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Autonomy in Video Games and Gamification

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ABSTRACT

AUTONOMY IN VIDEO GAMES AND GAMIFICATION

by Jonathan Leventhal

In the past decade, gamification (using game elements in non-gaming tasks to enhance motivation and engagement) has become a popular concept in many industries, but few studies have explored the principles under which it works. Self-determination theory suggests three psychological needs that gamification fulfills: competence, relatedness, and autonomy. Autonomy, a person's perception that they have the ability to act however they choose, has emerged as an important, yet less-studied aspect in gamification. Inclusion of autonomy in gamification should foster engagement, enjoyment, and better performance. An experiment inspired by the above was carried out in which a sample of college students (N = 57) played a video game called Super Mario Bros. Crossover with either the choice to customize the aesthetics of their character and background (autonomy-supportive) or no choice of aesthetics (non-supportive). It was hypothesized that conditions involving more choice would lead to higher perceived autonomy and performance, and that perceived autonomy would be positively correlated with engagement, enjoyment, and performance. The manipulation resulted in no significant difference in perceived autonomy or performance, and perceived autonomy was only significantly positively correlated with enjoyment. Prior Super Mario Bros. experience was also found to positively correlate with perceived autonomy in the autonomy-supportive condition. The choice of aesthetics does not appear to have been sufficiently strong enough to increase perceived autonomy in this context.

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Introduction

In 2014, the popular online video game League of Legends drew over 27 million unique players per day and over 67 million unique players a month (Tassi, 2014). Perhaps more astonishing is the fact that even though the game is free to play, many players reported spending hundreds of dollars to change the aesthetics of their existing playable characters (LeJacq, 2015). Revenue-generating elements in games such as these are crucial in today's economy, in which most independently produced games are commercial failures whether or not they are well-received (Jaffa, 2016). Spending money on aesthetics in League of Legends does not net players any external reward, nor does it give them a competitive edge. Instead, players seem motivated to satisfy internal needs, a phenomenon commonly referred to as intrinsic motivation (Ryan & Deci, 2000). Game elements such as customizable aesthetics, points, leaderboards, badges/achievements, chat functions, and immersive storylines can all foster intrinsic motivation (Ryan, Rigby, & Przybylski, 2006). This intrinsic motivation to continue to play or spend money on a video game is of great importance to the game's commercial success.

The use of game elements to increase user satisfaction in video games has also led to the concept of repurposing those elements to "gamify" other products to increase user engagement. This has been termed "gamification" and consists of using game elements from video games to promote intrinsic motivation in non-video game products or applications (Deterding, Dixon, Khaled, & Nacke, 2011). Gamification can be directed towards learning, promoting beneficial behaviors, or increasing consumer engagement. Just as in video games, game elements that foster intrinsic motivation in a product may mean the difference between its financial success or failure. For this reason, using game elements to motivate consumers to use products has been a hot area of research over the past decade (see Figures 1 and 2), and overall it appears to increase motivation in users (Hamari, Koivisto, & Sarsa, 2014).

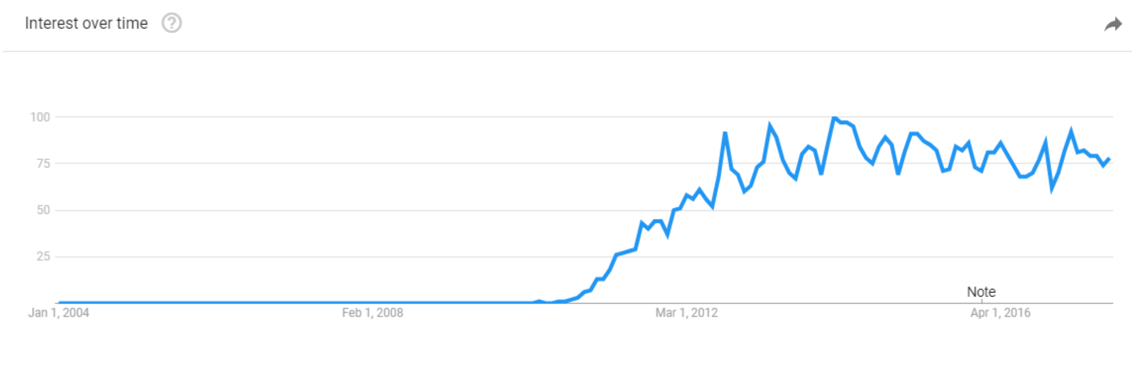

Figure 1. Results for searches involving the term "Gamification" since 2004. Data source: Google Trends (www.google.com/trends)

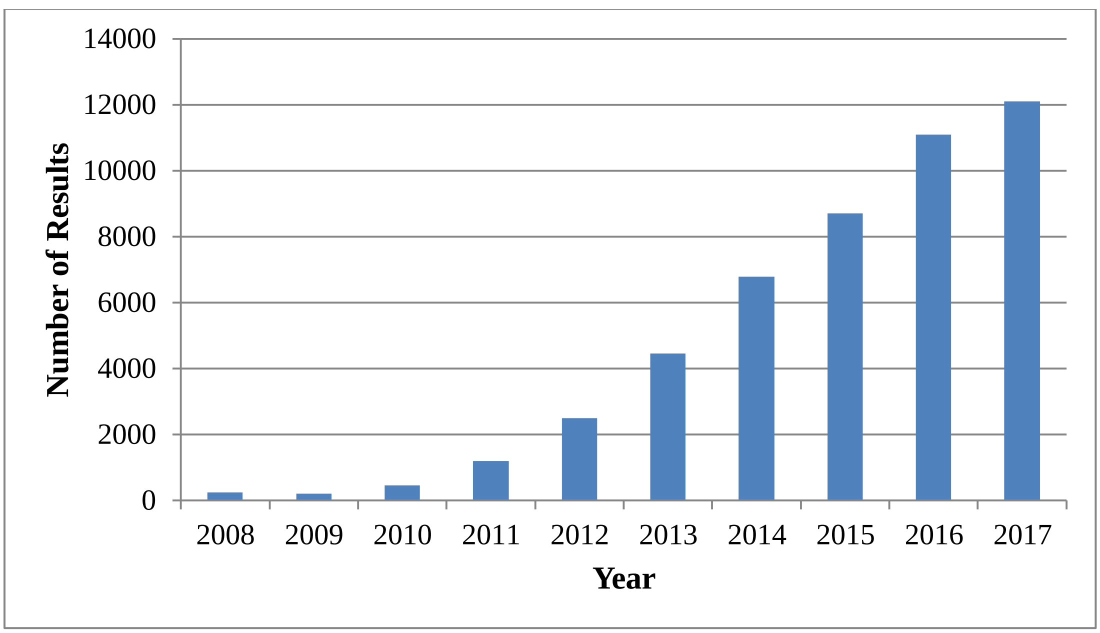

Figure 2. Results for searches involving the term "Gamification" in Google Scholar over the past decade by year. Data source: Google Scholar (https://scholar.google.com)

However, less research has examined exactly how and why the use of game elements works. In their literature review of gamification, Hamari, Koivisto, and Sarsa (2014) reported that of the thousands of articles that mention gamification, only 24 articles studied gamification empirically. They went on to report that the unifying question in these articles was whether or not gamification worked at all. However, in Hamari et al.'s suggestions for future research, they mentioned that both they and others (e.g., Thom, Millen, and DiMicco, 2012) speculated that the context in which gamification is applied may have an effect on its success. That is to say, the same gamification in some contexts may be successful, while in other contexts it may not be. They suggested that success may depend on factors such as the user characteristics and method of gamification. Hamari et al. posit that questions remain in this domain and future work should examine the factors that contribute to successful gamification, not just whether or not gamification works.

Research on gamification since 2014 has seen slightly better methods utilized through greater focus on featuring game elements based on Deci and Ryan's (1985) self-determination theory (discussed in-depth in the next section); however current research has still displayed few examples of manipulating individual game elements to gain a better understanding of exactly how they work. For instance, De-Marcos, Garcia-Cabot, and Garcia-Lopez (2017) tested whether an e-learning application would be well-received when gamified with a combination of achievements, points, leaderboards, and self-set lesson plans as opposed to no gamification at all. Shi and Cristea (2016) similarly investigated the gamification of e-learning with points, leaderboards, chat functions, and choice of lesson topics to pursue versus no gamification. Kappen, Mirza-Babaei, and Nacke (2018) gamified exercise for older adults and allowed for custom fitness goal-setting, achievements, and challenges compared to a group with just a pedometer and a group with no intervention. Ortiz-Rojas, Chiluiza, and Valcke (2017) measured reactions to a gamified computer programming course, offering badges and points for completed assignments as opposed to a control group with no gamification. While each one of these studies found gamification to be effective in increasing participant motivation to some degree, none actually manipulated the game elements present. Instead, recent studies still often focus upon whether gamification as a whole was working or not. Individual studies will be elaborated upon in a later section, but warrant mentioning here to illustrate that despite slight improvement in methods, there has been very little research attempting to bring about a systematic understanding of how particular game *elements* work, rather than examining gamification as a whole.

The present study pursues that line of research by studying whether a supposed autonomy-supportive game element actually inspires more autonomy and whether perceived autonomy is associated with increases in performance, engagement, and enjoyment. Although competence, relatedness, and autonomy-supportive game elements are all important to gamification, autonomy-supportive game elements were singled out in the present work due less representation in other literature. This research can help improve the understanding of what makes gamification successful by focusing on the methods of gamification itself, through the lens of self-determination theory (Deci & Ryan, 1985). In the next sections, this commonly accepted theoretical explanation of the motivational pull of gamification (self-determination theory) will be presented, followed by an overview of a few implementations of gamification in modern culture. Finally, relevant literature on gamification will be reviewed to set the stage for the present study.

Self-Determination Theory

Hamari et al. (2014), and other, more recent, researchers such as Shi and Cristea (2016) and Pramana et al. (2018), cite Deci and Ryan's (1985) self-determination theory as a theoretical framework for understanding the motivational pull of gamification. Several publications by Ryan, who co-authored the original self-determination theory publication, have also argued for self-determination theory's application to game elements (e.g. Przybylski, Rigby, & Ryan, 2010; Ryan, Rigby, & Przybylski, 2006). Self-determination theory proposes that intrinsic motivation stems from the satisfaction of three basic psychological needs: competence, relatedness, and autonomy.

Competence refers to a sense of skill mastery. It is the feeling that one has developed a skill and successfully utilized it. Przybylski et al. (2010) describe how competence may be fulfilled through particular game elements. In games, competence is often facilitated through points, levels, or badges, which all allow the user to track how well they're doing and gain a better sense of their accomplishments. This boosts intrinsic motivation in that users may feel satisfaction in their progress and can more easily set goals for improvement to achieve in the future.

Relatedness involves social connection and comparison to others (Przybylski et al., 2010). Game elements that promote relatedness usually come in the form of leaderboards, achievement-sharing, and chat functions. Leaderboards and achievement-sharing allow for users to see how others have performed and celebrate their own performance with others. Chat functions allow for users to socialize and form bonds. These types of game elements allow users to assess their performance as compared to others, compete with others, and gain a sense of community. This can feed a need for social interaction, boost a sense of accomplishment through social comparison, and increase the drive to improve when competing with others (Przybylski et al, 2010).

Autonomy is a little more amorphous than the prior two needs, but it essentially refers to one's perception of having freedom of choice (Przybylski et al., 2010). Generally this freedom of choice applies to which activities users have the ability to take part in or aesthetic customization such as their avatar's in-game appearance. Users that do not feel they have much freedom in their everyday life may especially appreciate game elements that cater to this need, as it gives them a sense of control in the activities they take part in (Przybylski et al., 2010).

Examining how and why autonomy, competence, and relatedness are achieved in games and gamified products may provide important insights into how to more efficiently facilitate intrinsic motivation (Ryan, Rigby, & Przybylski, 2006; Shi & Cristea, 2016). Facilitating higher intrinsic motivation, in turn, can then be leveraged to create higher levels of engagement, enjoyment, and performance (Ryan & Deci, 2000).

In their work on validating a user experience survey aimed at video games, Phan, Keebler, and Chaparro (2016) defined engagement and enjoyment within a game context. Engagement refers to a user's overall involvement in the game or product. This includes their levels of interest, attention, and immersion. Enjoyment is a subjective measure of how much a user likes the experience of using the game or product (Phan, Keebler, & Chaparro, 2016). Performance may take on many meanings depending upon the context, but generally can be thought of as a measure of the proficiency in which a user carries out the tasks or accomplishes the goals of a game or gamified product. Each of these elements are of note in that they have the potential to bolster the success of a product or the performance of users that utilize the product. However, further work is still needed to empirically demonstrate connections between these elements and intrinsic motivation.

Though each need outlined in self-determination theory is valuable, autonomy has seen less study than competence and relatedness. Furthermore, even when autonomy-supportive factors are included in studies, there is little systematic study of their efficacy. Examples of these trends will be discussed in more depth during in the Discussion of Gamification Research Approaches section below. Due to less focus on autonomy than other factors in recent literature, the present study focuses on the need for autonomy in gaming and gamification.

Gamification Implementations Today

Gamification involves the use of game elements in non-game products or applications (Deterding, Dixon, Khaled, & Nacke, 2011). These game elements can be anything that one would normally find in a video game that enhances motivation to play (Deterding, Dixon, Khaled, & Nacke, 2011). As described by Ryan, Rigby, and Przybylski (2006), game elements can be categorized as they relate to the three components of self-determination theory which provides an explanation for their ability to motivate users (See the Self-Determination Theory section above for a more in-depth discussion of this).

Gamification with game elements such as points, leaderboards, achievements, chat functions, and free choice of action has been utilized in many domains, including health (Hamari & Koivisto, 2013), education (Domínguez et al., 2013), and the workplace (Flatla, Gutwin, Nacke, Bateman, & Mandryk, 2011). Hamari and Koivisto (2013) studied the influence of social motivations behind gamification's success in an exercise application called Fitocracy. They found that social factors in particular affect one's perception of and intention to use the gamified health app, and that larger social networks provided more opportunities for social recognition of application-related achievements. Domínguez et al. (2013) developed a gamified plugin for an e-learning website featuring badges, achievement sharing, and positive feedback. The researchers reported that participants who utilized the plugin tended to score higher in practical applications of their skills, though lower on writing assignments. Flatla, Gutwin, Nacke, Bateman, and Mandryk (2011) presented work promoting the use of gamification in calibration software for human-computer systems. They called these "calibration games" and created three using the guidelines they presented. They reported that users found the calibration games more enjoyable than standard calibration procedures, and that the data gained from them suffered no ill consequences.

Several examples of gamification also exist in the commercial sector. A popular gamified health product is Fitbit, a wearable device that tracks steps, heart rate, and sleep. The device connects to the internet to show the performance of others, track the user's own progress, provide goals, and grant badges for hitting certain milestones (Tang &

Kay, 2014). Fitbit fosters relatedness through comparing and competing with others, and competency through tracking performance and awarding badges.

A similar approach is taken by Khan Academy, a website that offers online learning courses for a wide variety of topics. Users of the website can sign up for lessons or classes, and are awarded badges for completed courses and points for their performance. The points and badges promote a sense of competency that can lead to further user engagement (Sinha, 2012). Users may see that if they complete one more course they will earn a badge. Gaining this achievement can be enough for some users to return for another lesson. In getting the user to use the product more, additional opportunities to inspire further engagement are present and can be utilized.

Finally, a common workplace implementation of gamification is using leaderboards in a sales department. Numerous commercial examples exist, such as the popular software packages offered by Hoopla. Services like Hoopla utilize leaderboards and targeted salesperson-to-salesperson face-offs in order to foster competition between salespeople (Hoopla Sales Gamification, n.d.). Having direct feedback as to how one's sales are stacking up can increase a salesperson's motivation to perform for both professional reasons (praise from superiors, advancement opportunities, etc.) and for social reasons (satisfaction of being the best in one's own group; Callan, Bauer, & Landers, 2015).

Each of these companies has experienced great success with their gamified offerings. Though Khan Academy is a non-profit, their annual report indicates over eight million users each month (Khan Academy Annual Report, 2016). Hoopla boasts over 60 highprofile companies purchasing their services from LinkedIn to the Sacramento Kings (Featured Customers, n.d.). Fitbit has demonstrated the greatest financial success of the three, generating close to a billion dollars in revenue each of the past three years (MarketWatch, n.d.). Success in the aforementioned companies through using game elements to motivate sales or user engagement has only further motivated academic studies investigating the use of gamification. An overview of some of these gamification studies will be presented next.

Discussion of Gamification Research Approaches

As interest in gamification has grown in popularity over the past decade due to the success of products such as Fitbit and websites like Khan Academy, so has research investigating the source of that success. Hamari, Koivisto, and Sarsa (2014) conducted a literature review of empirical research involving gamification to summarize current findings. They found that gamification does tend to be an effective way to increase motivation, engagement, and enjoyment, reporting significant positive reactions in 15 of their included studies and descriptive statistics suggesting similar results in seven others (out of a total 24 studies utilized). However, the extent of their speculation as to why gamification worked in some cases and not others was limited to the context in which the gamification interventions were implemented. These contexts included work, education, and health, which all demonstrated varying levels of successful gamification (in that motivation, engagement, or enjoyment increased to some degree). They suggested that the type of gamification probably needed to match the context it was applied in, but did not offer any specifics and mentioned a need for future research exploring why gamification works.

Hamari, Koivisto, and Sarsa (2014) also noted a severe lack of proper empirical methods within the studies they found, stating that the work often lacked appropriate sample sizes, valid psychometric measurements, and control groups. These deficiencies will be explored in-depth in the next section.

As has been mentioned, researchers in this domain have also primarily focused on whether or not gamification works in a particular context without specifically identifying the underlying components responsible (e.g., Barata, Gama, Jorge, & Gonçalves, 2013). However, some studies have experimentally examined gamification's usefulness in educational, health, or commercial settings. A careful review of the extant literature suggests that the success of the gamification may hinge upon whether or not feelings of autonomy have been adequately promoted.

As an example, Barata, Gama, Jorge, and Gonçalves (2013) studied the effects of a gamified engineering course on college students. The students navigated through a skill development tree in which they could choose unique paths, complete assignments that earned them points and leveled them up, and have their progress tracked and ranked by a leaderboard. The points were used to compare students against their peers, while levels affected what assignments they had access to. The course supported autonomy through freedom of choice in how students progressed through the skill development tree. Compared to a non-gamified version of the course, the gamified version yielded higher levels of engagement (measured by activity on the student messaging forums) and mastery of the material by most students.

Tan, and Hew (2016) took a similar approach to gamifying a research methods course. Students in the course were split into experimental and control groups. Gamification of the research methods course included the use of points and badges that were awarded for completing course material, as well as leaderboards so that the students could track their performance against others and compete. Additionally, autonomy was supported by allowing students free choice of which lesson they wanted to complete within a particular group of lessons. Discussion forums were also included to facilitate communication between students (supporting needs for relatedness). Students in the experimental group showed better performance in the course, as well as more engagement with the discussion forums. Furthermore, all students in the experimental group reported that they found the course motivating, while only half in the control group did so.

In a healthcare setting, Peng, Lin, Pfeiffer, and Winn (2012), atypically for gamification research, experimentally manipulated autonomy in a gamified exercise application. The application either included or excluded autonomy-supportive features for two groups of participants. The autonomy-supportive features included options such as selecting where to spend skill points, customizable social interactions, and the ability to customize the aesthetics of their in-game persona. Results showed significantly more motivation and engagement for users in the autonomy-supportive condition. Giving users the ability to choose things as simple as how their character looked and where they would spend skill points yielded improvements in self-reported engagement, even in the absence of free choice of activity. This is especially notable because it indicates that autonomy support in some aspects of a game may overcome a lack of autonomy in other aspects of the game (e.g. all players were still constrained to do a particular set of tasks rather than choosing what they would like to do).

A similar finding outside of gamification that warrants mention occurred in a study of golf putting by Lewthwaite, Chiviacowsky, Drews, and Wulf (2015). Participants were either able to choose the color of their golf ball or required to use a white ball during a practice putting session, and then completed a test putting session 24 hours later (using only a white ball). Those who were able to choose the color of their ball during practice showed significantly better putting performance in their second session. Lewthwaite et al. (2015) argued that choosing the ball color facilitated autonomy and that increased feelings of autonomy may have increased participants' motivation to perform well. Importantly, they also showed that the autonomy components must be task-relevant. A second experiment tested people who were given the opportunity to choose how a room unrelated to the activity was decorated, and showed no significant improvement in their putting skills. This study is especially notable, as it demonstrates increases in task performance that seem to be a result of facilitating task-relevant autonomy.

Back in the health domain, Pramana et al. (2018) studied a gamified cognitive behavioral therapy (CBT) application aimed at treating anxiety in children. A gamified version of an existing app (SmartCAT) was produced and utilized by some children, while others used the non-gamified version. The gamified application added interactive games, challenges, cues to use CBT in real-world situations, points and trophies for successful real-world use and game performance, and a therapist to patient messaging system. Autonomy was supported, although weakly, by asking the participants to try to come up with their own coping methods and picking challenges with their therapist. This autonomy is slightly weaker than other implementations since the therapists aided children in setting challenges and the children were forced to come up with a new coping method whether or not they already had one that was working for them. The researchers indicated that participants used the gamified application for significantly more time, but the significance threshold was set at .1 rather than the traditional .05.

Kappen, Mirza-Babaei, and Nacke (2018) conducted another gamified health study that saw mixed results. They studied a gamified health application for older adults (50+) against a no-intervention control group, and a group that was given a step-counter with no supporting plan for use. The gamified health application offered points and badges for completed health challenges and supported autonomy by allowing participants to set their own goals. Results indicated that those in the gamified group felt significantly more highly motivated to exercise and competent in their exercises. Interestingly, the step-counter group showed the highest amount of perceived autonomy (significantly more so than the control group, and non-significantly higher than the gamified group). No significant increase in actual exercise was reported for the gamified group compared to the other two groups.

Another study that illustrates the importance of task-relevant autonomy in increasing motivation (as in Lewthwaite, Chiviacowsky, Drews, & Wulf, 2015) was Berkling and

Thomas (2013). Berkling and Thomas examined a gamified engineering course which included immediate feedback via points awarded upon completing a lesson, new levels of lessons that were unlocked after completing prior ones, customizable pathways to take through the course material, and leaderboards comparing student performance. The researchers found that students reported either not caring about the gamified elements or that the gamification was an active hindrance to learning. One major issue with this study could have been due to the fact that they attempted to facilitate autonomy by allowing students to choose which lectures they wanted to hear, but no matter what students chose, they still needed to attend all non-selected lectures as well. During the lectures they had not selected they were expected to work independently. Thus, the element meant to facilitate autonomy did not reflect a real choice that aided their education and was instead seen as obstructing learning. As a result of this, it seems likely that the choice was not seen as relevant to their task of learning engineering.

Ortiz-Rojas, Chiluiza, and Valcke (2017) was another study that involved gamifying a course for engineering students that was less successful. In their study, a computer programming class for engineering students was augmented with game elements for half of the students and left as it normally was for the other half. The gamification included badges and "meta-badges" (a badge for getting certain other badges) as well as optional activities that could be completed on a gamified coding website called Code-Academy. Results showed no significant difference in performance, self-efficacy, or intrinsic motivation, although gamification did appear to increase engagement. No attempts to facilitate autonomy appear to have been made within this experiment.

An additional less-successful implementation of gamification that did not support autonomy was the semester-long longitudinal study conducted by Hanus and Fox (2015). In this study, researchers compared a gamified version of a college elective class to a non-gamified version. In the gamified class students were introduced to systems of earning badges and coins, as well as a leaderboard that tracked their progress. Badges were awarded for certain activities related to education such as studying in groups at the library or turning in an assignment early. Coins were awarded for performing well in class and could be used to purchase other rewards such as deadline extensions. The two student groups were educated separately and were surveyed multiple times throughout the course to assess their satisfaction, performance, motivation, and empowerment. The results of this study did not support the use of gamification in education. No significant improvement in any of the measures was seen for the gamified group and, in fact, students were significantly less intrinsically motivated, significantly less satisfied, and performed slightly (but not significantly) worse in the gamified course (Hanus & Fox, 2015). Notably, no efforts were made to facilitate the students' sense of autonomy or to make the gamified elements seem task-relevant. In fact, students were even forced to earn a certain quota of badges before certain deadlines or face lower grades in the class. These badges were likely no longer seen as an achievement, but rather an additional assignment.

Taken together, these studies emphasize the need for autonomy-supportive game elements in gamification. Autonomy-supportive game elements enhance the participants' perception of free choice by increasing the amount of customization or choices of things like aesthetics or which activities to take part in (Barata, Gama, Jorge, & Gonçalves, 2013; Peng, Lin, Pfeiffer, & Winn, 2012). These game elements must also reflect real choices that are task-relevant (Berkling & Thomas, 2013; Lewthwaite, Chiviacowsky, Drews, & Wulf, 2015).

Deficiencies in the Literature

Hamari, Koivisto, and Sarsa (2014) brought up several recurring issues of improper empirical methods being utilized in gamification research. A review of the literature performed for this study confirms these issues. Studies such as Flatla et al. (2011) included only eleven participants. Ong, Chan, Cho, and Koh, (2013) utilized only a study of general opinions regarding hypothetical gamification of education as evidence of effectiveness. De-Marcos, Garcia-Cabot, and Garcia-Lopez (2017) lacked any sort of control group to compare performance levels against in their gamified e-learning course on communication technology. Pramana et al. (2018) utilized a .10 significance level to report their results on a gamified app to reduce anxiety in children. Though each of these studies reported some degree of success in their use of gamification, their findings may not be valid due to improper empirical methods.

Another deficiency in the current state of the research on gamification is that very little of it has been conducted using randomized experiments. Examining the few studies that used manipulations also reveals that they have been mostly focused upon the presence or absence of gamification as a whole, rather than establishing which particular elements of gamification lead to success (e.g. Hanus & Fox, 2015; Ortiz-Rojas, Chiluiza, & Valcke, 2017; Tan, & Hew, 2016) . This is a limitation in that these types of studies could conclude that gamification is not viable overall in a given domain, rather than concluding that the method of gamification was flawed. This is especially an issue in that many different types of gamification (several of which are described above) are utilized by researchers. Collapsing different types of gamification into one construct leaves the field without knowledge regarding why some gamification appears to work and some does not. Furthermore, without any manipulation of the gamification implementation itself, there is no way to know the cause of success or failure within one study.

It is also an issue that until recently, very few studies acknowledged the importance of facilitating autonomy within gamification. Of the recent gamification studies that do acknowledge the importance of autonomy, none of them singled out autonomy-supportive game elements for study aside from Peng, Lin, Pfeiffer, and Winn (2012). There is a need for future work that explores the link between autonomy and motivation. In the work that has manipulated autonomy-supportive game elements, there is also much room for expansion (Lewthwaite, Chiviacowsky, Drews, & Wulf, 2015; Peng, Lin, Pfeiffer, & Winn, 2012). Very little work has been done establishing what particular game features support autonomy, and although it has been demonstrated that custom aesthetic choices can improve performance in a golf putting activity (Lewthwaite, Chiviacowsky, Drews, & Wulf, 2015), this has yet to have been replicated in a video game or gamification scenario.

These are all gaps in the literature that could lead to important findings for improving gamification methods. In the classroom, gamified pedagogy could lead to higher student engagement and promote more intrinsic motivation to learn. In the market, products that generate more intrinsic motivation could inspire more use and generate more revenue.

Better gamification also has the potential to increase physical wellness as with products like Fitbit, or enhance e-learning through websites like Khan Academy.

Significance of the Study

The present research explored game elements that foster autonomy and examined their effects on participants. This work expands upon Lewthwaite, Chiviacowsky, Drews, and Wulf (2015) that demonstrates increased golf-putting performance in those who had feelings of autonomy promoted as compared to a control group. The present study replicated this concept within a video gaming context to contribute to knowledge regarding increasing perceived autonomy in gamified products. This work also examined whether increased autonomy was associated with increased engagement, enjoyment, and performance.

Expanding knowledge of autonomy-supportive features in games and gamification has widespread implications for developing improved gamified systems and video games. Knowing how to better support intrinsic motivation in users may be the key to developing a game or gamified application that successfully draws in new users and motivates them to keep using the product. Additionally, this line of research is important scientifically for illuminating underlying causes of intrinsic motivation within gamification. Understanding these causes could allow researchers to better facilitate intrinsic motivation. New data that connect the autonomy element of self-determination theory (Deci & Ryan, 1985) to objective performance in video games and gamification could also help to inspire more scientific experimentation in that area. It is important that studies move towards looking into *why* gamification works or not, rather than simply *whether* it works or not.

Experiment

The purpose of this study was to contribute knowledge regarding what game elements may be used to increase feelings of autonomy and performance and to determine whether increased autonomy was associated with higher engagement, enjoyment, and performance in users of games in a laboratory setting. Feelings of autonomy were conceptualized as Ryan and Deci (2000) describe them, as the feeling that one has free will in making choices and acting upon them. These feelings were measured as perceived autonomy using a portion of the Player Experience of Need Satisfaction (PENS) scale created by Rigby and Ryan (2007). For this experiment, autonomy-supportive features were explored in the pre-existing game, Super Mario Bros. Crossover (Pavlina, 2013). Since game elements in gamification are thought to increase motivation in the same way that video games do (Hamari, Koivisto, & Sarsa 2014), results from this approach should be applicable to both domains.

Participants were placed in scenarios in which they either did or did not have the ability to customize the aesthetics of their character and their surroundings. The ability to choose aesthetics is a task-relevant and autonomy-supportive aspect of the proposed conditions since it increases the freedom of choice available in the central task of the experiment. The decision to use this type of manipulation was inspired by its use in a golf-putting activity by Lewthwaite, Chiviacowsky, Drews, and Wulf (2015), in which choosing ball color increased subsequent putting performance.

In this study, performance refers to how well participants score in the available game, and was measured via their score recorded by screen capture software. Engagement refers to a participant's desire to continue play, and enjoyment refers their subjective evaluation of the game. Enjoyment, engagement, and perceived autonomy were assessed via self-report surveys. A visual depiction of the variables discussed is included in Figure 3.

Research Questions and Hypotheses

There are two main categories of questions in this study. Does the ability to customize aesthetics increase performance and perceived autonomy? Furthermore, will increased feelings of autonomy be associated with increases in engagement, enjoyment, or performance? Hypotheses for these research questions are as follows:

H1. The ability to customize aesthetics will increase perceived autonomy.

H2. The ability to customize aesthetics will increase performance.

H3. Increased perceived autonomy will be related to increased engagement.

H4. Increased perceived autonomy will be related to increased enjoyment.

H5. Increased perceived autonomy will be related to increased performance.

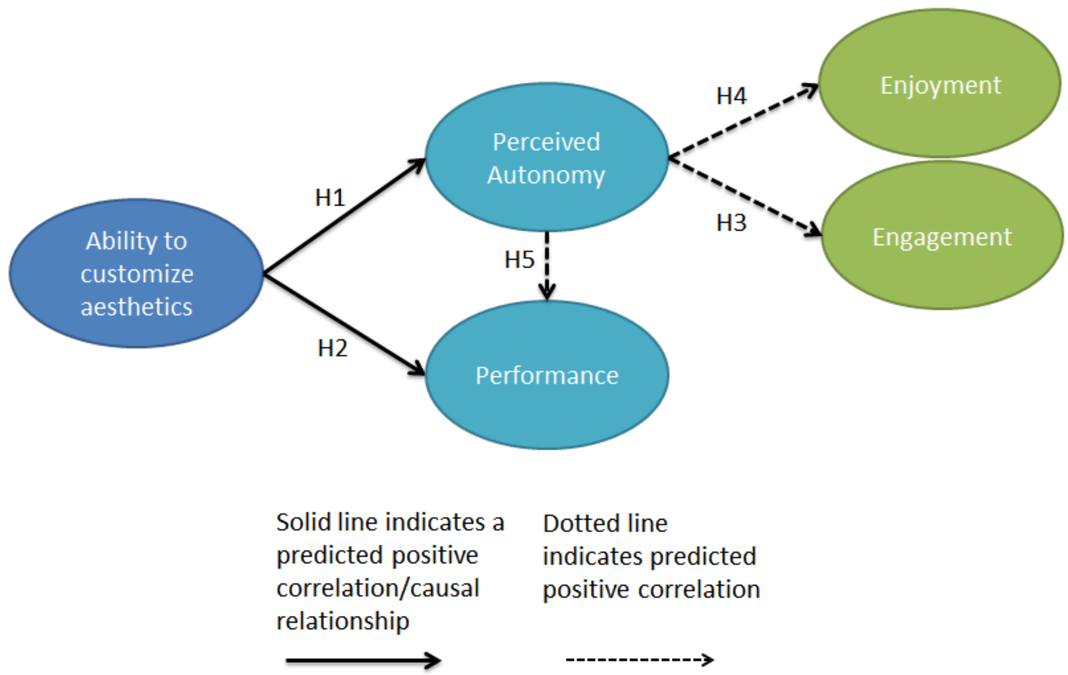

Figure 3. Visual Model of Relationship Between Variables. Ability to customize aesthetics is expected to increase performance and levels of perceived autonomy. Levels of perceived autonomy are expected to correlate positively with performance, enjoyment, and engagement.

Methods

Participants and setting. Participants were college students from San José State University who were recruited through the SONA system and offered course credit for participation. They played a simple video game, Super Mario Bros. Crossover (see Figures 4-7), on a computer. The game featured easily graspable concepts so that users were able to play even if they had no gaming experience. The game was also selected because it features no bright flashing lights that could pose a seizure risk. Based on medium effect sizes in Peng, Lin, Pfeiffer, and Winn (2012), a power analysis for an analysis of covariance (ANCOVA) was conducted using G*power with $1 - \beta = .95$ and $\alpha = .05$, yielding a recommended sample size of $N = 54$. In order to compensate for any technical failures or attrition, 63 participants were recruited. Six participants' data were unusable either due to technical errors or incomplete surveys; thus, the total participants for the study was *N* = 57. Four users were excluded due to technical errors that occurred, and two users were excluded who failed to answer several survey questions.

Four additional participants failed to answer one question each. No participant missed the same question, and each was part of a larger question set that was to be averaged for a total score of either engagement or enjoyment. Losing these users would have resulted in an under-powered experiment, and therefore the missing value from each user was replaced with the average value from the rest of the questions in that category for that play session as was performed in Friborg, Martinussen, and Rosenvinge (2006).

Of the included participants, 21 were male and 26 were female. Ages ranged from 18 to 38, though most fell in the 18 to 22 range (*M* = 19.96, *SD* = 3.28) as was to be expected with an undergraduate college sample. Responses regarding self-assessment of experience Super Mario Bros. games (*M* = 4.89, *SD* = 1.22) and with video games in general (*M* = 4.32, *SD* = 1.49) were reported to be close to the midpoint of a seven-point Likert-type scale, indicating that most felt they had an intermediate amount of experience with each, though slightly more so with Super Mario Bros. General video game experience and Super Mario Bros. experience responses were unimodal and close to normally distributed.

The experiment took place in the Learning, Attention, Vision, and Application (LAVA) Lab at San José State University and each session lasted approximately one hour. The participants were subjected to minimal risk, as the activity only involved playing video games and filling out a survey which collected no personally identifiable information. The study was approved by the San Jose State University Intsitutional Review Board.

Figure 4. Super Mario Bros. Crossover Menu Screen. The game is a copy of the first Super Mario Bros. game from the Nintendo Entertainment System, but with characters from other Nintendo games available to play.

Figure 5. All playable characters other than Simon Belmont were hidden in order to ensure players all played under consistent conditions.

Figure 6. Each playable character has many different costume choices available.

Figure 7. Background aesthetics may also be changed.

Materials. Participants were tested on one of three Mac Mini computers connected to identical 23-inch Dell P2317H monitors at 1024 x 1200 pixel resolution running at 60 Hz and Apple extended keyboards. The computer specifications were as follows:

1. A Mac Mini with a 2.3 GHz CPU Intel Core I5, 4 Gb RAM, and Intel Graphics 3000 running Mac OS Sierra 10.12.3.

2. Two Mac Minis with a 1.4 GHz CPU Intel Core I5, 4 Gb RAM, and Intel Graphics 5000 running Mac OS Sierra 10.12.3.

Participants played Super Mario Bros. Crossover (Pavlina, 2013). The game was accessed via the Google Chrome web browser (Version 61.0.3163.100). Super Mario Bros. Crossover required very little processing power, such that slightly different computer specifications made no difference in gameplay. Participants played the game using a wired Xbox 360 controller plugged into the computer. Gameplay was captured using Quicktime (Version 10.4) screen capture. This screen capture software was tested alongside the game and was found to run without issue on the available systems. In between play sessions, participants completed Qualtrics surveys, also using the Google Chrome web browser. Paper instructions for the participants' condition and general gameplay were present at all times on the table next to the computer. Participants read the instructions before participating and confirmed that they understood how to play and what they were doing.

Design. The experiment was conducted as a one-way within-subjects design comparing participants' scores in two main dependent variables (performance and perceived autonomy) at two levels of one independent variable (aesthetic choice or no aesthetic choice). This within-subjects design was necessary to allow for the differing skill levels present in each player. Correlations between four dependent variables were also examined (perceived autonomy, enjoyment, engagement, and performance).

The independent variable, autonomy, had the following levels: no aesthetic choices, and aesthetic choices. Participants were randomly assigned into one of two counterbalanced conditions (no aesthetic choices first or no aesthetic choices second), varying the order in which they experienced autonomy during gameplay. This variable involved the presence or absence of the ability to customize the aesthetics of the playable character and the level background. Choice of aesthetics was autonomy-supportive, while being unable to make such choices was not.

Variables and measures. The primary dependent variables were perceived autonomy and performance. Perceived autonomy was measured with the perceived autonomy portion of the Player Experience of Need Satisfaction (PENS) scale created by Rigby and Ryan (2007). The portion of the PENS scale that was used consists of five Likert-type questions with seven possible answers ranging from "Strongly Disagree" to "Strongly Agree." This scale was chosen for use due to more evidence of validation by Rigby and Ryan as compared to the original self-determination scale created by Sheldon and Deci (1996) that the PENS took inspiration from. The PENS scale was created by one of the authors of the original works on self-determination theory and has been used in many other studies as the standard way of measuring self-determination theory's three factors (relatedness, autonomy, and competence). Using this scale served as a manipulation check to confirm whether or not the conditions in the study truly manipulated feelings of autonomy.

Performance was measured through scores obtained in the game, and was recorded via Quicktime (Version 10.4) screen capture software. Two questions were also included in the surveys asking the participants' experience with classic Super Mario Bros. games and their experience with video games in general to check for covariate effects of their video game experience. These questions were answered via a seven-point Likert-type scale ranging from "No experience" to "Expert". Performance was compared at each level of IV to see if the ability to choose aesthetics significantly affects performance. Levels of performance were then compared to levels of perceived autonomy to see if higher levels of perceived autonomy were associated with better game performance.

Additionally, secondary dependent variables were enjoyment and engagement, and they were measured by the Game User Experience Satisfaction Scale (GUESS) developed by Phan, Keebler, and Chaparro (2016). The enjoyment and engagement portions of this scale that were used consist of five Likert-type questions regarding enjoyment and seven Likert-type questions regarding engagement with answers ranging from "Strongly Disagree" to "Strongly Agree". The GUESS was developed to measure user experience in video games. Although the scale is rather new, Phan, Keebler, and Chaparro tested its reliability, reporting Cronbach's alphas exceeding .7 for all factors included, with most exceeding .8. They also confirmed its content validity by consulting experts in the field of video games. The GUESS scale together with the PENS scale allow for examination of how enjoyment and engagement vary at differing levels of perceived autonomy.

Procedure. Participants were welcomed into the lab and given a seat at a desk with a computer. They were provided with an informed consent form to read over and sign before proceeding. Participants were given paper instructions regarding how to play the game, and the computers had screen capture software running. Instructions included how to play and encouraged users to score as many points as possible by destroying enemies, collecting pickups, and completing levels. Participants were given a three-minute practice period to test out the controls of the game to make sure they understood how to play.

Next, participants were either instructed to explore the different aesthetic choices available for their character and background, or told to choose the default option. Participants were constrained to one character so that the game experience was constant between all participants. All other character choices were hidden from the menu. They then played the game for five minutes. After the gameplay session, the participant was guided to a Qualtrics survey that contains the GUESS, the PENS scale, and video game experience questions. After they completed the survey, the participant was directed back to the game to repeat this process in the other condition (with the exception of being asked about their video game experience). After the repeated questions they answered two basic demographic questions indicating age and gender identity. Once the final survey was complete, the participant was debriefed and dismissed.

Data preparation. After data collection concluded, the gameplay videos were examined and scores were recorded by four researchers independently. The four researchers made sure that each score was calculated by at least two people independently, and any discrepancies were reexamined until resolved by both parties. Participants were required to play for the full five minutes of the test session whether they encountered a "Game Over" (when losing all available lives during gameplay) or not, and the score returned to zero after a Game Over. For this reason, scores immediately prior to any Game Over screen were added to the final score. Super Mario Bros. Crossover also features bonus points awarded at the end of each level based on time remaining in addition to a random bonus based on the digit the counter ended on. These bonuses had to be subtracted from the total score of each participant, yielding a "net score" for that play session. Bonus scores were not included due to the somewhat random nature in which they were awarded in an effort to focus more heavily on gameplay performance alone.

Survey data were collected by Qualtrics and displayed by gameplay session. Scores in question sets for engagement, enjoyment, and perceived autonomy were averaged within their set to yield one average score per construct per session for each participant.

During the first few days of data collection, it was not anticipated that users would fail to answer survey questions, and after this was observed an option was enabled in Qualtrics that did not allow users to proceed from the survey until all questions were answered.

Statistical Analyses. To assess perceived autonomy levels, a one-way, within-subjects analysis of covariance (ANCOVA) was conducted to compare each averaged value of perceived autonomy while able to customize aesthetics to their averaged value of perceived autonomy with no ability to customize aesthetics while also controlling for Super Mario Bros. experience and general video game experience. The same statistical test was used to assess performance levels. A one-way, within-subjects analysis of covariance (ANCOVA) was conducted to compare each participant's net score while able to customize aesthetics to their net score with no ability to customize aesthetics while also controlling for Super Mario Bros. experience and general video game experience. To explore whether increases in perceived autonomy would be related to increases in engagement, enjoyment, and performance, a correlation matrix was generated (See Table 1) to compare correlations of all relevant variables.

Results

Hypotheses 1 and 2

It was hypothesized that the ability to customize the aesthetics of a playable character and background of Super Mario Bros. Crossover while controlling for Super Mario Bros. experience and video game experience in general would result in a significant increase in both performance and perceived autonomy.

No significant difference in perceived autonomy was found ($F(1, 54) = 0.05$, $p = .82$). Therefore Hypothesis 1, that perceived autonomy would be significantly higher in the autonomy-supportive condition (choice of aesthetics), was not supported. Comparing means of perceived autonomy in the autonomy-supportive condition ($M = 5.26$, $SD = 0.80$) to perceived autonomy in the non-supportive condition ($M = 5.08$, $SD = 0.90$) shows that although slightly more autonomy seems to have been perceived in the autonomy-supportive condition, the two conditions were not significantly different (See Figure 8).

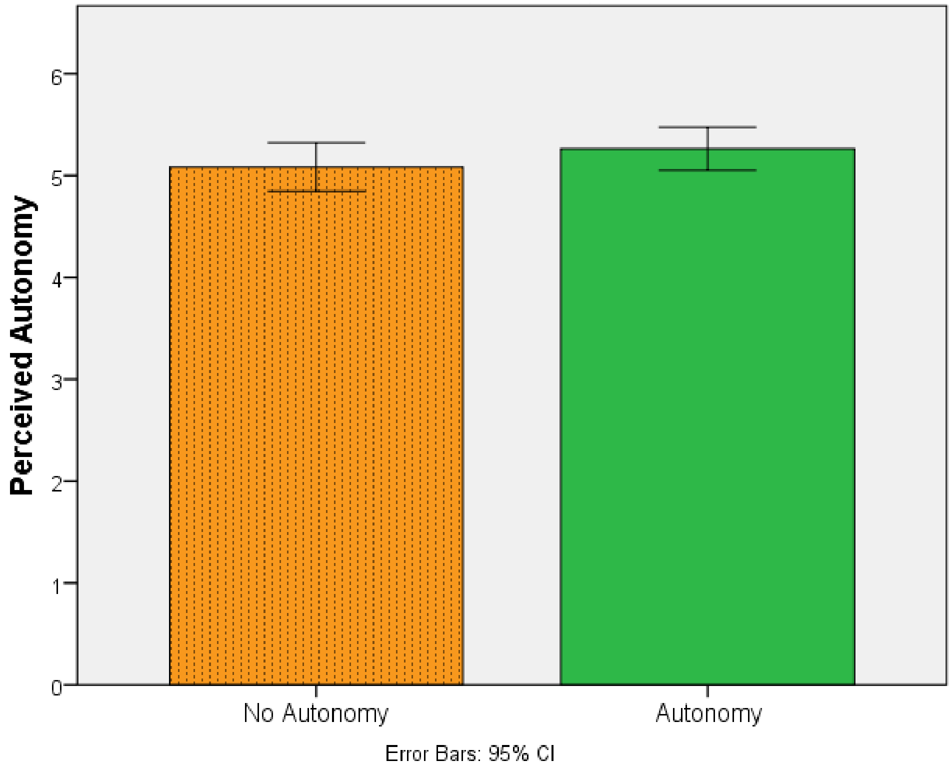

Figure 8. Mean perceived autonomy scores compared between conditions.

No significant difference in performance was found ($F(1, 54) = 1.41$, $p = .24$). Therefore, Hypothesis 2, that performance would be significantly higher in the autonomy-supportive condition (choice of aesthetics), was not supported. Comparing means of performance in the autonomy-supportive condition (M = 21904.39, SD = 9214.98) to performance in the non-supportive condition (M = 22361.40, SD = 9338.23) reveals they are nearly identical, with the non-supportive condition being slightly higher (See Figure 9).

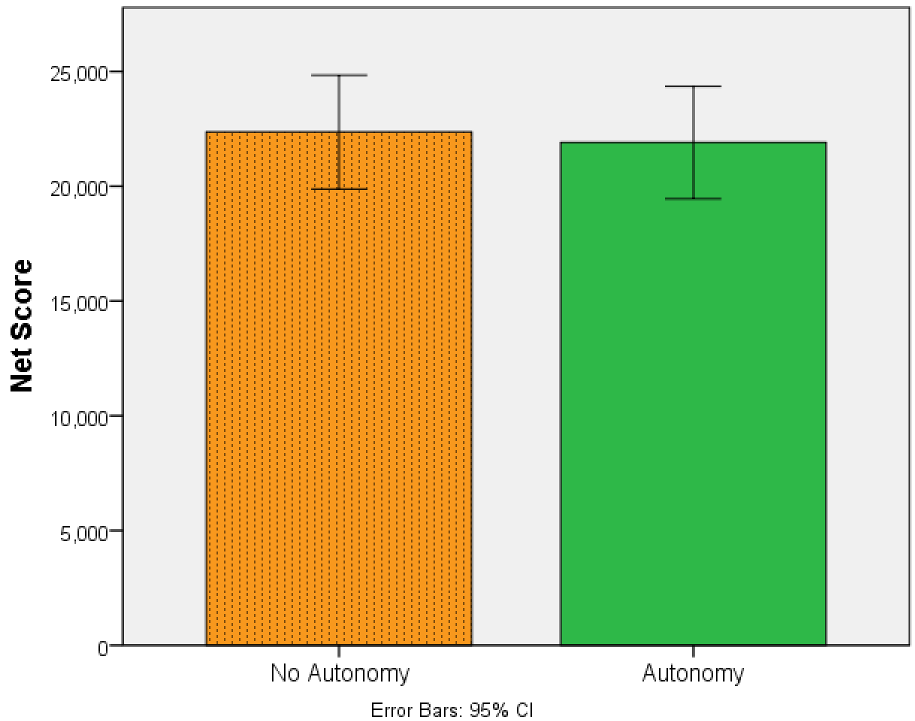

Figure 9. Mean net scores compared between conditions.

Table 1

Pearson Correlations of Variables (N = 57).

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Net Score - A	--									
2. Net Score - N	.68 ***	--								
3. Perceived Autonomy - A	.03	-.01	--							
4. Perceived Autonomy - N	.03	-.06	-.58 ***	--						
5. Engagement - A	-.08	-.17	.13	.17	--					
6. Engagement - N	-.14	-.16	.17	.26 *	.84 ***	--				
7. Enjoyment - A	.06	.10	.54 ***	.37 **	.37 **	.38 **	--			
8. Enjoyment - N	-.03	-.06	.55 ***	.47 ***	.43 **	.52 ***	.87 ***	--		
9. Super Mario Bros. Experience	.21	.36 **	.40 **	.26	-.14	-.11	.34 **	.24	--	
10. Video Game Experience	.32 *	.34 **	.19	.18	-.06	-.06	.18	.10	.37 **	--

A - Choice of Aesthetics
N - No Choice of Aesthetics

* p < .05 ** p < .01 *** p < .001

Hypotheses 3, 4, and 5

The secondary hypotheses in this experiment predicted that increases in perceived autonomy would be related to increases in engagement, enjoyment, and performance. In the autonomy-supportive condition (choice of aesthetics), perceived autonomy was found to be significantly positively correlated with enjoyment ($r = .54$, $p < .001$) but not with engagement ($r = .13$, $p = .35$). However, in the condition in which autonomy was not supported, perceived autonomy was significantly positively related to both enjoyment ($r = .47$, $p < .001$) and engagement ($r = .26$, $p = .05$). These results indicate that no matter what the condition, those who perceived more autonomy also indicated that they enjoyed the game more. Hypothesis 4 is supported by the data. Results were mixed when relating perceived autonomy to engagement. Only those in the no autonomy support condition seemed to be more engaged when they perceived more autonomy, so Hypothesis 3 is only partially supported. No significant results occurred when checking correlations between perceived autonomy and performance (all *p*s > .05), so Hypothesis 5 was not supported by the data.

Unplanned Analyses

A few other significant correlations were present that were not specifically predicted by the hypotheses. Video game experience was significantly positively correlated with performance in both the autonomy-supportive condition ($r = .32$, $p = .02$) and the non-supportive condition ($r = .34$, $p = .009$). This makes sense, as those with more video game experience should tend to have better performance in a video game. Experience with Super Mario Bros. games, however, was only significantly positively correlated with performance in the non-supportive condition (*r* = .36, *p* = .005). So, it seems that more experience with Super Mario Bros. games only sometimes was associated with higher performance in this sample.

Most notably, however, Super Mario Bros. experience was significantly positively correlated with perceived autonomy in the autonomy-supportive condition (*r* = .40, *p* = .002). It appears that the more people were familiar with Super Mario Bros. in general, the more autonomy they felt in the autonomy-supportive condition. Super Mario Bros. experience was not significantly correlated to perceived autonomy in the non-supportive condition.

Discussion

This experiment involved participants playing a video game (Super Mario Bros. Crossover) in which levels of autonomy were manipulated by altering whether or not choices of aesthetics were offered to the participants in a similar manner to Lewthwaite, Chiviacowsky, Drews, and Wulf (2015). This research was aimed at expanding knowledge regarding game elements that may be utilized to increase perceived autonomy. Furthermore, the work sought to confirm associations between perceived autonomy and performance, engagement, and enjoyment.

Hypotheses 1, 2, and 5

H1. The ability to customize aesthetics will increase perceived autonomy.

H2. The ability to customize aesthetics will increase performance.

H5. Increased perceived autonomy will be related to increased performance.

Hypotheses 1 and 2, predicting that the choice of aesthetics manipulation would lead to increased perceived autonomy and performance, were not supported by the data, which could have occurred for a variety of reasons. Although the choice of aesthetics manipulation was very similar to the choice of golf ball color in Lewthwaite, Chiviacowsky, Drews, and Wulf (2015) which yielded better performance, the present manipulation was much more complex. The different costumes available had completely different looks in addition to color-swapping, and the change of background aesthetics was similarly intricate. It is possible that this level of complexity was frustrating to users, since they were presented with many different choices. Additionally, Lewthwaite, Chiviacowsky, Drews, and Wulf (2015) utilized their manipulation during a training session 24 hours before a test session that had no manipulation, whereas all play sessions in the present experiment took place over the span of an hour. It could be that some sort of delay between the manipulation and the test session is necessary to see any effect.

However, it is also worth noting that Hypothesis 5, predicting a correlation between perceived autonomy and performance, was also not supported by the data. This result suggests that even those who did perceive more autonomy did not tend to perform significantly better at the game. Therefore, it is possible that even if the manipulation promoted higher perceived autonomy, there still would have been no significant increase in performance. It is possible that Super Mario Bros. Crossover, in general, is too complicated to yield the same result as a golf putting task.

It could also be the case that the questionnaire utilized in this experiment to assess perceived autonomy was not sufficient for this application. Lewthwaite, Chiviacowsky, Drews, and Wulf (2015) did not use such a questionnaire, instead basing their assessment of increased autonomy in their experiment on the fact that more choices were available in the autonomy-supportive condition. In light of the results from the current experiment, it is possible that autonomy was not facilitated at all in Lewthwaite, Chiviacowsky, Drews, and Wulf (2015) and that their increases in performance were due to another factor.

Hypotheses 3 and 4

H3. Increased perceived autonomy will be related to increased engagement.

H4. Increased perceived autonomy will be related to increased enjoyment.

Hypothesis 3 was partially supported by the data, as there was only a significant positive relationship between engagement and perceived autonomy in the non-autonomy supportive condition. This could mean that there is only a weak relationship between the two, or possibly that no relationship existed at all and the significant result occurred by chance. It is also possible that some other factor was more influential on engagement, so much so that the effects of perceived autonomy were overpowered. Notably, engagement was correlated with enjoyment both in the autonomy supportive ($r = .37$, $p = .005$) and non-supportive conditions ($r = .52$, $p < .001$). It could be that the perceived autonomy scale had enough overlap with enjoyment that results tended to correlate but that it is not a great scale for perceived autonomy alone.

Hypothesis 4 was fully supported by the data, indicating that the more people tended to perceive autonomy within the experiment, the more they enjoyed the game. This supports work by Ryan and Deci (2000), which states that there should be an association between the two. Since this association has been observed, the data seem to suggest that the questionnaire did have some success in assessing perceived autonomy. Taking this into account, it seems more likely that the manipulation that was used did not show an increase in perceived autonomy due to the manipulation being too weak.

Unplanned Analyses

The only other notable result discovered during analyses was that more Super Mario Bros. experience tended to be associated with higher perceived autonomy in the autonomy-supportive condition. This result could suggest that in order to fully appreciate the level of freedom of choice that one had within the experiment, one needed a certain baseline amount of knowledge of the original game. It is possible that those who did not know the Super Mario franchise well had no frame of reference for how much choice they were being granted, and thus the manipulation did not work well on them. Additionally, if the number of selections available was excessive enough to be viewed as frustrating or overwhelming, it is possible that having more experience with Super Mario Bros. might have mitigated overwhelming feelings. Players who were already experienced with the game were in less of a new situation and might have been able to experience the new options more favorably.

Limitations

This experiment had several limitations. First and foremost, the experimental procedure from Lewthwaite, Chiviacowsky, Drews, and Wulf (2015) involving a practice session followed by a test session the next day was not able to be replicated. This delay could have been a key reason for why the manipulation worked in that experiment and not this one. Another limitation was that the survey questions for perceived autonomy came from a different set than the questions for engagement and enjoyment and less academic work assessing its reliability and validity has been published (though it is commonly used). Last, the game may have been too complex for use in such a short amount of time. Though many participants were familiar with the Super Mario Bros. franchise, it is undoubtedly more complicated to play than a simple putting activity. It is possible that the numerous game features added too much complexity to the experiment such that results had less to do with the manipulation and more with the participant's individual reactions to the game.

General Discussion and Future Research

Choice of aesthetics alone as a manipulation in a video game such as Super Mario Bros. Crossover did not appear to make a significant difference in performance or perceived autonomy. Future research might attempt to look into what other game features can better facilitate perceived autonomy. It could be that the same experimental design but with a simpler game might yield more significant results as well, since it might allow the participants to focus more heavily on the manipulation that is present.

Additionally, the lack of significant results could have also been due to an issue with the perceived autonomy scale. The scale did appear to be acceptably reliable ($\alpha = .72$). However, if the scale were not properly measuring perceived autonomy, it would make sense that no association was seen with performance or the autonomy manipulation. Though the items (which cannot be discussed explicitly in this work as they are the intellectual property of Immersyve Inc.) in the scale do target specific themes of autonomy and freedom of choice, several questions seem very similar to those that would measure enjoyment as well. Questions often refer to how "interesting" the game was, and it seems likely that anyone who enjoyed the game would have reported it to be interesting. It would be beneficial if a more extensive perceived autonomy scale were to be validated for use in video game and gamification contexts that better differentiates itself and isolates autonomy-related questions.

The data also indicate that perceived autonomy was not significantly correlated with performance, only partly correlated with engagement, and correlated with enjoyment. Each of the correlations was expected to be significantly positive based on Ryan and Deci (2000). The mixed results further suggest the need for research involved in developing an updated perceived autonomy scale.

An unexpected finding was that Super Mario Bros. experience was observed to positively correlate with perceived autonomy in the autonomy-supportive condition. This may suggest that in order to perceive full freedom of choice, one needs a certain amount of experience in a given context. More research assessing relationships between perceived autonomy and experience using a game or gamified product could be useful to establish what other factors contribute to perceived autonomy in general. Perhaps things as simple as tutorials explaining how to better interact with a game or product could be useful in promoting feelings of autonomy along with engagement and enjoyment.

While the present results mostly did not support the hypotheses put forth in this experiment, they do open up many interesting new questions that can be asked. What other game elements might better facilitate autonomy? How could the validity of the perceived autonomy scale be improved? Is experience within a gamified product positively correlated with the perceived autonomy associated with that product? What sort of results may come from studying competency-supportive and relatedness-supportive game elements in a similar manner to the present work?

Research on gamification is still young, and these questions are important in moving towards a more systematic understanding of how gamification works. Further research explaining how to better measure and harness autonomy could be that important first push towards a better overall understanding of how to motivate people in an enjoyable way.

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Appendix A

Consent Form

Agreement to Participate in Research

San José State UNIVERSITY

Department of Psychology
DMH 157
One Washington Square
San Jose, CA 95192-1020
Voice: 408-924-5600
Fax: 408-924-5605
www.psych.sjsu.edu

Responsible Investigator(s): Dr. Evan Palmer
Title of Protocol: Reactions to a Retro Video Game

1. You have been asked to participate in a research study investigating reactions to playing a video game.

2. You will be asked to play a video game on the computer and share your opinions after each play session. The study will last approximately one hour and will be done in Hugh Gillis Hall 242 or 244.

3. This study presents no more than minimal risks of fatigue and eye strain.

4. You will receive no direct benefits from participating in this study.

5. Although the results of this study may be published, no information that could identify you will be included.

6. Students in the psychology research subject pool will receive partial credit towards their Psychology class even if they decide to withdraw or otherwise not complete the study. No other compensation is provided for participation in this study.

7. Questions about this research may be addressed to Dr. Evan Palmer (Assistant Professor, Department of Psychology, SJSU) at 408-924-5620. Complaints about the research may be presented to Dr. Ron Rogers (Chair, Department of Psychology, SJSU) at (408) 924-5547. Questions about a research subjects' rights, or research-related injury may be presented to Pamela Stacks, Ph.D., Associate Vice President, Graduate Studies and Research, at (408) 924-2427.

8. No service of any kind, to which you are otherwise entitled, will be lost or jeopardized if you choose not to participate in the study.

9. Your consent is being given voluntarily. You may refuse to participate in the entire study or in any part of the study. If you decide to participate in the study, you are free to withdraw at any time without any negative effect on your relations with San Jose State University.

10. At the time that you sign this consent form, you will receive a copy of it for your records, signed and dated by the investigator.

The signature of a subject on this document indicates agreement to participate in the study.

The signature of a researcher on this document indicates agreement to include the above named subject in the research and attestation that the subject has been fully informed of his or her rights.

______________________________ ____________
Signature Date

______________________________ ____________
Investigator's Signature Date

The California State University:
Chancellor's Office
Bakersfield, Channel Islands, Chico
Dominguez Hills, East Bay, Fresno,
Fullerton, Humboldt, Long Beach,
Los Angeles, Maritime Academy,
Monterey Bay, Northridge, Pomona
Sacramento, San Bernardino, San Diego,
San Francisco, San Jose, San Luis Obispo,
San Marcos, Sonoma, Stanislaus

Appendix B

Introduction and Instructions

Playing Super Mario as Different Video Game Characters

In this game you will play as characters other than Mario. Normally Mario will kill enemies by jumping on them, however if you play as different character, you will need to kill enemies as they do in their game. Link uses his sword, Samus her arm cannon, and Simon his whip.

This can be a little tough to remember if you're an experienced Mario player. Jumping on enemies will no longer kill them as other characters, it will damage you!

Attacking
Playing as another character like Simon involves using his whip. However, most enemies in Super Mario are too short to be killed unless Simon ducks before attacking.

To do this, hold down on the left stick, then press X to attack the enemy.

Special Abilities
Some characters also have special abilities that can be used by pressing B or Y.

For Example: Simon will throw an axe that can break blocks and kill enemies, but only if he has enough hearts as indicated in the top left of the screen.

Jumping
Pressing A will trigger a jump. Characters also jump as they would in their own game.

For Example: Simon can double jump by pressing A, and then A again in the middle of the previous jump.

Details on the controls and practice instructions follow in the next page.

Practice Instructions

If you are not familiar with how Super Mario games are played, please refer to the next page entitled "Super Mario Basics". If you feel up to speed, continue with the practice activity here.

For practice, you'll be playing as Simon from the Castlevania game series.

During this round, you'll be playing with his first costume selection, so make sure your cursor is there.

(Let the experimenter know if you have any trouble with this)

Take a few minutes now to play the game and experiment with the controls listed below. The experimenter will let you know when to stop.

A diagram is shown to the right, and only relevant buttons are labeled.

Left Stick: Navigate menus and move your character.

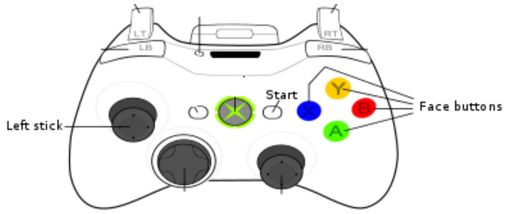
Start: Pause Game, Select Menu Item

Face Button A: Jump/Select Menu Item (hold to jump higher)

Face Button X: Attack in Game/Back in Menu

Face Button B: Secondary attack (not all characters have this)

Face Button Y: Extra ability (not all characters have this)

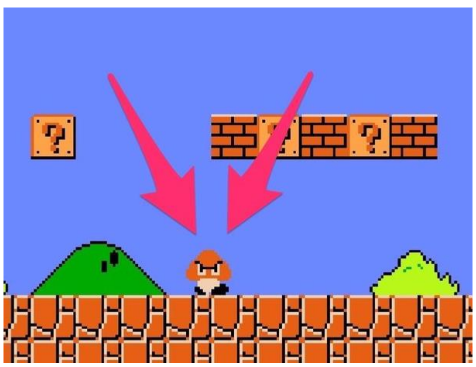


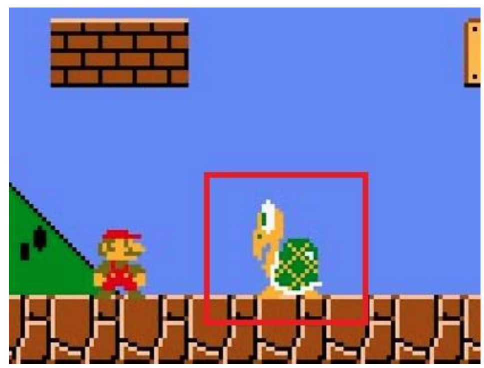
Super Mario Bros Basics

Welcome to Super Mario Bros Crossover!
In this game you will be playing classic Super Mario levels but as different Nintendo characters.

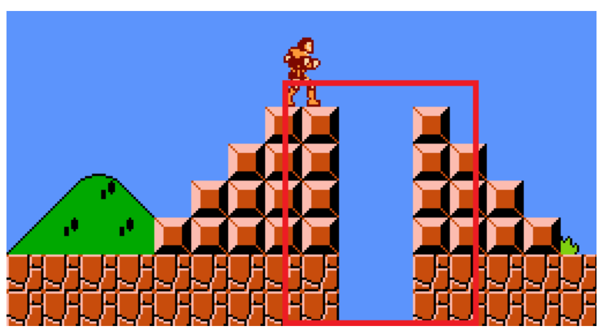
The game concepts are all similar to Super Mario:

1: Don't get hit by enemies.

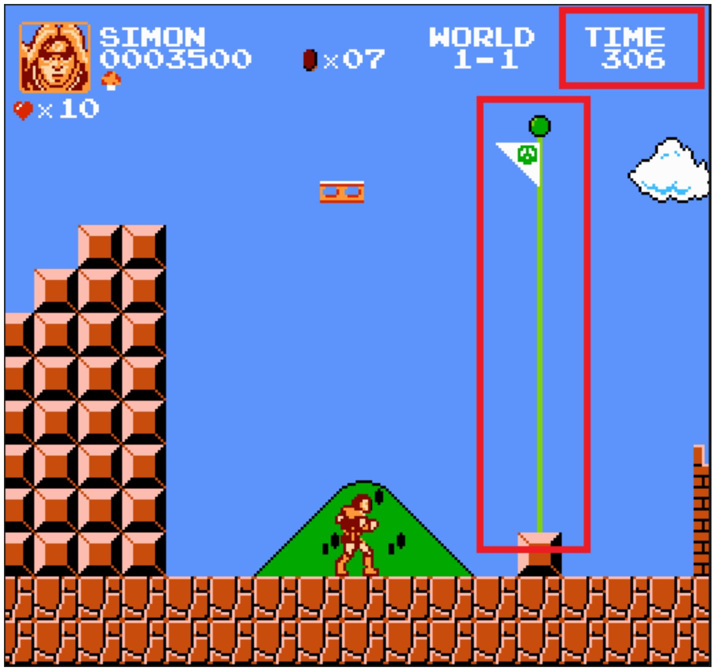




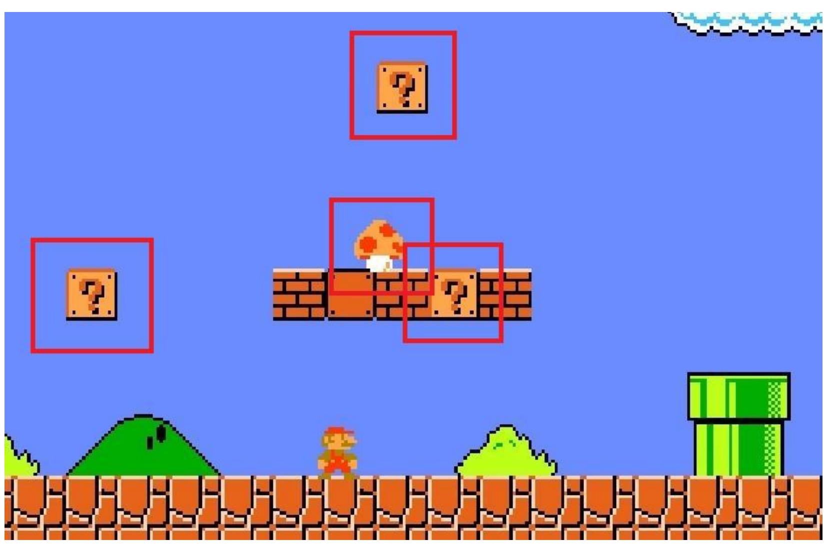
2. Don't fall down the pits. You'll die.



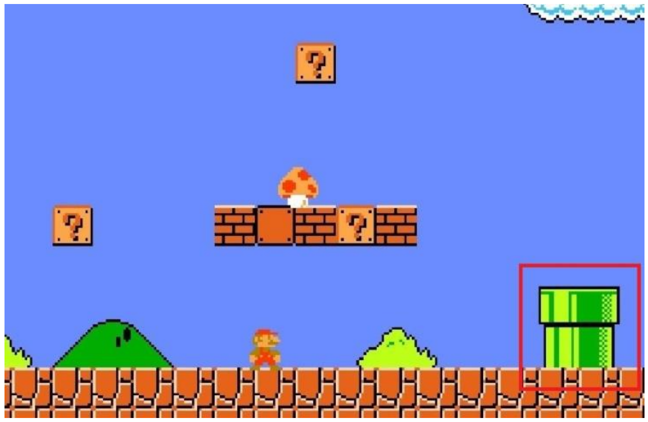
3. Get to the end of the stage and jump on the flagpole before the timer reaches 0. The higher you grab it, the more points you receive.



4. Jump up into blocks to break them or knock out coins, stars, flowers, and mushrooms. Collect (run into them) these for points and powerups!



5. Some of the green pipes can be entered by standing on top of them and pressing down using the left stick, or jumping up towards them and pressing up (if they are upside-down)



Appendix C

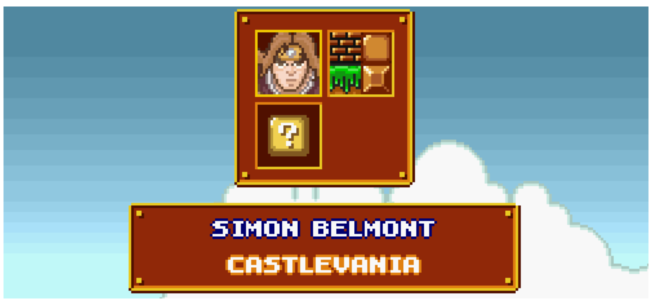
Condition-Specific Instructions

Reactions to a Retro Video Game Condition 1

Welcome to Super Mario Bros. Crossover!

You will be playing this game for a few rounds as part of the experiment today. Each round will have different conditions that you will play under.

During this round, you'll be playing as Simon from the Castlevania game series!



(Let the experimenter know if you have any trouble navigating this menu)

Read ahead and follow instructions, but do not proceed with the next selection until the experimenter instructs you to do so.

During this round, you'll be playing with his first costume selection, so leave your cursor there.

(Let the experimenter know when you have done this)

When the experimenter tells you to commence play, you will have five minutes. Try to earn as many points as you can! If you lose all of your lives, no problem, just select "Yes" when asked if you would like to continue. Please keep playing for the entire time the experimenter allows, and let them know if you run into any issues.

Reactions to a Retro Video Game Condition 2

Welcome to Super Mario Bros. Crossover!

You will be playing this game for a few rounds as part of the experiment today. Each round will have different conditions that you will play under.

During this round, you'll have the ability to customize the graphics of the level you'll be playing. The top right selection in the character select screen allows you to change this.

Try a few selections and find one that you like. Tell the experimenter when you have made your choice.

(Let the experimenter know if you have any trouble finding this option)

Read ahead and follow instructions, but do not select your final character until the experimenter instructs you to do so.

This time, you will be playing as one of the characters from Castlevania or River City Ransom series! You can find all of these characters under the "Simon" selection in the character selection screen. You may explore the available characters now, but do not actually select anyone until the experimenter has instructed you to do so.

(Let the experimenter know if you have any trouble finding this selection)

Let the experimenter know when you have settled on a character.

When the experimenter tells you to commence play, you will have five minutes. Try to earn as many points as you can! If you lose all of your lives, no problem, just select "Yes" when asked if you would like to continue. Please keep playing for the entire time the experimenter allows, and let them know if you run into any issues.

Appendix D

Engagement, Enjoyment, and Perceived Autonomy Survey

(Note that five questions are redacted due to being copyrighted by Immersyve Inc.)

Reactions to a Retro Video Game

Ask the experimenter to enter your unique user ID.

Please indicate how much you agree or disagree with the following statements.

[redacted]

Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
O	O	O	O	O	O	O

[redacted]

Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
O	O	O	O	O	O	O

[redacted]

Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
O	O	O	O	O	O	O

[redacted]

Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
O	O	O	O	O	O	O

[redacted]

Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

I felt detached from the outside world while playing the game.

Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

I did not care to check events that are happening in the real world during the game.

Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

I couldn't feel myself getting tired while playing the game.

Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

I lost track of time while playing the game.

Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

I temporarily forgot about my everyday worries while playing the game.

Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
O	O	O	O	O	O	O

I could block out most other distractions when playing the game.

Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
O	O	O	O	O	O	O

When I stopped playing the game I couldn't wait to start playing it again.

Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
O	O	O	O	O	O	O

I think the game is fun.

Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
O	O	O	O	O	O	O

I enjoy playing the game.

Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
O	O	O	O	O	O	O

I enjoy playing the game.

Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
O	O	O	O	O	O	O

I feel bored while playing the game.

Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
O	O	O	O	O	O	O

I am likely to recommend this game to others.

Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
O	O	O	O	O	O	O

If given the chance, I want to play this game again.

Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
O	O	O	O	O	O	O

Appendix E

Demographics and Game Experience Survey

What is your gender identity?

- Male
- Female
- Non-Binary
- Prefer not to answer

How old are you?

How would you rate your familiarity with Super Mario Games?

1 - Never played before	2	3	4 - Moderate	5	6	7 - Expert
O	O	O	O	O	O	O

How would you rate your familiarity with video games in general?

1 - Never played before	2	3	4 - Moderate	5	6	7 - Expert
O	O	O	O	O	O	O