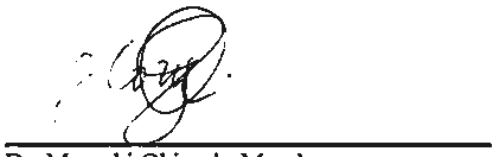

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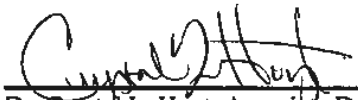

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Chapter 1 – Background and Theory:

Introduction:

Gamification, which applies game elements to non-game scenarios, has become increasingly prevalent in recent years. One of the main driving factors has been the rise of smartphones and mobile apps. Over the previous few decades, the production and prevalence of

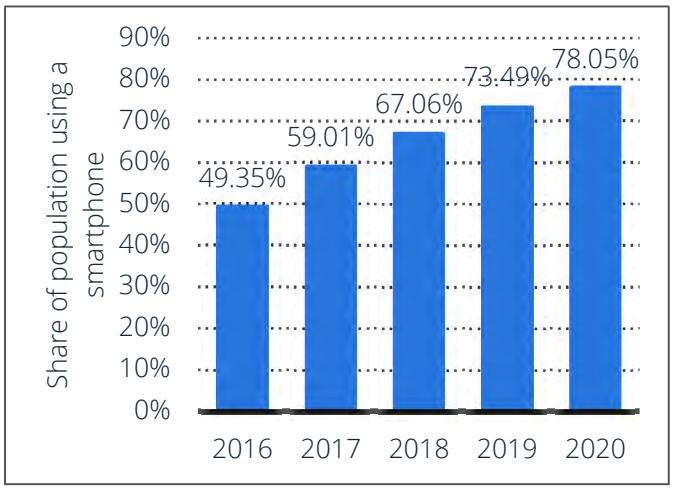


Figure 1.1

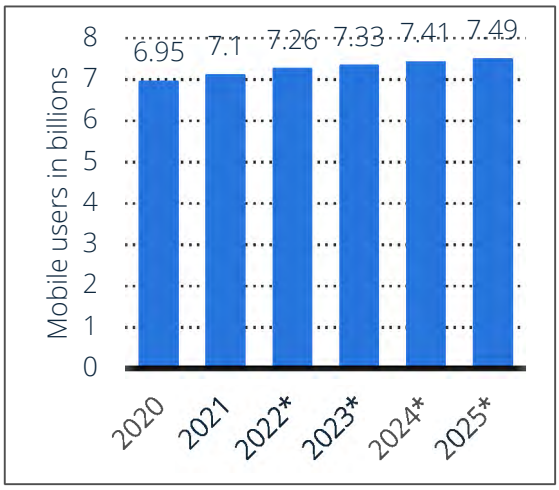


Figure 1.2

smartphones has radically increased. Figure 1.1 shows an almost 30% increase in the percentage of the population who have smartphones from 2016 to 2020 (“Smartphone Penetration Worldwide”). Currently, in 2022, the number of people who have smartphones is 7.26 billion people (“Forecast Number of Mobile Users Worldwide 2020-2025”).

A large majority of people in the world use smartphones, and the versatility of smartphones has rapidly digitalized many important aspects of society and become a daily aspect of many people’s lives. For example, managing money, such as banking or investments, can be done from mobile devices. Purchasing groceries, convenience items, or general shopping is also

accessible through smartphone apps. There are numerous basic life elements that smartphones have digitalized, and apps are constantly being developed that expand the digital domain.

This expansion has allowed for new opportunities for applications that make use of game design elements that make the app “more fun” or “addictive” to be made. Many game design techniques are grounded in behavioral science and are designed to elicit certain behaviors or emotions in people. One of the foundational aspects of gamification, or the use of game design elements in a non-game context, is behavioral change. Therefore, the effects of gamified apps have important implications for Leadership Studies, because part of the foundation of Leadership Studies is the ethical evaluation of phenomena that impact individuals or society. Gamified apps have the potential to have an impact on a huge number of individuals and societies across the world because of the billions of people who have access to smartphones.

Understanding both the threats and potential benefits of smartphones and modern gaming systems is important because of their ubiquity and capacity to control behavior, as well as the massive scale upon which they could affect both individuals and social groups. The purpose of this project is to examine the latter – how the use of smartphone apps can help us to improve the quality of our lives through the development of game-like systems that encourage positive habit formation. Specifically, this project is designed to study the impact of gamified apps on individual behaviors, with an eye toward future group-level benefits.

This thesis is broken up into three chapters. The first chapter explores the theoretical background, namely game design theory, motivation theory, gamification, and the intersection of game design and motivation. The second chapter explores the intersection of ethics and gamification, specifically, the ethical framework used in developing the model for this thesis, as well as the broader ethical implication of gamification in society. The third and final chapter

contains the experimental model and design. This chapter focuses on the model used, as well as the theoretical and ethical aspects that influenced design decisions, as well as a suggestion for future avenues of research and policymaking.

It is worth mentioning that behavior modification has been studied in numerous other fields. For example, within the computing community, specifically among scholars of human-computer interaction, there has been a large amount of research on behavior modification and the effects caused with computer interaction. Mohr et al. in their article, "The Behavioral Intervention Technology Model: An Integrated Conceptual and Technological Framework for EHealth and MHealth Interventions," focus on creating a model for eHealth platforms. Klasnja et al. in "How to Evaluate Technologies for Health Behavior Change in HCI Research" instead focus on the evaluation of behavioral change technologies and the ramifications within the HCI field. The use of gamification differs from platforms such as patient portal apps or health reminder apps, and is just one subset field of research on the effects of behavioral modification. This thesis contends that it is an often-underused methodology from which the health field could derive additional benefits if it drew more from known principles of game design and play.

There are currently many existing apps that apply motivational techniques or game design principles to incite people to create exercise habits. Some notable examples are Nike+, Fitbit, Fitocracy, Zombies, Run!, and Habitica. While these apps may use praise, shame, and notifications to achieve user engagement, they have a different focus and purpose than the design model used this thesis. The above apps use gamification mechanics designed to draw users back into the application. This allows the creators to profit off data collected from users, through ads or in-app purchases, or through other profit methods. In contrast, this thesis attempts to use

gamification to create behavior modification that does not require sustained use of an app, but still generates positive habit formation.

The ideal goal is to leverage the culture-shaping aspects of games and play in a way that facilitates positive habit formation in individuals and decouples the need for those individuals to rely upon an external app to maintain that habit, thus making the habit sustainable long-term. Understanding how games affect us, as well as how successful games are designed, will allow for those elements to be applied in non-game contexts to see if similar (hopefully positive) change can be induced. Specifically, this project attempted to use praise, shame, and notifications in order to encourage healthy exercise behaviors; the purpose in doing so is to establish a pattern of behavior modification that could, in theory, be applied to other positive habits in the future but does not require continued use of an app.

Theory:

This section begins with a brief history of why we play games and some ways they impact our lives before proceeding into the psychological motivations of games—specifically, Flow theory. The final part of the section explores gamification, or the intersection of play and non-play behaviors in non-game scenarios.

Games and Game Design:

Games and game design are a foundational part of this thesis because of the critical role they play in shaping culture and the large impact games can have on our lives. In *Homo Ludens*, Johan Huizinga writes about the emergence of culture from play, stating, “The spirit of playful competition is, as a social impulse, older than culture itself and pervades all life like a veritable ferment” (Huizinga 172). Play and games are an innate aspect of what it means to be human, and

play elements shape and build culture around us. Huizinga demonstrates this by showing how some of the central elements of society have underpinnings of play elements. In cases like law, the integral element is verbal contests where each side engages in rhetorical battles—a.k.a., debates—to try to determine the correct outcome (Huizinga 84). The central element is also emphasized by the importance that sports have in our culture. Soccer alone has an estimated 240 million players registered worldwide, with fans numbering in the billions (Terrell). As a result of the critical role play has in shaping culture, studying play in games and game designs can be a conduit to understanding how to affect culture and behavior through game elements.

Games have been an integral part of human history dating back thousands of years. Huizinga explains that culture is produced by play: "ritual grew up in sacred play; poetry was born in play and nourished in play; music and dancing were pure play" (Huizinga 172). Huizinga analyzes several different aspects of culture, pointing out play elements that are foundational to all of them. For example, the play elements that philosophy are rooted in is riddle-play and a game of wits, where two people engage in a contest to outsmart each other (Huizinga 147). In short, games are instrumental to the production and maintenance of human culture, and culture would not exist without play.

The importance and impact of games can be seen in the first example of written gameplay, found in "Herodotus' *Histories*, the ancient Greek account of the Persian Wars—dating back more than three thousand years" (McGonigal 5). Herodotus's account of games describes how the Lydians engaged in games every other day to distract themselves from the struggles of the famine surrounding them (McGonigal 5). The idea behind this is that by regularly actively engaging in games, the Lydians would be able to get through the famine with more ease. McGonigal writes, "games made life bearable … [and] gave a starving population a

feeling of power in a powerless situation, a sense of structure in a chaotic environment" (McGonigal 6). These psychological principles—recognized in contemporary psychological studies—demonstrate how games have the ability to improve our lives and provide a system of psychological and social support.

Games also serve to provide us a sense of structure as well as escapism in modern times. Some examples of this appear when companies include game rooms for their employees or encourage workers to take mini-breaks to play on apps. A study done by Rupp et al. found that "Participants who played the casual video game exhibited greater engagement and affective restoration than the relaxation condition … [and] playing a casual video game even briefly can restore individuals' affective abilities, making it a suitable activity to restore mood in response to stress" (Rupp et al. 1096). Games serve as an escape or break from everyday life and can have restorative effects on our mood and cognitive abilities. The sense of power and structure McGonigal writes about extends past the conclusion of the game and can be applied to a person's life, acting as a support and improving our lives.

There are two primary psychological drivers that help us to understand why people are motivated to play games: *Fiero* and Flow. Huizinga and McGonigal both talk about *Fiero*; in *Homo Ludens,* Huizinga states that there is an intensity of play, and "in this intensity, this absorption, this power or maddening, lies the very essence, the primordial quality of play" (Huizinga 2-3). McGonigal further explains *Fiero* as a primal emotion people feel "after we triumph over adversity … [and] it's a craving for challenges that we can overcome, battles we can win, and dangers we can vanquish" (McGonigal 33). In essence, *Fiero* is the elation we feel after overcoming a challenge, whether in a game or in real life. People experience *Fiero* both in and out of game settings. A player can experience it after defeating the final boss in *Skyrim,* or

they could experience it after finally summiting the peak of a hike they have been on for hours. Regardless of the scenario, people are chasing the feeling of elation once they beat the challenge.

In addition to *Fiero*, Flow is central to understanding why there is large-scale engagement with games. Mihaly Csikszentmihalyi is the pioneer of the theory of Flow, defined as "the state in which people are so involved in an activity that nothing else seems to matter; the experience itself is so enjoyable that people will do it even at great cost, for the sheer sake of doing it" (Csikszentmihalyi 4). Applying this to the case of the Lydians, we can understand why they had success in using games to overcome the difficult experience of famine. The Lydians entered a state of Flow when they were engaged with games, allowing them to temporarily forget the hardship of the famine. Csikszentmihalyi parallels McGonigal's comment about games providing a sense of structure, saying, "instead of being buffeted by anonymous forces, we do feel in control of our actions, masters of our own fate. On the rare occasions that it happens, we feel a sense of exhilaration, a deep sense of enjoyment that is long cherished and that becomes landmark in memory for what life should be like" (Csikszentmihalyi 3). Entering a Flow state is what produces both the senses of structure and control, as well as itself being an enjoyable experience. Like *Fiero*, Flow can also be experienced both in and outside of games.

One common example of how many people experience Flow occurs when they are reading a book or watching a tv show. If the person is so focused on reading the book, they may tune out the surrounding noise and not realize that another person is talking to them. Similarly, a person who enters a Flow state while watching a tv show may find that they have binged the same show for several hours and forgotten to eat anything that day. Similarly, Flow states can induce prolonged engagements with a game or other task. A common case of Flow in video games follows the saying "just one more game," where the person ends up playing for several

hours longer than they intended. Other cases could be when a person refuses to give up on a puzzle before the last piece is set into place or a student becomes very invested in the paper they are writing and produces many more pages than anticipated. Overall, there are many ways and types of actions that can put people into a Flow state. At its root, Flow is closely tied to intrinsic motivation, during which people have the innate desire to engage with the task simply for the pleasure of doing or accomplishing the task.

Overall, helping players enter Flow states and achieve *Fiero* are central goals to game design because of the increase in engagement they produce and the positive outcomes they have for players. When people are in Flow states, chemicals like dopamine and serotonin are released in the brain, inducing higher levels of concentration, perception, and enjoyment for the task being done. Additionally, Flow states and *Fiero* increase eustress rather than stress. Eustress is commonly known as positive stress because it can increase motivation, feel exciting, and increase performance, as opposed to negative stress, which can increase anxiety, decrease performance, and cause negative mental and physical outcomes (Mills, Reiss, & Dombeck). Eustress is positively linked to intrinsic motivation because of the components of motivation and excitement with respect to a task. As a result, Flow and *Fiero* can be used to create positive outcomes and increase intrinsic motivation through the release of dopamine, serotonin, and the increase of eustress.

Game design theory centers around the application of design principles and visuals to create games in a wide variety of areas, from entertainment to education, such that the elements of game design will produce both Flow and *Fiero*. Flow plays an important role in game design for two main reasons: it keeps players engaged with the game for longer periods of time, and players derive the most amount of enjoyment from the game when in a Flow state. Keeping

players engaged with the game for longer periods is advantageous from the game developers' point of view because their income structure could be centered around in-game advertisements or an in-game store. Additionally, an increase in enjoyment is advantageous for both the player and the game developers.

To increase the likelihood of players entering a Flow state, there are several methods games can employ: "have rules that require learning the skills[;] … set up goals[;] … provide feedback[;] … make control possible[;] … facilitate concentration and involvement by making the activity as distinct as possible from the so-called 'paramount reality' of everyday existence" (Csikszentmihalyi 72). Skill based rules are ones that are not simply prescriptive, but instead require players to be engaged with the game and not mindlessly playing. Goal setting is where missions or targets are established for players to achieve and feedback systems are in place to update players about those goals or in accordance with other actions the player takes in the game. Making control possible refers to allowing the player to be the primary driver in decision making and not forcing them down one singular play path. The final method refers to abstracting the game away from reality, so there is a clear distinction and boundary between in-game and out-of-game life. These methods can easily be seen in games that use missions (goals) and rewards (feedback) to engage players. Below are several examples of how games use these methods to produce Flow states.

Steam, a platform similar to the App Store, but for computer games, has an achievement system built into it. For each game when players meet certain requirements, they will receive a notification and have their achievement displayed on their screen. Figure 1.3 is what an achievement page for the game *Borderlands 2* looks like:

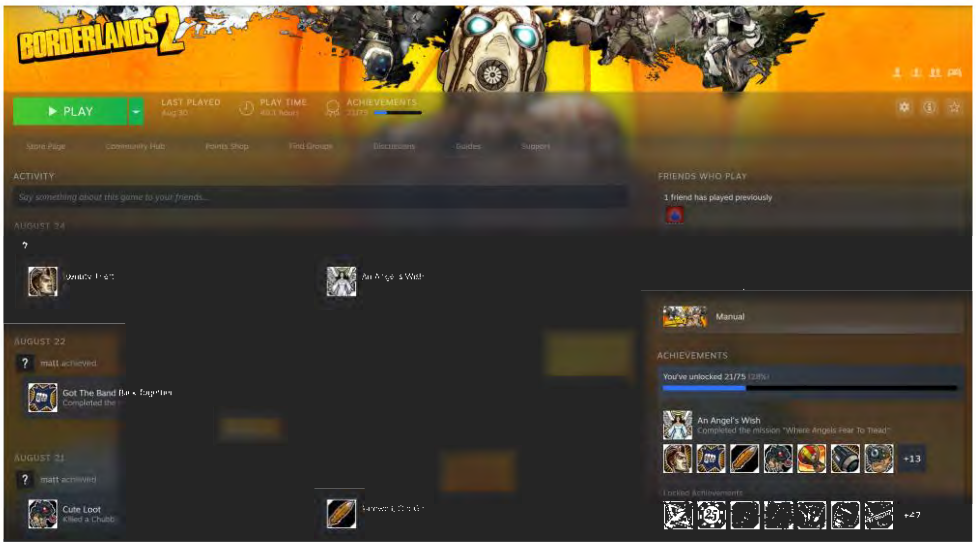


Figure 1.3

The achievements that the player has earned are displayed alongside those that are unearned, incentivizing the player to try and complete all the challenges to fill the achievement page. Achievement systems fall into several categories of Csikszentmihalyi's Flow model. Specifically, setting goals, providing feedback, and making control possible. The achievement itself is the goal being set, and each player has constant feedback of how close they are to achieving each goal before finally reaching it. Finally, because each of these achievements is optional, a player is able to have control over their game style and complete or not complete the achievements according to their preference.

Other examples of setting goals can be seen in games like *Candy Crush Saga*, where players are ranked against their friends and compete against each other to see who can gain the most levels. Chasing the top of the leaderboard can create moments of *Fiero* if a player is able to reach the top. Additionally, *Candy Crush Saga* increases the likelihood of inducing Flow because it satisfies three of the requirements: goals, feedback, and control. The game sets up the goal of completing as many levels as possible and reaching the top of the leaderboard. Constant

feedback is given about the relative rank of the players, and a player's ranking is in complete their complete control; it is directly proportional to the amount they play. A picture of *Candy Crush Saga's* leaderboard is pictured in Figure 1.4.

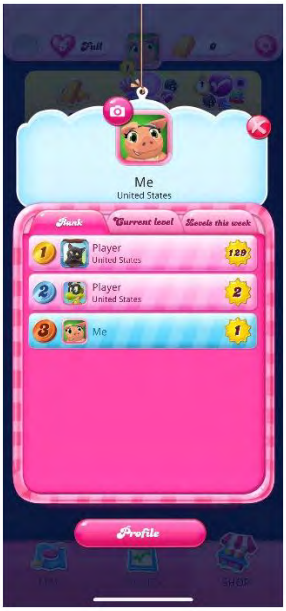


Figure 1.4

The positive outcomes that games can produce has led to the application of game design principles to other areas, also known as gamification. Gamification is defined as the "application of lessons from the gaming domain to change behaviors in non-game situations" (Robson et al. 412). Though gamification has been around for hundreds of years, it was more formally solidified as an industry starting in the late 2000s (Deterding et al. 9). An example of a service that uses badges is Reddit. Comments that the Reddit community thinks are particularly worthy may be awarded the trophies pictured in Figure 1.5.

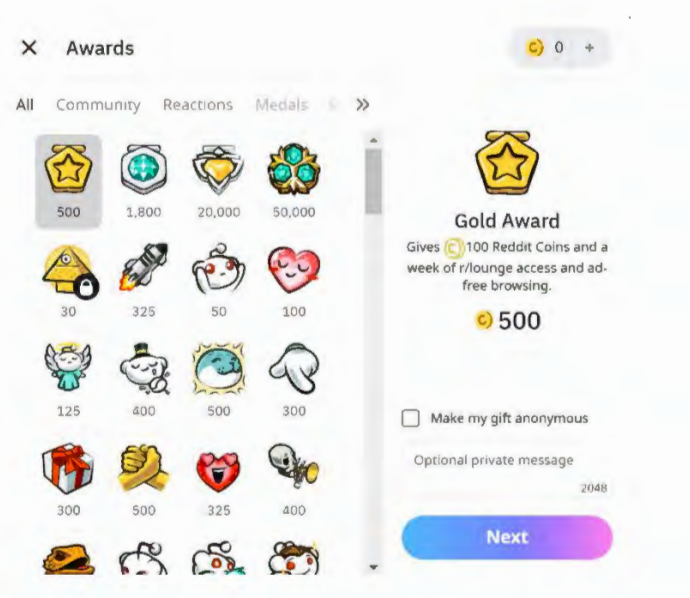


Figure 1.5

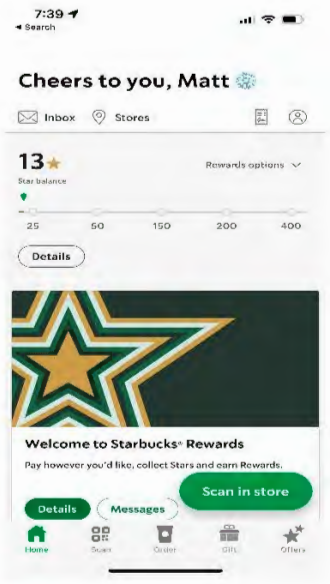


Figure 1.6

Another example of a gamified experience is commonly used by companies like Starbucks and other retailers who use reward point systems. Points are awarded for each purchase customers make, incentivizing them to spend more money to get the rewards at certain markers or to cash in those points later. Similar to game design, gamification seeks to make their users enter a Flow state to keep the person more engaged with the activity or app in question. In short, gamification tries to replicate the motivational techniques of game design in non-game areas.

One of the main areas that has been gamified in recent years is health. For example, Nike+ uses a reward system of badges. Users receive these badges upon completing certain markers, such as the Bronze High Mile Trophy after running more than fifteen miles in a month. This type of gamified system is better than others, like Reddit or Starbucks, because of the positive outcomes it can generate. This is not implying that there is anything particularly unethical about the ways Reddit or Starbucks use gamification, but those gamified systems lack the positive outcome of exercise that Nike+ is promoting. Nike+ seeks to improve people's lives

by having them engage in exercise rather than just selling a product or encouraging engagement. The positive more positive social outcomes that this type of gamified system can produce is one of the reasons I focused on this type of gamification in this thesis's experimental model.

In fact, one of the foundational aspects of this thesis is understanding the effects of game design principles on exercise motivation. The thesis works to understand the effects of gamifying exercise. The purpose in this gamification is to attempt to leverage the positive benefits games have on people. My hypothesis is that if users are engaged in Flow states, specifically with respect to exercise behavior, they will be more likely to engage in sustained exercise and form habits due to the intrinsically motivation nature of Flow. One of the main challenges is dealing with the reliance on an application and its system to create Flow states to motivate exercise, rather than the exercise itself creating the Flow state. The purpose of this thesis, in contrast to many existing applications, is to determine if there are effective ways to transition from the reliance on an application to a more intrinsically motivated system.

Motivation:

Understanding different types of motivation and how motivation is affected is fundamental to behavioral science, games, and this thesis. Motivation is a spectrum with intrinsic motivation on one side and extrinsic on the other. Richard M. Ryan and Edward L. Deci define intrinsic motivation as "doing an activity for the inherent satisfaction of the activity itself" (Ryan and Deci 71). This contrasts with extrinsic motivation, which "refers to the performance of an activity in order to attain some separable outcome" (Ryan and Deci 71). For example, if a person works out for the satisfaction completing the workout brings them, they would be considered intrinsically motivated. However, if another person buys them ice cream after each workout, and the person only works out to get the ice cream, the motivation is an extrinsic factor. In short, if

the driving motivation for an action is due to some external factor, it is closer to an extrinsic motivator than an intrinsic one. These two cases are both on the extremes of the scale. However, intrinsic and extrinsic motivation "are not a binary, but a gradient where the more the motivation comes from 'your true self,' the more internal it is" (Schell 157). The more the motivating factor aligns with a user's identity, the more intrinsically motivating the factor is.

The distinction between intrinsic and extrinsic motivation becomes important when considering the effects each motivational source can have on future motivation, specifically, the detrimental effect extrinsic motivation has on intrinsic motivation. Cruz et al. explain that "considerable research suggests that giving someone a reward for a task not only increases extrinsic motivation, it decreases intrinsic motivation" (Cruz et al. 517). McGonigal further explains this phenomenon, saying, "compensation typically *decreases* motivation to engage in activities we would otherwise freely enjoy. If we are paid to do something we would otherwise have done out of interest … we are less likely to do it in the future without being paid" (McGonigal 243). The provision of an extrinsic compensation or reward will increase extrinsic motivation for task, while simultaneously reducing intrinsic motivation.

Pritchard et al. explain two of the reasons why extrinsic rewards can decrease intrinsic motivation. The first reason is a change in a "person's perceived locus of causality from within himself to his environment" (Pritchard et al. 9). Losing causality from within themselves implies that the person is only completing the task for the reward, not for the pleasure of the task. The second effect of extrinsic rewards on intrinsic motivation is a decrease in "a person's feelings of competence" (Pritchard et al. 9). According to Self-Determination Theory, actions that undermine competence will serve to decrease intrinsic motivation. As a result, extrinsic rewards can decrease intrinsic motivation.

Interestingly, Woolley and Fishbach conducted studies in which extrinsic rewards could also increase intrinsic rewards. However, this only occurred in conjunction with a specific type of extrinsic reward linked to the activity. Their findings reinforce that extrinsic rewards can lead to a decrease in intrinsic motivation, saying, "likely that whenever the introduction of external rewards decreases intrinsic motivation, it occurs by diluting the association between the activity and the original goal" (878). For an extrinsic reward to have potential in positive affecting intrinsic motivation, it must be closely associated and related to the task being completed so that it is specifically the consequence of the action and not externally applied to it. The study therefore does not invalidate the view that purely extrinsic reward systems negatively impact intrinsic motivation.

Further delving into understanding intrinsic motivation, there are two main theories that explain the workings and influence of intrinsic motivation: Self-Determination Theory (SDT) and Cognitive Evaluation Theory (CET). Self-Determination Theory was developed by Ryan and Deci as an "approach to human motivation and personality that uses traditional empirical methods while employing an organismic metatheory that highlights the importance of humans' evolved inner resources for personality development and behavioral self-regulation" (Ryan and Deci 68). Ryan and Deci identified three fundamental needs necessary for self-determination: "competence, relatedness, and autonomy" (Ryan and Deci 68). Autonomy refers to a person being able to choose what they desire. Competence refers to the skill with which the person performs the task, and relatedness is the social aspect, referring to how connected the task makes us feel towards others (Ryan and Deci 16). To successfully maintain intrinsic motivation, these three categories must be reinforced, while actions that undermine these needs will have the adverse effect of decreasing intrinsic motivation.

Continuing with the exercise example used earlier, there are many ways intrinsic motivation can be increased by validating the three categories in SDT. Starting with competence, if a person working with a trainer receives validation from the trainer about their form or technique, this will reinforce the person's perception of competence and build their confidence about the correctness of their action. Similarly, if a trainer has the person select their own workout (within certain bounds), the freedom of choice will satisfy the need for autonomy. Finally, ways to increase relatedness while exercising could be to exercise with a friend or group of people. Exercising with others satisfies the social component and creates a comradery of the action, increasing intrinsic motivation.

In addition to Self-Determination Theory, another theory that focuses on intrinsic motivation is Cognitive Evaluation Theory (CET). CET grew out of Determination Theory, focusing on explaining changes in intrinsic motivation levels. The theory argues "that social – contextual events (e.g., feedback, communications, rewards) that conduce toward feelings of competence during action can enhance intrinsic motivation for that action" (Ryan and Deci 70). Actions that validate an individual's perception of task competence can help to increase their intrinsic motivation. Additionally, CET posits that "when a feedback event occurs that we perceive as being information of our mastery of something, we use this to satisfy our intrinsic need for competency" (Lewis 15). Events and information that provide feedback about our competency help people better understand their competency and increase intrinsic motivation.

Underlying information feedback systems are an extensively tested field in behavioral science—specifically, reward and punishment, otherwise known as carrot-and-stick, approaches to motivation. The carrot refers to positive incentives or reinforcement techniques, while the stick is a negative incentive or reinforcement technique. These studies work to determine which

approach is more motivationally influential. In the analysis across seven studies, Alixandra Barasch and Deborah A. Small "demonstrate that carrot incentives are more effective than stick incentives in prosocial domains [and] loss aversion makes stick incentives more successful in non-prosocial domains" (Barasch and Small 12). Depending on the scenario, positive and negative reinforcement techniques can have varying success in motivating individuals.

Some of the ways behavior modification techniques emerge in games can be seen through the feedback systems in Apex Legends. In Figure 1.7 there are several different colored armor vests. Each player begins a game with the white vest, and if the player inflicts enough damage on other players, their vest will be upgraded to the next colored vest in the line, with the red vest being the strongest armor. Players are rewarded with better loot for the greater damage they inflict on other players.

Figure 1.7

Two types of information feedback systems, praise and shaming (which are milder versions of the carrot/stick paradigm), can be effective ways to increase intrinsic motivation, according to CET. Chris Lewis explains that "praise describes feedback systems that communicate to users that their behavior is correct" (Lewis 69). This praise reinforces the need for competency. Conversely, shaming can also enhance intrinsic motivation. Jesse Schell

explains shaming as the flipside of praise, where the communication indicates the user's behavior is incorrect (Schell 235). Shaming, within reason, indicates a sense of incompetence in the person, increasing the intrinsic motivation to increase task competency and to avoid being shamed in the future.[1]

Examples of information feedback systems come in many different contexts or forms. In a classroom setting, it could be the teacher saying "great idea" to the child's idea for a project. It could be a coach cheering for a player who just scored a goal or a boss congratulating their employee on a good presentation. Whatever the case, receiving positive feedback regarding an action serves to reinforce a person's conception of their task competence, thereby increasing their intrinsic motivation for the action. Conversely, shaming messaging shows a deficiency in task competence, generating optimism and a desire to improve.

Motivation in Game Design:

Going further into the intersection of motivational theory and games is important because this thesis pulls heavily from both fields in attempting to stimulate exercise habit formation. Both Self-Determination Theory and Cognitive Evaluation Theory play a central role in how game designers attempt to motivate users. Understanding which game design elements most closely align with intrinsic motivation was critical in designing the treatments in the study.

As mentioned above, extrinsic motivation can decrease intrinsic motivation. This effect is problematic for sustained action because once the compensation or reward stops being effective, the decreased intrinsic motivation leads to a lapse in action. To address this problem, within

[1] Thresholds for shaming are important to establish, otherwise punishments can feel overwhelming or hurtful. In creating that threshold, Schell explains that punishments should be understandable and preventable, but never random and unstoppable (Schell 235).

games, McGonigal calls for the creation of a "**sustainable engagement economy** – an economy that works by motivating and rewarding participants with intrinsic rewards" (McGonigal 243). Rather than competing in an unwinnable arms race of extrinsic rewards, relying on intrinsic motivation factors instead will create sustained engagement. Game designers have relied on theories, such as SDT and CET, to attempt to create the "sustainable engagement economy" to which McGonigal refers by using rewards or feedback systems that will increase intrinsic motivation.

Valorant, a first-person shooter video game, can show how Self-Determination Theory is used to create a more sustainable engagement economy. Starting with autonomy, the character select option allows players to voluntarily select what type of gameplay they engage in. At the beginning of each game, players select the character they would like to play for the rest of the game. Though the number of characters is limited, and the player is forced to play only one for the duration of the game, each character has different abilities and play styles that allow a person to define how they play the game.

Figure 1.8

Competence is reinforced through the competitive feature. Players can participate in ranked, competitive matches that will determine their overall rank relative to other *Valorant* players. This seeks to motivate players according to competence because a player's rank is awarded based on their skill level, and they are able to see their progress towards moving up in rank.

Figure 1.9

Finally, *Valorant's* emphasis on teamwork seeks to increase the relatedness of the game. All gameplay is team-based, never individual. Players must effectively work together with others to win matches and progress in *Valorant*. This reliance on others to perform well results in increasing the connectedness of players to others within the game and increasing intrinsic motivation.

In addition to SDT, Cognitive Evaluation Theory is used to intrinsically motivate players and create a sustainable engagement economy. Information feedback systems of praise and shaming are also used in games. This can be seen in Figure 1.10, in which designers attempt to make motivational systems that fall in the bottom two categories.

Figure 1.10

This figure shows the transition from external to internal motivational factors according to pain avoidance and pleasure seeking. Designing factors that are either ‘to avoid shame’ or ‘for fun’ will have the most success in creating a sustainable economy because they are more internally motivating than avoiding punishment or reward seeking. These categories closely align with the praise and shame information feedback systems in CET. As a result, these two categories work to increase intrinsic motivation by providing information about the person’s task competency.

Praise is a very common type of feedback given in games that falls under the ‘for fun’ category. For example, in *League of Legends*, players receive praise messages that are announced to all other players in the game once they have defeated three or more enemies in a row. The more enemies the person defeats, the more positive the message announced. These praise messages increase intrinsic motivation because they reinforce a player’s sense of competency.

Consecutive kills	In game announcement
8+	Legendary
7	Godlike
6	Dominating
5	Unstoppable
4	Rampage
3	Killing spree

Figure 1.11

Figure 1.12

In addition to praise, shaming feedback systems and fun failure are used as ways to motivate players. McGonigal writes about the phenomenon of fun failure in *Reality is Broken*, saying, “when we’re playing a well-designed game, failure doesn’t disappoint us. It makes us happy in a very particular way: excited, interested, and most of all optimistic” (McGonigal 64). In well-designed games, failure can be a positive influence on players’ intrinsic motivation. This is because the failure generates a “positive feeling and a stronger sense of agency” (McGonigal 66), resulting in players wanting to play more. As a result, failure and shame feedback systems can be used to intrinsically motivate players.

An example of shaming in games can be seen in *Dead or Alive 4*, an online fighting game that pits players against each other. A player will receive a shaming achievement after losing, five, ten, or twenty straight games.

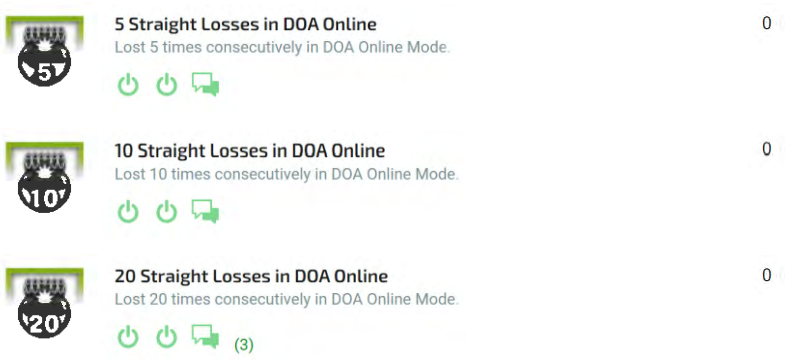


Figure 1.13

After getting one, or more, of these 'achievements,' players engage in shame-avoiding behavior. They are intrinsically motivated to improve their skills in order to avoid getting any subsequent achievements that will shame them further. Games use shaming tactics that are both understandable and avoidable to increase players' motivation to keep playing and improve their skills.

Overall, game design heavily incorporates behavioral science and motivation theories, including Self-Determination Theory, Cognitive Evaluation Theory, Flow, and *Fiero*. By utilizing these theories, games can increase players' intrinsic motivation to play the game, thereby increasing player engagement and enjoyment, as well as generating positive outcomes for the players. This thesis attempts to apply the same motivational techniques used in game design to generate positive outcomes in people's non-game lives, as well.

Chapter 2 - Ethical Implications:

Introduction:

An examination of the ethics of using gamification and motivational design patterns is important due to the persuasive power these tools can have, in addition to the large-scale effect they can have on populations. Gamification is an effective technique for instigating and perpetuating behavioral change. Because gamification can have a direct impact on human behavior, understanding the ethical benefits and drawbacks of this persuasion tool is important to discuss. This discussion is increasingly critical when considering that the scale on which gamification can operate is in the billions. Specifically, gamification techniques rolled out in smartphones around the world have the potential to modify human behavior on a global scale.

This chapter will be comprised of three main sections. The first will cover a brief background about the ethical paradigms used in this thesis: specifically, deontological and consequentialist ethics. The second section will explain Kim and Werbach's model to determine if a gamified system is morally permissible. Finally, a general ethical examination of both the process and consequences of gamification attempt to determine if certain limitations should be placed on the application of gamified experiences. This general examination will be conducted across the three areas of manipulation, exploitation, and outcomes to determine the overall moral permissibility of gamification techniques.

Deontological and Consequentialist Ethics:

To begin, deontological ethics centers around prescriptions of acceptable and inacceptable actions. Emmanuel Kant developed a deontological account of ethics centered

around positive and negative duties in which humans ought to engage. One of the foundational aspects of Kant's theories revolves around individual intentions. To engage in ethical behavior, a rational agent must engage in the right action for the right reason. Also known as the Formula of Humanity, in this theory, Kant states that rational agents should "Act in such a way that you always treat humanity, whether in your own person or in the person of any other, never simply as a means, but always at the same time as an end" (Kant 96). In essence, the formula prescribes that individuals should respect the autonomy of other individuals and not engage in actions that will be detrimental to those individuals and treat them in an objectified manner. According to Kantian theory, the outcome of actions is not relevant to the ethical standing of the situation; instead, the moral weight of a situation is determined by the intention of the individual actor.

In contrast to Kantian deontological approaches to ethics, consequentialism bases ethical judgement and weight solely on the outcomes of an action, irrespective of actor's intentions. Consequentialism works to maximize the utility for the most amount of people. As a result, an action that maximizes happiness, and minimizes any harm, will be the ethical choice for a consequentialist.

For example, a classic example of the distinction between the two approaches is understood through the trolley problem shown in Figure 2.1.

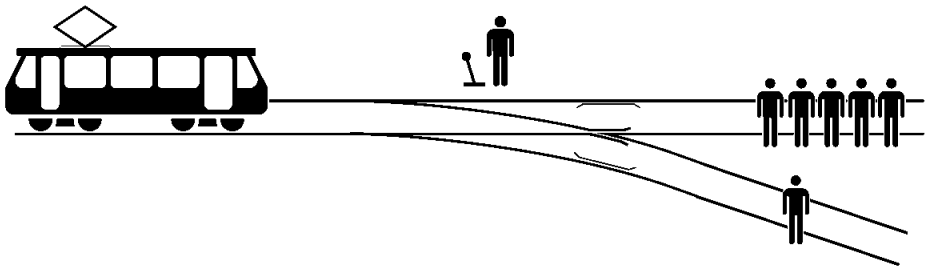


Figure 2.1

In this scenario, there is an individual standing next to the lever. The current track the runaway trolley is on will cause the trolley to kill the five people on the track above. Pulling the lever will cause the trolley to be diverted to the lower track, killing the one person on that track. This scenario assumes that all the individuals in danger on the track have equal moral worth and the ability to produce utility. According to Kantian ethics, the individual would not be allowed to pull the lever. Even though this inaction would result in the death of five people, Kantian ethics has a strict negative duty against direct action that results in killing. An individual pulling the lever would violate the strict negative duty against murder because the individual's choice directly resulted in the death of another individual. As a result, even though five others may die from the person's inaction, a fundamental Kantian would not pull the lever. In contrast, a consequentialist would pull the lever. The aim of consequentialism is to maximize the benefit for the most individuals. As a result, pulling the lever to save five people at the expense of one individual is the correct choice for a consequentialist.

The deontological model of ethics looks at the intentions of individuals, while consequentialism looks at the outcomes produced to determine ethics. By applying both of these paradigms to the experimental model in this thesis, the moral permissibility of the model can be determined. Determining the moral value of gamified systems is important because of their scope

of impact. In the case of this experimental model, the scope was rather small. However, gamified systems can affect millions of people. Because of that large impact, evaluating the intentions of the inventors of these systems and the outcomes the systems produce is extremely important. The ultimate goal is to find a rough framework that can be used to create gamified systems that are ethical and uplift their users rather than taking unfair advantage of them or creating negative consequences.

Kim and Werbach's Ethical Gamification Model:

The ethical evaluation of gamified systems is done by using Tae Wan Kim and Kevin Werbach's model in the paper "More than Just a Game: Ethical Issues in Gamification." They state that their starting point for analysis is a "context-relative stance" (12). In this model, the ethical status of a gamification scenario is dependent upon each individual case, rather than gamification as an entire categorical standard. To evaluate different cases, Kim and Werbach use a fourfold framework:

> (1) takes unfair advantage of workers (e.g., exploitation); (2) infringes any involved workers' or customers' autonomy (e.g., manipulation); (3) intentionally or unintentionally harms workers and involved parties in various ways; or (4) has a socially unacceptable degree of negative effect on the character of involved parties. (12)

The first two considerations revolve around the actions of the designers and creators of the gamified system. The second two considerations are more closely aligned with evaluating the effects the gamified system produces.

Though this framework was developed for a work-related context, it is easily generalizable to other scenarios. This can be done by replacing the keyword "worker" with

"individual." As a result, the framework would include exploitation of individuals, manipulation of individuals, intentional/unintentional harm to individuals, and a negative effect on individual's character. This framework was chosen for the ethical analysis of gamified systems because it analyzes each part of the system, allowing for a robust ethical analysis on the entire gamified system. The first two considerations in the framework revolve around the intentions of the creators, and the other two considerations evaluate the outcomes that are produced by the system. In short, this framework was chosen because it generalizes well to encompass any given gamification system and allows for robust ethical analysis.

Kim and Werbach define exploitation as follows: "Transaction *x* is exploitive when Person *A* takes unfair advantage of Person *B*" (13). An example of exploitation can be seen within a theoretical labor market. If employer *A* is the only employment option for a number of workers, employer *A* can reduce the pay of employees without due recourse. This payment reduction takes unfair advantage of the employees.

A hypothetical example of an exploitive gamified system would be the unauthorized use of an individual's data. When people use an exercise app like Fitocracy or FitBit, they share demographic information such as age, gender, height, weight, workout goals, location, etc. If a company were to sell this individual's data without their knowledge or consent, this would be user-data exploitation. Additionally, if this were a scenario in which individuals were forced to use a service that was gamified and did not have the ability to opt out of the gamification, that would be considered exploitive, as well. This scenario is exploitative because it violates a person's autonomy and freedom of choice.

Moving onto the second part of Kim and Werbach's framework, manipulation is defined such that, "[o]ne person manipulates another when he intentionally causes that person to behave as he wishes through a chain of events that has the desired effect only because the manipulated person is unaware of that chain" (Qtd in Kim & Werbach 17). The critical point to pull out of the definition is that in order for there to be manipulation, the action must be conducted at a level below the conscious level of the subject. The action is purposely obfuscated to generate an effect. In an app, this could include the manipulation of a user into making in-app purchases that are actually unnecessary even though the user believes that they are required. This would be considered manipulative because it eliminates or reduces a user's agency in the use of the app.

The last two criteria in Kim and Werbach's model focus more on a consequentialist model of ethics. Both emphasize the outcomes produced. The third criterion concerns intentional or unintentional harm caused by the gamified system. Finally, the fourth also focuses on harm, but harm to the character of the individual who engages with the gamified system. A non-gamified example of this would be rewarding a child for a wrongdoing, rather than disciplining them. in that scenario, the reward reinforces the wrong behavior and harms the character development of the child.

Beginning with intentional harm, this refers to gamification systems that "intentionally attempt to motivate players to harm others and themselves in ways subject to moral and social condemnation" (24). This intentional motivation to cause harm does demonstrate a deontological ethical failure on the part of the creators of the system. However, it has additional consequentialist implications because of the negative utility caused. Kim and Werbach use an example of a website called Camover, in which protestors would be awarded points for creative ways of destroying CCTV cameras in Berlin (24). The intentional harm that is motivated and

produced by the gamified website is unethical because the harm does not come with a greater benefit. The destruction of the CCTV cameras was not outweighed by a greater benefit in utility, so the actions are unethical according to consequentialist reasoning.

The final criterion focuses on adverse effects to an individual's character as a result of the gamified system. If the gamified system results in a negative effect on a person's character traits, the system can be considered unethical. Within the scope of Kim and Werbach's argument, they consider how "gamification in some limited contexts can motivate people to cultivate and display a socially inappropriate degree of moral indifference – a building block of bad character or vice" (28). The example they cite is the badge and point system the Israel Defense Force employed to rally military support against Hamas (28). The problem with this is that the IDF was trying to garner support for a conflict where innocent people were dying on both sides by having people make tweets for points. The ethical issue with this is that the system promotes "moral indifference to fundamental human values like the sanctity of life" (30). In general, if a gamified system promotes moral indifference to human values, it can potentially lead to the degradation of positive societal character traits.

Ethics of Gamification in Society:

The ethical use of gamified systems is important to consider because of the scale of these systems and the limitless ways gamification can be used to influence social movements and individual behaviors. The regulation of gamification and gamified apps may also be relevant to leaders and policy-makers, particularly as these platforms become even more ubiquitous. This section will first start by examining ways and cases when gamified systems can become unethical or harmful. In particular, the negative categorical effects that will be examined are

privacy-related issues, psychological and physical harm, and dependence and addiction. These categories are not a comprehensive analysis of all the possible negative implications of gamified systems. However, they do provide a solid foundation from which to create ethical practices in gamification application. As each negative effect is examined, there will be a discussion of how ethical standards can be established for gamified systems to avoid producing these harmful consequences.

Privacy related issues are not just an issue in gamified applications, but an issue across many digital spaces. With the rise of machine learning and data-driven predictive models, there has been a scramble to collect data to make those models more precise and successful. Generally speaking, the more pieces of data a company can collect on an individual, the more targeted, precise calculations a company can do. Sometimes these calculations try to figure out what type of product to advertise to individuals. These calculations are not inherently unethical, unless the data being collected on individuals is being done without their knowledge or explicit consent, which is often the case.

A hypothetical example of data exploitation could be a physical health-focused app that collects user information and then sells it to third parties without their user's knowledge or permission. If the gamified app pushes for users to provide their personal data, primarily for the purpose of selling the data, this would be exploitive of the users. Either failing to provide notice of what is done with the data or not allowing the users to opt out of data-sharing would be a violation of users' privacy and would be exploitive and manipulative.

To avoid unethical scenarios of data exploitation, there are several potential solutions. The first is to give complete control to the users about what happens to their data. Each user can share only the information they want and have control over how that data is used. By used, I am

referring both inside and outside of the gamified application. Secondly, there should be explicit, broadcast notice available to all users about the default uses for user data. Broadcasting how data will be used allows users to either consent to these practices or opt out of some of the ways data is used. Finally, the third solution would be to place constraints on the creators of gamified applications through legal actions. In the European Union, the Data Privacy and Protection legislation places limits on companies about how they can collect and use data they get from individuals within the EU. Additionally, it guarantees certain decision-making rights for individuals in how their data is used. Compared to the EU, the United States does not have equivalent or adequate legislation to protect individuals' data privacy rights. As a result, it is primarily up to companies to maintain ethical privacy practices at the moment. Ideally, similar legislation will be passed in the US to increase the protections and rights people have over their digital data.

The first two solutions about how to ethically deal with data collection place the primary responsibility upon the creators of the gamified system. The final solution places responsibility on governmental entities to oversee the responsible use of users' information. I believe that the more sustainable option would be to have a codification of data privacy rights. This codification would establish rules and laws surrounding how data privacy would operate. Doing so would minimize user confusion about what will happen with their data and to create a foundation of ethical data use.

The second negative effect gamification applications can produce are physical and/or psychological harms. These harms are assumed to be created unintentionally. It is impossible to perfectly predict all the possible outcomes an action will have. Unforeseeable variables will come up for which creators and users were not prepared. In a gamified system, some of the ways

that will produce unintentional, emergent behavior are if people use the app the wrong way, for different purposes than intended, or if something in the app produces an unexpected behavioral response. Unintentional responses are not necessarily unethical unless they produce harmful results for participants or other people.

An example of a gamified system that could have unintentional negative consequences is a game called Tombstone Hold 'Em. What follows is an abbreviated rule list of Jane McGonigal's description of the activity:

1. Card suit is determined by the tops of each tombstone
    a. Pointy top → spades; Statue → clubs; Rounded → hearts; flat → diamonds
2. Last digit of year of death → face value
3. Two names on a stone, ignore the year of death → card is a jack
4. Three names on a stone → card is a queen
5. Four or more names on a stone → card is a king
6. The game is played in pairs, where each pair creates a hand of two stones, but must be able to touch each other.
7. Rest of the game follows the rules of Texas Hold 'Em (199)

Essentially the way the game is played is that teams of two find tombstones that represent different cards and play a game of Texas Hold 'Em.

The purpose of this game was to "make remembering death easier and more rewarding, by taking advantage of the largely underutilized social and recreation potential of cemeteries" (198). The goal of this game is admirable, and, based on the anecdotal evidence, it appears to have worked for some people. McGonigal states that "players widely report being able to think

about death and lost loved ones in a more positive way after playing Tombstone Hold 'Em" (198). Players seemed to have a positive response to the game.

While players of Tombstone Hold 'Em may have enjoyed the game, there easily can be unintentional psychological harm created by the game. For example, if this game were to be played during a grave-side funeral ceremony. In Figure 2.2, a team stretching out on the ground touching two headstones to form their poker hand. If an actively grieving person were to see this during a burial of a loved one, that could cause lasting psychological harm. Additionally, the gentleman on the left is placing his foot on the tombstone. A family member or friend of that deceased person could see that being done and take offense. Additionally, placing a foot on the gravestone could degrade it more quickly, or cause other negative physiological effects. In general, this game is controversial because of the setting of the game and the potential psychological harm that could come to people who are in the cemetery to grieve.

Figure 2.2

As mentioned before, it is impossible to create a gamified system that will account for all possible outcomes. However, taking time to test gamified systems for common case and edge case scenarios before launching wide scale could help to identify potential pitfalls before they happen. Additionally, if negative effects are unintentionally produced, the designers of the gamified system should quickly work to address the root cause and prevent the effect from occurring again.

The final negative effect that gamified applications can produce are dependency and addiction. McGonigal explains in *Reality is Broken* that "too much fiero can lead to addiction"

(McGonigal 43). McGonigal was speaking of addiction in the case of games. However, *Fiero*-produced addiction can also be applied to gamified systems because one of the tactics in gamification is to replicate the high engagement of games by inducing *Fiero* responses in users. Addiction or dependency can be unethical because it can be exploitive, causing an under-provision of important tasks outside the gamified system. Finally, dependency can eventually lead to an under-provision of a task due to the detrimental effect of extrinsic rewards on intrinsic motivation mentioned before.

Beginning with the potential for exploitation, a gamified system may seek to include addictive game mechanics to generate user engagement. After the user is addicted to the mechanic, arbitrary paywalls or pay-to-win tactics may be in place to extract money from users. This kind of tactic is what Chris Lewis calls "Monetized Dark Patterns … [that] exploit user competitiveness, encouraging them to spend money they would not otherwise spend, in order to achieve status" (Lewis 114). By first creating addictive behaviors through the overuse of *Fiero*, a gamified system could then try to exploit money from its users by only allowing making further progression feasible by paying.

The second issue that could arise from addiction to gamification elements is the due to the overuse of that system. If a person engages with the gamified system too much, instead of performing other tasks or satisfying needs they have, this could lead to an undesirable outcome. For example, if a person spends too much time using a gamified app, they might not do other basic tasks they were supposed to do, such as food preparation or laundry. Though these examples are not extreme, they reflect a larger issue. The addiction to the gamified system could lead to a degradation in the completion of other important tasks in a person's life.

A dangerous case of this happening can be seen in *Pokemon Go*. *Pokemon Go* is a game in which players attempt to catch Pokemon, which are fantasy creatures. These creatures can be used to battle or complete missions in the game. The dangerous part of the game arises because of the manner in which the Pokemon are captured. The app operates overlaid on top of a live map of the world. When players travel around, for example going to Central Park or Tokyo, there are different Pokemon in each area that can be captured. This requires players to concentrate on their phone screens in order to "throw" a ball at the creatures, which appear "in" the real world (viewed through the phone's camera). The highly addictive nature of the app caused people to recklessly play *Pokemon Go* while driving, attempting to catch Pokemon even on the road. Niantic, the creator of the game, did quickly address this issue by putting in safety measures to prevent people driving and playing after several accidents were caused. However, Niantic did not address the underlying issue of the addictive tendencies of the game.

In addition to addiction leading to negative consequences, dependency on a gamified system to motivate certain behaviors can also lead to a longer-term under-provision of the given task. This negative consequence returns to the case of extrinsic rewards causing a decrease in the intrinsic motivation to complete a task. A hypothetical scenario can be seen through the gamified app Chore Wars. McGonigal describes chore wars as a way to complete normally tedious chores in a competitive, collaborative way (McGonigal 120). The basis of the game revolves around assigning point to players after they complete chores. There is a level system, and getting other people involved in the chore completion adds a competition element to the game.

In a case where a person begins to play Chore Wars with another person, the game could initially be highly motivating to complete house chores that were previously tedious. Both players are engaged and complete the chores that need to be completed, both seeking to level-up

and get more points. The drive to complete the chores doesn't come from a desire to do the chore itself, but instead to compete with the other person. Eventually, the extrinsic point and level system will no longer be engaging or motivating for the person. This drop in interest will correspond with a decrease in chore productivity because the primary motivating factor to do the chores centered around getting points and leveling up. Overall, using gamified apps that create user dependencies on the app may lead to a long-term under provision of certain tasks.

There are several ways that gamification addiction and dependency can be addressed. One way that comes from the gaming work are time limitations. McGonigal describes that in part of the world there are 'fatigue systems' in place where "after three hours of consecutive online play, gamers receive 50 percent fewer rewards (and half the fiero) for accomplishing the same amount of work" (McGonigal 44). In-game fatigue systems would work to limit the rewards users can get, which would put an active deterrent from overuse of a gamified system. A similar tactic used is a 'resting bonus.' This is where a player is rewarded for the time they do *not* play a game (44). The system rewards the user for taking time off from the game and not playing. This reward would work in contrast to the rewards a player might get for being active in the game.

Another possible solution to counter addiction and dependency is to follow a similar gamified structure to the one described in the discussion section of the previous chapter. The purpose of this model was to move from a more extrinsically driven model to an intrinsic motivation system for the participants. By starting at a low level of gamified aspects, then scaling the gamified aspects up, the gamified system can generate high engagement from users. However, to avoid dependency on the system for task completion, a process of descaling the gamified aspects should take place. By slowly removing the gamified aspects, the system would

work to slowly remove the system as a crutch users rely on for the task. The hopes would be that the person would eventually form a self-sustaining habit for a given task.

This section focused on several ways gamified systems can generate undesirable outcomes, as well as potential ways to address these issues. In general, Marczewski sums up the main point well, saying, “the key elements … are a need for transparency and honesty with the user about the intentions of the system, and not creating systems that deliberately trick users into behaviors that could cause them harm” (Marczewski 59). The primary responsibility in creating ethical gamification systems begins with the designers. Additional regulation and oversight by governmental agencies can also be helpful in ensuring ethical practices are in place.

It was with all of the above ethical considerations that the model for this thesis was designed. It attempts to minimize reliance upon extrinsic motivating factors; seeks not to exploit, manipulate, or harm its users; and has an ultimate goal of benefitting users both physiologically and psychologically. By conforming to deontological and consequentialist ethics and using Kim and Werbach’s model, the app model conforms to an ethical framework of gamified app design.

Chapter 3 – Experimental Model & Design:

Introduction:

This chapter will focus on the experimental design and model of this thesis. The purpose of the experiment was to see if an increase in intrinsic motivation to exercise could be stimulated within participants by applying motivation design patterns within a mobile app. The experimental design of this honors thesis pulls its methodology from several different areas, including game design, motivation theories, experimental economics, and ethics. The goal in using these different areas was to determine the most effective and ethical way to stimulate exercise habit formation. This section starts by listing the treatments used in the experiment before going into an explanation of why each treatment was chosen. Additionally, this section also reflects on the medium used for the delivery method of the experiment (mobile devices). This chapter will then turn to an overview of the experimental design and hypotheses, followed by an explanation of the five treatments and the design, ethics, and logic decisions behind the app development for the experiment. Following the treatments, limitations will be discussed before discussing the findings and future implications of the model.

Overall, each of the treatments used in this experimental app attempts to affect the intrinsic motivation of the participant, avoiding extrinsic rewards that could decrease long-term intrinsic motivation and prevent habit formation from occurring. The five treatment models are as follows:

1. *Control* – Participants only took the pre-survey and post-survey. The app did not include any features on it.

2. *Nudges* – The participants took both surveys and received a notification every two days asking if they had worked out that day. The app included an exercise reporting feature.
3. *Positive Praise* – The participants took both surveys and received a notification every two days asking if they had worked out that day. The participant would receive a positive reinforcement message if they self-reported exercise.
4. *Negative Praise* – The participants took both surveys and received a notification every two days asking if they had worked out that day. The participant would receive a negative reinforcement message if they did not self-report exercise.
5. *Positive and Negative Praise* – The participants took both surveys and received a notification every two days asking if they had worked out that day. The participant would receive a negative reinforcement message if they did not self-report exercise, or a positive reinforcement message if they did self-report exercise.

Beginning with the control, it was important to see the influence that just taking the pre-survey and post-survey would have on participants. These surveys asked participants to reflect on current exercise routines and whether they had exercise-related goals. This helped to establish a baseline of exercise frequency and duration for the participants, as well as determining if the act of taking the surveys had an effect on stimulating participants' intrinsic motivation without additional intervention.

Treatment two used notifications to prompt participants to exercise in a manner similar to nudges in behavioral economics. Nudges were initially coined through the work of Richard Thaler and Cass Sunstein in *Nudge: Improving Decisions About Health, Wealth, and Happiness*. Bruns et al describe nudges as a "diverse set of instruments that utilize behavioral insights in order to affect individual behavior, without limiting options or significantly changing economic

incentives" (Bruns et al. 41). Simply put, nudges are a means to influence human behavior. Nudges have been studied in a variety of areas, from healthcare to financial investment. In a study that manipulated Swedish investor behavior, Thaler demonstrated that nudges can have powerful and long-lasting impacts on behavior (Cronqvist and Thaler; Thaler "From Cashews"). Due to this strong and lasting impact, nudges could potentially have a positive correlation with exercise habit formation.

Treatments three and four build upon treatment two by using notifications in addition to a praise or shaming feedback system. The praise feedback system is designed to intrinsically motivate the participants, falling under the pleasure seeking, intrinsically motivating quadrant in Figure 1.10. In "The Power of Feedback," John Hattie and Helen Timperley explain that positive feedback "can increase the likelihood that [people] will return to or persist in an activity and self-report higher interest in the activity" (Hattie and Timperley 99). This treatment seeks to leverage that repeated interaction and interest of participants with respect to stimulating exercise habit formation.

Similarly, the shaming feedback system seeks to do the same thing. This treatment falls under the shame avoiding, intrinsically motivating quadrant. In the same paper, Hattie and Timperley found that "there is much evidence to suggest that negative feedback or disconfirmation can be more potent than positive feedback or confirmation at this self level" (Hattie and Timperley 98). This treatment was designed to determine if the greater potency at the self level will have an impact on habit formation in participants.

Additionally, the purpose in combining the notifications with the positive or negative feedback is because notifications are "useful to amplify the effects of another motivational design pattern" (Lewis 71). Combining notifications with the praise and shaming motivation

patterns attempts to leverage the effects of those patterns and determines how the inclusion of both shame and praise impacts intrinsic motivation.

Finally, treatment five combines treatments two, three, and four by using notifications, praising feedback, and shaming feedback. The purpose of this was to test if there is an ideal combination of feedback systems with respect to exercise motivation.

The study is being run through a limited app because of the prevalence and flexibility afforded by smartphones. In the study that used a gamified monitoring app to change adolescents' snack intake, Lippevelde et al. reported a multitude of advantages provided by having participants use smartphones to do the study. The first advantage is the prevalence of smartphones. A study conducted by the Pew Research Center found that 85% of adults indicated they owned a smartphone (Pew Research). While the scope of this thesis was centralized on a university campus, the high prevalence of smartphones makes dissemination of a study very easy. The other advantages of using a smartphone app for this thesis are "lowered participant burden [and] flexible program tailoring" (Lippevelde et al. 2). Having an application on each participant's phone reduces the amount of time to self-report information in the study and removes the need to be in a physical lab to participate in the study. Additionally, by building the app, tailoring the specific treatments is very easy. Finally, a mobile app is being used because it is the most natural delivery system. People are already familiar with having games and gamified apps on their phone, such as the Nike+ app or Starbucks app. As a result, using an app will avoid running into artificial usability challenges.

Experimental Model:

The overall design of the experiment was comprised of five treatments, including the control group. There were three phases of the experiment over the six-week period. The first phase was used to create a baseline of exercise tendencies from the participants. The second phase added notifications, increasing the gamified experience for the participants. In the third phase, all gamification mechanics were removed to determine if there was longevity of behavior across phases.

The hypotheses were as follows:

H1: Each treatment, other than the control, will be positively correlated with an increase in exercise frequency/duration.

H2: From strongest to weakest, the respective positive correlation with exercise frequency/duration will be: positive and negative praise; positive praise; negative praise; nudge.

Method:

The participants in this study were undergraduate students at the University of Richmond. They were recruited using word-of-mouth, posters and flyers placed on campus with QR codes linking to the app download, and through, SpiderBytes, JepsonBytes, email and Slack promotions. 22 participants completed both the pre-survey, post-survey, and were placed into treatments, and the mean age of these participants was 21. Additionally, the gender breakdown of the participants was 59% female and 41% male, with 13 and 9 participants respectively. Students who were engaged in college athletics that required three or more scheduled practices or games per week were excluded from the study because it would be infeasible to measure habit

formation when the athlete already had a regular exercise schedule with reinforced motivational schedules (likely both intrinsic and extrinsic). Because there were limitations on the number of students who participated (to be discussed later), the analysis of the experimental model was directional and used as a proof of concept.

To participate in the experiment, students first downloaded the app from the Apple App Store (which required participants to have an iOS device, such as an iPhone or iPad). The onboarding process for the app started with the participants seeing Figure 3.1 and 2.2. After clicking the *Sign Up* button on Figure 3.1, the participants would be taken to the second screen (Figure 3.2). Participants were asked to indicate their name, email, password, and University of Richmond Student ID. The reason for entering this information was to facilitate the data collection process. To create a record for each participant that could be tracked across phases, each participant needed to be logged in as a "user" in the database. As a result, this sign-in process was necessary to set up a record for each participant.

Figure 3.1

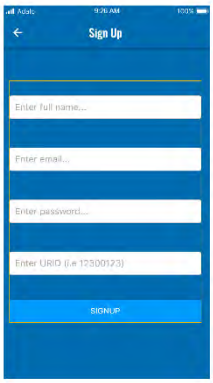


Figure 3.2

After new participants entered their information and clicked the *Sign Up* button on the second screen, an in-app window would pop up. This in-app window would have an embedded Qualtrics survey. An in-app browser was used to minimize the effort needed by participants to complete the survey and to increase the likelihood the survey would be completed. The purpose of the pre-survey was to collect information about the participant that could be analyzed for an impact on exercising behavior. For example, data points about race, employment status, on-campus vs off-campus living, and past exercising behavior were recorded. In short, this pre-

survey was designed to get a measure of the participants' current exercise habits, past exercise habits, and other factors that would affect exercising.

Once the pre-survey was completed, the participants were moved to the third screen of the onboarding process, Figure 3.3. This screen asked participants to enter the treatment number they received at the end of the pre-survey. For every participant who completed the pre-survey, there was a displayed treatment number at the end of the survey. This number was randomly distributed to the participants. The participants were instructed to copy this code into the *Enter Number* field, funneling them into their respective treatment. In the event the participant did not complete the survey and receive a code, the *Take Pre-Survey* button was provided at the bottom of the screen. After clicking the *Enter* button, participants would be taken to the home screen corresponding to their treatment.

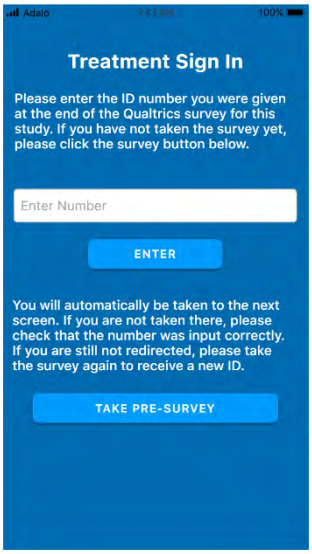


Figure 3.3

No sign-out option was offered for several reasons. First, it would have required the participants to remember or keep a copy of their treatment sign in for future logins. There would have been a significant chance that a participant did not remember or record this number, barring them from being able to continue in the experiment. Secondly, there would be no purpose to a sign-out feature. Once participants were in a treatment, they would remain in that treatment for the entire experiment. The sign-in system was needed only to set up a database record for each participant. If a participant no longer wished to participate in the experiment, they could uninstall the app, removing themselves from the experiment and deleting any data from their phone.

Finally, all participants were entered into a raffle to win one of four $25 Amazon gift cards. This amount was chosen to incentivize people to participate in the study and participants

were made aware of this reward when they began the onboarding process. The winner had to complete the study (including the post-survey) to be eligible for the gift card. The amount was capped at $25 to prevent the primary incentive to exercise to be because of the gift card, rather than the gamification mechanics.

In summary, the complete onboarding flow is shown in Figure 3.4:

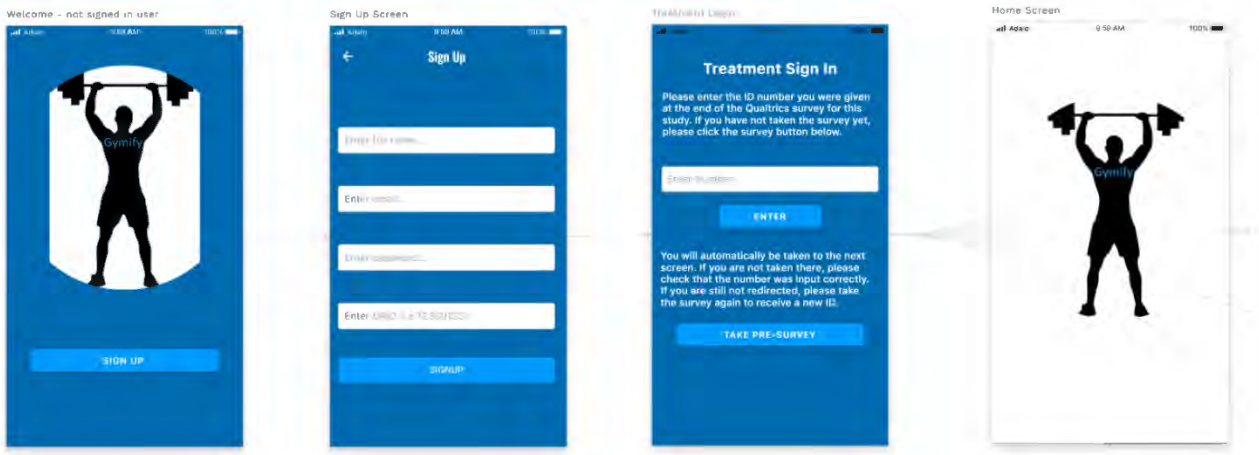


Figure 3.4

The screen on the far right was the loading screen that each participant would see when opening the app before being directed to their treatment home screen. Finally, the lines coming out of the right hand side of the Treatment Sign In page represent the decision logic in the app. Depending on the treatment number the participant input into the *Enter Number* field, the participant would be taken to a different screen corresponding to the lines.

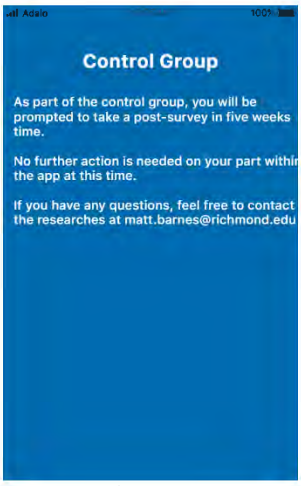


Figure 3.5

Participants were placed into one of five treatments after entering their treatment number: control; nudge; positive praise; negative praise; positive and negative praise. Beginning with the control group, participants in this group only took the pre-survey and post-

survey. They did not have any functionality within the app other than the *Report A Bug* button. The purpose of having no functionality in the control group was to get a baseline of behavior without any intervention. The decision to make the control group without any self-reporting capability was due to a potential impact of the app itself. All other treatments had a self-report capacity, to record exercise. However, the control group did not have this because the act of self-reporting within the app could have had an impact on behavior. As a result, the control group was limited to only the bug reporting feature.

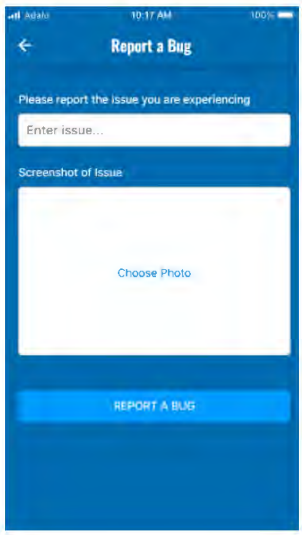


Figure 3.6

Going further into the bug reporting feature, the *Report A Bug* button was included in this treatment, as well as all other treatments, to allow participants to record anything unexpected or any major glitches in the experiment. Clicking the *Report A Bug* button would take participants to Figure 3.6 where they could describe the issue in the text field, as well as include a picture of the issue if they wanted.

Nudge

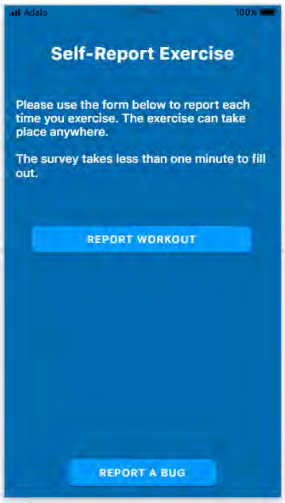


Figure 3.7

Moving onto the second treatment, nudges, the nudge treatment group had two additional app features over those offered to the control group. This group still took both the pre-survey and post-survey. The first additional feature is the exercise self-report. The participants were asked to log any exercise they did in a day. The *Report Workout* button opened a similar in-app browser to the pre-survey. Figure 3.7 is the only screen that was shown to this treatment until the conclusion of the experiment.

The self-report survey was a four-question survey that asked the participants for their student ID, what the exercise was, how long they engaged in the exercise,

and when the exercise was started. Student ID was recorded to facilitate cross analysis for each participant, similarly for exercise type and duration. The purpose of asking when the exercise started was to eliminate duplicate entries and allow for multiple entries in one day. Specifically, the reporting feature should allow a participant to enter multiple reports if they work out more than once, but should be able to discriminate between that scenario and if a participant input information wrong in one report and re-reported the same workout with correct information. By collecting the start time of information, this time can be used in combination with duration to see if there is an overlap in reporting.

The second feature the nudge group had that the control group did not was notifications. During the second phase of the experiment, this group received notifications every two days. More detailed information about the phases will come after the explanation of the rest of the treatments. The notifications the participants received asked if they had worked out that day, and, if they had, to please report it. If the participants clicked on the notification, the app would open to the screen above and they could record their workout. The notifications were sent out at 10:00pm. This time was chosen to increase the likelihood that the participants would have already completed any exercise they were going to do that day.

The third treatment was positive praise. In addition to taking the pre-survey and post-survey and receiving notifications every other day during the second phase, the participants would receive a positive reinforcement message if they self-reported exercise during the first two phases. Figures 3.8 - 3.10 show the screens that the positive praise group would see.

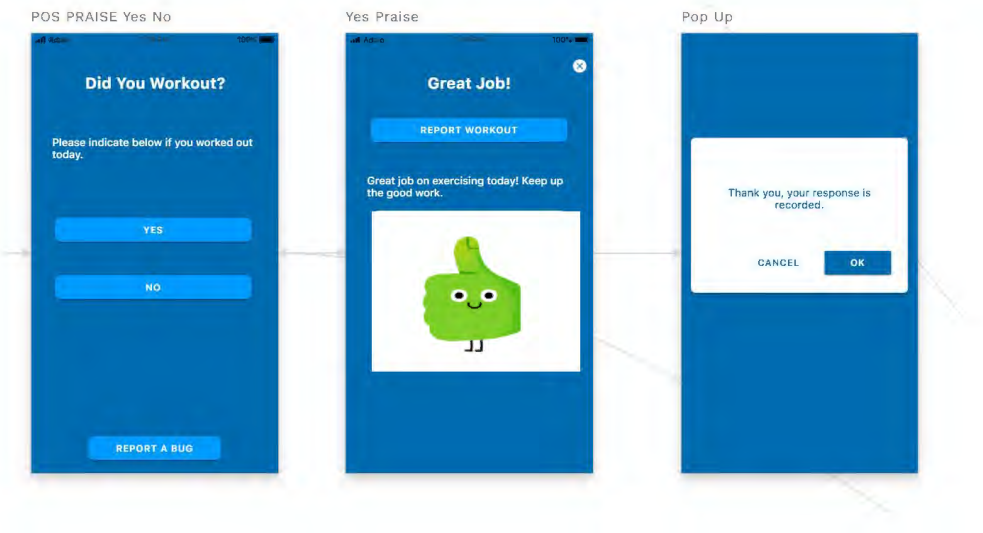


Figure 3.8 *Figure 3.9* *Figure 3.10*

Figure 3.8 is the positive praise home screen. The screen was made to be as simple as possible. Participants were asked to indicate if they worked out. Clicking the *Yes* button would take them to the screen in Figure 3.9. This screen had a *Report Workout* button for the participants to allow them to make an entry in the Qualtrics survey. Additionally, the positive praise was a combination of the message and the gif. The design of this messaging was to fit with the sustainable engagement economy by using a praising informational feedback system. The happy thumbs-up gif was chosen to be playful, cute, and encouraging for the participants. Ideally, this combination would induce the release of a small amount of endorphins, making future exercise more likely.

Finally, the screen in Figure 3.10 was triggered when the participants clicked the *No* button. This treatment was not designed to give any gamified informational feedback if the participants clicked the *No* button. However, if the participants clicked the *No* button and nothing happened, there might be a chance they thought it did not work and would spam the button. To decrease the likelihood of this happening, the screen in Figure 3.10 was put in to notify the

participant that their response was recorded. Effort was taken to make the messaging on this screen neutral so as to not place evaluation on the participants' decision not to exercise.

In the negative praise treatment, the participants took both surveys and received a notification every two days asking if they had worked out that day. The participant would receive a negative reinforcement message if they did not self-report exercise. The message they received is converse to the positive praise group. If the participants clicked the *Yes* button, no action was triggered. However, if they clicked the *No* button, they were taken to the screen pictured in Figure 3.12 with the message "Remember, exercise can lead to positive physical and mental health outcomes!" The purpose of this message was to use a negative informational feedback system to create the sustainable engagement economy. Specifically, this fell in the Pain Avoiding, Internal category to create shame-avoidance behavior in the participants. Additionally, the red frowning face was chosen to increase the impact of the disappointed sentiment. The gif of the sad bird (Figure 3.13) is included because that was the original gif to be used in the feedback system. However, the bird was to be found too cute, and it elicited a happy feeling when shown to several consultants. As a result, the red crying gif was chosen because it is much more consistent in the negative sentiment it elicits.

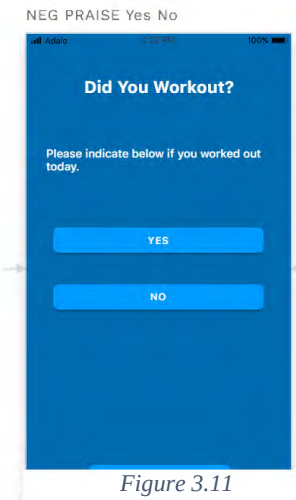


Figure 3.11

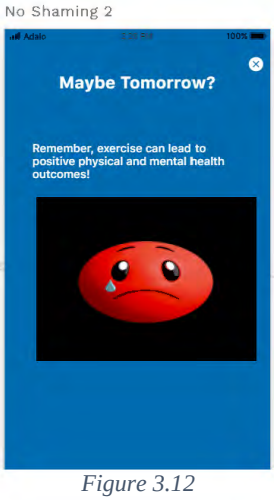
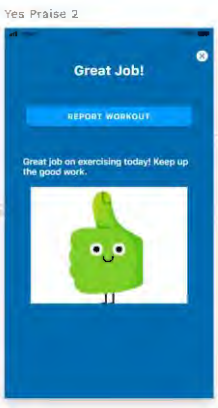


Figure 3.12

Figure 3.13

In the final treatment, the positive and negative praise group, participants took both surveys, received notifications every other day, and would receive positive or negative messaging depending on whether or not they indicated they exercised. This treatment was a combination of the positive praise and negative praise treatments.



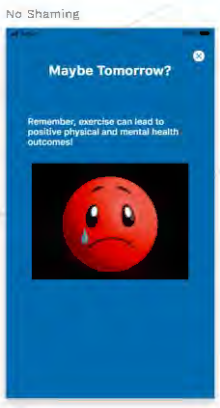


Figure 3.14 *Figure 3.15* *Figure 3.16*

If the participant clicked the *Yes* button on Figure 3.14, they would be taken to Figure 3.15 with the happy, thumbs-up gif. This screen was the same one described in the positive praise treatment. As with the negative praise group, if the participants in this treatment clicked the *No* button, they would be taken to Figure 3.16 with the red, crying gif. The purpose of this treatment was to see if the combination of both positive and negative feedback systems could stimulate a greater effect on exercise behavior than the positive praise or negative praise treatments individually.

In summation of the treatments, Figure 3.17 is a table of the treatments and what features each included:

	Pre/Post Survey	Bug Reporting	Exercise Self-Report	Notifications	Positive Reinforcement Message	Negative Reinforcement Message
Control	Yes	Yes	No	No	No	No
Nudge	Yes	Yes	Yes	Yes	No	No

Positive Praise	Yes	Yes	Yes	Yes	Yes	No
Negative Praise	Yes	Yes	Yes	Yes	No	Yes
Pos & Neg Praise	Yes	Yes	Yes	Yes	Yes	Yes

Figure 3.17

Procedure:

The procedure of the experiment took place in three phases. The first phase included participants downloading the app and creating a baseline. Nothing changed for the control group across any phase. For simplification, Figure 3.18 is a table of the features changed from phase to phase for each treatment.

	Phase 1	**Phase 2**	**Phase 3**
Nudge	No Notifications	Notifications	No Notifications
Positive Praise	No Notifications	Notifications	No Notifications or Positive Message Feedback
Negative Praise	No Notifications	Notifications	No Notifications or Negative Message Feedback
Pos & Neg Praise	No Notifications	Notifications	No Notifications or Positive/Negative Message Feedback

Figure 3.18

Phase 1 took place over a one-week period. This established the effect of the baseline gamification mechanic in each group. For example, in the positive praise group, that was the positive feedback system. During phase two, which was four weeks, the level of gamification was increased by using push notifications every two days asking if the participants had exercised. Finally, in phase three, which lasted two weeks, all gamification mechanics were removed. No notifications were sent out or feedback given if a participant logged exercise. This was achieved by changing the home screen for all participants to Figure 3.19.

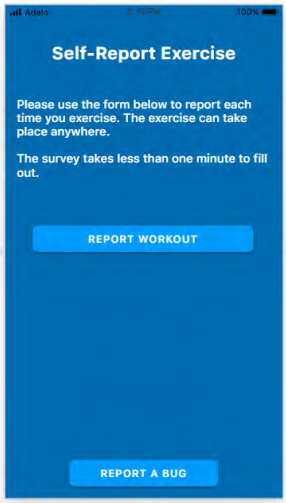


Figure 3.19

The purpose of removing the gamified mechanics was the measure the motivational factors driving the participants to exercise, as well as the levels of motivation. The first two phases were designed to see if motivation to exercise could be increased by scaling the level of gamification used. The third phase was designed to remove those mechanics to see if any effect on motivation caused by the first two phases would have a lasting effect on exercise patterns.

At the conclusion of the third phase, a push notification was sent out asking all the participants to take the post-survey. Additionally, the app screen that all participants saw changed to Figure 3.20. This screen asked all participants to take the post-survey. This change stopped any further data collection and would ensure that participants could take the post-survey at any time.

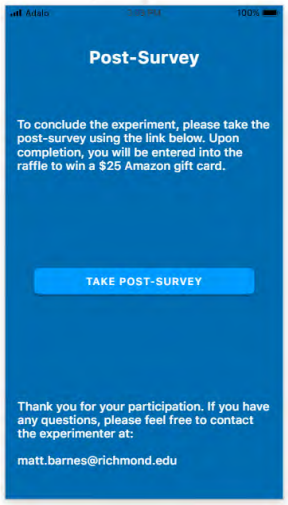


Figure 3.20

The post-survey was designed to collect information about each participant's exercise behavior during the experiment. Questions were asked first about how much they exercised each week. After determining what experiment a participant was in, questions were asked about the effectiveness of the treatment for them. For example, how participant felt after receiving the positive message in the positive praise group. In general, the post-survey was used to get information about the exercise each participant did during the duration of the experiment and to determine the effect each gamification mechanic may, or may not, have had on them.

Figure 3.21 is a visual representation of the entire app flow. The sign-up process led each participant into one of the five treatments. Each treatment had access to screens horizontally aligned. For example, positive praise had the three screens, yes/no, thumbs-up, and response pop-up available to it. Finally, each treatment had access to the bug report screen for the duration

of the experiment, and the post-survey screen became available at the conclusion of the testing.

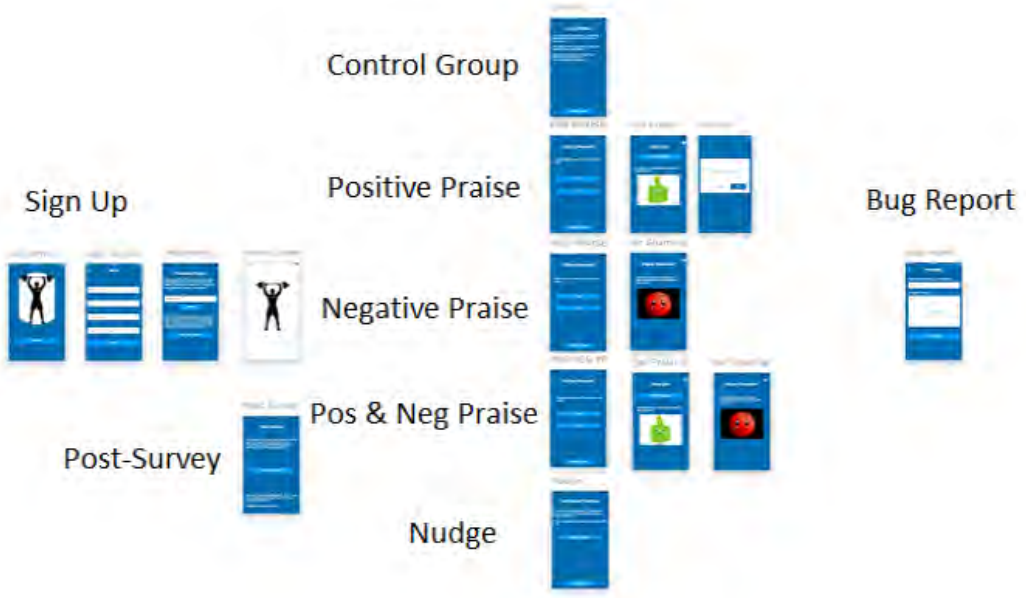


Figure 3.21

In conclusion, the experiment was designed to test if participants' exercise motivation could be increased using gamification mechanics and to see if that increase in motivation could translate over to sustained intrinsic motivation to exercise. As investigated before, it is known that extrinsic motivation can lead to a decrease in intrinsic motivation for a given task. However, the design of these gamification mechanics was as closely aligned to intrinsic motivation as possible. The goal was to see if these extrinsic motivators could initially be used to stimulate an increase in exercise behavior before scaling back the extrinsic motivation and have participants transition to intrinsically motivated exercise behaviors. Determining if this is possible is important because it would allow for positive change in a variety of areas. Gamification mechanics could be used to initially stimulate behavior change before transitioning people off of the mechanics for lasting habits. Essentially, people would then engage in behaviors of their own

volition, rather than relying on a gamified crutch. The potential good this type of model can achieve will be explored in more depth later in the thesis.

Limitations:

There were several limitations in this experiment. First, the number of participants in the study did not allow for statistical significance given the number of treatments. As a result, this experiment had to be used for directional data and a proof of concept. A potential cause for the low turnout of participants was due to this experiment being lengthier and more involved than typical experiments at the University of Richmond. Additionally, there was an expected amount of participant dropout. One potential cause of this could have been how the spring break lined up for students during the experiment or a heavier than expected workload. 5 users also reported injuries or illness preventing them from continuing to exercise as much as they would have wished in the post-survey, which impacted exercise frequency for those users. Finally, the impact of the COVID-19 pandemic on overall levels of stress among students has led to a general downturn in exercise motivation, which may also be a factor (Lopez-Valenciano et al.).

Other limitations were due to platform constraints and issues in app development. Adalo was chosen as the platform on which to implement the app, and the app was made only for Apple devices, not android, Google, or Microsoft devices. This platform was chosen because it was believed to be a rapid, easy way to develop the app. Adalo is a no-code platform. This means that instead of needing to code the app itself, Adalo provides functionality and pre-built selections that can be linked together and make the app. A no-code platform was chosen because it would theoretically reduce the amount of time needed to test the app for correct functionality and increase the speed of development. Of the no-code platforms, Adalo was chosen based upon

budget, the availability of expert support in the development, and it providing all the built in features needed to implement the experimental model.

Despite Adalo seeming to fit all the requirements for the experimental model, there were numerous limitations caused by the platform. First, Adalo's data collection did not work properly for undetermined reasons. When participants clicked the *Yes* or *No* buttons on Figure 3.14, a record was made of which button was selected. However, Adalo did not record which user clicked the button (despite having a column in its data report for users), it only recorded the treatment group of the participant. As a result, there was a loss in individual data analysis. Second, the app was developed, tested, and launched over a one-month period. Apps rarely, if ever, successfully launch without problems the first time or in such a narrow time frame. More time was likely needed than was available to adequately test the app before running the experiment.

The third issue was caused by Adalo's notification system being not fully functional as advertised by the company. A posting went out during development that clicking on the notifications would *only* take users to home screens, rather than a target screen that developers could specify. The original design of the experiment was to have the home screen of all treatments be that of the one for the nudge group (Figure 3.19). Clicking on a push notification would then take the participant to the yes/no screen (Figure 3.14) for the positive, negative, and positive & negative treatment groups. Then if the participants clicked the *Yes* or *No* button, it would give them their respective feedback. However, because the notifications were broken, this functionality would not work. A workaround had to be made, resulting in different home screens than initially planned. This limitation made it harder to study the effect of adding the notifications.

The final issue was caused by a lack of possible interface between Qualtrics and Adalo. After each participant took the pre-survey, their random treatment code was generated at the end of the survey. Ideally, the participants would have automatically been placed into their treatment, but there was no way to automatically apply that code in the Adalo app. This extra step for the participants could have been confusing or frustrating if they did not copy the code correctly into the ID Treatment field of Figure 3.3.

Results:

Due to the limitations of the experiment, directional results were not able to be found. The size and quality of the data was diminished by the number of participants and Adalo's loss of individualized data. Additionally, of the 22 participants who participated, 9 of those individuals were not treated properly. Figure 3.22 shows the breakdown of participants who reported if they received notifications during the experiment. All treatments, except the control should have received notifications during the second phase. 9 participants across the other four groups indicated they did not receive notifications. There are a couple possibilities leading to these 9 responses. These participants might not have allowed the app to send them push notifications as they were directed to do, or second, they were confused by the question and did not answer correctly. The combination of this limitation and others resulted in a lack of directional findings.

Participant Received Notifications	**Control**	**Pos Praise**	**Neg Praise**	**Pos and Neg Praise**	**Nudge**	**Total**
No	6	4	2	0	3	15
Yes	0	2	2	1	2	7
Total	6	6	4	1	5	22

Figure 3.22

Discussion:

Though no results were able to be found from the experimental model due to these limitations, the model itself could still be an effective method to engage people in positive behavioral change. Despite the limitations, some participants gave anecdotal support, such as one participant who wrote in their post-survey that "I maintained the frequency on my own, but the duration was increased by the app." Another user reported they "began feeling better" after exercising more. Going forward, and under idealized scenarios, there are several ways this model can be improved and tested more thoroughly. Primarily, the experiment would run for significantly longer, with more phases and with more targeted and specific (rather than ad hoc) app development focused on the experiment. These changes would allow for the ideal data to be collected and for potential statistical significance to be found.

To analyze for correlation between the gamified mechanics and exercise habit formation, there are several data markers that would need to be collected. First, accurate measures on the exercise frequency and duration of each participant. Additionally, metrics surrounding how frequently the participant interacted with the gamified mechanic. This could be in the form of individualized screen visits or click counters for different components. Using this data, treatment level and individual level analysis could be done on responses across different phases to determine the effect the gamified mechanics had on exercise behaviors.

Moving onto the duration of the experiment, the ideal length of time would be a minimum of two months because full habit formation is believed to happen after 66 days (Gardner et al. 664). By running the experiment over a longer period, the effects of gamification mechanics on motivation levels, as well as habit formation, would be better determined. The app was not run for this length of time because of the limited amount of time in the University of Richmond's semester.

The app was implemented in a barebones manner rather than a high scale production due to time and funding constraints. It would also be made available across multiple platforms, including iOS, android, Google, and Microsoft phone systems. Given more resources, the app would also ideally be more customized and commercialized to increase the user experience and increase participants' engagement. For example, implement automatic placement into the treatments to avoid confusion or complication for the participants. Many limitations were put on the design and implementation of the app because of the constraints imposed by Adalo, timing, and funding.

Finally, under ideal circumstances, the gamification mechanics would be tested in a greater number of phases in a scaling manner across multiple treatments. The scaling would operate by starting each participant using an app with a low level of gamification and ramping up the gamified aspects in each subsequent phase. After reaching the middle phase, the gamification mechanics would then be gradually removed in each subsequent phase, returning to the original gamified level of the first phase. The purpose of scaling up, then down, the gamified mechanics serves to initially engage and then disengage people from the app. This experimental model was not able to scale gamified mechanics in this manner because of the short experimental period. However, this format suits the longer testing period very well.

The logic behind this scaling comes from the application of Woolley and Fishbach's research. They conducted several studies to determine the effect of immediate vs delayed rewards on intrinsic motivation. Their key finding was that "immediate rewards increase intrinsic motivation by strengthening the activity-goal association" (884). Using rewards that were associated with the activity in question could increase a person's motivation to complete a task. By using immediate rewards in the scaling model, the hopes would be to use these rewards to

increase activity-goal association and stimulate habit formation. Then, once habit formation had begun, the reward system would be slowly removed, while still preserving an intrinsically motivated habit for the person. This transition would ideally lead to longer lasting, self-sustaining habits that do not require the crutch of a gamified system, which is at the center of the model's ethical framework.

The experimental model of this thesis was designed using Kim and Werbach's model, explained in chapter two. Beginning with the criterion of exploitation, this experiment passes this test because it did not engage in unfair arrangements with the participants of the study. There are several reasons why the model is not exploitive. First, participation in the experiment was purely voluntary. All participants signed a consent form agreeing to participate, and the form indicated the purpose of the experiment. The model is not exploitive because participation is "at-will" at all times, and each participant has full autonomy to engage with the app, or not, at all times. No participant is penalized for any action they choose, therefore never violating a participant's freedom of action.

The second reason that this model is not exploitive is because participants could be rewarded for participating, but the reward was not manipulative or exploitative. All participants were entered into a raffle at the end of the experiment to compensate them for their participation. Additionally, participants may receive physiological benefits from participating in the study if the app caused them to increase their exercise frequency or duration (as noted by the participant who said they "began feeling better"). The benefits participants received creates a fair exchange within this model.

Finally, there was no unfair advantage that I have as the experimenter or creator of the gamified system because any benefit I gained did not come at the expense of the participants. I

received no monetary benefit from the production of this thesis; the benefit I received was an honors distinction on my degree. No information collected was or will be released to third parties for profit, and the only product produced was this thesis. As a result, this experimental model does not exploit the participants because there is a balance of benefits for both parties that does not come at the expense of either.

Moving onto manipulation, the thesis does not fit this definition because participants were made aware of the purpose of the experiment going in. The consent agreement explained that motivation design patters were being employed to see if behavior change with respect to exercise could be stimulated. If these motivation design patterns were used on the participants without them knowing their purpose, then that would have counted as manipulation. However, because the participants were informed of the influences being placed upon them, this does not classify as manipulation. The scope of the experiment was intentionally clear. The app clearly stated it was studying the impact of gamification on exercise, rather than stating the intention was another criterion and secretly looking at the effect on exercise.

Evaluating the ethics of the experimental model through the presence of exploitation or manipulation can be more broadly categorized as a deontological ethical evaluation. In this case, the intentions of the creator—this experimenter—of the gamified system and the way they treat their users or participants is what determines if the system is ethical or not. From the Kantian perspective, for a gamified system to be ethical, it must both respect the autonomy of rational agents and never treat them as a mere means. Applying this perspective, this thesis's experimental model also passes Kantian scrutiny. The model was designed to stimulate a positive, healthy habit. The mode of stimulus never undermined the autonomy of the participants in their decision to, or not to, exercise.

Additionally, the app did not treat the participants as pawns in a larger operation, but rather as rational individuals who may have different aims and goals. The app did not prescribe how or in what way the individuals should work out. The app only asked *if* the person worked out and allowed for them to report what form of exercise it was and the duration. By not prescribing the type, frequency, or duration of exercise the participants should engage in, the app respected the participants' autonomous choice to exercise.

An important distinction to make before moving on to the last two criteria in Kim and Werbach's model centers around the Negative Reinforcement treatment. A counterargument could be made to my claim above that this mode of stimulus *does* undermine a participant's decision not to exercise and therefore is not ethical. However, this treatment is still ethical even though it does censure the participant's decision not to exercise. The negative reinforcement, specifically the frowning face gif, does not undermine the *autonomy* of the individual making the decision. The gif does not inhibit their decision-making process for future decisions concerning exercise. As a result, this treatment still respects the participants as autonomous agents, satisfying Kant's Formula of Humanity. Another way to view the Negative Reinforcement treatment is as a disagreement. If someone disagrees with another person, that disagreement is not considered unethical. In the same way, the frowning gif expresses disagreement with an individual not choosing to exercise. In conclusion, the experimental model passes deontological scrutiny because it respects the autonomous decisions of the participants and does not attempt to manipulate or extort them.

With respect to harms, no harm was intentionally sought. The only outcome that is intentionally sought after is the stimulation of exercise. The goal centers around increasing the amount of exercise individuals do. Additionally, because exercise has positive health benefits,

barring injury, the model can be viewed as a positive ethical system because it intentionally promotes beneficial actions.[2]

A gamified system can still be unethical even if it does not intentionally promote and produce negative behaviors if the system produces unintentional negative consequences. However, based upon the responses from participants in the post-survey, none of them indicated that they had an adverse reaction to or effect specifically caused by the experiment. Additionally, steps were taken to mitigate any misuse of the application. To limit any unexpected behavior, the functionality of each treatment was kept to a minimum, both to ensure no confounds arose within treatments, and also to ensure that participants would not use the app for any other purpose than to report workouts. The bug report feature included in all of the treatments was also put in place to allow for participants to report if any problem arose during the experiment. Because there were no unintentional consequences found and steps were taken to minimize the potential for any misuse of the app, the experimental model is morally permissible according to Kim and Werbach's third criterion.

Finally, alteration of character traits is not within the scope of effect. The only cultivation that is taking place revolves around exercise and increasing the motivation to exercise. Increasing a person's motivation to exercise is ethical because it can lead to positive health outcomes if the person then decided to exercise. As a result, this fourth criterion is outside the scope of ethical consideration for the experimental model.

[2] Although five participants reported injuries, the app itself cannot be held responsible because it does not manipulate users into exercising in an unsafe manner; users have full control over when, how, and how much they exercise, and receive praise or shaming feedback (in those conditions) regardless of the intensity or style of workout.

The prior paragraphs outline why the experimental model is not unethical according to deontological and consequentialist lenses. However, the model is additionally ethically good, rather than simply not unethical. The primary reason that this model is ethically good is because of the mental and health benefits that are produced by exercising. Exercise has been linked to preventing the onset of over forty chronic diseases, as well as improving people's cognitive capabilities (Ruegsegger and Booth 1). Because the app is intentionally promoting behavior that can have a positive benefit for individuals, the model is deontologically ethical because it treats the individuals with respect and tries to help them. Similarly, the model is ethically good from a consequentialist understanding because the outcomes produced for participants involved are majority positive.

One caveat that should be addressed is the potential for people to use the app in order to engage in harmful behaviors. The participant may choose to use the app to do the wrong kind of exercise or exercise that may be harmful to the participant. For example, over-exercising or overexerting. The model attempts to address this issue by not being prescriptive in how participants should exercise. The number of notifications sent to participants was limited, as to not encourage over-exercising. Additionally, the app does not push people to increase the rigor of their exercise or recommend a specific type of exercise. All messaging in the app comes after a person reports exercising, but never prescribes how, or in what way, a person should exercise. This was done to not encourage people to exercise too frequently or too hard, both of which would increase the chance of injury.[3]

[3] If the app were developed for commercialized launch, the app would include warnings that all exercise should be undertaken under the supervision of a medical professional. This would help to prevent any unintentional injuries for users.

In conclusion, the experimental model is morally permissible, and, in fact, ethically *beneficial*, because not only does it not violate either a deontological or consequentialist account of ethics, but it encourages beneficial behaviors. The experiment does not extort or manipulate the individuals involved, and it did not have intentional or unintentional negative consequences.

Epilogue:

Exploring the behavioral effects that gamified systems can have on individuals is increasingly important due to the large-scale societal impact they will continue to have as we move deeper into the twenty-first century. Understanding the ramifications of these systems is particularly important for Leadership Studies because of the various ways gamified applications can generate or hold back social or political change. The theoretical gamification structure developed in this thesis has applications in many other areas besides just exercise. For example, applications could be made that help people modify behaviors surrounding diet, anger, time management, or ADHD. There is also a multitude of ways that gamification can be used to positively encourage social engagement or aid social movements.

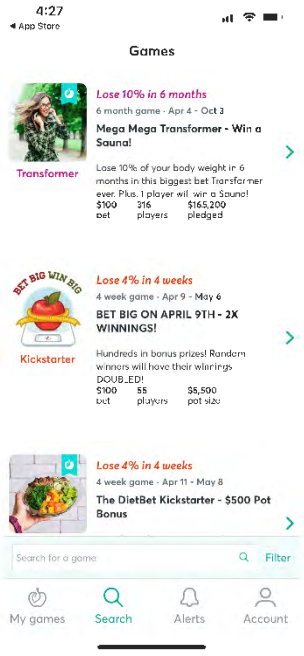


Figure 3.23

Two examples of gamified apps that already exist for dieting and time management are DietBet and Habitica. DietBet allows for users to set, or join in on, bets about weight loss. Some examples are pictured in Figure 3.23, where losing 10% of a person's bodyweight in 6 months could result in winning a sauna. This app is ethically problematic because it centers around addictive reward structures of gambling. Creating a gambling addiction related to dieting could lead to many of the detrimental effects discussed earlier. In this case, some of the negative effects could be rapid weight loss or gain to enable a person to participate and win more bets on the app. In general, what leads DietBet to be ethically problematic is the emphasis on betting.

Instead of the emphasis being centered around promoting healthy behaviors, it revolves around winning bets with dieting as the means of participation.

A more ethical approach to a gamified dieting app would be one that centers its goal around the formation of healthy dieting practices. If the reward structures are set up initially to promote diet behaviors, such as coupons for healthy food options in grocery stores, people could start to develop healthy dieting habits. After habits have formed, transitioning away from the rewards may still result in habit retention. This approach is more ethical than DietBet's because it does not attempt to exploit or manipulate users and seeks to have users engage in beneficial behavior change. Instead, the reward structure is directly related to reinforcing good diet behaviors.

Similarly, Habitica is an app that focuses on time management. The app allows users to input tasks and other goals they have in the app. Figure 3.24 shows some sample positive and negative goals that a person might want to balance, from eating fewer sweets to finishing their homework. Each user has a character that levels up if they successfully complete a task or goal in the list. Users receive awards that allow their character to be customized, and some of the customizations are pictured in Figure 3.25. The app is not ethically problematic because it does not have the addictive reward structures that DietBet has. However, the app is not ideal because the reward and feedback system is primarily executed through extrinsic rewards. These rewards

may be highly motivating at first, but once users get tired of them, the longevity of time management behaviors will not be sustainable.

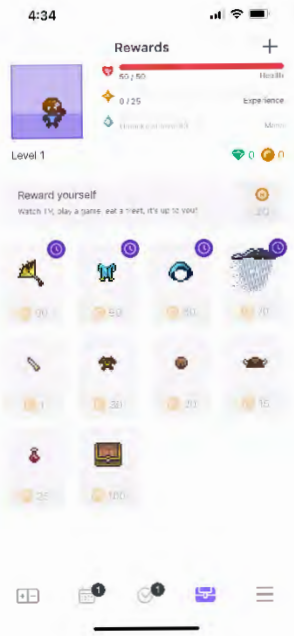


Figure 3.24

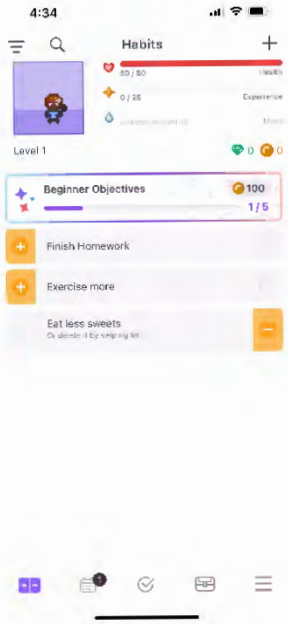


Figure 3.25

A hypothetical structure for an ethical time management app that could be more impactful and sustainable in its engagement would center around reinforcement of the actions of planning out a person's day, week, or month. Rather than incentivizing the user in ways that will bring them back to the app, such an app would incentivize the user to make the most effective time management plan for themselves, increasing their self-sufficiency.

In addition to creating positive individual benefits, gamification can impact social movements. This can be seen through gamified apps like Causes. The app was developed to allow constituents to contact their representatives through text, email, or voice calls. It also creates a platform for community engagement surrounding political legislation and elections. Figure 3.26 is a reaction page pertaining to the potential confirmation of Judge Ketanji Brown

Jackson to the Supreme Court. Users can give their opinion whether they believe Judge Jackson should be confirmed by the Senate or not. Similarly, Figure 3.27 allows users to give input about their perceived importance of microplastics. The app allows for an additional avenue for constituents to make their voices heard in democracy in a way that encourages increased knowledge about and engagement with actual bills up for a vote and has the potential to increase communication between constituents and their representatives.

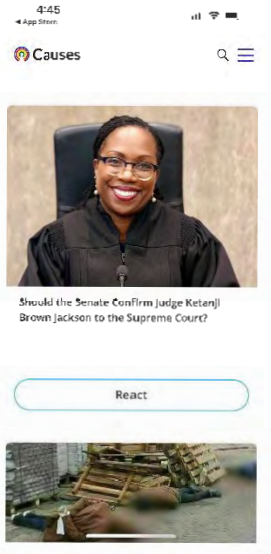


Figure 3.26

Figure 3.27

Causes is a good representation of an ethical gamified app because it does not engage in any of the unethical avenues explained in Kim and Werbach's model. The app presents informative articles surrounding political or social phenomenon and creates a space where people can engage critically with issues. The app does not exploit the users of its platform monetarily or temporally and does engage in manipulative behaviors to trick people. Additionally, no unintentional consequences have been discovered currently. In part this is because of the simple design Causes which keeps functionality narrowly focused on people voicing opinions, with little option of misuse. Causes is an ethically good, gamified app because it promotes prosocial behaviors in people to maintain and uphold representative democratic practices.

More generally than just this thesis's model, gamified applications have the potential be used as effective instruments of positive social change. Given that billions of people have smartphones around the world, smartphones allow for widescale dissemination of information in an almost instantaneous manner. For example, most major news networks have mobile applications with articles, and Amber Alerts send out mass broadcasts to smartphones about kidnappings or missing children. Additionally, Huizinga clearly shows the central importance games have in creating and shaping culture. By leveraging the potential smartphones create for reaching people and using the cultural shaping power of games, gamified apps can influence behavioral and societal changes on a massive scale. Some of the forms these apps could take include the organization of political campaigns, fighting against injustice, reducing carbon emissions, or promoting human rights. Creative, gamified applications can be created to enhance almost any movement.

However, the effectiveness of gamification acts as a double-edged sword. If not used carefully, gamified applications could also produce negative consequences on a massive scale. All the cases of unethical gamification explored in this thesis were individually focused, but if a gamified application operates with millions of users, there is potential for massive detrimental impact. To avoid negative consequences, future work must be done to create and enforce ethical guidelines for gamified systems. This thesis briefly discussed two levels on which this framework would be created.

The first level of responsibility starts with the creators of the gamified systems. Ethically-minded creators should not exploit or manipulate the users of their application. Additionally, they would take steps to proactively prevent unintentional consequences and periodically measure and evaluate the consequences created. This evaluation would help to identify any

unintentional consequences that were no prevented, allowing the creators to quickly address and prevent those negative consequences from being reproduced in the future.

The second level of the ethical framework comes from legislative work. Legislation like the EU's privacy laws are critical. Part of this legislation mandates companies disclose, what data they are collecting, as well as how they will use and share the data. Under idealized scenarios, the creators of gamified systems would self-police, and there would not be a need for oversight. However, legislation that provides protections for individuals and enforceable consequences for violations of those rights increases the likelihood that creators will make ethical gamified applications. Additionally, legislation provides the benefit of a clear standard that can be applied across gamified applications, reducing potential user confusion about how they may be influenced by the apps they are using.

The combination of both levels can greatly increase the likelihood of ethically good gamified systems being created. This allows for negative consequences to be avoided and gamified systems to be used as tools of positive change. As the world continues to enter a more digitalized, connected era, digital systems of all forms, not just gamified systems, will have an increasing impact upon people's lives. Analyzing the ethical and social implications of digital phenomenon is foundational to creating a more just, equitable, and inclusive society that does not replicate the prejudices and exploitations of the past.

Appendix

Pre-Survey

Start of Block: Default Question Block

Q1 You are being asked to take part in a research study investigating how particular motivational design patterns can influence gym attendance. Below, details about this study are discussed. It is important that you understand this information so that you can make an informed choice about being in this research study. If you have questions, please feel free to ask the researcher for more information. The purpose of this study is to learn more about motivational design patterns can influence gym attendance. The study should take approximately 5 minutes per day, not including any exercise done by you, to complete. If you agree to participate, you will be asked to complete an initial survey, log gym attendance, and complete a post survey, all through the app you just downloaded. Participants must abide by all local/CDC COVID-19 mandates in order to protect participants and other gym attendees, if the participant is working out in a public space. This research is being conducted by Dr. Haley Harwell and Matthew Barnes. If you have any questions about the project, Matthew can be contacted at matt.barnes@richmond.edu. There is no more than minimal risk involved in participating in this study. That is, the risks for completing this study are no more than the risks experienced in daily life. If you do experience any discomfort during the study, remember you can stop at any time without any penalty. You may also choose not to answer particular questions that are asked in the study. Additionally, this study does not present any more risks than what one would experience in going to a gym in their current, daily life, other than the potential exposure to contracting COVID. Participants will get the benefits associated with exercise depending on their gym attendance. Additionally, you may get some satisfaction from contributing to this investigation. Reasonable steps will be taken to ensure that your individual results will remain confidential. However, as with any research process, the risk of a breach of confidentiality is always possible. Nevertheless, to the best of the investigators' abilities, your answers in this study will remain anonymous and confidential. Once the study is completed, we will completely "de-identify" our data. All identifiers will be removed from the identifiable private information or identifiable biospecimens and only then will the information be used for future research studies. We will not tell anyone the answers you give us. Your responses will not be associated with you by name and the data you provide will be kept secure. What we find from this study may be presented at meetings or published in papers, but your name will not ever be used in these presentations or papers. If you have any questions concerning your rights as a research participant, you may contact the Chair of the University of Richmond's Institutional Review Board (IRB) for the Protection of Human Subjects of Research at (804) 484-1565 or irb@richmond.edu for information or assistance. The study has been described to me and I understand that my participation is voluntary and that I may discontinue my participation at any time without penalty. I understand that my responses will be treated confidentially and used only as described in this consent form. I understand that if I have any questions, I can pose them to the researcher. I have read and understand the above information

and I consent to participate in this study by selecting "Yes, I consent to participating in this experiment". Additionally, I certify that I am 18 years of age or older.

- ○ Yes, I consent to participating in this experiment
- ○ No, I do not consent

Skip To: Q45 If You are being asked to take part in a research study investigating how particular motivational de... = No, I do not consent

---

Q2 Student ID Number

_____

Q4 What is your year of birth?

_____

Q5 Hometown, State? (i.e. Richmond, VA)

_____

Q6 Are you on a competitive sports team, where you have mandated training/competition more than 3 times per week?

- ○ Yes
- ○ No

Skip To: Q46 If Are you on a competitive sports team, where you have mandated training/competition more than 3 ti... = Yes

---

Q7 Academic year in school

- ○ Freshman
- ○ Sophomore
- ○ Junior
- ○ Senior
- ○ Graduate
- ○ Other _____

Q9 What is your GPA?

_____

Q10 Do you live on or off-campus?

- ○ On-campus
- ○ Off-campus

Q11 Do you have a car?

- ○ Yes
- ○ No

Q12 What is your gender identity?

- ○ Male
- ○ Female
- ○ Nonbinary
- ○ Other _____

Q13 Are you Spanish, Hispanic, or Latino or none of these?

- ○ Yes
- ○ None of these

Display This Question:

If Are you Spanish, Hispanic, or Latino or none of these? = Yes

Q14 Are you Spanish, Hispanic, or Latino?

- ○ Spanish
- ○ Hispanic
- ○ Latino

Q15 Choose one or more races that you consider yourself to be:

- ☐ White
- ☐ Black or African American
- ☐ American Indian or Alaska Native
- ☐ Asian
- ☐ Native Hawaiian or Pacific Islander
- ☐ Spanish, Hispanic, or Latino
- ☐ Other

Q16 What is your current student status?

- ○ Full-time
- ○ Part-time

Q17 Do you work a job during the school year?

- Yes
- No

Display This Question:

If Do you work a job during the school year? = Yes

Q18 Are you employed part or full-time?

- part time (less than 38 hours)
- full time (38 hours or more)

Display This Question:

If Do you work a job during the school year? = Yes

Q19 Please indicate your occupation:

_____

Display This Question:

If Do you work a job during the school year? = Yes

Q20 Are you employed on campus? (i.e. Lou's employee)

- Yes
- No

Q21 Are you currently interviewing for an internship anywhere?

- Yes
- No

Display This Question:

If Are you currently interviewing for an internship anywhere? = Yes

Q22 In what field is your internship? (i.e. marketing, administration, etc)

_____

Display This Question:

If Are you currently interviewing for an internship anywhere? = Yes

Q23 Is your internship paid?

- Yes
- No

Q24 What is the income of your entire household? Please indicate the answer that includes all the members that live in your home (parents/guardians, siblings, you, etc).

- ○ $20,000 or less
- ○ $40,000 to $69,999
- ○ $70,000 to $99,999
- ○ $100,000 to $149,000
- ○ $150,000 to $179,999
- ○ $180,000 to $199,999
- ○ $200,000 to $299,999
- ○ $300,000 to $499,999
- ○ $500,000 to $799,999
- ○ $800,000 or more

Q25 How much money do YOU earn each year?

- ○ less than $1,000
- ○ $1,000 to $1,999
- ○ $2,000 to $3,999
- ○ $4,000 to $7,999
- ○ $8,000 to $9,999
- ○ $10,000 to $14,999
- ○ $15,000 to $19,999
- ○ $20,000 or $29,999
- ○ $30,000-$39,999
- ○ $40,000-$59,000
- ○ $60,000 or more

Q26 How much money do you have available during the week? (after groceries, rent, etc)

_____

Q27 Did you play a varsity sport in high school?

- ○ Yes
- ○ No

Q28 How long have you been attending the gym?

- ○ 0-3 months
- ○ 3-6 months
- ○ 6-12 months
- ○ 1-2 years
- ○ 2-4 years
- ○ more than 4 years
- ○ I do not attend the gym

Q29 Are there any barriers that prevent you from going to the gym?

- ○ Yes _____
- ○ No

Q30 In the past, about how many times per week did you typically exercise?

- ○ Never
- ○ 1-2 times a week
- ○ 3-4 times a week
- ○ 5-6 times a week
- ○ Everyday

Display This Question:

If In the past, about how many times per week did you typically exercise? != Never

Q49 Do you exercise multiple times per day?

- ○ Yes
- ○ No

Display This Question:

If In the past, about how many times per week did you typically exercise? != Never

Q31 About how long did you typically spend exercising?

- ○ less than 30 minutes
- ○ 30-45 minutes
- ○ about an hour
- ○ about an hour and a half
- ○ about 2 hours
- ○ over 2 hours

Display This Question:

If In the past, about how many times per week did you typically exercise? != Never

Q32 What days of the week do you typically go to the gym?

- ☐ Sunday
- ☐ Monday
- ☐ Tuesday
- ☐ Wednesday
- ☐ Thursday
- ☐ Friday
- ☐ Saturday

Display This Question:

If In the past, about how many times per week did you typically exercise? != Never

Q33 Do you attend a gym or fitness center off campus?

- Yes
- No

Display This Question:

If Do you attend a gym or fitness center off campus? = Yes

Q34 In the past how many times a week did you typically attend this off campus gym or fitness center?

- Never
- 1-2 times a week
- 3-4 times a week
- 5-6 times a week
- Everyday

Display This Question:

If Do you attend a gym or fitness center off campus? = Yes

Q35 What gym do you attend? (i.e. Crunch Fitness, Orange Theory, etc.)

_____

Display This Question:

If How long have you been attending the gym? != I do not attend the gym

Q36 What type of exercise do you typically do at the gym (either on or off campus)? Select all that apply.

- ☐ Cardio (running, elliptical, bike, etc)
- ☐ Weight lifting
- ☐ Yoga
- ☐ Workout Class
- ☐ Body weight workout
- ☐ Swimming
- ☐ Other _____

Q37 How many times a week do you typically spend exercising outside a gym-setting (i.e. outdoor run around campus)?

- ○ Never
- ○ 1-2 times a week
- ○ 3-4 times a week
- ○ 5-6 times a week
- ○ Everyday

Q38 Do you have a desire to increase your amount/duration of exercise?

- ○ Yes
- ○ No

Q40 Do you have a desire to become more physically fit?

- ○ Yes
- ○ No

Q41 What motivates you to workout?

- ☐ To maintain a healthy lifestyle
- ☐ To look fit
- ☐ All my friends workout
- ☐ I feel pressured to workout
- ☐ I do not workout regularly
- ☐ Other

Q42 Do you currently play for an IM sports team?

- ○ Yes
- ○ No

Q43 Do you currently play for a club sports team?

- ○ Yes
- ○ No

Q47 Are you currently diagnosed or have you ever been diagnosed with any of the following conditions?

	Current	Past Only	Never
Attention-Deficit/Hyperactivity Disorder (ADHD) or Attention Deficit Disorder (ADD)	○	○	○
Learning Disorder or Disability	○	○	○
Depressive Disorder (Major Depressive Disorder, Dysthymia)	○	○	○
Bipolar Disorder	○	○	○
Anxiety Disorder	○	○	○
Traumatic Brain Injury (TBI)	○	○	○
Seizure Disorder	○	○	○
Autism Spectrum Disorder or Asperger's Disorder	○	○	○
Schizophrenia Spectrum Disorder	○	○	○

Page Break

Q44 Thank you for participating in the first part of the study. By completing this survey, you have been admitted into the study. **You should see a code generated at the end of this survey. Please copy and paste this code into the corresponding line in the app to move onto the next part of the experiment**.

If you have any questions or concerns in the meantime, please do not hesitate to reach out to: Matt Barnes (matt.barnes@richmond.edu) or Dr. Haley Harwell (hharwell@richmond.edu)

Display This Question:

If You are being asked to take part in a research study investigating how particular motivational de... = No, I do not consent

Q45 Thank you anyway for your interest in the study. We hope you remain safe and healthy!

Skip To: End of Survey If Thank you anyway for your interest in the study. We hope you remain safe and healthy! Is Displayed

---

Display This Question:

If Are you on a competitive sports team, where you have mandated training/competition more than 3 ti... = Yes

Q46 Due to your athletic status, you do not qualify for this study. Thank you anyway for your interest and we hope you remain safe and healthy!

Skip To: End of Survey If Due to your athletic status, you do not qualify for this study. Thank you anyway for your interes... Is Displayed

End of Block: Default Question Block

Start of Block: Block 2

Q52 **Reminders:**
1. Allow the app to send you notifications.
2. Don't forget to report whenever you exercise.

End of Block: Block 2

Start of Block: Block 1

Q48 **CRITICAL** - on the next page, there will be a number at the bottom of the screen. You must copy this number and input it into the app after closing this survey. If you do not, you will need to recomplete the survey to participate in this study.

End of Block: Block 1

Exercise Self-Report

Start of Block: Default Question Block

Q3 Student ID number

_____

How long did you exercise for today?

- 30 minutes
- 30-45 minutes
- About an hour
- About an hour and a half
- About 2 hours
- More than 2 hours

Q6 What time did you start exercising? (i.e. 4:00pm)

_____

Q2 2. What type of exercise did you do?

- ○ Cardio (running, elliptical, bike, etc)
- ○ Weightlifting
- ○ Yoga
- ○ Workout class
- ○ Body weight workout
- ○ Swimming
- ○ Other _____

Display This Question:

If Invalid Logic Click Here to Edit Logic

Q5 Click to write the question text

- ○ Click to write Choice 1
- ○ Click to write Choice 2
- ○ Click to write Choice 3

End of Block: Default Question Block

Post-Survey

Start of Block: Default Question Block

Q6 In what year are you at Richmond?

- ○ first year
- ○ second year
- ○ third year
- ○ fourth year
- ○ other _____

Q7 About how many times a week did you attend the gym week 1?

_____

Q9 About how many times a week did you attend the gym week 2?

_____

Q10 About how many times a week did you attend the gym week 3?

_____

Q11 About how many times a week did you attend the gym week 4?

_____

Q12 About how many times a week did you attend the gym week 5?

_____

Q13 About how many times a week did you attend the gym week 6?

_____

Q14 Did you receive push notifications? (Notification - pop ups asking, "Did you work out today?")

- Yes
- No

Display This Question:

If Did you receive push notifications? (Notification - pop ups asking, "Did you work out today?") = Yes

Q15 What actions did the notifications trigger when you clicked on them?

- Opened to a yes/no page
- Opened to a self-report page

Display This Question:

If What actions did the notifications trigger when you clicked on them? = Opened to a yes/no page

Q16 What happened when you clicked the YES button on the yes/no page?

- ○ Pulled up an exercise self-report survey
- ○ Taken to a screen with a green thumb emoji

Display This Question:

If What actions did the notifications trigger when you clicked on them? = Opened to a yes/no page

Q17 What happened when you clicked the NO button on the yes/no page?

- ○ Received a "responses received" pop up
- ○ Taken to a screen with a red face emoji

Q18 How much did the app increase your exercise frequency/duration?

	None at all		A little		A moderate amount		A lot		A great deal
	0	1	1	2	2	3	3	4	4	5
0 = not at all, 5 = a great deal										

Display This Question:

If Did you receive push notifications? (Notification - pop ups asking, "Did you work out today?") = Yes

Q21 What were your feelings towards exercise after receiving a notification? Please rank (1 most frequent emotion, 10 being less frequent by dragging the options in the order of which you prefer most).

_____ motivated
_____ happy
_____ excited
_____ thankful
_____ dreadful
_____ irritated
_____ unmotivated
_____ unbothered
_____ tired
_____ other

Display This Question:

If What happened when you clicked the YES button on the yes/no page? = Taken to a screen with a green thumb emoji

Q19 What were your feelings towards exercise after receiving the message connected to clicking the YES button? Please rank (1 most frequent emotion, 10 being less frequent by dragging the options in the order of which you prefer most).

_____ motivated
_____ happy
_____ excited
_____ thankful
_____ dreadful
_____ irritated
_____ unmotivated
_____ unbothered
_____ tired
_____ other

Display This Question:

If What happened when you clicked the NO button on the yes/no page? = Taken to a screen with a red face emoji

Q20 What were your feelings towards exercise after receiving the message connected to clicking the NO button? Please rank (1 most frequent emotion, 10 being less frequent by dragging the options in the order of which you prefer most).

_____ motivated
_____ happy
_____ excited
_____ thankful
_____ dreadful
_____ irritated
_____ unmotivated
_____ unbothered
_____ tired
_____ other

Q22 Please rate your increase in gym attendance during these past three weeks

0 1 1 2 2 3 3 4 4 5

0 = no increase, 5 = significant increase

Q23 Please select which days of the week you attended the gym most consistently.

- [ ] Sunday
- [ ] Monday
- [ ] Tuesday
- [ ] Wednesday
- [ ] Thursday
- [ ] Friday
- [ ] Saturday

Q24 What type of exercise do you typically do at the gym? (select all that apply)

- ☐ Cardio (running, elliptical, bike, etc)
- ☐ weight lifting
- ☐ yoga
- ☐ workout class
- ☐ body weight workout
- ☐ swimming
- ☐ other _____
- ☐ none

Q25 Did you try any new exercise activities during this experiment (i.e. new workout class)?

- ○ Yes
- ○ No

Display This Question:

If Did you try any new exercise activities during this experiment (i.e. new workout class)? = Yes

Q26 If so, what was the new activity?

_____

Q27 In a few words, what motivated you to increase/decrease/maintain your exercise frequency/duration?

_____

Q28 Was there anything that prevented you from exercising as you normally would during this experiment?

- ○ Yes
- ○ No

Display This Question:

If Was there anything that prevented you from exercising as you normally would during this experiment? = Yes

Q29 In a few words, please indicate what prevented you (i.e. Too busy, injury, etc.)

_____

Q30 If you had trouble with the app, please write here what the issue was (write n/a if not applicable)

_____

Q31 If you would like to be entered in the drawing to win a $25 Amazon gift card, please answer these last 4 questions.

Q5 Please enter your First and Last name

_____

Q1 Please enter your Student ID number

_____

Q2 Please enter your Richmond email

_____

Q4 What is your home address?

_____

End of Block: Default Question Block

Figures

Figure 3.27. Article on microplastics from *Causes*. Mobile, Countable Corp, 2007.

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