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UNIVERSITY OF CALIFORNIA,
IRVINE

The Role of Failure and Mastery Orientation in a Challenging Video Game

DISSERTATION

submitted in partial satisfaction of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

in Informatics

by

Craig Gordon Anderson

Dissertation Committee:
Professor Constance Steinkuehler, Chair
Professor Kurt Squire
Professor Katie Salen Tenkinbaş

2020

DEDICATION

To

My family for raising me to be a curious and playful person.

To my Father, Doug Anderson, for always guiding me through my adventures and helping me find the way forward.

To my Mother, Paula Anderson, for always helping to make sure I was equipped for my quests.

To my brother, Scott Anderson, for always being willing to pick up the second controller (or more accurately for allowing me to).

To my sister, Teri-Lee Cale, for always playing along even when you were too cool to play with the kids.

I owe this accomplishment to all of you for raising me and for the all the support you have so generously given me.

I love you.

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ACKNOWLEDGMENTS

This dissertation would not have been possible without the support of a long list of characters.

Foremost, my advisor, Professor Constance Steinkuehler. Your guidance has been instrumental to my development as a researcher and as a person. I will do my best to repay you by passing on everything you've taught me to the next generation as best as I can.

Likewise, Professor Kurt Squire, my second mentor in my academic journey. I've always looked up to you as a scholar, but also as a person. I hope to see the same success you have had in your personal and professional lives.

The third member of my committee, Katie Salen Tekinbaş. Thank you for the valuable feedback you've provided throughout this journey.

I would like to acknowledge my friend, Kate Campbell, for your statistical expertise that brought confirmation and peace of mind to my analyses.

This work would also not be possible without the hard work Studio MDHR put into developing a game as amazing and challenging as *Cuphead*.

Finally, to all my friends and coworkers. Especially Samantha McDonald, and Jason G. Reitman, for all the edits, happy hours, and support.

To all of you, from the bottom of my heart, thank you.

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Working Examples

Binzak, J., Beall, M., Anderson, C. G., Azari, D., Wielgus, L., Dasen, J., Squire, K., Steinkuehler, C. (2015). Designing Tenacity. Working example presented at the 11th Annual Games + Learning + Society Conference, Madison, WI.

Video Submissions

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INVITED TALKS AND SEMINARS

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Anderson, C. G. (2017, October). *Failing Up: The Role of Difficulty and Failure in an Educational Video Game*. Panel on Games and Learning Research. Panel presented at Digital Media and Learning Conference 2017, Irvine, CA.

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ABSTRACT OF THE DISSERTATION

The Role of Failure and Mastery Orientation in a Challenging Video Game

By

Craig Gordon Anderson

Doctor of Philosophy in Informatics

University of California, Irvine, 2020

Professor Constance Steinkuehler, Chair

Failure is a crucial part of a game experience. Players expect to be challenged to a level that invites failure, showing lower engagement if they don't fail at all. While an important aspect of the game experience, the ways video games frame failure and how players react while playing remains understudied. Borrowing from literature in psychology, this dissertation uses mastery orientation, a measure of how individuals react to failure, to develop a behavioral measure which observes how 56 individuals reacted to failure while playing notoriously challenging video game, *Cuphead* for two weeks.

Results validate this measure, showing that those who reported higher mastery orientation scores also show more mastery-oriented behaviors in-game, show more mastery-oriented behaviors sequentially, and are less likely to abandon a level before completing it. No change in mastery orientation towards game contexts was initially found after playing *Cuphead* for two weeks, although closer inspection shows a leveling out of mastery orientation scores as those who started on the lower end of the scale increased while those who started in the higher end of the scale decreased. This is shown in women significantly increasing in their mastery orientation scores after playing *Cuphead* for two

weeks while men significantly decreased. Visualizing these effects suggest that some women began the study underconfident in their ability to persist through failure while some men began the study overconfident, with mastery orientation scores leveling out through the course of the study. Finally, distribution of gameplay behaviors shows that players persist for longer when further into the game, suggesting that the more time and effort the player expends, the more likely they are to continue to persist through failure. This sheds some light on how players react to failure depending on where in the game they currently are.

This study opens a new perspective for how researchers and game developers can understand the behaviors players take when they encounter failure, develops a new methodology to gauge mastery orientation, and begins to show where and why in a game players begin to give up. The implications of these results and areas for further investigation are discussed.

The Role of Failure and Mastery Orientation in a Challenging Video Game

1.1 Problem Statement

Video games provide a unique environment in which to experience failure. While play theorists

and game researchers have argued for decades that failure is an important part of the play experience

(Squire, 2005; Juul, 2013; Ramirez, Seyler, Squire, & Berland, 2014), failure remains an under researched

aspect to this pervasive media. As video games become more engrained in the culture of the current

age, games become less of a niche hobby that require players to congregate at arcade halls to play their

favorite games. As a result, the population that plays video games is growing in size and in diversity; the

demographics of people who play games is wider than ever. Countless numbers of communities have

emerged around games and game culture – from "old school" game clubs, streamers, esports

competitors, or LAN groups. This has spurred a robust field of video game studies ranging from the

influence games have on cognition to how games can be designed to encourage players of all types to

feel welcome in the play space.

The different types of video games that have been designed through the decades have created a

wide and deep pool of game genres, each defining the general style of play around which they are

developed. Within genres, each game itself is different - posing different goals, mechanics, aesthetics,

and playstyles. Most games present players with goals to accomplish: save the prince or princess, defeat

the onslaught of attacking aliens, break all the bricks. This goal is designed to be an obtainable

challenge, and games are developed to teach players how to complete them - step by step. As the player

progresses, the game gets harder, providing the player with a consistent challenge. Common to all

games is the threat of failure. In all games, the player acts with a purpose. They make choices in the

game that their character enacts, even if that purpose is not intended by the game developers. Because

of this, no matter if the player is abiding by the rules laid out by the developers or not, that player has

the capacity to fail at any time.

The ways that developers introduce failure into their games drastically influences the experience players have throughout the game. Failure can be punished by making the player start the level over, revert to a check point, or lose the game entirely; each eliciting a different reaction from players. As players develop the skills they require to progress through a game, the difficulty of the game needs to increase to keep players challenged and engaged. However, the art of maintaining a challenging environment for a wide range of players is non-trivial. Many game developers understand the importance of keeping players challenged and use a wide variety of techniques to maintain this constant and consistent increase in difficulty (Salen Tekinbaş, & Zimmerman, 2004; Hunicke, 2005). However, there is little documentation or research into these techniques to understand how developers ensure players are challenged at an appropriate level as they progress through the game.

Outside of games, failure is thought of as a lack of success and is often seen as the worst possible outcome when making an attempt, whereas while playing a game, failure is a natural and expected occurrence (Juul, 2013). In part, this derives from the challenge that is expected while playing most games. A video game that does not present players with a challenge in some way is often considered trivial. As a result of their design, players are likely to face failure at some point throughout the game, but are encouraged to retry when they fail. A few studies have investigated topics related to failure in games including how failure helps players learn the skills they need (Squire, 2005), that players report lower engagement when they complete a game without failing (Juul, 2009), and how failing in an educational game can help individuals learn the embedded material (Anderson, et al., 2018) However, there is a dearth of research in the nuances of how failure is experienced and how players react when encountering it while playing a game.

We can borrow conceptualizations from other fields of research to better understand how individuals typically react to failure in other settings. Cognitive psychology has spent half a century pondering the patterns behind people's reactions to failure, developing multiple approaches to

understand an individual's mindset towards goals and failure. The construct most closely tied to how an individual experiences failure is coined "mastery orientation" (Dweck & Reppucci, 1973). A mastery-oriented individual is more likely to try again after failing, uses self-promoting talk, and relishes in a challenge (Dweck & Reppucci, 1973; Diener & Dweck, 1980; Dweck & Leggett, 1988). Opposed to mastery-oriented individuals are helpless-oriented individuals. These individuals typically respond to failure by shutting down, giving up either by increasing ineffectual responses, or by quitting altogether (Diener & Dweck, 1978). These individuals might seem very similar when they experience success, but it is only when they fail that they diverge in behavior; mastery-oriented individuals are invigorated while helpless-oriented individuals give up (Diener & Dweck, 1980).

Three common methodology are currently used to gauge mastery orientation: surveys, role-play activities, and discourse analysis of interviews related to failure (Dweck, Chui, & Hong, 1995; Mueller & Dweck, 1998; Auten, 2014). Each of these methods rely on self-report and capture snapshots of how an individual perceives their own reactions to failure, yet none capture the behaviors an individual exhibits when they fail. The self-report nature of these methods also leaves open the possibility of a range of biases in participant responses, skewing how an individual might be seen to react to failure as more towards a desirable reaction. Likewise, the static nature of the data also tends to categorize individuals as being either mastery or helpless-oriented. This tends to lead to assumptions about how the individual will act at any moment they encounter failure, assuming helpless-oriented individuals will always give up and mastery-oriented individuals will always keep trying. However, this leaves how long an individual will persist through failure unaccounted for, or what environments or events encourage individuals to persist or give up.

Understanding how individuals react to failure at a finer-grain level and in environments in which failure is routine would provide insights into a wide range of areas. For example, understanding how individuals react to failure in environments where it occurs frequently can inform teachers on how

to build curricula to encourage persistence through failure in difficult content. Programs that have diverged from traditional instruction that allow for more exposure to failure and encourage positive reactions have seen success in the past few decades. Students who learn material in environments with little guidance benefit from productive failure, initially encountering failure more often as they explore the problem space but inevitably understand the solution better than students taught through direct instruction (Kapur, 2008). Understanding how individuals react to failure can help educators and researchers frame failure in these environments in ways that maximize the effects we already see.

This leaves open converging gaps in these literature. Game research has yet to investigate how players react to failure in games, and cognitive psychology has yet to investigate the behaviors individuals portray when encountering failure.

1.2 Study Purpose

This dissertation aims to fill these gaps through a behaviorally-driven study of how individuals react to failure in a challenging game. The presented study will investigate the role that failure plays in a player's actions as well as develop new methodology for gauging mastery orientation to include behavioral analysis. To frame this study, I will begin by introducing play and game literature that discusses failure in play spaces. I will also outline concepts used in psychology literature to gauge how an individual reacts to failure, and how these constructs have previously been measured and interpreted. This will highlight the gap in the literature this study aims to investigate. I will then describe the study conducted, starting with the methodology used and the data collected. I will then outline the analyses conducted and the findings from them. To conclude, I will discuss the impact of the findings, the limitations of the study, and future directions that this line of research should take. This study will expand our understanding of how players react to failure in challenging video games and develop new methodology for understanding how an individual reacts to failure.

Chapter 2: Literature Review

This chapter will thoroughly examine the literature to which this dissertation relates. I will begin

by covering how failure is conceptualized in play theory and game research, describing the role that

failure takes in theories of play and the studies conducted in games research that focus on or relate to

failure in games. I will also touch on how game developers adjust challenge in games, how failure relates

to flow theory, how different play styles relate to failure, and the biases that have led to stereotypes

among women playing games. Following this, I will detail areas of the Learning Sciences that have

embraced failure, highlighting productive failure. I will then introduce the relevant psychological

constructs to how we understand what individuals do when they are confronted by failure. This will

include three aspects of a positive failure strategy: mastery orientation, growth mindset, and

achievement motivation. I will also detail the common measurements for these constructs – surveys,

roleplaying activities, and discourse analysis of interviews on failure. Together, this literature reveals

gaps in the literature that this dissertation aims to fill.

2.1 The Role of Failure in Play

Play is inherently ambiguous (Sutton-Smith, 2009); commonly described as something that you

know when you see. Play theorists describe play as voluntary, non-serious, uncertain, and not real

(Huizinga, 1949; Caillois, 2001). Players can opt in and opt out of play, which happens in an environment

that is removed from reality requiring exploration. Huizinga (1949) calls this removal from reality the

'Magic Circle' of play; a space between what's real and what's not, where boundaries can be pushed,

where individuals can roleplay as another person to try out their perspective, or otherwise bend their

reality. The magic circle can be exited at any moment to break the game and return to reality and being

serious. The non-serious and opt-in nature of these spaces allows the individual to explore with lower

consequences; if the risk of failure that the player faces is too high, they can exit the magic circle. As

such, players can choose when to fail in these spaces, and can easily shrug failures off as something that

wasn't serious or that they were 'just playing around'. Hand-in-hand with play are the games created in

and for the play space. Games take the uncertain and ambiguous realm of play and bound it by rules.

Still falling within the Magic Circle, games now have an agreed upon purpose. Caillois early definition

argues that there are 4 classifications of games: competition (agôn), chance (alea), simulation (mimicry),

and vertigo (ilinx). Each classification of game comes with different goals in mind, and this influences

what it means to fail in these games. The main goal of competition games is to win at whatever the

competition is; if the player loses the competition, they have failed. Games of chance focus on

predicting factors that are less predictable; if the player makes the wrong prediction, they have failed.

Games of simulation require the player to take on an unfamiliar role; if the player does not convincingly

demonstrate their ability to behave like the intended simulated target, they have failed. Vertigo games

seek to give the player the pleasurable sensation felt after spinning or moving quickly; if the player does

not achieve this sensation, they have failed. Failure in each of these very broadly defined classifications

are very different from each other. Even within the games of these classifications, the exact goals the

player aims to achieve are subject to the rules of that specific game, making the conditions for failure

unique to both game and player. In his book The Well-Played Game, De Koven (2013) walks the reader

through how play is explored, noting that rules are often changed to adjust the play experience as you

go. Although they apply beyond, he primarily uses competitive games as examples of how we negotiate

the rules of a game to find the feeling of a "good game". Often, this is to accommodate one of the

players or teams playing at a different skill level than the other. The rules are adjusted to bring the

challenge level up for the more skillful team or player and down for the less skillful team or player,

ensuring that everyone playing feels challenged at their relative level. The aim is to ensure all players

feel as though they have a chance at winning, but also a chance at losing; if the game is too easy and

without the prospect of loss, the game is not 'well played'. These classifications are predicated on the

assumption that players are adopting the goals set by the game. Quite often, the rules dictate the goals

the players strive for, but by the nature of a play space, a player may decide to explore and pursue a different goal than expected. An illustration of this comes from Bartel's (1996) categorization the different ways that players approach online multiplayer games. Bartel created a 2-axis measure: acting on vs interacting with, and player vs world. This created 4 categories that players could fall into: acting on the world (achievers), acting on players (killers), interacting with the world (explorers), and interacting with players (socializers). Each of these types of players generally have different goals in mind while playing the same game, which in turn influences what it means for each player to fail at the same game. While achievers might aim to complete the challenges placed in the virtual world by the developers, killers might aim to compete against other players, explorers might aim to see everything in the game, and socializers might aim to interact with other players. Each of these approaches require the player to focus on different goals, which create different fail-states depending on what the player strives to do in the game. The vast differences in types of games, ways to play, and the general ambiguity of play make failure in games a topic worthy of thorough investigation.

2.2 The Role of Failure in Video Games

2.2.1 Failure in Games

Video games confront players with moments of failure by virtue of their design. Salen and Zimmerman (2004) argue that conflict is a necessary aspect of games. Players are challenged to accomplish a task and pitted against forces that oppose the player, aiming to cause them to fail. Gee (2005) argues that games are designed to help players learn how they can successfully navigate through them by being "at the outer edge, but within, their 'regime of competence'" (p. 10). This is also described as being pleasantly frustrating as the game is challenging enough that players must put in effort to succeed and are likely to fail multiple times. However, Gee argues that upon failure, many games provide feedback that highlight the progress players are making and the effort they put in. Squire (2005) also highlights the importance of challenge in any game environment, arguing that "game-based

learning environment(s) *start* with failure" (their emphasis, p. 4) and that "different games offer unique challenges, but part of what makes any game engaging is its difficulty" (p. 3). Juul (2013) argues that although failure is typically an undesired outcome and often looked down upon, in games, we're drawn to it. In a game, we come to expect a level of challenge that can sufficiently push our abilities beyond their limits – for which failure is a measure. In fact, Juul (2009) found that players of an action arcade game reported dissatisfaction when completing the game without failing at all. This suggests that failure plays a pivotal role in a game experience and that players expect it. Salen and Zimmerman (2004) look towards the problems that game designers can face and reflect that a common trap designers can fall into is not making clear to players why they failed when they do. This illustrates how commonplace failure is in games and that it is designed into games purposefully to allow players to progress. These environments frame failure to be commonplace, informative, and even desired. However, the ways in which designers integrate failure into their games is an important, yet under-researched topic.

2.2.2 The Influence of Failure in Video Games

Researcher have done some preliminary work investigating how players react to failure in video games. Littz and Ramirez (2014) call for the reinterpretation of failure, pointing out that the nature of failure in video games provides an example of how failure can be viewed as a positive influence. Within games but outside of digital spaces, Montola (2010) as well as Hopemaesta (2014) found that players of Live Action Role Playing (LARP) games reported positive experiences when failure is encountered. Likewise, Carter et al. (2013) found that even when failure is very consequential to the play experience, players still report positive reactions to failure in *DayZ* (Hall & Nespensny, 2013). Dying in *DayZ* is permanent, at least on that server. The player might have spent hours collecting items, forging alliances with players, and clearing out an area of zombies, but if they slip up even once, it could mean the permanent death of that character. Despite the high level of time and resource loss, players still report positive experiences with permanent death in *DayZ*. Carter et al. (2013) argue that this is due to the

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narrative experience that players develop through these moments. Another franchise known for high level of challenge and frequent player deaths is the *Dark Souls* series. Petralito et al. (2017) found that players of *Dark Souls III* (Hirai, Kimijima, Ishizaki, & Yoshida, 2016) report that these challenging game sessions are enjoyable because of the feeling of achievement and sense of learning that occurs. Hoogen et al. (2012) argue that failure in these game environments reinforces the level of challenge the player is undertaking, eliciting a positive response upon completion. Beyond entertainment, failing while playing a game designed for educational impact was seen to increase learning gains through the discourse that players engaged in upon failure (Anderson, et al., 2018). Ramirez, Seyler, Squire and Berland (2014) also show that players who identify as 'gamers' are more likely to think that failure is a natural occurrence when undertaking a new task, suggesting that those who play games frequently are more comfortable with failure. Through this research we can begin to see the role that failure plays in video games and what players think about failure, particularly in games with a high level of challenge. However, not all games are built with a set difficulty in mind.

2.2.3 Dynamic Difficulty Adjustment Systems

Not all players begin a game with the same level of skill. As such, designers often strive to ensure their games are able to cater to a wide range of skill levels; many have different levels of difficulty so that the player can find the level that is difficult enough to challenge them but within their ability to accomplish. The importance of this was shown by Cox, Cairns, Shah, & Carroll (2012) in their investigation of the role challenge has on game engagement. They found that players with a higher level of expertise preferred a higher difficult setting, while players with a lower level of expertise preferred a lower difficulty setting. Intuitively, players are drawn to the level of challenge that matches their ability. As De Koven (2013) pointed out, we often negotiate the rules of play to fit the players' skill levels, and as such, we would expect that a more skilled player would want to take on a greater challenge, and a lower-skilled player would need to work their way up to that skill level before taking it on. However, as

video games are preprogrammed, changing the rules to adjust to a player's skill level needs to be premeditated.

One of the ways that designers ensure that players of different skill levels are met with an appropriate level of challenge is to embed mechanics into the game that enable it to adapt to the skill level of the player. This can be done through manual difficulty settings (i.e. Easy, Normal, Hard) that the player chooses at the start of the game or sometimes mid-game. This requires the developers to create a system that leads to multiple gameplay experiences depending on the difficulty chosen, of which the player often only experiences one. Another tool that developers commonly use are feedback mechanics. If a player is doing well in a game, a mechanic will be triggered to increase the difficulty, or vice versa if they are doing poorly. An example of this comes from Nintendo's *Mario Kart* franchise (Miyamoto, S., Konno, H., Iwata, S., Tezuka, T., 1992-2019). Players chose a character to drive their go-kart and race to finish three laps in the fastest and can also obtain items by driving over item blocks that can be used to sway the race in their favor. When a player is in first place and they drive over an item block, they are less likely to receive a powerful item and more likely to receive a weaker item. Conversely, the player who is in last place is more likely to receive a powerful item that helps them climb the ranks. Through this mechanic, the developers tailor the play experience to the player's skill level – more skilled players are confronted with a more challenging game while less skilled players are confronted with an easier one.

Developers have designed other systems that automatically adjust the game's difficulty in response to the player's ability. Coined as dynamic difficulty adjustment (DDA), these systems can change variables of the game code in response to a player impasse, automatically making the game easier so that the player can progress. DDA can also increase the level of challenge through modification of the game variables if the player does not seem to be challenged enough to stay engaged. Further, DDA has been shown to use machine learning heuristics to design challenging levels appropriate for the

players' ability, tailoring the game levels to the player's demonstrated skill level (Jennings-Teats, Smith, & Wardrip-Fruin, 2010). These systems are designed not to take the challenge out of the game, but to ensure it does not dissuade the player, showing that designers are not only concerned about making sure their games aren't too hard, but also that they aren't too easy. Hunicke describes the goal of one of these systems as preventing the player from "flailing" rather than failing, described as when a player repeatedly edges towards an inability to succeed. Thus, these systems are designed not to remove failure from the game, but to ensure that players are kept at a level that is challenging while obtainable (2005).

2.2.4 Flow Theory

The importance of keeping a balance between being too difficult and being too easy directly relates to Csikszentmihalyi's (1990) concept of flow. Game designers use mechanics like the ones described above to try to keep players within the 'flow zone'. This is described as a state in which an individual has intense and focused concentration, a merging of action and awareness, loss of self-consciousness, a sense of personal control, distortion in perception of time, and intrinsic motivation for the task. If the task is too difficult, the player might get frustrated and lose their flow state. Likewise, if the task is too easy, the player might get bored and lose their flow state. This becomes even more complex as the player's ability develops throughout the game. As the player progresses, developers must increase the difficulty at a pace that matches the players developing skill level. This requires developers to find a balance between increasing the difficulty too quickly and too slowly, while considering that each player is going to develop their ability at a different pace.

As part of trying to keep players within the flow zone, developers aim to adjust the difficulty of the game while the player develops the skills required to progress to ensure they are neither bored nor overly frustrated. However, one overlooked aspect of this are the beliefs the players hold to completing the challenges placed before them. Regardless of their current ability, if the player believes they are

capable of completing a difficult task, they will likely keep playing until they succeed or change their mind. If they don't believe they can complete the task, they are likely to quit. Investigation into the players beliefs regarding challenge and failure are warranted to better understand how they relate to flow in games and may tell us more about how games can be constructed around the player's beliefs.

2.2.5 Player Motivations and Failure

Even while playing the same game, two players can play in very different ways. Different player motivations have been described, detailing the motivations behind different kinds of play in a game. Bartle (1996) argues that players fall into one of four categories while playing Multi-User Dungeons (MUDs), based on if their motivations for playing align with acting or interacting and if they aim their actions towards the world or towards players. Individuals who prefer acting towards players are considered "Killers" as they are motivated to take actions upon other players within the game, which primarily means challenging other players to combat in these games. Players who prefer acting towards the world are considered "Achievers" as they are motivated to take actions on the world, which primarily means accomplishing quests and tasks within the game. Individuals who prefer interacting with players are considered "Socializers" as they are motivated to interact with other players in the game, forming communities or guilds. Players who prefer to interact with the world are considered "Explorers" as these players are motivated to explore the virtual world and find out what they can do within it.

Through a wider lens, Yee (2006) found that players motivations can be categorized into three components, each with 3 or 4 subcomponents. Player motivations can be driven by an achievement component, which contains the subcomponents of advancement, mechanics, and competition. Players who are attracted to advancement are motivated by completing goals and progressing through the game, those who are attracted to mechanics are motivated by mastering the controls of the game, and those who are attracted to competition are motivated by proving their relative skill to other players.

Player motivations can be driven by a social component, which contains the subcomponents of socializing, relationships, and teamwork. Players who are attracted to socializing are motivated by meeting and interacting with other players. Players who are attracted to relationships are motivated by forming meaningful connections to other players. Players who are attracted to teamwork are motivated by collaborating with others and creating shared experiences. Player motivations can also be driven by an immersion component, which contains the subcomponents of discovery, role-playing, customization, and escapism. Players who are attracted to discovery are motivated by exploration and finding all that the world has to offer. Players who are attracted to role-playing are motivated by immersing themselves in perspective of their character and how they fit into the world. Players who are attracted to customization are motivated by customizing the appearance of their character to ensure they are unique. Players who are attracted to escapism are motivated by finding a space to relax or relieve stress from their out of game lives.

These motivations inherently change the goals different players pursue while playing, which in turn changes the ways players fail. Each of these motivations represents a way for that player to fail. While a player motivated by social interactions might feel as though they have failed when they spend all day looking for a guild to join but do not, a player motivated by exploration might feel as though they have failed if they cannot reach the top of the mountain they are aiming to explore. While a player who is motivated to complete the game's content might feel as though they failed when they cannot defeat a boss, a player who aims to immerse themselves into roleplay might feel as though they failed if they break character. Through this perspective, what it means to fail in a game becomes more complicated than simply not completing the game. Further, some players might desire to play in a way that is directly counter to the way the developers intended. These players are also creating their own goals that can be failed.

The further a player progresses through the game, the more likely they will become invested in it. Davidson (2003) argues that players begin a game with initial involvement, during which they are in the process of learning how the game works and how to play. Once they are comfortable with the game and interested in continuing to play, they enter the immersion phase. During this phase, they have an invested interest in progressing though the game, pursuing the goals they have adopted, or playing more. This can lead to the player becoming invested enough in the game that they feel the desire to persist through the challenges the game presents and complete it. While these stages of initial involvement, immersion, and investment in a game ring true for many players, there is no indication of how players transition between these phases. Davidson uses role-playing adventure game, Ico (Euda, 2001) to illustrate how this interest and investment occurs, noting the transition between initial involvement and immersion involves moving towards a comfort zone with the game, however what leads to this is unclear. Likewise, when players moving from immersion to investment involves when they have "mastered the gameplay and have complete comfort within the world itself" and that "the compelling goal is to actually finish the game itself". This suggests that this final level of investment is a shift towards completing the final goal of the game's progression, however, there is no indication what might cause this shift in change. The driving forces behind these transitions and nuances of what it means to go from involvement to immersion to investment require further exploration.

2.2.6 Counterplay and Failure

Players enter the virtual environment to pursue some goal, whether they pursue the goals built into the game or create their own. Creating their own challenges also allows players to create their own fail-states, allowing them to define what it means to fail in the game. Some players enter the game with an intent counter to what the developers intended. This playstyle is referred to as "counterplay" (Meades, 2015), not to be confused with the conventional use of the phrase counter-play to mean using a strategy that counters your opponent's strategy. Sometimes, these players aim to break the rules of

the game, break the spirit of the game, or sometimes just break the game itself. When we consider

failure in games, these players, holding their own counter-goals would fail in very different ways. For

instance, a player who joins a first-person shooter game determined to not hurt anyone would fail if

they shot another player. For most first-person shooter games, this approach is directly counter to what

the game intends for players to do, and may actually spoil the game for other players on their team who

might be trying to work together to accomplish the game's prescribed goals. Salen and Zimmerman

(2004) point out that some players only aim is to spoil the game for others. Coined as "the spoil-sport",

these players disobey rules and ignore the goals of the game in order to ruin the other players' play

experience. In this case, the spoil-sport might fail if the other players ignore them and continue playing

the game. In each of these cases, failure still exists, but is defined by the players goals and intent,

showing that failure in these spaces can be thought about through the player's perspective as well as

the goals built into the game.

2.2.7 Women in Games

Researchers and developers have agreed that a gender gap exists in who plays games and what

games they play (Taylor, 2012; Taylor, Jenson, & de Castell, 2009; Raten et al., 2015; Trepte, Reinecke, &

Behr, 2009; Witkowski, 2013) and it's important to note that historical and cultural influences cause

women to have very different experiences playing games than men. The expectations and pressures

placed on women when joining a gaming community often led them to filling roles that reify stereotypes

that women want to or must fill support roles (Ratan, 2015). These stereotypes also lead to women

considering themselves to be less suited to playing games and less skilled at video games then men

(Richard, & Hoadley, 2013). Likewise, Vermeulen, Núñez Castellar, and Van Looy (2014) found that

women felt more stress and gauge their ability as lower when they thought they were playing versus a

man. This comparison leads women to this stereotype, lowering their confidence when playing with

men or in a male-dominant play space and resulting in avoidance of those spaces (Routsalainen &

Friman, 2018). However, when controlling for game experience, no difference in skill is found between men and women (Vermeulen, Nunez Castellar, & Van Looy, 2014). These barriers prevent women from exploring these play spaces, leading to calls for opening the receptiveness of these spaces to women:

> "We need to open up more space for girls to join - or play alongside - the traditional boy culture down by the river, in the old vacant lot, within the bamboo forest. Girls need to learn how to explore 'unsafe' and 'unfriendly' spaces, and to experience the 'complete freedom of movement' promised by the boys' games, if not all the time, then at least some of the time, to help them develop the self-confidence and competitiveness demanded of professional women. They also need to learn how, in the words of a contemporary bestseller, to 'run with the wolves' and not just follow the butterflies. Girls need to be able to play games where Barbie gets to kick some butt."
>
> (Jenkins, 2007)

Great effort and purpose from advocates are required to ensure these spaces are more welcoming to women and the stereotypes that drive women away are dispelled. As with changing widespread opinion about anything, this effort will take constant effort and time.

2.3 Learning Through Failure

2.3.1 Productive Failure

Within the learning sciences, the idea that failure is an important part of the learning experience is not new. Learning scientists and educators have long considered failure to be a positive influence on an individual's understanding. Kapur (2008), shows that students who explore a problem through an ill-structured context initially fail much more than students who explore in a more structured traditional learning environment. However, after this failure-rich exploration, students come to a much more robust understanding, showing better conceptual understanding and transfer to other related subjects. Coined as "productive failure", these students come to a better understanding of the problem space

because they were given the opportunity to explore and learn the boundaries through failure. Kapur and

Bielaczyc (2012) argue that to elicit productive failure, an environment must contain two phases –

generation/exploration, and consolidation. To achieve this, they argue that an environment must be

designed with three core design principles in mind:

　　1. Create problem-solving contexts that involve working on complex problems that

　　challenge but do not frustrate.

　　2. Provide opportunities for exploration and elaboration.

　　3. Provide opportunities to compare and contrast the affordances and constraints of

　　failed or suboptimal representations and solution methods, and assembly of conical

　　representations and solution methods.

　　This perspective is directly reflected in how a video game environment is structured to

encourage players to learn from failed attempts and come to the best strategy for completing

challenges. Game levels are typically designed to encourage players to explore the game and

possibilities within it, pose challenges to the player that are designed to be difficult but not frustrating in

which they are posed with a problem-solving task in the form of deciphering the best strategy to

progress. Many games form communities that explore and experiment the possibilities afforded in the

game, sharing the strategies they think are best to completing the challenges the game presents. Video

games often provide an environment in which learning is driven by productive failure, allowing players

to explore the play space, challenge players to solve complex problems, and provide opportunities to

contrast solution methods to optimize their play. Through the failures that this environment

encourages, players come to understand the affordances the game allows, demonstrating their mastery.

　　These concepts from the learning sciences show how an environment can promote positive

reacts to failure. To better understand how an individual reacts to failure, we turn towards the

psychological theories behind failure, motivation, and achievement.

2.4 Psychological Theories of Failure

2.4.1 Pre-Failure Context

Research on motivation in learning environments takes a social-cognitive approach. This helps to characterize adaptive and maladaptive strategies, explain them as specific underlying processes, and provide an empirical basis for intervention (Dweck, 1986). Adaptive motivational goals include the establishment, maintenance, and attainability of personally challenging and valued achievements, whereas maladaptive motivational goals involve the failure to establish reasonable, valued goals, maintain progress towards them, or attain goals within reach (Dweck, 1986).

2.4.2 Implicit Theories of Mindset

When attributing causality of our ability, Heider (1958) points out two common approaches: an individual will generally attribute the ability to achieve or fail at a task to perceived invariant internal properties such as intelligence or to the amount of effort they put in. Later described as parts of the implicit theories of intelligence by Dweck, Chui, & Hong (1995), the approach in which ability is due to perceived invariant internal properties is known as a fixed mindset. Heider associates this as describing one's actions as what you can or cannot do. This suggests that the person believes that the traits needed to accomplish the task are invariant and they either have them or they don't – no amount of effort will change their ability to accomplish the task. The approach in which ability is due to amount of effort exerted is known as a growth mindset and is associated with someone describing their actions as *trying* to do something. This emphasis on attempts suggests that their success or failure is not static and results from the amount of effort exerted. This perception of abilities versus effort is core to how a person reacts when failure is encountered (Weiner et al., 1987). Individuals with a fixed mindset typically view the amount of effort they expend as increasingly negative as this shows that they are less and less inherently capable of a task. These individuals will also typically avoid challenge, preferring tasks they know they can complete with ease that show their strengths and hide their shortcomings

(Diener & Dweck, 1978). Upon failure, this behavior can lead to a cascade of negative reactions, suggesting that they are incapable of completing the task, which in turn causes the individual to withdraw even further. In these cases, fixed mindset individuals tend to show signs of anxiety, depression, boredom, and defiance (Dweck & Leggett, 1988). On the other hand, those with a growth mindset typically view the amount of effort they expend as increasingly positive, as success shows that they are capable of putting in a high amount of effort into a task. Attributing cause to effort in a growth mindset amplifies the value of the outcome, enriching both success and failure (Elliott & Dweck, 1988). The focus on progress through effort we see in a growth mindset can result in challenge-seeking behavior and energization when a challenging task is presented.

2.4.3 Achievement Motivation

Closely related to how individuals react to failure is the motivation that drives their behavior. A way in which psychologists view motivation in behavior is through an individual's achievement needs (Weiner, 1972). While the mindset literature focuses on how an individual reacts to failure through their beliefs about their abilities, achievement needs focus on what motivates an individual to accomplish a task, which can in turn influence how an individual reacts to failure while striving towards those goals. Achievement motivation is defined as the need to meet realistic goals, receive feedback, and experience a sense of accomplishment. This comes with a tendency to ascribe success of an activity to high levels of ability and effort, while they ascribe failure to a lack of effort (Weiner, 1974). As seen in fixed mindset individuals from Dweck's implicit theories of intelligence, those with low achievement motivation tend to ascribe success and failure to ability rather than effort. Further, this assessment worsens with every failure; when an individual who believes their failure is due to a lack of ability fails, they only reaffirm that they do not have the ability to succeed, and don't believe they can improve. High motivation individuals are more likely to initiate achievement activities such as working with greater intensity, persisting longer in the face of failure, and choosing more tasks of intermediate difficulty (Weiner,

1972). Two types of motivational goals can be pursued: performance goals or learning goals.

Performance goals are similar to behaviors of fixed mindset individuals in that they aim to demonstrate

their ability and gain favorable judgement on competence, whereas learning goals are similar to

behaviors of growth mindset individuals in that they aim to identify areas in which they can develop and

aim to increase competence. Focusing on performance goals promotes the individual looking good in

their current state rather than developing. However, even when individuals pursuing performance goals

succeed and a favorable performance is achieved, it's fragile. Similar to individuals with a fixed mindset,

when failure is eventually encountered there is more to lose – the performance-based assessment they

strive for is shattered. This threatens intrinsic interest and causes challenge-avoidance behavior, leading

to feelings of shame, causing withdrawal, and lower motivation (Weiner, 1972). Even in those who are

initially successful, this can be a danger. Bright and talented individuals who focus on performance goals

and succeed most of the time can be devastated upon failure, as they do not know how to react and

may have higher expectations to maintain high-level performance. This fear of failure can lead to

challenge-avoidance and has been found particularly in bright girls (Dweck, 1986). Individuals that focus

on learning goals on the other hand, react to failure in a very different way; they tend to use failure as a

cue that they need to increase effort and analyze their current strategy. Whereas failure in performance

goals can cause feelings of shame, failure in learning goals are attributed to low effort and cause feelings

of guilt, eliciting very different responses. Guilt reflects that the individual could have put more effort in,

whereas shame reflects that the individual is not capable of success. Similar to those with a growth

mindset, if an individual with learning goals fails, it is attributed to the amount of effort put in, and can

result in approach behavior, retribution, and motivational action (Weiner, 1985).

2.4.4 Mastery Orientation

Dweck and Reppucci (1973) found that although some children shut down in the face of failure,

others responded quite differently: "two children may receive the same number of success and failure

trials yet react quite differently whether they interpret the failure to mean the situation is beyond or in

their control" (Dweck, 1975, p.675). The latter reaction to failure was coined as "mastery orientation"

and is characterized by behaviors seen in individuals with a growth mindset: challenge-seeking and

persistence in the face of failure (Dweck & Leggett, 1988). These individuals are more likely to repeat a

task after failing (Dweck & Reppucci, 1973); use positive, self-focusing language (Diener & Dweck, 1980);

engage in solution-oriented self-instruction, self-monitoring, hypothesis testing, maintain optimism, use

spontaneous statements of positive progress, have heightened affect when approaching a difficult

problem, increased effort in the face of a challenge, and seek help when stuck (Dweck & Leggett, 1988).

Mastery-oriented children also respond to failure feedback chiefly as information leading to problem

solution rather than as a failure or as a prediction for future failure - even when they actually succeeded

at the task, but were told they failed (Dweck & Reppucci, 1973). In fact, mastery orientation children

don't even seem to think they failed at all during failure trials; thought more of as a setback, they treat

these as moments of reflection rather than assessment (Elliot & Dweck, 1988). Contrast to this are

children who shut down in the face of failure, known as a having a helpless orientation. Diener & Dweck

(1980) argue that the only difference between helpless and mastery orientation children is in their

response to failure, and in fact, observe similar behaviors between the two groups until they fail at a

task. Helpless-oriented children initially use the same strategies, but when failure is encountered, their

strategy deteriorates, and ineffectual responses increase. Similar to fixed mindset individuals, this is

caused by an attribution to stable personal inadequacy, rather than unstable, changeable characteristics

(Dweck & Reppucci, 1973). Helpless-oriented children do respond to success differently as well.

Helpless-oriented children are more likely to put a lower value on success and see it as less predictive of

future performance. Despite previous successes, helpless-oriented children show an absence of progress

after failure, report negative self-conditions, negative affect including boredom, aversion, anxiety,

decreased performance, and use of ineffective or impossible strategies (Diener & Dweck, 1978). Despite

being successful in prior situations, failure stops these children in their tracks completely, whereas mastery orientation children are invigorated by failure, renewing their efforts and resolve.

2.4.5 Positive Failure Strategies

The theories discussed above each approach an individual's reactions to failure in different ways. Implicit theories of intelligence focus on how an individual attributes the cause of failure, achievement motivation goals focus on how an individual strives for their goals and deal with failure along the way, and mastery orientation focus on how an individual reacts when failure is encountered. Together, having a fixed mindset, a focus on learning goals, and a mastery-orientation constitute a suite of behaviors that describe positive strategies used in and around failure, whereas fixed mindset, a focus on performance goals, and helpless orientation describe negative strategies towards failure. These theories comingle in the cognitive strategies held by individuals, leading researchers to use these terms across a wide range of experiments with similar aims. While these concepts represent a suite of positive failure strategies and can be seen to overlap in a variety of ways, throughout this dissertation I will focus on the terms of a mastery or helpless orientation. This conceptualization focuses closest on what an individual does when they fail. However, other behaviors seen in these positive failure strategies will be considered where they overlap in contribution to a mastery or helpless orientation.

2.4.6 Methods of Positive Failure Strategy Investigation

The current methodology used to measure these concepts is limited to self-report survey, roleplay, and discourse analysis. These methods each rely on participant perceptions of how they feel they generally react to failure, and do not capture any behavioral measures of how an individual react when encountering failure. The scale most commonly used typically creates a snapshot in time that then characterizes the individual as either mastery or helpless-oriented. It is noted that the context in which questions are asked can change the individual's perspective on failure. It is recommended that these instruments are modified to fit the context in which researchers are interested to ensure that

individuals' frame of mind towards failure is properly set. This suggests that individuals' mastery

orientation is not a static trait and does change at least dependent on the context. Currently, little

research has investigated other factors that influence how an individual reacts to failure.

2.4.7 Survey Measurement

There are multiple versions of surveys used to measure to what extent a person uses positive

failure strategies, most of which are very brief. The initial and most common survey used to measure

growth mindset is known as the intelligence theory measure, validated by Dweck, Chui, & Hong (1995).

Containing only three questions, the survey is kept brief as the authors believe that "implicit theory is a

construct with a simple unitary theme, and repeatedly rephrasing the same idea may lead to confusion

and boredom" (p.269). The questions answered on a 6-point scale from "strongly agree" at 1 to "strongly

disagree" at 6 are:

1. You have a certain amount of intelligence and you really can't do much to change it;

2. Your intelligence is something about you that you can't change very much;

3. You can learn new things, but you can't really change your basic intelligence.

Scores are averaged to find an overall implicit theory score, with higher scores indicating

more of a growth mindset. The survey was found to have high internal reliability, is independent

of sex and age, independent of political affiliation and religion, is not confounded with self-

presentation measures found in self-monitoring and social desirability scales, is unrelated to

scholastic aptitude tests, confidence in intellectual ability, self-esteem, optimism or confidence

in other people and the world, or social-political attitudes (Dweck, Chui, & Hong, 1995). The

survey has been used as an assessment of current mindset as well as a measure of change in

mindset over time as well. Some studies have conducted the 3-question survey throughout

stages of development to view changes in mindset over time as Romero, et al. (2014) did to

show that middle school students that report higher growth mindsets were more likely to move

up to advanced math classes over the course of the 2 years the surveys were administered. The survey has likewise been used to bookend some interventions; in their dissertation work, Brougham (2017) used the 3-question survey to measure growth mindset of urban high school students before and after an attempt to train them to adopt a growth mindset. These questions have also been used in conjunction with a battery of other questionnaires. West, et al. (2016) used multiple surveys on similar topics to tease apart any differences in long-term development, measuring conscientiousness, self-control, grit, and growth mindset all at once. They found that of the measures, only growth mindset positively correlated with academic performance in terms of test score improvements, attendance, and behavioral measures.

Modified versions of the survey have also been used in subsequent studies, including reverse-scale items to present questions worded for both fixed and growth mindsets, again on a 6-point Likert scale from "strongly agree" at 1 and "strongly disagree" at 6. The additional questions are reverse-scored and are again averaged with the growth mindset scores to find an overall score, wherein a higher score reflected more of a growth mindset (Donohue, Topping, & Hannah, 2012). The survey questions are also often modified to fit the context in which the survey is being administer as well. Snipes & Tran (2017) conducted a large-scale study of over 120k students between the 4th and 12th grade in the 3rd largest school district in the United States, Clark County, Nevada. They used 5 modified questions asking students to rate how often they do the following:

1. Do the readings or other assigned work to prepare for class;

2. Turn in assignments on the due date;

3. Actively participate in class;

4. Have all of my class materials with me;

5. Do more than what is expected of me.

The respondents were asked to rate these questions on a scale from "never" at 1, "once in a while" at 2, "about half the time" at 3, "most of the time" at 4, and "always" at 5. Although framed in a different way, the authors argue that these modified questions still represent a growth mindset. They found that the majority of students responded high on the scale, but did vary by academic achievement, ESL learners, and ethnicity. However, the modification to the questions was not validated against standard survey questions gauging a growth mindset which brings this modification into question. Although these surveys give researchers a glimpse at an individual's mindset, many of the aforementioned studies speculate that social desirability and response biases may cloud their results. This has been a persistent problem with the self-report nature of the surveys and signal the possible strengths of other methods to gauge positive failure strategies.

2.4.8 Roleplaying Responses

A second common approach used to gauge positive failure strategies includes roleplaying and hypothetical situations. In a study to investigate the influence of different types of praise on children's performance, Mueller & Dweck (1998) asked children to work on three problems. After the first, the children received some feedback and were given the option to choose 1 of 4 different tasks which had were designed to embody learning and performance goals. In an attempt to dissuade bias towards a socially motivated answer, Mueller & Dweck weighted 3 of the 4 tasks towards performance goals and one towards learning goals in an attempt to reduce social desirability, trying to make it seem like the learning goal option was less obvious. The final of the four following options for their next task that the child was given was framed towards learning goals. The tasks they were asked to state their preference from were:

1. problems that aren't too hard, so I don't get many wrong;

2. problems that are pretty easy, so I'll do well;

3. problems that I'm pretty good at, so I can show that I'm smart;

4. problems that I'll learn a lot from, even if I won't look so smart.

The participant picked which of the tasks they wanted to do next, and this was taken as a measure of their goal preference. In similar fashion, Kamins & Dweck (1999) asked children to roleplay four different scenarios with dolls. These scenarios involved the doll engaging in some task that a teacher had asked them to complete but made a mistake. After this mistake, the children were given different types of feedback from the teacher and then were asked a series of questions designed to gauge their patterns of coping with failure including rating their performance, how they felt, if they wanted to persist, and the stability of "badness" as a trait. While persistence, affect, and self-perceptions of performance are factors in their responses to failure, the stability of "badness" as a trait was taken as the most direct measure of their mindset, showing that this measure was associated with a helpless pattern.

Skipper & Douglas (2012) conducted a similar study on the influences of different kinds of praise and used a similar measure of the participants mindset; they had the participant read a written scenario in which a person succeeds at a task and is praised for it. They were asked to imagine they were that person while reading it and completed a 3-question survey after, including the same questions on perceived performance, affect, and persistence. Although they removed the question on the stability of "badness" with no justification for doing so, the study was still framed around praise and reactions to failure, and the authors make claims about growth mindset based on the collected measures. With no justification, it is unclear if these modifications were appropriate or influenced the results.

Taken together, these studies adopt a more direct measure of a person's positive failure strategies than self-report through a survey in that they attempt to introduce the participant

into a scenario through roleplay and ask them to imagine how they would respond in that situation. Opposed to self-report, the roleplay method may potentially resolve some of the response and social-desirability bias that occurs in self-report survey; by placing a participant in even a hypothetical situation where behavior can be observed, we might get a better glimpse at how they are reacting towards failure. However, respondents may still modify what they say they would do in these scenarios to what they deem as more favorable socially. Mueller & Dweck (1998) include 3 times as many performance goal options as learning goal options in an attempt to make the learning goal less obviously the "right" answer, but there is no indication if this method is effective. As such, it is unclear if this methodology of measuring mindset or goal preference is favorable to self-report through survey.

2.4.9 Interview Discourse

The final method currently used to measure positive failure strategies in individuals found in the literature is through interview discourse. In their dissertation work, Auten (2014) interviewed 14 teachers who had taken a workshop on developing a growth mindset in their students, measuring the number of utterances related to a fixed and growth mindset about either teachers or students. By coding different utterances in these ways, Auten shows how these different mindsets can manifest in the language that students are using in the context they are in. The teachers reported that students showed a fixed mindset through utterances like "I'm not good at writing; that's you and not me", or "I don't have the math gene, so I am doomed to never get math". To gauge student growth mindsets, teachers were asked to describe their students' language, behaviors, and attitudes. Often not specific utterances, the teachers gave descriptions of the students responses to failure and challenge: "They have an awareness that they are not strong in reading, but they are looking to improve, engaged in the learning, asking questions, and approaching problems positively", or "no matter if the grade is

good or bad, they (students) are still with me, still focused, looking for direction from the teacher and from fellow students". The teachers were also asked to consider their own mindset in relation to the study. Auten notes that a common response from the teachers to having a fixed mindset was "I'm good in _____, but can't do _____", or "I really believed that you either had it or you didn't". Likewise, respondents were asked if their mindset had changed and responded that they are "not paralyzed by failing or looking silly or being embarrassed" anymore, and they now "accept challenges and seek out resources to overcome the challenges". Auten uses reflections of their own behavior and views to measure how much they lean towards a growth or fixed mindset and does so in the context of the activity they are responding to. Blackwell, Trzensniewski, & Dweck (2007) likewise use this approach to measuring mindset when asking teachers to reflect on their students' performance in terms of their mindset. They did so in conjunction with the survey method described earlier, to corroborate the findings with observable outcomes reported by the teacher, analyzing discourse for signs of these mindsets is similar to the previous methods. However, attempts to take the measurements closer to the context of the failure since they are describing events in which they failed rather than a general disposition towards failure. As such, this method further helps eliminate the potential for social desirability and response biases influencing self-report results, as the behaviors upon failure of the respondent are verified by an outside observer. However, it may not completely eliminate it; even though the teachers are not given any information on what condition of the experiment their students are in, there may still be potential biases in their descriptions of them based on their opinions of the individual, or with a desire to make their students or tutelage appear more professional.

2.4.10 Missing Methodology

These methodology for measuring positive failure strategies have been validated and attempt to address potential response and social-desirability biases. Self-report through survey responses may hide a participant's true feelings in relation to failure as they may report a more favorable response. The move towards observing behavior through roleplay and discourse may provide a more reliable account of the participant's mindset in regard to failure, however a methodology that directly observes participant's behavior in response to failure has yet to be seen. There are other common methodologies that have not yet been used that may measure individual's positive failure strategies to a finer grain, reduce potential response biases further, and might be easier to collect. Although the roleplaying methodology attempts to measure how one would react in the result of failure given the scenarios provided and interview discourse has the participants describe those moments, none of the methodology directly measure one's response to a failure event. This could be achieved through multiple research approaches. Ethnographic work in a chosen area with a high chance of failure could focus on these moments and record and describe the reactions individuals have, how those reactions change as they develop, and what factors contributed to the reaction. Likewise, with the growing number of digital activities and environments we routinely engage in, there is opportunity for these systems to monitor the user's behavior through telemetry, which is especially true for video games. This may prove to be a powerful tool for measuring mindset in digital environments as statistical modeling can be used to describe more adaptive patters and how they are developed through direct observation of fail-states and the player's response. It would also provide a much larger sample of data to observe behavioral patterns, allowing for a better understanding of the nuances in a player's responses to failure. Finally, it would avoid response biases to a greater degree as data can be scraped from a natural digital setting unobtrusively and continuously in the background.

Chapter 3: Player Reactions to Failure in *Cuphead*

3.1 Gaps in Literature and RQs

The environments that video games create necessitate a unique relationship between players and the failure they encounter. Players are encouraged to persist through failures that are innate to the challenge that comes with the play experience. Players learn through failures as they progress through the game, improving on the abilities they need to succeed. Challenge is required for an engaging gameplay experience, with failure being a hallmark of an appropriately challenging experience. While failure has been identified as an integral part of a gameplay experience, the nuances of what constitutes failure in a video game environment or how players react when failure is encountered remains unclear.

While psychological research has developed tools to help researchers understand how individuals respond to failure, these measures are limited to survey responses, roleplay activities, and discourse analysis. These assessments provide a snapshot that is largely based on self-assessment of how the individual feels about their own reactions to failure. Currently there are no behavior-driven assessments of how an individual reacts to failure. A behavior-driven assessment would shed light on patterns we might not see in the standard assessments. Early research has shown that individuals who are attracted to challenge when playing a video game score higher on mastery orientation scales (Anderson, Campbell, & Steinkuehler, 2019), although the link between how these individuals react to failure when in game remains unclear.

These gaps leave open crucial questions to our understanding of game environments and how individuals react to failure. To address these gaps, I have conducted a research project that addresses the following question and sub questions:

Main Research Question: What is the relationship between mastery orientation and mastery-oriented behaviors in Cuphead?

Sub questions:

- Do individuals who score higher on the mastery-orientation survey perform more mastery-oriented behaviors in Cuphead?

- Do mastery-oriented individuals perform more mastery-oriented behaviors before performing helpless-oriented behaviors in Cuphead?

- What level features encourage players to persist through failure in Cuphead the most?

- Does mastery-orientation score increase with more game or failure exposure?

- What demographic differences appear in mastery-oriented behaviors in Cuphead or mastery score?

3.2 Methodology

3.2.1 Study Summary

To investigate these questions, participants were recruited to play notoriously challenging video game, *Cuphead* (Moldenhauer, 2017). Their in-game behaviors were analyzed through the lens of mastery and helpless-oriented behaviors as described in psychology literature to investigate patters of how individuals respond to failure in a challenging video game. These behaviors were compared to traditional survey measures of mastery orientation framed in a general-context and a game-context before and after playing *Cuphead* for two weeks. One week into these two weeks and then again at the conclusion, participants were interviewed to gain insights into participants' opinions on failure and to confirm motivations behind changes in behavior. The study design is outlined in figure 3.1:

Figure 3.1

Study Summary
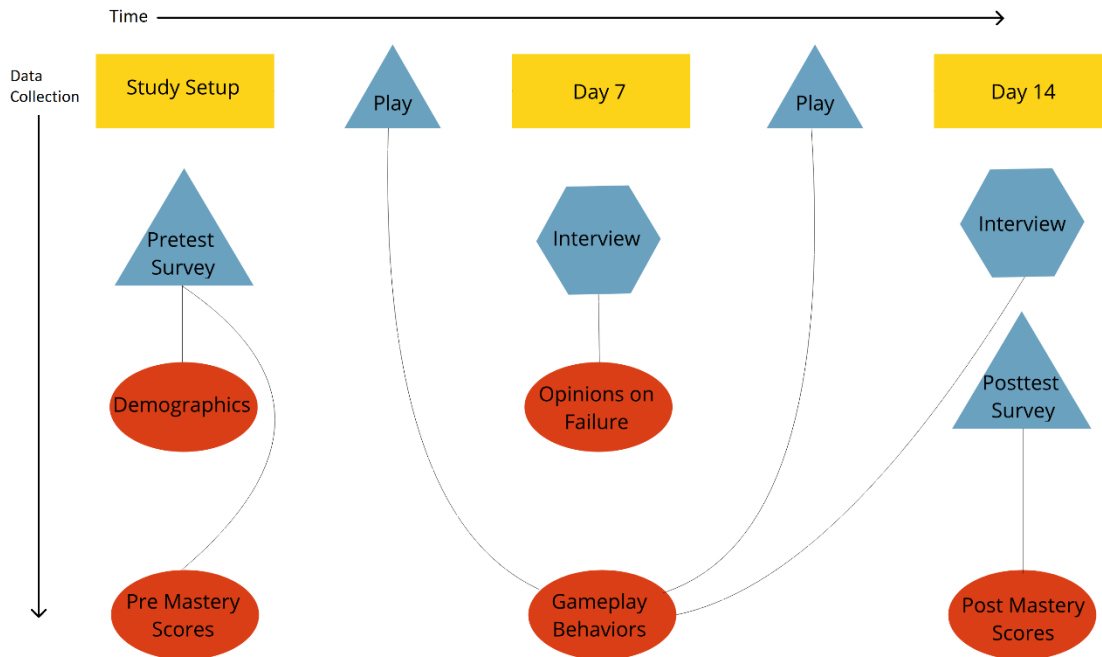
This study qualified as self-exempt under UCI HHRP policy #12 for meeting category 3i requirements: "The research involves behavioral interventions in conjunction with the collection of information from an adult subject through verbal or written responses (including data entry) or audiovisual recording if the subject prospectively agrees to the intervention and information collection and the behavioral interventions are brief in duration, harmless, painless, not physically invasive, not likely to have a significant adverse lasting impact on the subjects, and the investigator has no reason to think the subjects will find the interventions offensive or embarrassing. Provided all such criteria are met, examples of such benign behavioral interventions would include having the subjects play an online game, having them solve puzzles under various noise conditions, or having them decide how to allocate a nominal amount of received cash between themselves and someone else." As well as subcategory 3iA: "The information obtained is recorded by the investigator in such a manner that the identity of the

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human subjects CANNOT readily be ascertained, directly or through identifiers linked to the subjects."

As such, IRB review was not required, although records of all IRB materials were kept as a record of the study.

Recruitment was conducted through two avenues: departmental listserv and class announcements. Two departmental listservs were chosen for recruitment: Informatics undergraduates and Computer Science undergraduates. These listservs include all undergraduate students in the departments of Informatics, Computer Science, Software Engineering, Computer Game Science, and Business Information Management at the University of California, Irvine. Class announcements were made at the beginning of an undergraduate class titled "Video Games and Society". These avenues were chosen for convenience and as a space in which game-friendly undergraduate students could be reached. One student heard about the study through word of mouth and approached the researcher to participate. Students were asked to sign up for the study if they were interested in playing notoriously challenging game, *Cuphead*. Students were informed that for their participation they would get to keep the game and would receive a $20USD Amazon gift card upon completion of the study. Students signed up for the day they would prefer to begin the study in a Google doc by commenting their name on the preferred date or to leave their email on a paper signup sheet so their appointment could be confirmed. After all slots were filled, additional students who were interested in participating were added to a wait list and received an email if any participant dropped out. A total 3 individuals dropped out, with new participants filling the slots within a few hours. A total of 8 participants were turned away after all available slots were filled and all necessary data had been collected.

3.2.2 Setup

Participants were invited to a shared lab space to conduct their setup interview. During which, participants were welcomed and thanked for coming in. Next, they were asked if they have any experience playing *Cuphead* and if they are excited to play the game. Participants who had previously

completed the game were ineligible and replaced. Participants who had played some but had not completed it were permitted to play it again. This was done to ensure that there would be material that was new to the participant. Participants had the study details and requirements explained to them and were asked if they had any questions about the procedures and what was expected. Participants were informed that the data collected from the study would be completely anonymized and that nothing they did would be able to be traced back to them from any publication resulting from the study. After any questions were addressed, they were asked if they would like to participate. If they agreed, they were asked to accept a friend request through Valve's Steam platform (Valve, 2003), which is required to send game with the system. Once the game was sent, the participant was asked if they had any experience video recording their gameplay. If so, they were recommended to use the software that they are familiar with, and if not, they were instructed on how to use the Xbox Game Bar video recording software native to Windows 10 OS (Microsoft Corporation, 2018), Open Broadcast Software (OBS) for Mac (Bailey, 2012), or Quicktime, depending on their computer OS and preference. Participants were asked to send a 3-5 second clip of them playing through the game's tutorial via email when they installed the game to demonstrate that they had the game and video recording software installed and properly setup. Following this, the participant was asked to schedule two following interviews, one week and two weeks from their setup interview. They were informed that these interview would be conducted in a private interview space to alleviate any discomfort they might face from talking about their experiences in public. Next, the participant was asked to complete their opening survey through Qualtrics on the researcher's computer.

Participants were asked to play *Cuphead* for 2 weeks in their own preferred play environment. Participants were encouraged to play the game as if they had purchased it themselves and were playing in their own free time. The only requirement in their play was that they prioritized playing *Cuphead* in their leisure time over other games to ensure some footage was captured. It was emphasized that

participants should allow their own desires to dictate how much they played and that there was no minimum or maximum amount of time required for compliance. Participants were encouraged to avoid playing more than they desired and advised to stop playing if they ever felt as if they were forcing themselves to play to comply with the study. This method was chosen to allow for the capture of a natural play environment, in which players did not feel pressured to persist in order to comply with the research study. If participants were forced to play when they were discouraged, they might persist when they would naturally not. This would undermine the data that this study aims to collect.

3.2.3 Cuphead

Figure 3.2

Cuphead Gameplay

Cuphead is a "Run 'n Gun" style video game in which players fight enemies on a 2D level (figure 3.2). To reach these levels, players navigate a hand-drawn cartoon world, selecting a level by walking to it and selecting start (figure 3.3).

Figure 3.3

Cuphead Overworld

There are 4 different level styles throughout the game – boss levels, airplane levels, run 'n gun levels, and mausoleum levels. In boss levels, the player is placed on a non-scrolling stage and must defeat a boss as it goes through multiple stages. The airplane levels are similar to boss levels, except that the player is piloting an airplane with 2 set weapons that cannot be changed (figure 3.4).

Figure 3.4

Cuphead Airplane Style Level

In the run 'n gun levels, the player is placed in a scrolling stage with many weaker enemies and obstacles that the player must defeat or dodge to progress to the right side of the stage until they reach the end (figure 3.5).

Figure 3.5

Cuphead Run 'n Gun Style Level

Within these run 'n gun levels, players can collect coins that may be exchanged at a store found on the world map for new weapons or items that enhance the player's abilities. The weapons available to the player include a low-range but high damage spread shot, an auto-targeting but low-damage chaser shot, a long-range boomerang shot, a bouncing lob shot, and a high-damage charged shot. Defensive abilities available include health upgrades, increasing your life by one or two hit points, an upgraded dash that makes the player invulnerable while performing the move, an upgraded parry which automatically parries the first projectile encountered while jumping, an upgraded parry that damages the target parried, and a passive item that slowly charges the player's "Super Meter". Shooting enemies also builds up the player's "Super Meter" shown by playing cards at the bottom of the screen. One of these cards can be consumed to power up each of these weapons for a special effect.

Finally, mausoleum levels place the player in a room as pink ghosts rush in to possess an urn at the center. The player cannot shoot the ghosts but can double-jump to parry and defeat them. If any of the ghosts reach the urn, the player loses the level (figure 3.6).

Figure 3.6

Cuphead Mausoleum Style Level

Completing these mausoleum levels award special items that allow the player to consume all 5 cards at once will activate a powerful special ability, dealing massive damage, making the player invulnerable for a short time, or summoning a spirit that damages enemies. Without upgrades, players have 3 hearts, allowing them to be hit by a boss or projectiles up to 3 times before losing. Losing a level by being hit 3 times or having a ghost reach the urn in mausoleum levels results in the player being taunted (often through pun) and shown how far they progressed into the level on a slider (figure 3.7). At this screen, the player may choose one of 3 options – retry, exit to map, or quit game. Selecting retry will place the player at the start of the level to try again, exit to map will place the player back in the level-select world, and quit game will place the player at the opening screen of the game where they can exit the game or select a different save file.

Figure 3.7

Cuphead Game Over Screen
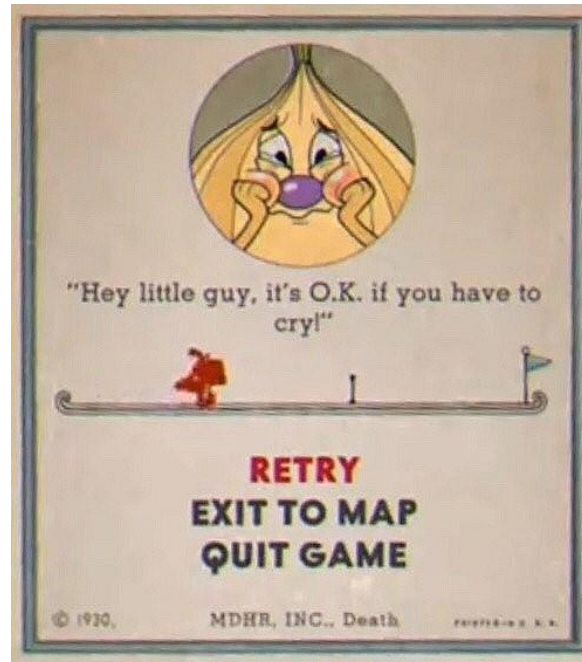
Cuphead contains a total of 28 levels, including 12 boss levels, 7 airplane levels, 6 Run 'n Gun levels, and 3 mausoleum levels. The player begins the game with access to 1 Run n' Gun level, and 2 boss levels. As they complete these levels on any difficulty, the map transforms and gives access to new levels. If they player completes a level on simple mode, they are reminded that they must complete all of the levels on regular mode to finish the game.

3.3 Data collection

3.3.1 Surveys

The surveys that participants were asked to complete during their setup and final interview were designed to gauge their mastery orientation in a game setting and a general setting. The general questions of the survey were taken from the mastery section of the Family and Work Orientation Questionnaire (Helmreich, Beane, Lucker & Spence, 1978). Previous literature has argued that mastery orientation can also be context dependent and recommend that the question be modified to fit the study. To this end, the questions were modified to a game setting as well. This was done by changing the language of the questions to reflect on the participant's attitude towards games where the questions

referred to their general attitudes. Participants were asked to rate how strongly they agree or disagree with 8 statements on a Likert scale ranging from "Strongly disagree" to "Strongly Agree". Questions in the general mastery orientation survey included:

1. I would rather do something at which I feel confident and relaxed than something that is challenging and difficult.

2. When a group I belong to plans an activity, I would rather direct it myself than just help out and have someone else organize it.

3. I would rather learn something easy than something difficult.

4. If I am not good at something, I would rather keep struggling to master it than move on to something I may be good at.

5. Once I undertake a task, I persist.

6. I prefer to work in situations that require a high level of skill.

7. I more often attempt tasks that I am not sure I can do than tasks that I believe I can do.

8. I like to be busy all the time.

   These questions were modified for the game context mastery orientation section as follows:

1. I would rather play a game at which I feel confident and relaxed than a game that is challenging and difficult.

2. When a group I belong to plays a game, I would rather call the shots myself than just help out and have someone else call the shots.

3. I would rather learn to play a game that is easy than one that is difficult.

4. If I am not good at a game, I would rather keep struggling to master it than move on to a game I may be good at.

5. Once I begin a game, I persist.

6. I prefer to play games that require a high level of skill.

7. I more often play games that I am not sure I can do than games that I believe I can do.

8. I like games that keep me busy all the time.

Each section is scored 1-5, 1 being strongly disagree and 5 being strongly agree. In both the general and game context sections, the first and third questions are reverse scored. This results in a mastery score for general contexts and for game-contexts, taken as a measure of how an individual perceives their reactions to failure in these two contexts.

Demographic information collected included participant age, gender identity, year in school, average number of gameplay hours per week, and number of years playing games. Average gameplay hours per week and years playing games was included as a measure of gameplay experience. While not taken as a measure of the number of hours the participant has played games throughout their lives, this was used to gauge how familiar the participant is with video games generally.

3.3.2 Game metrics

Game metric data were collected from gameplay videos via behavioral coding software, BORIS (Behavioral Observation Research Interactive Software; Friard & Gamba, 2016). This software was designed to allow researchers to code behaviors in video footage, primarily for animal behavior research. However, the software allows for the coding of any video, making it a useful tool to hand-code game metrics from gameplay videos as well. Hotkeys were created to allow coding of gameplay behaviors at a keypress. Codes were generated from game states denoting hard-coded fail states in *Cuphead* (hits), mastery-oriented behaviors (retries, adaptations), helpless-oriented behaviors (quits, deteriorations) and level markers (level start, phase complete, level complete).

A hit was defined as any time the player lost health. This can occur from colliding with a projectile, a boss, or can occur when the player fell into a hazardous area such as a pit. As the player can modify the number of hit points they have, losing all of their hit points and failing the level was denoted from actions taken at the game over screen.

A retry was defined as the player selecting the "RETRY" button at the game over screen after losing all their health in a level. This occurred only after the player lost all their health and encountered the game over screen.

An adaptation was defined as a player changing their strategy in response to encountering failure. If a player did not get hit while playing a level, they would not have a moment to change their strategy in response to a failure. Most often, adaptation was coded when the player encountered the same situation that caused a recent hit. For example, if a player fails to jump over the dirt clods spit out by the potato phase of the first boss and a hit was coded, and then subsequently started jumping over them the next time the boss started spitting them, it would be considered an adaptation of their strategy to pay attention to the projectile and avoid it by jumping. If a player avoided the projectile initially, got hit on a later attempt, and then resumed avoiding it, it would not be considered a change in strategy as the player demonstrated that they understood the strategy to begin.

A quit was defined as selecting either the "EXIT TO MAP" or "QUIT GAME" button at the game over screen after losing all their health, or the "EXIT TO MAP" button in the pause screen before losing all their health while playing.

A deterioration was defined as a player purposefully allowing themselves to take damage in response to failure, representing a deterioration of strategy and increase in ineffectual responses. A deterioration was only coded if the player's strategy deteriorated in response to a moment of failure. For example, if a player failed to avoid a projectile shot out by a boss and then immediately made efforts to run into the boss or another projectile, it would be considered an ineffectual response and deterioration of strategy.

3.3.3 Interviews

Participants were asked to meet the researcher for 2 interviews. Participants met the researcher in a private meeting space and were informed that this was to try to make sure they were more

comfortable talking about experiences that may have been frustrating. Doing so in public could cause the participants some discomfort potentially discouraging them to speak about their beliefs or feelings candidly. Participants were informed that the private meeting space was used to mitigate this discomfort and allow participants to speak honestly and candidly about their experiences. Participants were reminded that the interview would be audio recorded using a voice recorder on the researcher's computer.

During the first interview, participants handed in the gameplay videos that were taken the previous week and were asked about their general experiences playing Cuphead. Questions included:

1. Did you record all of your gameplay?

2. Does any of the video contain other people playing?

3. What do you think of Cuphead so far?

4. Do you typically enjoy playing "challenging" games?

5. Is Cuphead as hard as you thought?

6. When you start a new level, where would you put your expectations on a scale of 1-10, 1 being going to fail, 10 being going to win?

7. Does this change over time?

8. What do you consider "failure" in Cuphead?

9. What do you do when you fail?

10. How do you feel about failure?

11. What strategies have you used to get through the game?

12. What are some of your strategies for improving when you're having difficulties?

13. For what reasons did you stop playing?

14. What did you think of the levels you played?

15. What was the most fun level so far?

16. What was the hardest level so far and what did you think of it?

17. What was the easiest level so far and what did you think of it?

18. Did you consult any outside resources such as a strategy guide?

19. Why or why not?

20. Is there anything else you want to talk about?

Follow up on answers to these questions was conducted as well if deemed necessary and were done to explore further how the participant experienced and reacted to failure in *Cuphead*, and what other factors had influence on their experience.

The second interview was also conducted in a private meeting space to ensure that the participant would feel comfortable reviewing and talking about their gameplay. The interview followed a data-driven retrospective interview protocol, crafting questions directly from data collected from the participant's gameplay (El-Nasr, Durga, Shiyko & Sceooa, 2015). To craft these questions, coded gameplay was reviewed and taken as examples to form questions. Behavior changes coded as adaptations and deteriorations were selected to confirm the player's motivations. This included watching clips of their gameplay with the researcher to refresh their memory and then were asking about their motivations for changing their strategy. If the participant cited getting hit or as motivation for changing their behavior, the code was confirmed. For example, Participant 5 (P5) was observed to change their strategy while fighting the bosses in the third level, Ribby and Croaks. In the second phase of this fight, the bosses periodically shoot out fireball projectiles at three heights that the player must dodge. P5 encountered the boss using this ability a few times and got hit by failing to dodge or by trying to jump over the projectiles (figure 3.8).

Figure 3.8

Player Faced with Dodging Projectiles

However, this did not work - they took a point of damage, and died to the attack (figure 3.9).

Figure 3.9

Player Hit by Projectile

The next time that P5 encountered this ability, they changed their strategy to ducking under the projectiles, which prevented them from taking damage (figure 3.10).

Figure 3.10

Player Adapts Next Attempt

During their second interview, the participant was asked:

Researcher: "here, you start ducking under when they shoot the second one (projectile). Can you tell me a little about why you started ducking more often?".

Participant 5:

"I think that came from the realization that uh, from the clip before, I died just standing up. So I realized 'can I duck?' and when I tried it, it worked. So I was like, okay I'm just going to duck the second one because after a while I started realizing that if I jump the second one, I have to jump the third one, [and I] might not have enough time ."

This was taken as a moment in which P5 adapted to encountering a moment of failure. When they got hit, the next time they encountered the projectile they were hit by, they changed their strategy to one that was more effective, using failure as information on how to improve.

If the participant cited other reasons for changing their behavior, the code was removed, and adaptation or deterioration coding was modified to better capture mastery and helpless-oriented moments in their gameplay. For example, another change in strategy was coded as an adaptation of strategy in Participant 5's gameplay while fighting the boss in the second level, Gloopy Le Grande. During this fight, when the boss transitions to the second phase, it generates three pink question marks above it's head, which can be parried for extra points. On their initial encounters, P5 attempted to parry one of these question marks, and landed on top of the boss, taking damage (figure 3.11).

Figure 3.11

Player Lands on Goopy Le Grande

In a subsequent attempt, P5 parried all three of the question marks, which prevented them from taking damage from landing on the boss (figure 3.12).

Figure 3.12

Player Parries Pink Question Mark

In their second interview, the player was asked about this change in strategy:

Researcher: "Can you explain to me why you were putting more effort behind trying to parry all three (pink question marks)?"

Participant 5: "If I can use these to get the super meter up, and it's basically for free, why not just get all three if I can?"

Researcher: "So you would say this was more motivated to help you charge your meter. Would you say it was partially because when you only parried one, you'd get hit as well?"

Participants 5: "When I only parried one, I just felt like I could do more".

As the player noted that this change in strategy was motivated by obtaining super meter power and not because they were taking damage from landing on the boss, this was deemed not to be an adaptation in strategy in response to failure because it was not in responding to the hard-coded failure being recorded by this study. This code was subsequently removed, and further coding was informed to

better capture moments of strategy adaptation in response to failure. It was noted that this could be considered a reaction to failure if the player had set themselves a goal of filling their super meter as quickly as possible. However, since this study focuses on reactions to hard-coded fail states, this was considered outside of the scope of the study.

Approximately 10 clips were confirmed with each participant during their second interview depending on the length of their gameplay and number of moments of failure. If the participant had more adaptations in their gameplay than was deemed necessary or efficient to confirm with the participant, a sample of approximately 10 adaptations or deteriorations were observed and confirmed. After confirmation of these codes, participants were asked more questions about their experiences with the game based on general gameplay trends observed. They also handed in their second week of gameplay footage which was subsequently coded, taking into account any changes to the coding that arose during their second interview.

Game metrics were exported into a csv file for analysis. Some data transformation was required for analysis and was done in RStudio (See Appendix C for data cleaning scripts). Time of event was calculated by converting the date and time that the file was created to its corresponding epoch time. Each event was then was tagged with an epoch time based on the number of seconds after the start of the video it occurred. Current level for each event was calculated by tagging the level a player entered, then tagging all subsequent events until they exited that level via quit game, exit to map, or completed the level. Current phase for each event was also calculated by tagging the start of level as the first phase, increasing by one when they completed a phase and resetting to zero when they exited or completed the level.

Play patterns of interest were also tagged, including when a player restarted a level before losing all their lives (restart), and when a player gave up on a level before completing it (abandon). Distinct from a retry, a restart was defined as when a player selects the retry button during play before

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losing all their health in a level. Restarts were not coded for directly but were captured through a

sequence of codes. When the player restarted a level before losing all their health, the behavior was

coded with quit and then retry. These instances were later coded as a restart through RStudio, in

addition to both a quit and retry. This was done because the player is not only choosing to quit the level

early, but also to retry, making it a special instance of behavior that could be used to describe both

mastery-oriented behavior as well as helpless-oriented behavior.

Retries and adaptations were considered mastery-oriented behaviors. Mastery-oriented

individuals are described in the psychology literature as reacting to failure by retrying the task and using

failure as information for improving. These behaviors would be what one would expect to see for

someone who scores high on the mastery orientation scale. As such, these behaviors were summed as

mastery-oriented behaviors.

Quits and deteriorations were considered helpless-oriented. Helpless-oriented individuals are

described in the psychology literature as reacting to failure by giving up or increasing ineffectual

responses. These behaviors would be what one would expect to see for someone who scores low on the

mastery orientation scale. As such, these behaviors were summed as helpless-oriented behaviors.

Number of mastery behaviors until a helpless behaviors was also calculated to capture how long

an individual will persist before giving up. This was calculated in RStudio by tallying actions that are

tagged as mastery-oriented (retry or adaptation) until a helpless-oriented behavior (quit or

deterioration) is observed.

Survey data were transformed to a number scale, with questions 1 and 3 of each survey reverse

scored. Scores from the game mastery orientation survey were summed to create a game mastery for

both pre and post intervention. Scores from the general mastery orientation were summed to create a

general mastery score for both pre and post intervention. This resulted in a scale that ranged from 8 to

40, with a high number denoting a more mastery-oriented response. A score of 24 would result in a

neutral score, with the participant responding as neither agree nor disagree to every question on the survey.

The data were checked for inaccuracy by looking for impossibilities such as players getting hit outside of a level, or a player retrying a level before receiving three hits or quitting the level. When a discrepancy was found in the data, the gameplay video was consulted to determine where the inaccuracy originated. Events that were improperly coded or missing were modified or replaced to correct the inaccuracy. Once the data were sufficiently cleaned, the planned analyses were conducted.

3.4 Analyses

Before formal analyses were conducted, Sapiro-Wilk tests for normality were conducted on pre game mastery orientation score, pre general mastery orientation score, outro game mastery orientation score, outro general mastery orientation score, number of mastery-oriented behaviors per hit, number of helpless-oriented behaviors per hit, ratio of mastery-oriented behaviors to helpless-oriented behaviors, average number of mastery-oriented behaviors exhibited until a helpless-oriented behaviors is exhibited, number of times a level was abandoned, total gameplay, game experience score, and age. Density plots and qq plots were used to visualize the data to view non-normal data to determine if transformation was warranted.

After transformation of the data for normalization of the distributions, planned analyses were conducted to answer the study research question and sub questions. Linear modeling was conducted between number of mastery-oriented behaviors per hit logged and scores from each of the four surveys; number of helpless-oriented behaviors per hit logged and scores from each of the four surveys; ratio of mastery-oriented behaviors per hit to helpless-oriented behaviors per hit and scores from each of the four surveys; average number of mastery-oriented behaviors exhibited until a helpless-oriented behaviors is exhibited logged and scores from each of the four surveys; number of times a level is

abandoned before completion logged and scores from each of the four surveys; and total amount of gameplay footage in seconds logged and scores from each of the four surveys.

Multivariate modeling was also conducted to capture interactions. To this end, two models were tested: scores from each of the four surveys were first compared with number of mastery-oriented behaviors per hit logged, ratio of mastery-oriented behaviors to helpless-oriented behaviors logged, average number of mastery-oriented behaviors exhibited until a helpless-oriented behavior is exhibited logged, and total amount of gameplay in seconds logged. Factors that were not significant were removed from the model until the best fit was found. The second model was designed to view interactions between helpless-oriented behaviors and mastery scores. This model tested scores from each of the four surveys with number of helpless-oriented behaviors logged, ratio of mastery-oriented behaviors to helpless-oriented behaviors logged, number of mastery-oriented behaviors exhibited until a helpless-oriented behavior is exhibited logged, number of times a level is abandoned before completion logged, and total amount of gameplay in seconds logged. Factors that were not significant were removed from the model until the best fit was found.

Analysis of Variance modeling was conducted to test differences in mastery orientation scores and behaviors between reported gender identities and year in undergraduate program. These were compared against pre game mastery scores, post game mastery scores, pre general mastery scores, post general mastery scores, number of mastery-oriented behaviors per hit logged, number of helpless-oriented behaviors per hit logged, average number of mastery-oriented behaviors exhibited until a helpless-oriented behavior is exhibited logged, the ratio of mastery-oriented behaviors to helpless-oriented behaviors logged, and number of times a level was abandoned before completion logged.

Linear modeling was conducted between age and game experience scores, and pre game mastery scores, post game mastery scores, pre general mastery scores, post general mastery scores, number of mastery-oriented behaviors per hit logged, number of helpless-oriented behaviors per hit

logged, average number of mastery-oriented behaviors exhibited until a helpless-oriented behavior is

exhibited logged, the ratio of mastery-oriented behaviors to helpless-oriented behaviors logged, and

number of times a level was abandoned before completion logged.

T-tests were conducted between reported gender and pre game mastery score, post mastery

score, pre general mastery score, post mastery score, and change in mastery score to investigate gender

differences in survey responses.

To view patterns between level phases and mastery or helpless-oriented behaviors, frequencies

of behaviors were conducted on mastery-oriented behaviors per hit, helpless-oriented behaviors per hit,

level abandons, and average number of mastery-oriented behaviors exhibited before a helpless-

oriented behavior is exhibited, for each phase of each level attempted. Choosing simple or expert

difficulty or playing a level with 2 players changed the goals and playstyle of the level and was recorded

as a separate level, however for simplicity, only levels played as a single player on regular mode were

used for this analysis. The following Guzdail chart summarizes the data collected and analyses

conducted to answer the proposed research question and sub questions.

Table 3.1

Guzdial Chart for Data and Analyses used for Sub Research Questions

Research Questions	Data collected	Analyses
SubQ 1: Do individuals who score higher on the mastery-orientation survey perform more mastery-oriented behaviors in *Cuphead*?	• Mastery score pre/post • Count of mastery/helpless-oriented behaviors	• Linear regression between mastery score vs mastery behaviors
SubQ 2: Do mastery-oriented individuals perform more mastery-oriented behaviors before performing helpless-oriented behaviors in Cuphead?	• Mastery score pre/post • Count of mastery-oriented behaviors before helpless-oriented behavior • Game metric data (i.e. phase/level complete)	• Linear regression between mastery score vs mastery-oriented behaviors before helpless-oriented behaviors
SubQ 3: What level features encourage players to persist	• Game metric data (i.e. phase/level complete) • Count of mastery behaviors	• Frequencies of mastery-oriented behaviors between levels and phases

through failure in *Cuphead* the most?	• Count of mastery behaviors before helpless behaviors	
SubQ 4: Does mastery-orientation score increase with more game or failure exposure?	• Mastery score deltas • Count of mastery/helpless-oriented behaviors • Time played • Game experience	• Linear regression between mastery score delta and game experience, time in game, and count of mastery-oriented behaviors
SubQ 5: What demographic differences appear in mastery-oriented behaviors in *Cuphead* or mastery score?	• Demographics (Gender, Age) • Mastery score • Count of mastery behaviors	• T-tests and linear regression of mastery scores and mastery-oriented behaviors between reported gender identities

A power analysis was conducted in R to determine the required sample size for the proposed research. A medium effect size (0.5) was assumed for these analyses, desired power was set at 0.8, and alpha was set at 0.05. was With these factors, the multiple regression analyses would require a sample size of at least 32, and the t-tests would require a sample size of at least 128. As this methodology limits number of participants per day to 1, this was deemed too onerous to logistically carry out in the timeframe of this dissertation. This would require over 28 weeks of data collection, assuming a participant attrition rate of 10% and gaps in the rolling recruitment. Instead, this study limited the sample size to 60, which would require an effect size of 0.74, but could be completed in a more reasonable amount of time. A post-hoc power analyses was conducted on the collected data to measure the actual power and effect size of the data used for the t-tests and a permutation t-test was conducted to verify results.

3.5 **Data**

3.5.1 Participants

Of the 60 participants recruited, 23 identified as female and 37 identified as male. Participants age ranged from 17 to 26, with an average of 19.98 (SD = 2.24). 19 were in the first year of their program, 13 were in the second year, 14 were in the third year, 8 were in the fourth year, 1 was in their

fifth or later year, and 1 participant was enrolled in a graduate program. Average number of hours

playing video games per week ranged from 0 to 50, with an average of 15, a standard deviation of 12.45,

and median of 10. Number of years playing games ranged from 1 to 21, with an average of 11.45, a

standard deviation of 4.65, and a median of 12. Participant's game experience score was calculated by

multiplying average number of hours playing video games per week by 52 and number of years playing

video games. This was taken as a score of general game familiarity, not as a calculation of how many

hours the participant has played video games throughout their life. This score ranged from 0 to 42120,

with an average of 9913.66, a standard deviation of 8811.61, and a median of 8060.00.

3.5.2 Gameplay Data

A total of 434 gameplay files were handed in, 28 of which only contained the opening cutscene

or tutorial and did not contain codable gameplay footage, resulting in 406 total videos coded. Number

of gameplay files per person ranged from 2 to 29, averaging between 7 and 8 gameplay files. Total

amount of gameplay coded was 256 hours, 23 minutes, and 30 seconds. Participants averaged 37

minutes and 55 seconds of gameplay per file, and averaged a total of 4 hours, 34 minutes, 38 seconds of

gameplay footage. This resulted in a data corpus containing 67637 lines of gameplay data, each

representing a coded event in the gameplay data.

3.5.3 Interview Data

A total of 116 files were recorded during participant interviews totaling 85 hours, 56 minutes,

and 14 seconds. This interview data was partially transcribed, selecting for specific questions pertinent

to the data used for this dissertation. These questions included "Is [Cuphead] as hard as you thought?",

"on a scale from 1 to 10, 1 being definitely going to fail and 10 being definitely going to succeed, where

would you put yourself on your very first attempt at a level?", and "what do you consider 'failure' in

Cuphead?". These data were used to inform the interpretation of the findings and for future research.

3.5.4 Normality Tests

Shapiro-Wilk normality tests summarized in table 3.2 showed that pre game mastery score, pre general mastery score, and post general mastery score were normally distributed. Post game mastery score was found to be non-normally distributed, showing a bimodal distribution (figure 3.13). Number of mastery-oriented behaviors per number hit (figure 3.14), number of helpless-oriented behaviors per hit (figure 3.15), ratio of mastery-oriented behaviors per hit to helpless-oriented behaviors per hit (figure 3.16), average number of mastery-oriented behaviors exhibited until a helpless-oriented behaviors was exhibited (figure 3.17]), number of times a level was abandoned before completion (figure 3.18), total amount of gameplay (figure 3.19), and game experience score were all found to be non-normally distributed (figure 3.20), skewing to the right. Log transformations of the skewed data were generated and check for normality using Shapiro-Wilk tests, showing normal distributions (table 3.2), apart from game experience score, which was squared to achieve normality. Post game mastery score was not adjusted, as a bimodal distribution does not affect the assumptions for regression analyses.

Table 3.2

Shapiro-Wilk Normality Tests

Factor	W	p-value	Transformed W	Transformed p value
Pre Game Mastery Score	0.98	0.57		
Pre General Mastery Score	0.97	0.25		
Post Game Mastery Score	0.94	0.01*		
Post General Mastery Score	0.97	0.24		
Mastery Behaviors per hit	0.86	<0.01*	0.96	>0.05
Helpless Behaviors per hit	0.73	<0.01*	0.99	0.86
Mastery to Helpless Behavior ratio	0.66	<0.01*	0.97	0.14
Average Mastery Behaviors Until Helpless Behavior	0.76	<0.01*	0.98	0.42
Level Abandons	0.77	<0.01*	0.96	0.10
Total Time in Game	0.79	<0.01*	0.98	0.50
Game Experience Score	0.89	<0.01*	0.99	0.77

Note. A significant p-value for Shapiro-Wilk Normality test indicates a non-normal distribution.

Figure 3.13

Game Mastery Post Test Density Plot

Density plot of Game Mastery Outro
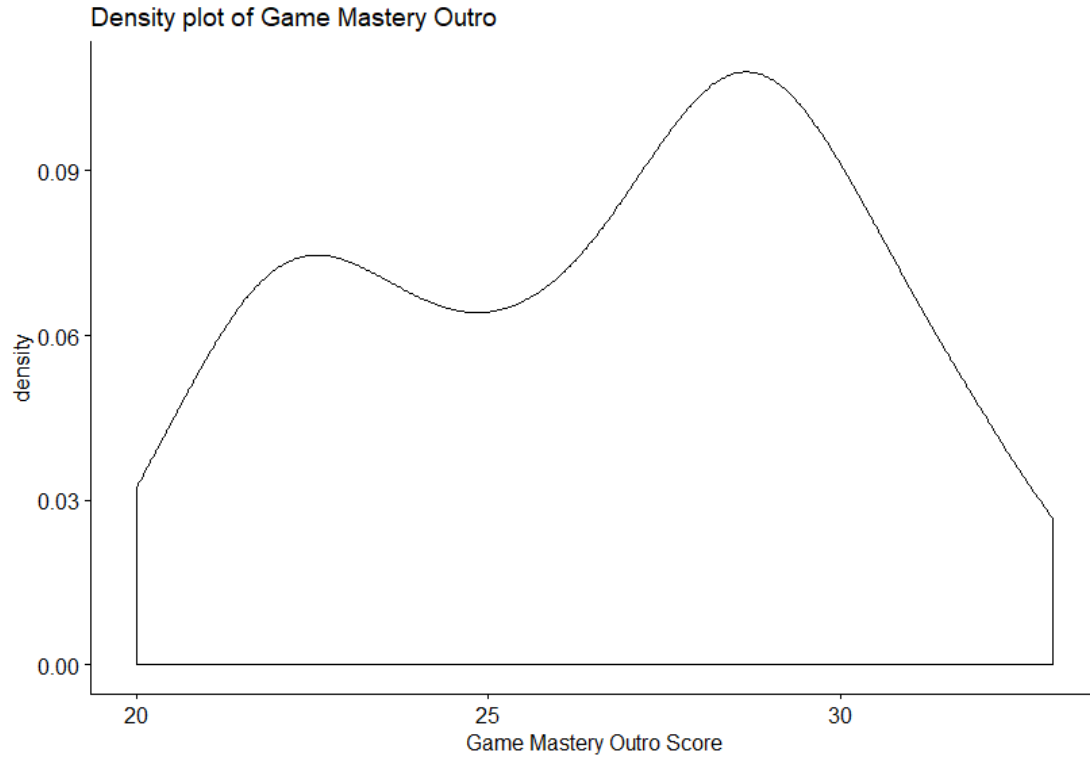
Figure 3.14

Mastery-Oriented Behavior Frequency Density Plot

Density plot of mastery behaviors per hit
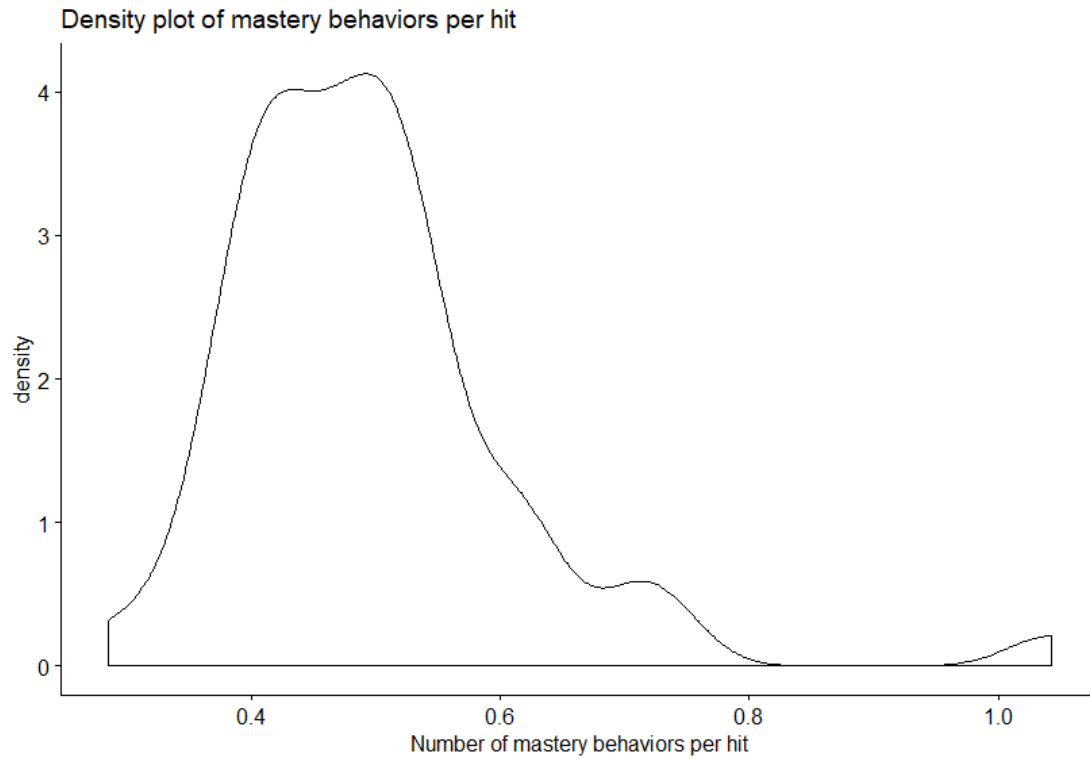
Figure 3.15

Helpless-Oriented Behavior Frequency Density Plot

Density plot of helpless behaviors per hit
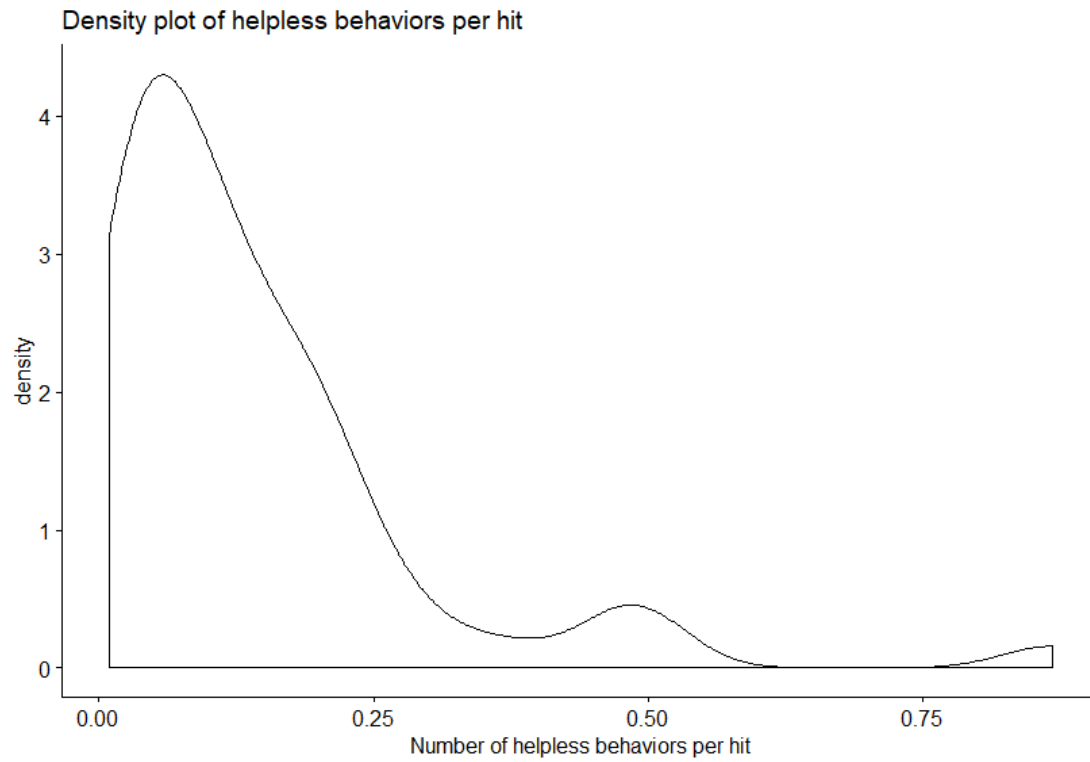
Figure 3.16

Ratio of Mastery-Oriented to Helpless-Oriented Behaviors Per Hit
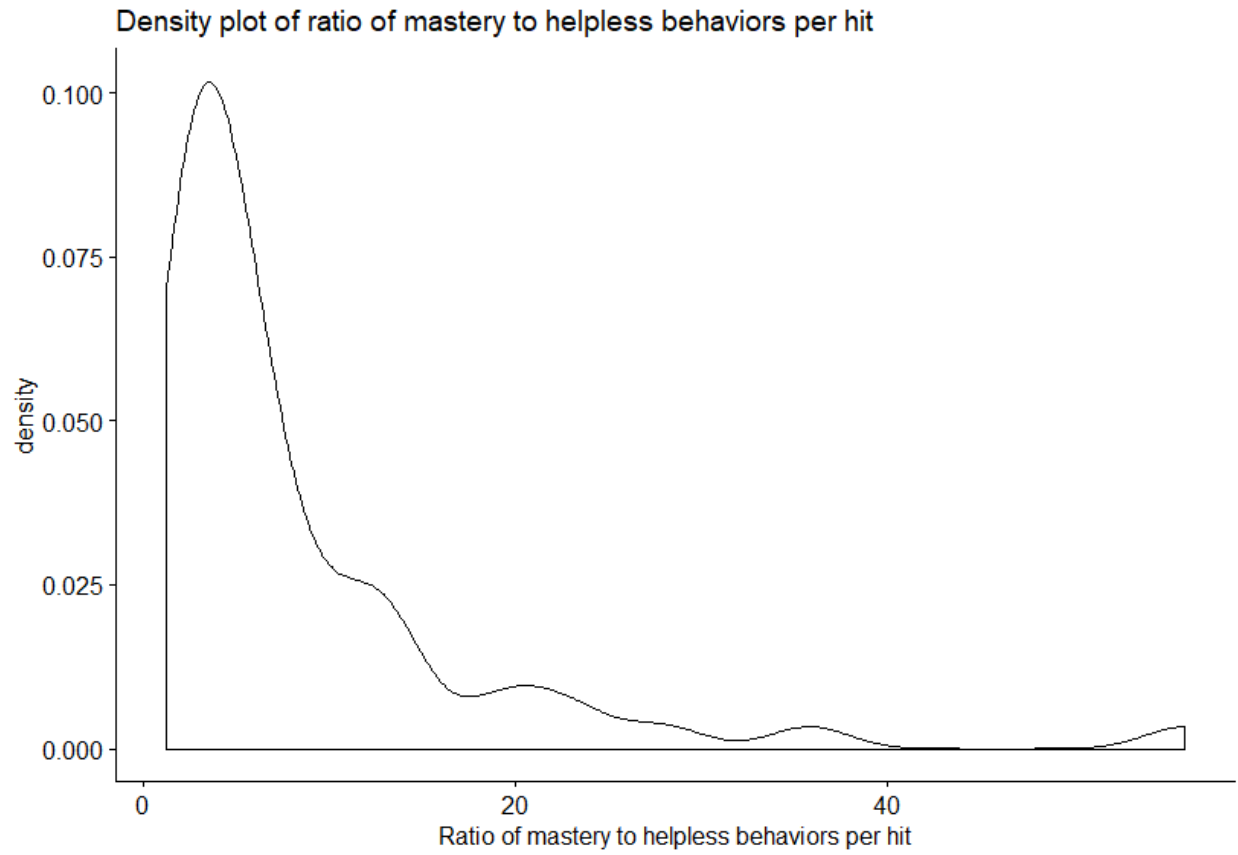
Figure 3.17

Average Mastery-Oriented Behaviors Until Helpless-Oriented Behavior Density Plot

Density plot of mastery behaviors until helpless behavior average
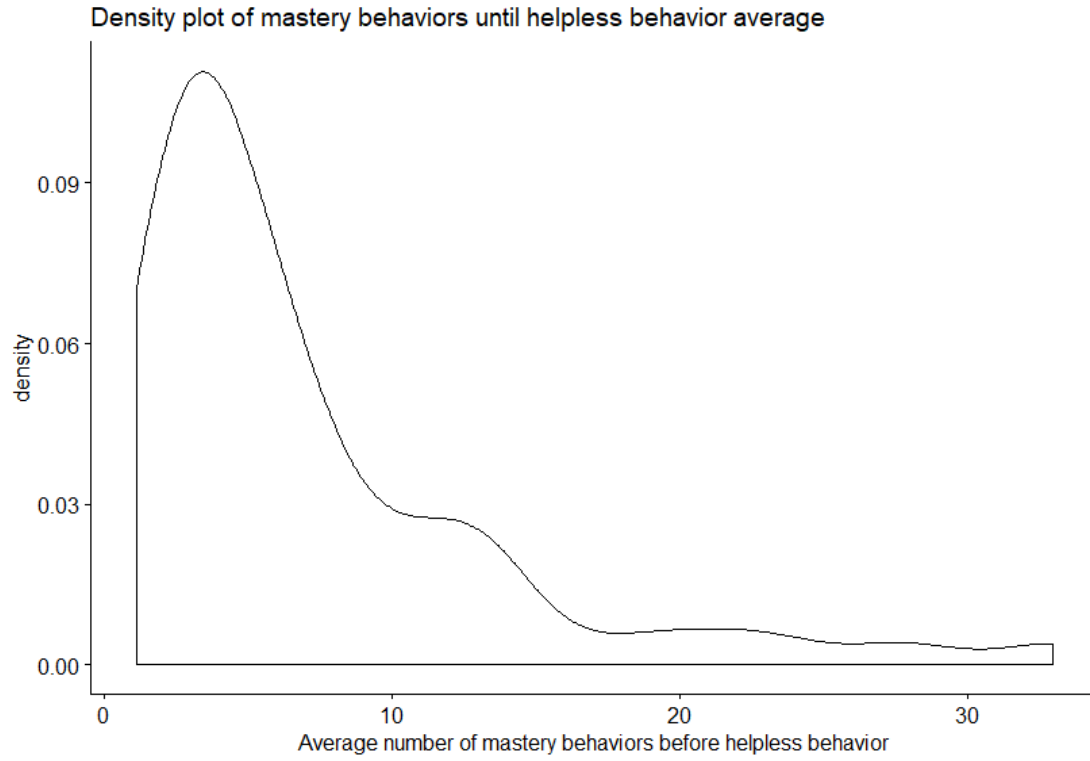
Figure 3.18

Level Abandon Density Plot

Density plot of level abandons
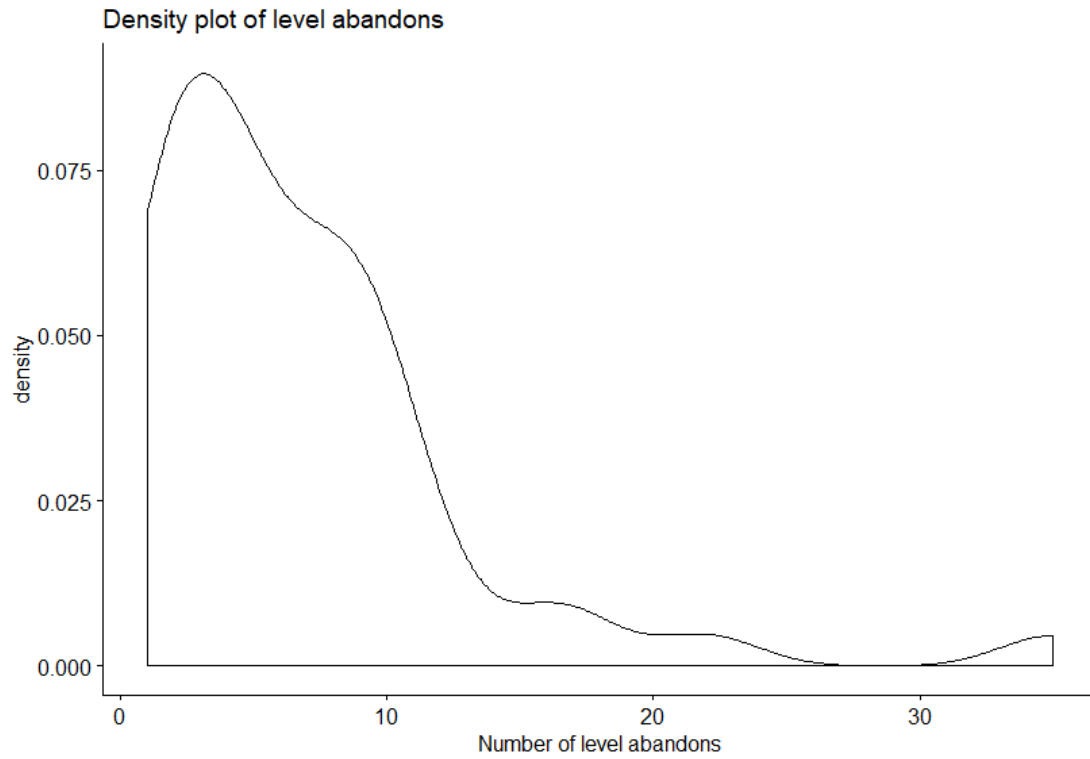
Figure 3.19

Total Gameplay Density Plot

Density plot of gameplay length
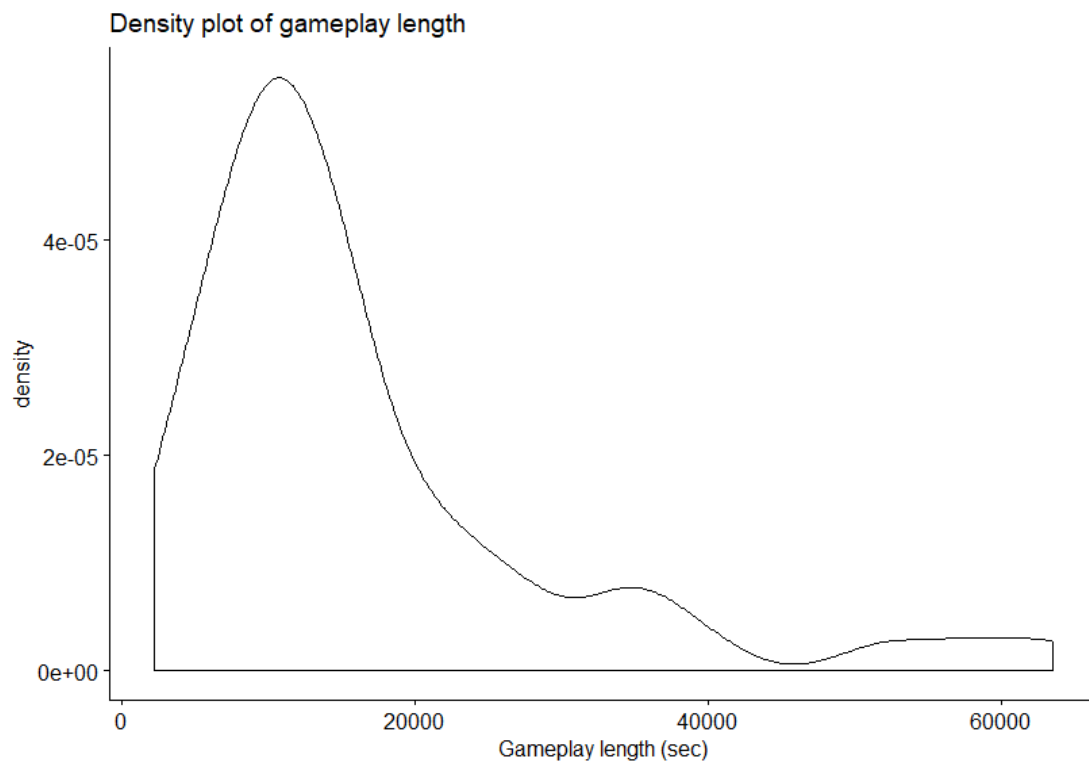
Figure 3.20

Game Experience Score Density Plot

Density plot of game experience score
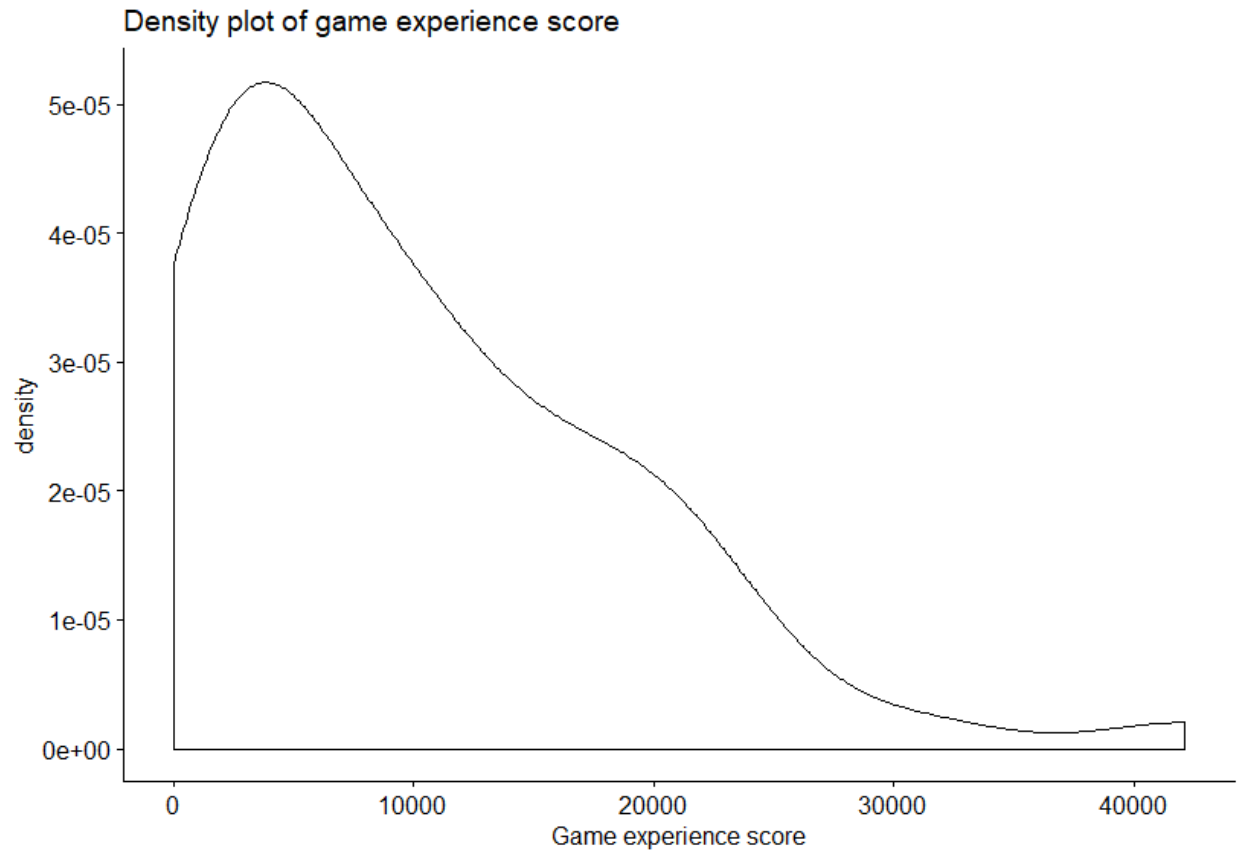
Chapter 4: Results and Discussion

4.1 Results

4.1.1 Summary of the Results

Results validate the behavioral method developed in this study, showing that individuals who score higher on the mastery orientation scale are more likely to show mastery-oriented behaviors overall and sequentially, and less likely to give up before completing a level. Results also suggest that playing *Cuphead* for two weeks had a leveling out effect on individual's mastery-orientation scores, with those who began the study with a higher scores lowering and those who started the study with a lower score, raising. This appeared to be especially true for men and women - whereas an initial gender gap was visually found in mastery-orientation, this gap closed with women increasing and men decreasing in mastery orientation scores. Finally, results show multiple patterns emerge in mastery-oriented and helpless-oriented behaviors across phases and level of *Cuphead*, suggesting some areas that illicit these reactions more than others. These results are detailed below.

4.1.2 Descriptive Statistics

Min, max, mean, median, and standard deviation for survey and behavioral data are reported in Table 4.1:

Table 4.1

Descriptive Statistics of Survey and Behavioral Data

	Min	Max	Mean	Median	Standard Deviation
Pre Game Mastery Score	16	38	27.50	28.00	4.84
Post Game Mastery Score	20	33	26.61	27.5	3.51
Delta Game Mastery Score	-12	12	-0.80	-0.50	4.84
Pre General Mastery Score	20	36	27.32	27.00	4.06
Post General Mastery Score	16	34	26.00	25.00	4.01
Delta General Mastery Score	-10	7	-1.39	-2.00	4.29
Number of Mastery-Oriented Behaviors Per Hit	0.28	1.04	0.50	0.10	0.12
Number of Helpless-Oriented Behaviors Per Hit	0.01	0.87	0.14	0.10	0.15

Average Number of Mastery-Oriented Behaviors Until a Helpless-Oriented Behavior	1.12	33.00	7.16	4.67	6.73
Ratio of Mastery-Oriented to Helpless-Oriented Behaviors	1.20	56.00	7.16	4.67	9.66
Number of Levels Abandoned	0	35	5.34	4.00	6.29
Game Experience Score	0	42120	9914	8060	8811.61
Total Amount of Gameplay in Seconds (hours)	2213s (0.61h)	63485s (17.63h)	16478s (4.58h)	12359s (3.43h)	13121s (3.64h)

4.1.3 Univariate Linear Models

Univariate linear modeling between mastery orientation survey scores and number of mastery-oriented behaviors per hit logged shows a negative association between number of mastery-oriented behaviors logged and game mastery orientation score delta, summarized in table 4.2 and visualized in figure 4.1:

Table 4.2

Linear Modeling of Mastery-Oriented Behaviors Per Hit Logged and Mastery Survey Scores

	Estimate	Std. Error	t value	p value
Pre Game Mastery Score	0.01	0.01	1.96	>0.05
Pre General Mastery Score	0.01	0.01	1.03	0.31
Post Game Mastery Score	-0.00	0.01	-0.34	0.74
Post General Mastery Score	0.00	0.01	0.03	0.97
Delta Game Mastery Score	-0.01	0.01	-2.23	0.03*
Delta General Mastery Score	-0.01	0.01	0.95	0.34

Figure 4.1

Linear Modeling of Mastery-Oriented Behaviors Per Hit and Delta Game Mastery Survey Scores
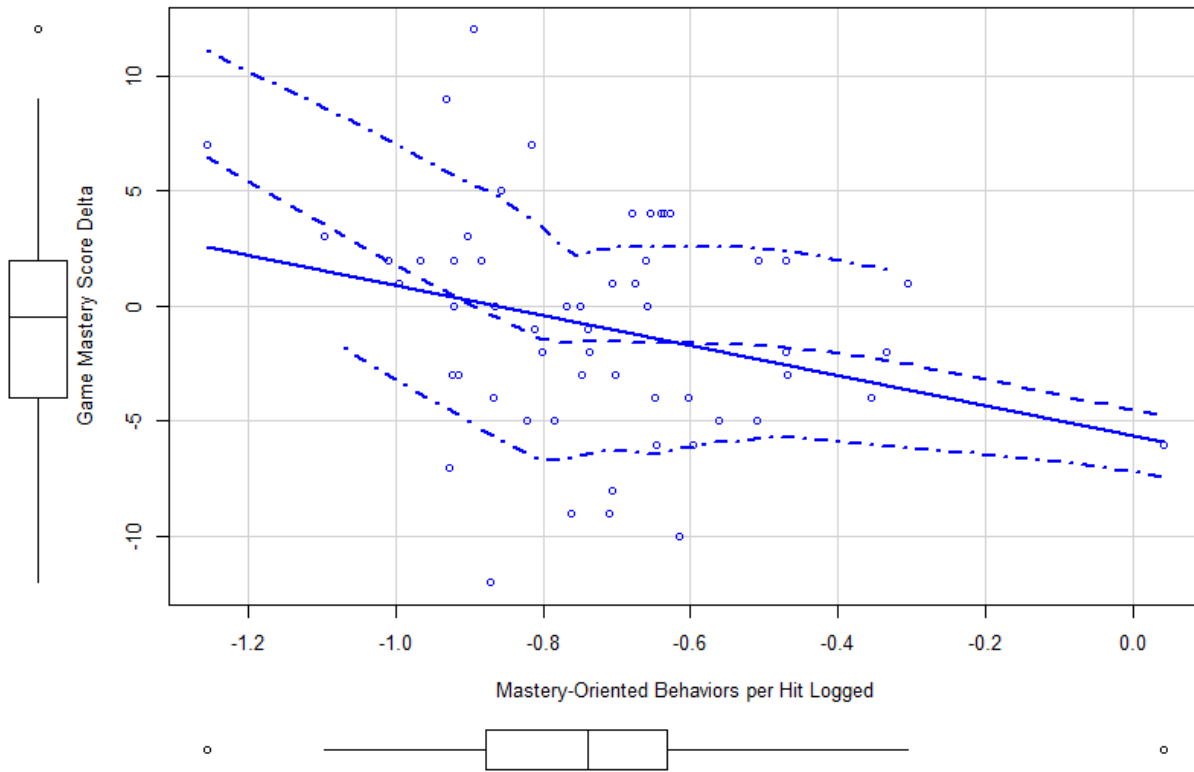
Univariate linear modeling between mastery orientation survey scores and number of helpless-oriented behaviors per hit logged show no associations between number of helpless-oriented behaviors and mastery orientation scores or deltas, summarized in table 4.3:

Table 4.3

Linear Modeling of Helpless-Oriented Behaviors Per Hit and Mastery Survey Scores

	Estimate	Std. Error	t value	p value
Pre Game Mastery Score	-0.03	0.03	-1.04	0.30
Pre General Mastery Score	-0.06	0.03	-1.75	0.09
Post Game Mastery Score	-0.03	0.04	-0.65	0.52
Post General Mastery Score	0.01	0.03	0.24	0.81
Delta Game Mastery Score	0.01	0.03	0.56	0.58
Delta General Mastery Score	0.06	0.03	-1.86	0.07

Univariate linear modeling between mastery orientation survey scores and ratio of mastery-oriented to helpless-oriented behaviors per hit logged shows a positive association between ratio of

66

mastery-oriented to helpless-oriented behaviors and pre game mastery orientation score, and a negative association with general mastery orientation score delta. These findings are summarized in table 4.4 and visualized in figure 4.2-4.3:

Table 4.4

Linear Modeling of Ratio of Mastery-Oriented Behaviors to Helpless-Oriented Behaviors and Mastery Survey Scores

	Estimate	Std. Error	t value	p value
Pre Game Mastery Score	0.04	0.02	1.70	0.10
Pre General Mastery Score	0.07	0.03	2.33	0.02*
Post Game Mastery Score	0.02	0.03	0.67	0.51
Post General Mastery Score	-0.01	0.03	-0.27	0.79
Delta Game Mastery Score	-0.03	0.02	-1.19	0.24
Delta General Mastery Score	-0.06	0.03	2.43	0.02*

Figure 4.2

Linear Modeling of Ratio of Mastery-Oriented to Helpless-Oriented Behaviors and Pretest General Mastery Survey Scores
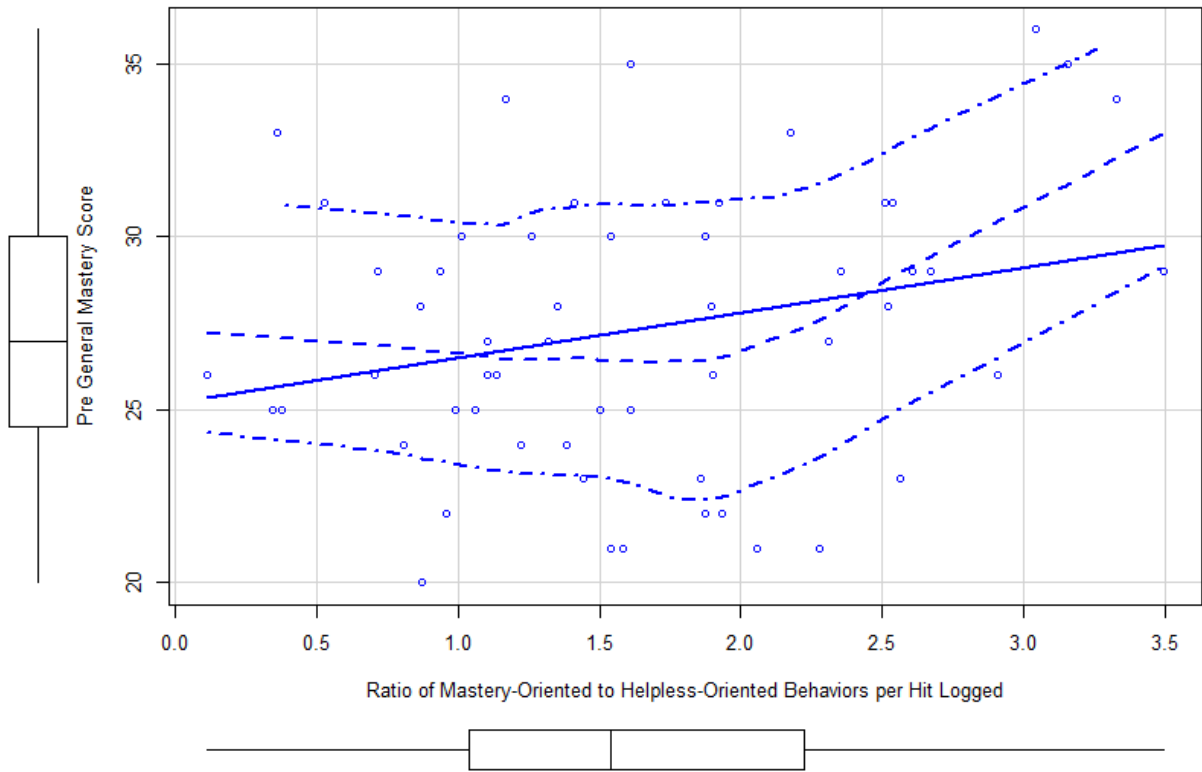
Figure 4.3

Linear Modeling of Ratio of Mastery-Oriented to Helpless-Oriented Behaviors Per Hit Logged and General

Mastery Score Delta
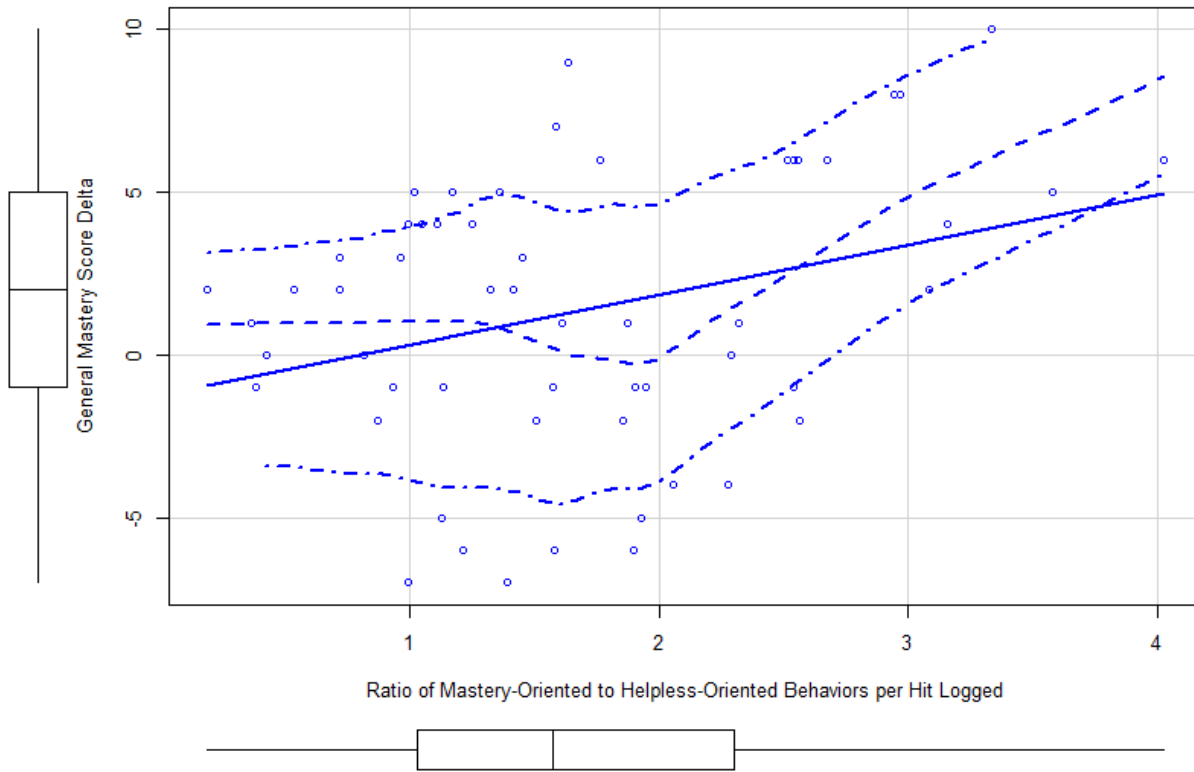
Univariate linear modeling between mastery orientation survey scores and average number of mastery-oriented behaviors before a helpless-oriented behavior per hit logged shows a significant negative association between average number of mastery-oriented behaviors before a helpless-oriented behavior and delta general mastery scores as summarized in table 4.5 and visualized in figure 4.4:

Table 4.5

Linear Modeling of Average Number of Mastery-Oriented Behaviors Until a Helpless-Oriented Behavior and Mastery Survey Scores

	Estimate	Std. Error	t value	p value
Pre Game Mastery Score	0.03	0.02	1.45	0.15
Pre General Mastery Score	0.05	0.03	1.98	>0.05
Post Game Mastery Score	0.03	0.03	0.83	0.41
Post General Mastery Score	-0.01	0.03	-0.27	0.79
Delta Game Mastery Score	-0.02	0.02	-0.83	0.41
Delta General Mastery Score	-0.05	0.02	2.10	0.04*

Figure 4.4

Linear Modeling of Average Number of Mastery-Oriented Behaviors before a Helpless-Oriented

Behaviors and Delta General Mastery Survey Scores
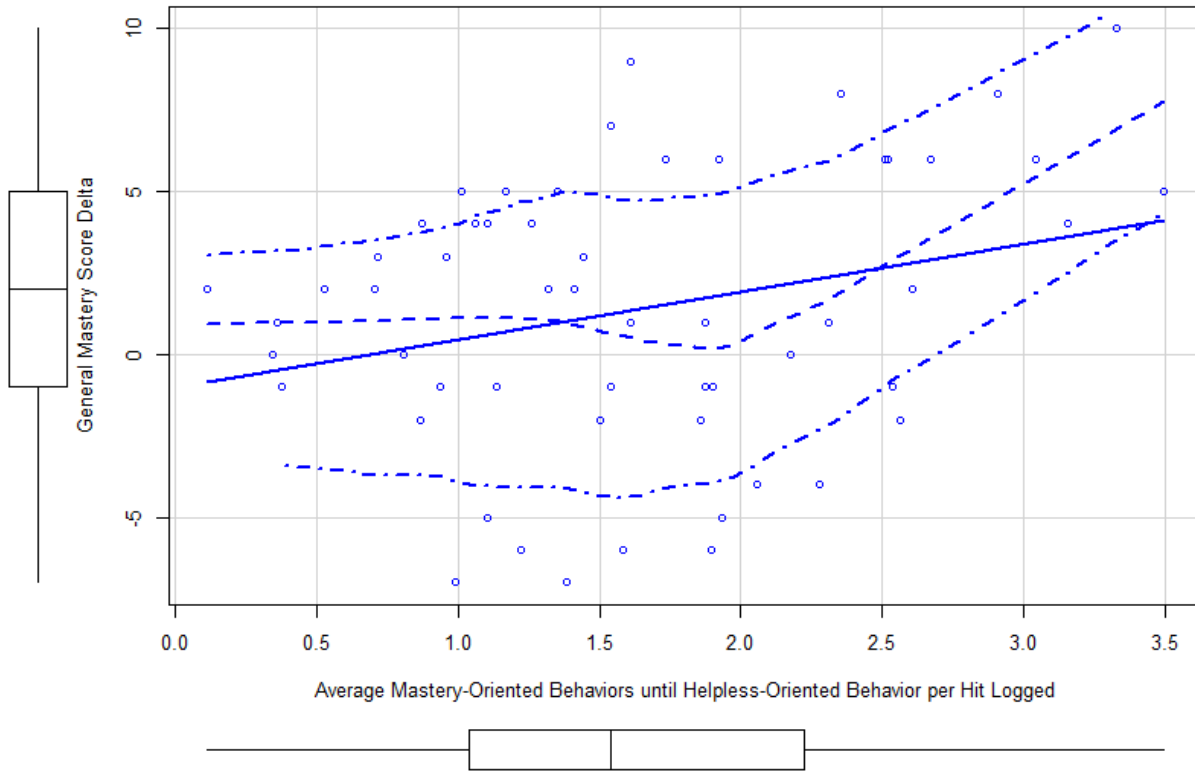
Univariate linear modeling between mastery orientation survey scores and number of levels abandoned logged shows a significant negative association between number of number of levels abandoned logged and pre game mastery scores, a positive association between delta game mastery orientation scores, and a negative association with delta general mastery orientation as summarized in table 4.6 and visualized in figures 4.5-4.7:

Table 4.6

Linear Modeling of Level Abandons and Mastery Survey Scores

	Estimate	Std. Error	t value	p value
Pre Game Mastery Score	-0.07	0.03	-2.43	0.02*

Pre General Mastery Score	-0.01	0.03	-0.26	0.80
Post Game Mastery Score	0.02	0.04	0.41	0.69
Post General Mastery Score	0.06	0.03	1.95	0.06
Delta Game Mastery Score	2.06	0.84	2.45	0.02*
Delta General Mastery Score	-1.50	0.64	-2.33	0.02*

Figure 4.5

Linear Modeling of Number of Levels Abandoned and Pretest Game Mastery Survey Scores
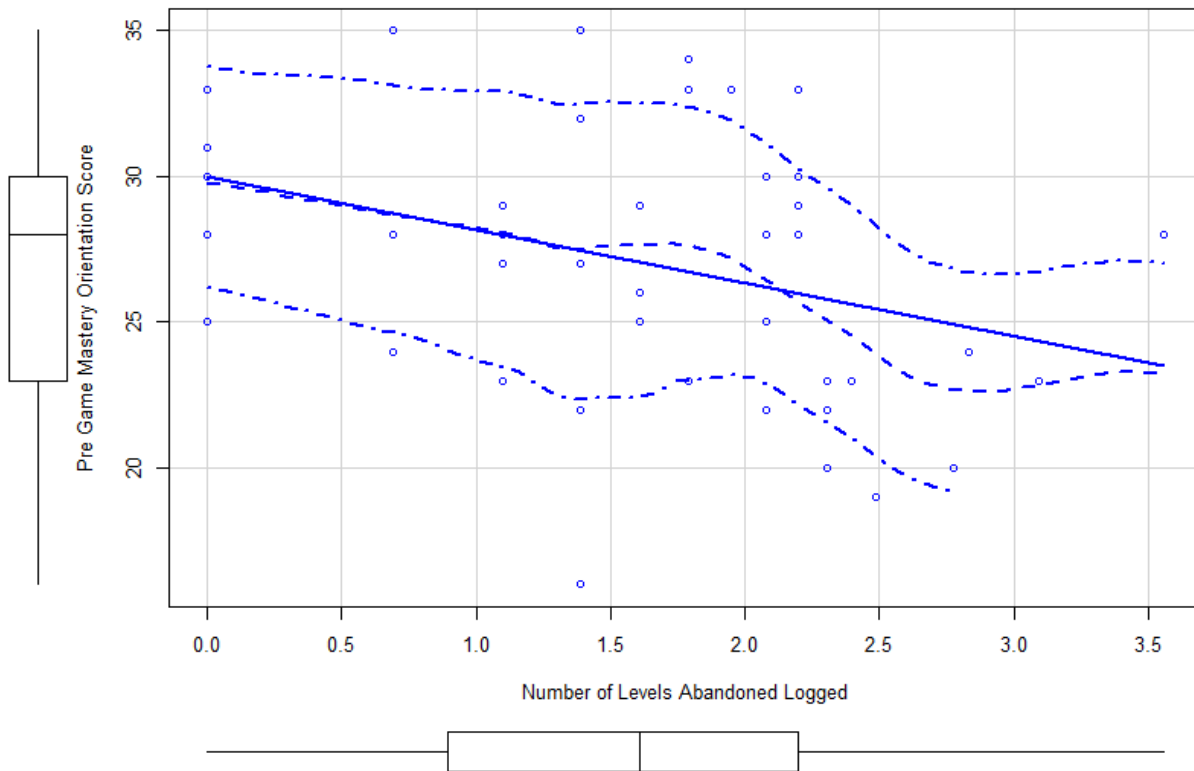
Figure 4.6

Linear Modeling of Number of Levels Abandoned and Delta Game Mastery Survey Scores
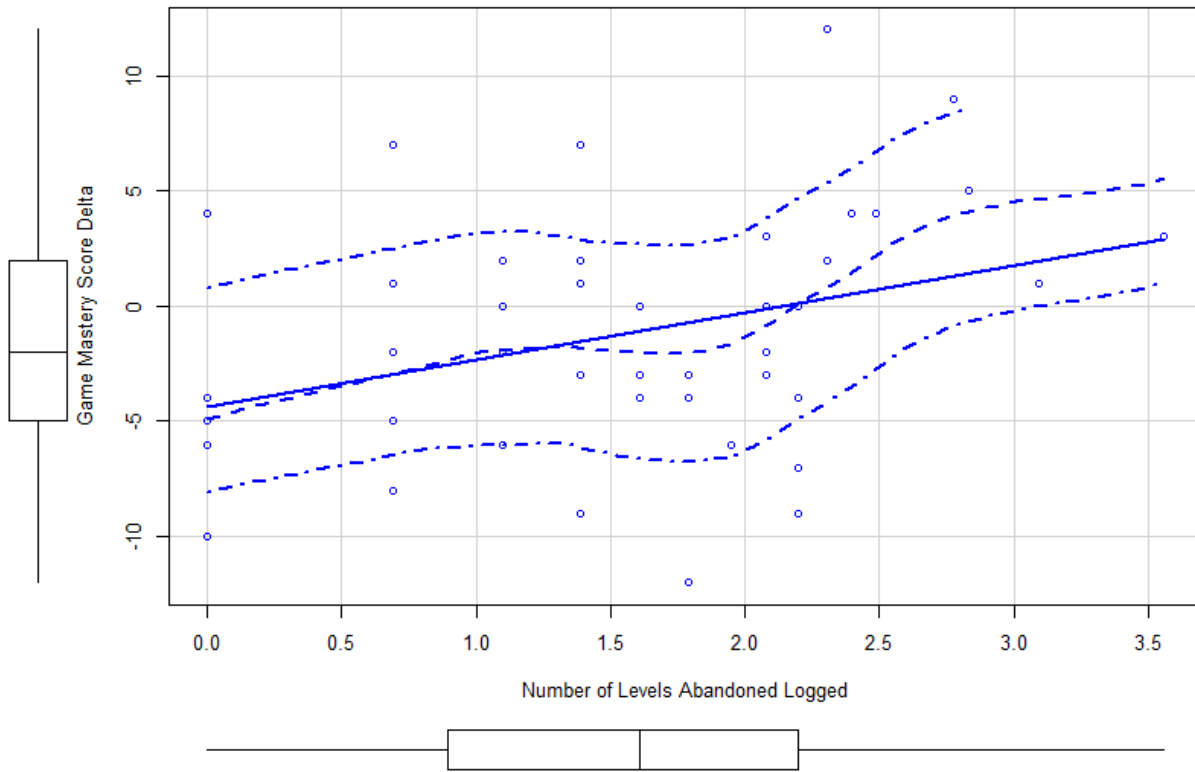
Figure 4.7

Linear Modeling of Number of Levels Abandoned and Delta General Mastery Survey Scores
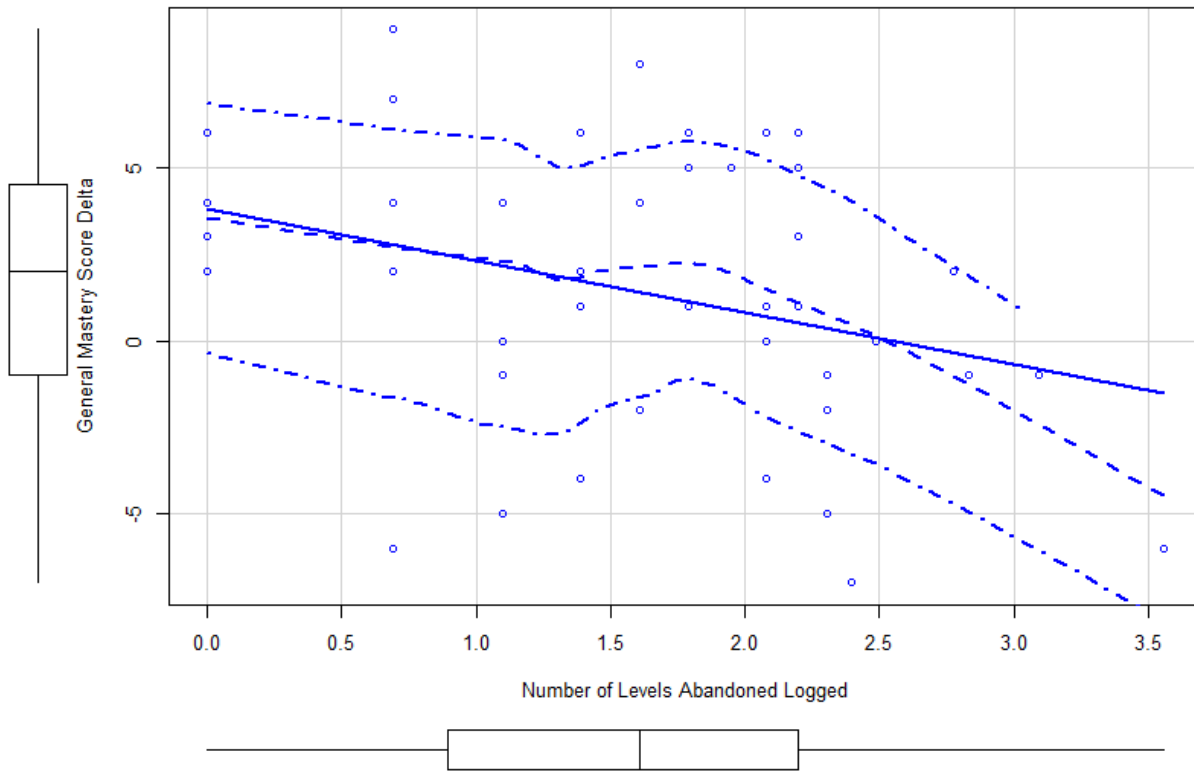
Univariate linear modeling between mastery orientation survey scores and total amount of gameplay in seconds logged show no associations between amount of gameplay and mastery orientation scores or deltas, summarized in table 4.7:

Table 4.7

Linear Modeling of Total Amount of Gameplay and Mastery Survey Scores

	Estimate	Std. Error	t value	p value
Pre Game Mastery Score	-0.01	0.02	-0.34	0.74
Pre General Mastery Score	0.00	0.02	0.03	0.98
Post Game Mastery Score	0.01	0.03	0.35	0.73
Post General Mastery Score	-0.02	0.02	-0.83	0.41
Delta Game Mastery Score	0.01	0.02	0.59	0.56
Delta General Mastery Score	-0.01	0.02	0.63	0.53

4.1.4 Multivariate Linear Models

Multivariate linear modeling was conducted on gameplay behaviors and demographics to predict mastery orientation survey scores through two models. The first aimed to investigate positive predictors on mastery orientation scores, using number of mastery behaviors per hit logged, average mastery behaviors exhibited before a helpless behaviors is exhibited logged, number of times a level was abandoned, gameplay experience score, and total amount of gameplay in seconds logged as factors. When predicting pre game mastery scores, this initial model found that number of mastery-oriented behaviors and average number of mastery-oriented behaviors exhibited before a helpless-oriented behaviors is exhibited are positively associated with pre game mastery orientation scores as summarized in table 4.8:

Table 4.8

Initial Multivariate Linear Modeling of Gameplay Behaviors Predicting Higher Pretest Game Mastery Survey Scores

	Estimate	Std. Error	t value	p value
Mastery Behaviors Per Hit	10.81	4.55	2.38	0.01*
Average Mastery Behaviors Until Helpless Behavior	2.56	1.26	2.03	0.05*
Level Abandons	-0.53	1.07	-0.50	0.62
Total Gameplay (sec)	-0.42	1.31	-0.32	0.75
Game Experience Score	0.01	0.02	0.51	0.61

Non-significant factors were removed until the best model was obtained. This resulted in a stronger model with the same factors predicting a higher pre game mastery orientation score as summarized in table 4.9 and visualized in figure 4.8:

Table 4.9

Final Multivariate Linear Modeling of Gameplay Behaviors Predicting Higher Pretest Game Mastery Survey Scores

	Estimate	Std. Error	t value	p value
Mastery Behaviors Per Hit	13.54	2.01	15.86	<0.01*

Average Mastery Behaviors Until Helpless Behavior	3.38	0.90	3.77	<0.01*

Figure 4.8

Multivariate Linear Modeling of Mastery-Oriented Behaviors Interaction and Pre Game Mastery
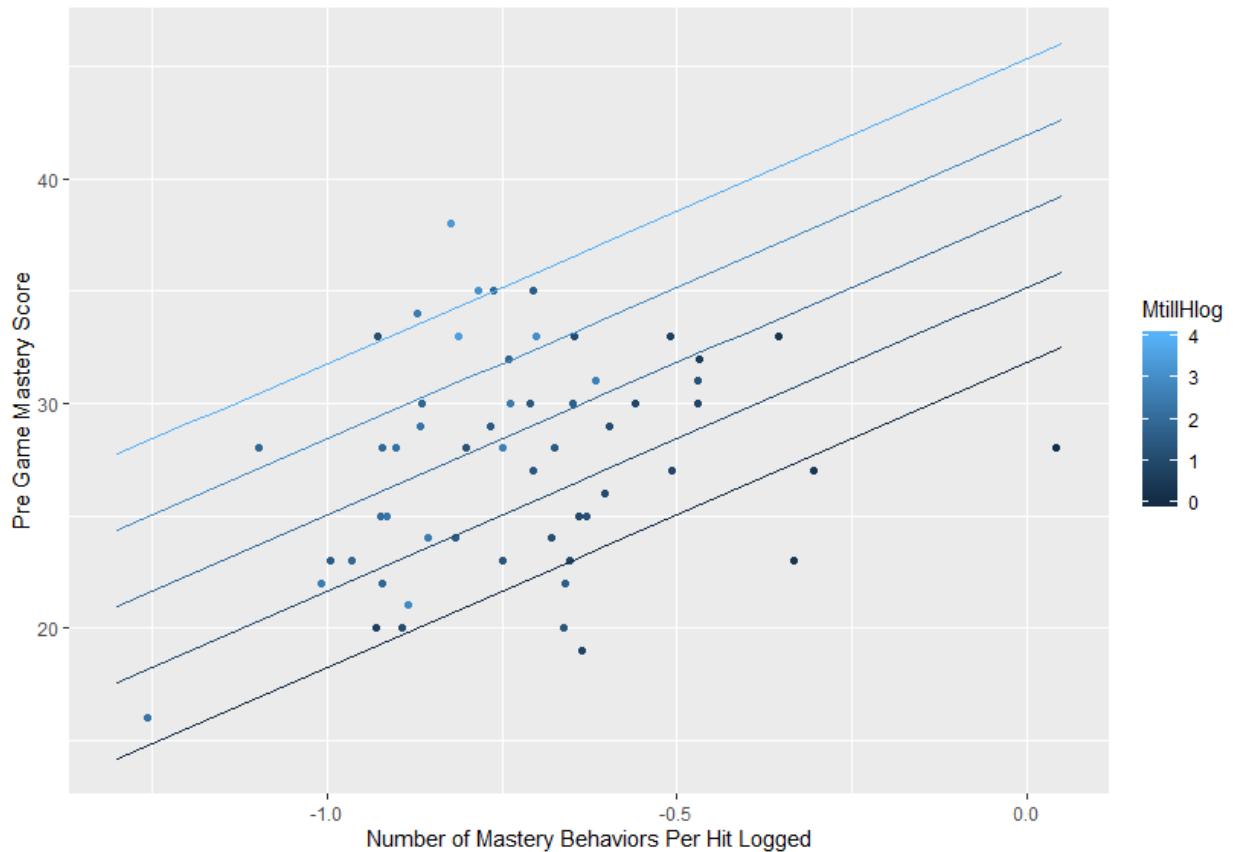
Orientation Score

Note. MtillHlog denotes Average Number of Mastery-Oriented Behaviors Until a Helpless-Oriented

Behavior.

When predicting general mastery orientation scores, the initial model found that number of

mastery-oriented behaviors and average number of mastery-oriented behaviors exhibited before a

helpless-oriented behaviors are exhibited are positively associated with pre general mastery orientation

scores as summarized in table 4.10:

Table 4.10

Initial Multivariate Linear Modeling of Gameplay Behaviors Predicting Higher Pretest General Mastery

Survey Scores

	Estimate	Std. Error	t value	p value
Mastery Behaviors Per Hit	10.18	4.19	2.72	0.01*
Average Mastery Behaviors Until Helpless Behavior	2.41	1.16	2.07	0.05*
Level Abandons	1.12	0.98	1.14	0.26
Total Gameplay (sec)	-0.28	1.21	-0.23	0.82
Game Experience Score	0.01	0.02	0.74	0.46

Non-significant factors were removed until the best model was obtained. This resulted in a stronger model with the same factors predicting a higher pre game mastery orientation score as summarized in table 4.11 and visualized in figure 4.9:

Table 4.11

Final Multivariate Linear Modeling of Gameplay Behaviors Predicting Higher Pretest General Mastery

Survey Scores

	Estimate	Std. Error	t value	p value
Mastery Behaviors Per Hit	9.00	2.92	3.09	<0.01*
Average Mastery Behaviors Until Helpless Behavior	2.78	0.78	3.57	<0.01*

Figure 4.9

Multivariate Linear Modeling of Mastery-Oriented Behaviors Interaction and Pre General Mastery
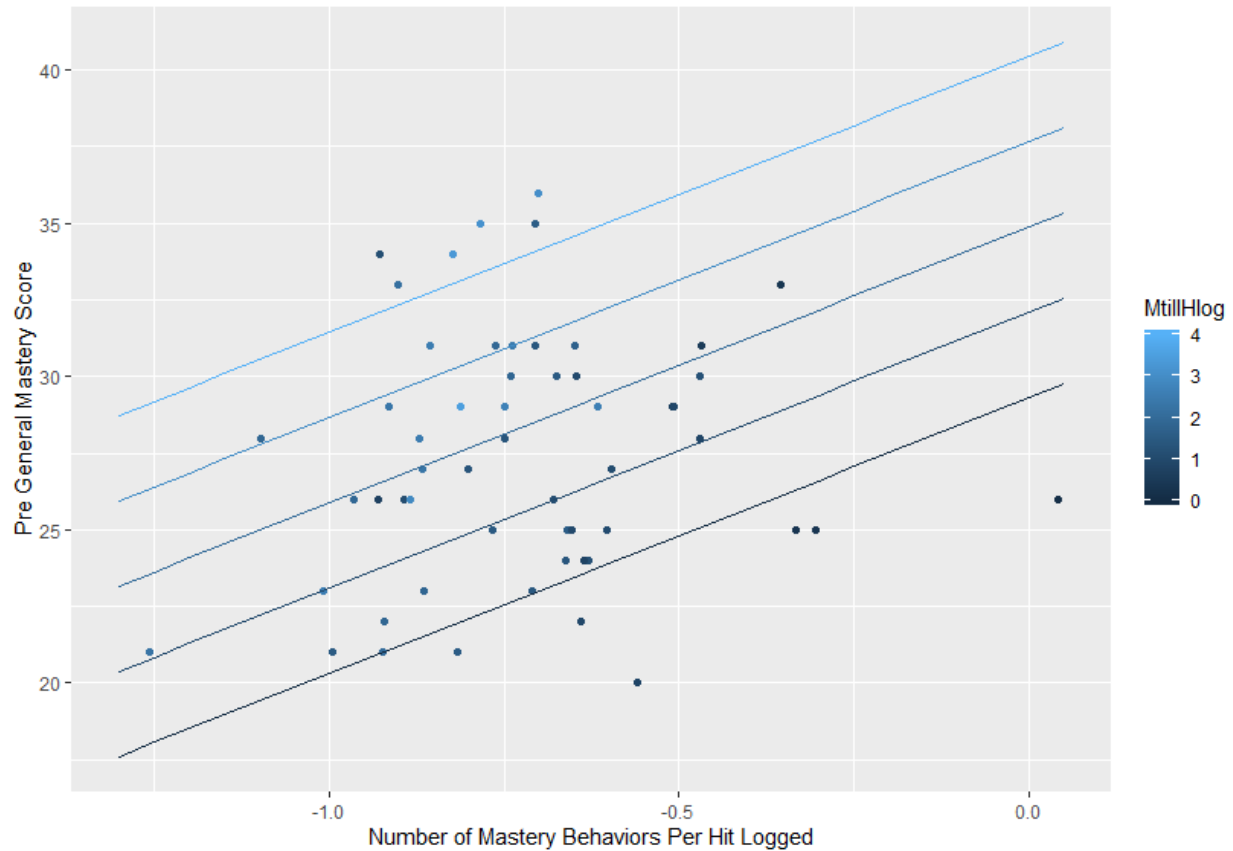
Orientation Score

Note. MtillHlog denotes Average Number of Mastery-Oriented Behaviors Until a Helpless-Oriented

Behavior.

When predicting post game mastery orientation scores and post general mastery orientation

scores, this model did not find any significant factors as summarized in table 4.12 and table 4.13:

Table 4.12

Initial Multivariate Linear Modeling of Gameplay Behaviors Predicting Higher Posttest Game Mastery

Survey Scores

	Estimate	Std. Error	t value	p value
Mastery Behaviors Per Hit	-3.90	3.60	-1.08	0.29
Average Mastery Behaviors Until Helpless Behavior	-0.86	1.00	-0.86	0.39
Level Abandons	0.23	0.84	0.27	0.79
Total Gameplay (sec)	0.16	1.04	0.16	0.88
Game Experience Score	0.02	0.02	1.06	0.30

Table 4.13

Initial Multivariate Linear Modeling of Gameplay Behaviors Predicting Higher Posttest General Mastery

Survey Scores

	Estimate	Std. Error	t value	p value
Mastery Behaviors Per Hit	3.01	4.33	0.70	0.49
Average Mastery Behaviors Until Helpless Behavior	0.55	1.20	0.46	0.65
Level Abandons	1.83	1.02	1.80	0.08
Total Gameplay (sec)	-0.10	1.25	-0.08	0.94
Game Experience Score	0.01	0.02	0.49	0.63

The second model aimed to investigate negative influences on mastery orientation scores and used number of helpless-oriented behaviors per hit logged, number of times a level was abandoned logged, average number of mastery-oriented behaviors exhibited before a helpless-oriented behaviors is exhibited logged, gameplay experience score, and total amount of gameplay in seconds logged to investigate negative predictors on mastery orientation scores. No significant factors were found as summarized in tables 4.14-4.4.17:

Table 4.14

Initial Multivariate Linear Modeling of Gameplay Behaviors Predicting Lower Pretest Game Mastery

Survey Scores

	Estimate	Std. Error	t value	p value
Helpless Behaviors Per Hit	4.51	3.61	1.25	0.22
Average Mastery Behaviors Until Helpless Behavior	6.26	4.54	1.38	0.18
Level Abandons	-1.36	1.03	-1.32	0.19
Total Gameplay (sec)	-0.19	1.37	-0.14	0.89
Game Experience Score	0.01	0.02	0.55	0.58

Table 4.15

Initial Multivariate Linear Modeling of Gameplay Behaviors Predicting Lower Pretest General Mastery

Survey Scores

	Estimate	Std. Error	t value	p value

Helpless Behaviors Per Hit	4.03	3.34	1.21	0.23
Average Mastery Behaviors Until Helpless Behavior	5.63	4.20	1.34	0.19
Level Abandons	0.32	0.95	0.34	0.74
Total Gameplay (sec)	-0.05	1.27	-0.04	0.97
Game Experience Score	0.01	0.02	0.77	0.45

Table 4.16

Initial Multivariate Linear Modeling of Gameplay Behaviors Predicting Lower Posttest Game Mastery

Survey Scores

	Estimate	Std. Error	t value	p value
Helpless Behaviors Per Hit	0.59	2.76	0.21	0.83
Average Mastery Behaviors Until Helpless Behavior	0.52	3.47	0.15	0.88
Level Abandons	0.67	0.79	0.85	0.40
Total Gameplay (sec)	0.03	1.05	0.03	0.98
Game Experience Score	0.02	0.02	1.00	0.32

Table 4.17

Initial Multivariate Linear Modeling of Gameplay Behaviors Predicting Lower Posttest General Mastery

Survey Scores

	Estimate	Std. Error	t value	p value
Helpless Behaviors Per Hit	3.40	3.24	1.05	0.30
Average Mastery Behaviors Until Helpless Behavior	4.20	4.08	1.05	0.31
Level Abandons	1.74	0.93	1.87	0.07
Total Gameplay (sec)	-0.08	1.23	-0.07	0.95
Game Experience Score	0.01	0.02	0.51	0.62

4.1.5 Delta T-Tests

A t-test comparing pre game mastery orientation score (M = 27.50, SD = 4.84) to postgame

mastery orientation score (M = 26.61, SD = 3.51) do not show any significant difference in means, t(55) =

-1.38, p = 0.17, as shown in figure 4.10. The t-test comparing pre general mastery orientation score (M =

27.32, SD = 4.06) to post general mastery orientation score (M = 26.00, SD = 4.01) shows that

participants significantly decrease after playing *Cuphead* for two weeks, $t(55) = -2.29$, $p = 0.03$, as shown in figure 4.11.

Figure 4.10

Pre vs Post Game Mastery Scores
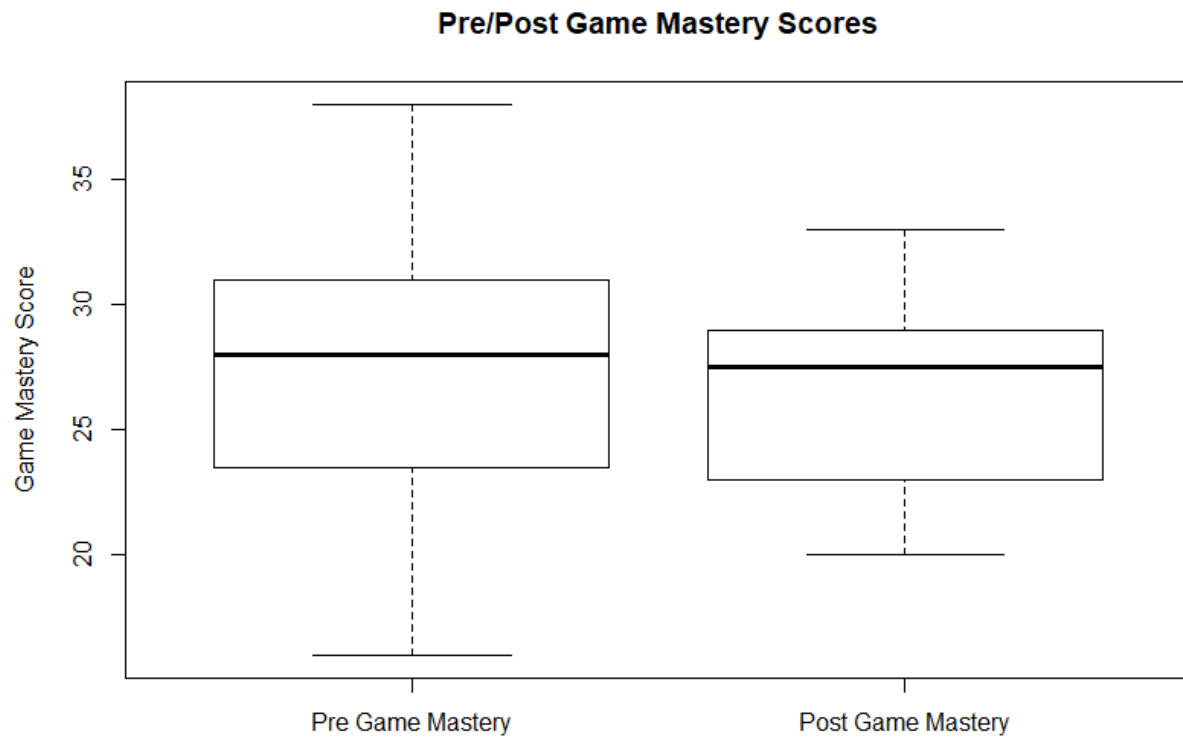
Figure 4.11

Pre vs Post General Mastery Scores

Pre/Post General Mastery Scores
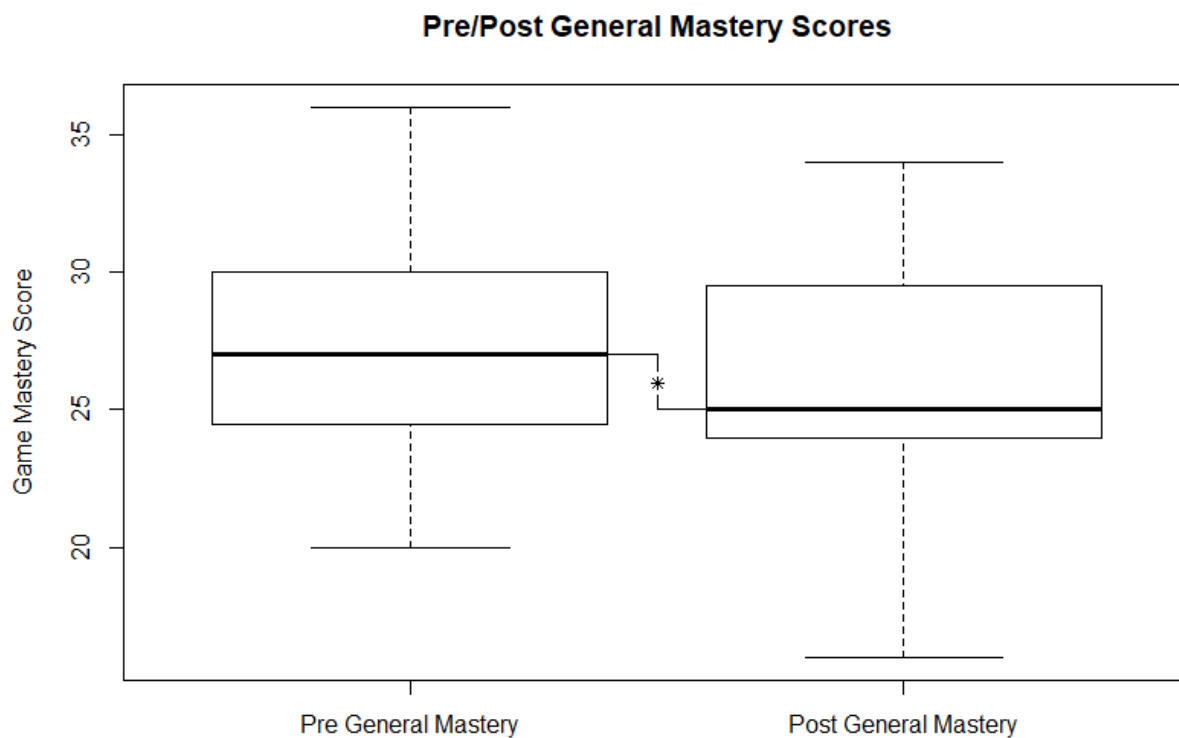
4.1.6 Demographic Factors

Analysis of variance modeling between gender and year in program with into game mastery

orientation scores found no significant factors and is summarized in table X:

Table 4.18

ANOVA of Demographic Factors on Pretest Game Mastery Survey Scores

	Df	Sum Sq	Mean Sq	F value	p value
Gender	1	80.5	80.48	3.62	0.06
Year in School	1	7.80	7.77	0.35	0.56
Residuals	53	1178.9	22.24		

Analysis of variance modeling between pre general mastery orientation scores and gender and

year in program found no significant factors and is summarized in table 4.19:

Table 4.19

ANOVA of Demographic Factors on Pretest General Mastery Survey Scores

	Df	Sum Sq	Mean Sq	F value	p value
Gender	1	16.60	6.58	1.00	0.32
Year in School	1	11.30	11.31	0.68	0.41
Residuals	53	673.00	12.70		

Analysis of variance modeling between post game mastery orientation scores and gender and

year in program found no significant factors and is summarized in table 4.20:

Table 4.20

ANOVA of Demographic Factors on Posttest Game Mastery Survey Scores

	Df	Sum Sq	Mean Sq	F value	p value
Gender	1	0.40	0.39	0.03	0.86
Year in School	1	6.00	6.01	0.47	0.49
Residuals	53	637.00	12.70		

Analysis of variance modeling between post general mastery orientation scores and gender and

year in program found no significant factors and is summarized in table 4.21:

Table 4.21

ANOVA of Demographic Factors on Posttest Game Mastery Survey Scores

	Df	Sum Sq	Mean Sq	F value	p value
Gender	1	0.30	0.31	0.02	0.89
Year in School	1	18.80	18.84	1.16	0.29
Residuals	53	864.90	16.32		

Analysis of variance modeling between mastery-oriented behaviors per hit and gender and year

in program found no significant factors and is summarized in table 4.22:

Table 4.22

ANOVA of Demographic Factors on Mastery-Orientated Behaviors

	Df	Sum Sq	Mean Sq	F value	p value
Gender	1	0.10	0.10	2.20	0.14
Year in School	1	0.00	0.00	0.07	0.79
Residuals	53	2.44	0.05		

Analysis of variance modeling between helpless-oriented behaviors per hit and gender and year

in program found no significant factors and is summarized in table 4.23:

Table 4.23

ANOVA of Demographic Factors on Helpless-Oriented Behaviors

	Df	Sum Sq	Mean Sq	F value	p value
Gender	1	0.21	0.21	0.20	0.66
Year in School	1	0.43	0.43	0.41	0.52
Residuals	53	55.87	1.05		

Analysis of variance modeling between average number of mastery-oriented behaviors

exhibited until a helpless-oriented behaviors is exhibited logged and gender and year in program found

no significant factors and is summarized in table 4.24:

Table 4.24

ANOVA of Demographic Factors on Average number of Mastery-Oriented Behaviors Before a Helpless-

Oriented Behavior

	Df	Sum Sq	Mean Sq	F value	p value
Gender	1	0.04	0.04	0.06	0.81
Year in School	1	0.20	0.20	0.30	0.59
Residuals	53	35.35	0.67		

Analysis of variance modeling between the ratio between mastery-oriented to helpless-oriented

behaviors logged and gender and year in program found no significant factors as summarized in table

4.25:

Table 4.25

ANOVA of Demographic Factors on Ratio of Mastery-Oriented Behaviors to Helpless-Oriented Behaviors

	Df	Sum Sq	Mean Sq	F value	p value
Gender	1	0.02	0.02	0.02	0.88
Year in School	1	0.36	0.36	0.46	0.50
Residuals	53	41.95	0.79		

Analysis of variance modeling between number of times a level was abandoned before

completion logged and gender and year in program found no significant factors and is summarized in

table 4.26:

Table 4.26

ANOVA of Demographic Factors on Number of Levels Abandoned Before Completion

	Df	Sum Sq	Mean Sq	F value	p value
Gender	1	1.39	1.39	1.72	0.20
Year in School	1	0.37	0.37	0.46	0.50
Residuals	41	33.24	0.81		

Multivariate linear modeling comparing pre game mastery orientation scores with age, the square root of game experience scores, and total amount of gameplay logged show a significant positive relationship with gameplay experience scores and is summarized in table 4.27 and visualized in figure 4.12:

Table 4.27

Linear Modeling of Demographic Factors on Pretest Game Mastery Survey Scores

	Estimate	Std. Error	t value	p value
Age	-0.25	0.29	-0.86	0.39
Game exp score	0.03	0.01	2.18	0.03*
Total gameplay (sec)	-0.47	0.89	-0.53	0.60

Figure 4.12

Game Experience Score vs Pre Game Mastery Score
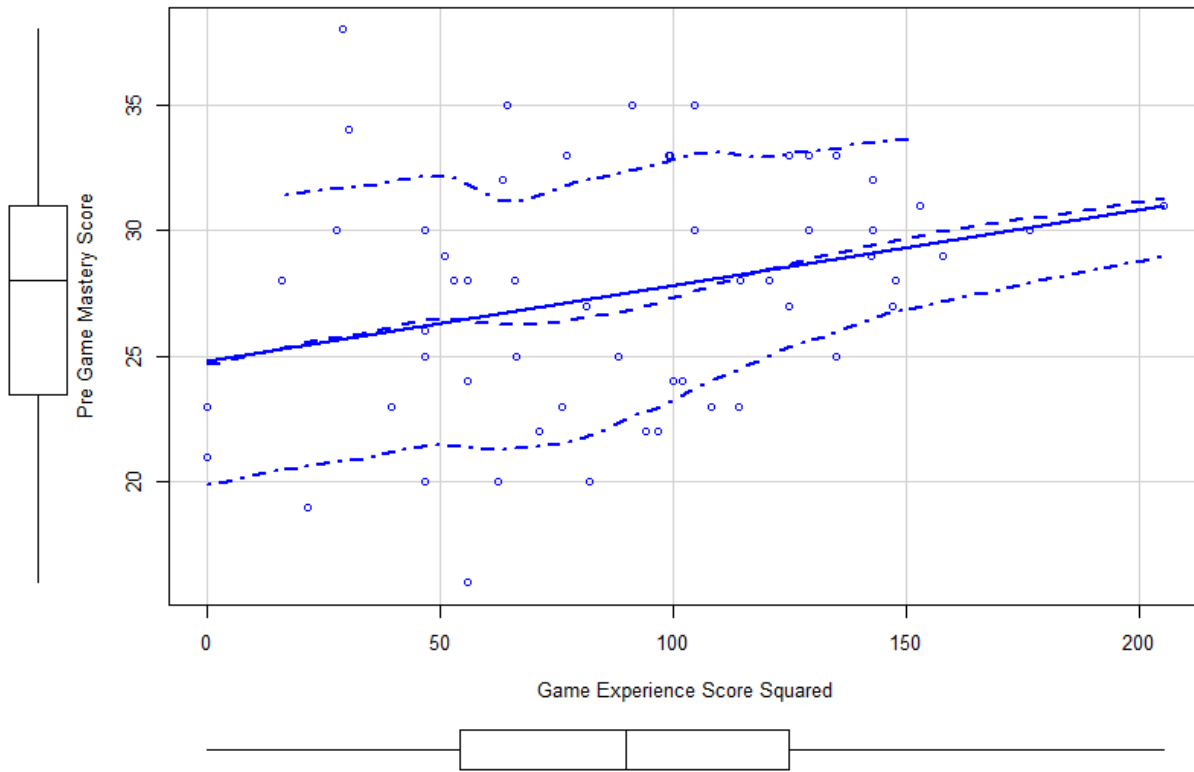
Multivariate linear modeling comparing pre general mastery orientation scores with age, the square root of game experience scores, and total amount of gameplay logged show no significant factors and is summarized in table 4.28:

Table 4.28

Linear Modeling of Demographic Factors on Pretest General Mastery Survey Scores

	Estimate	Std. Error	t value	p-value
Age	-0.02	0.25	-0.06	0.95
Game exp score	0.01	0.01	1.39	0.17
Total gameplay (sec)	-0.14	0.78	-0.18	0.86

Multivariate linear modeling comparing post game mastery orientation scores with age, the square root of game experience scores, and total amount of gameplay logged show no significant factors and is summarized in table 4.29:

Table 4.29

	Estimate	Std. Error	t value	p value
Age	-0.15	0.22	-0.71	0.48
Game exp score	0.01	0.01	11.38	0.17
Total gameplay (sec)	0.16	0.67	0.25	0.81

Multivariate linear modeling comparing post general mastery orientation scores with age, the

square root of game experience scores, and total amount of gameplay logged show no significant

factors and is summarized in table 4.30:

Table 4.30

Linear Modeling of Demographic Factors on Posttest General Mastery Survey Scores

	Estimate	Std. Error	t value	p value
Age	-0.19	0.25	-0.78	0.44
Game exp score	0.01	0.01	0.74	0.46
Total gameplay (sec)	-0.60	0.77	-0.79	0.44

Multivariate linear modeling comparing number of mastery-oriented behaviors per hit logged

with age, the square root of game experience scores, and total amount of gameplay logged show a

significant positive relationship with gameplay experience scores and is summarized in table 4.31 and

visualized in figure 4.13:

Table 4.31

Linear Modeling of Demographic Factors on Mastery-Oriented Behaviors

	Estimate	Std. Error	t value	p value
Age	-0.01	0.01	-0.76	0.45
Game exp score	$7.29e^{-6}$	$3.29e^{-6}$	2.22	0.03*
Total gameplay (sec)	<0.01	<0.01	0.05	0.96

Figure 4.13

Game Experience Score vs Total Mastery-Oriented Behaviors
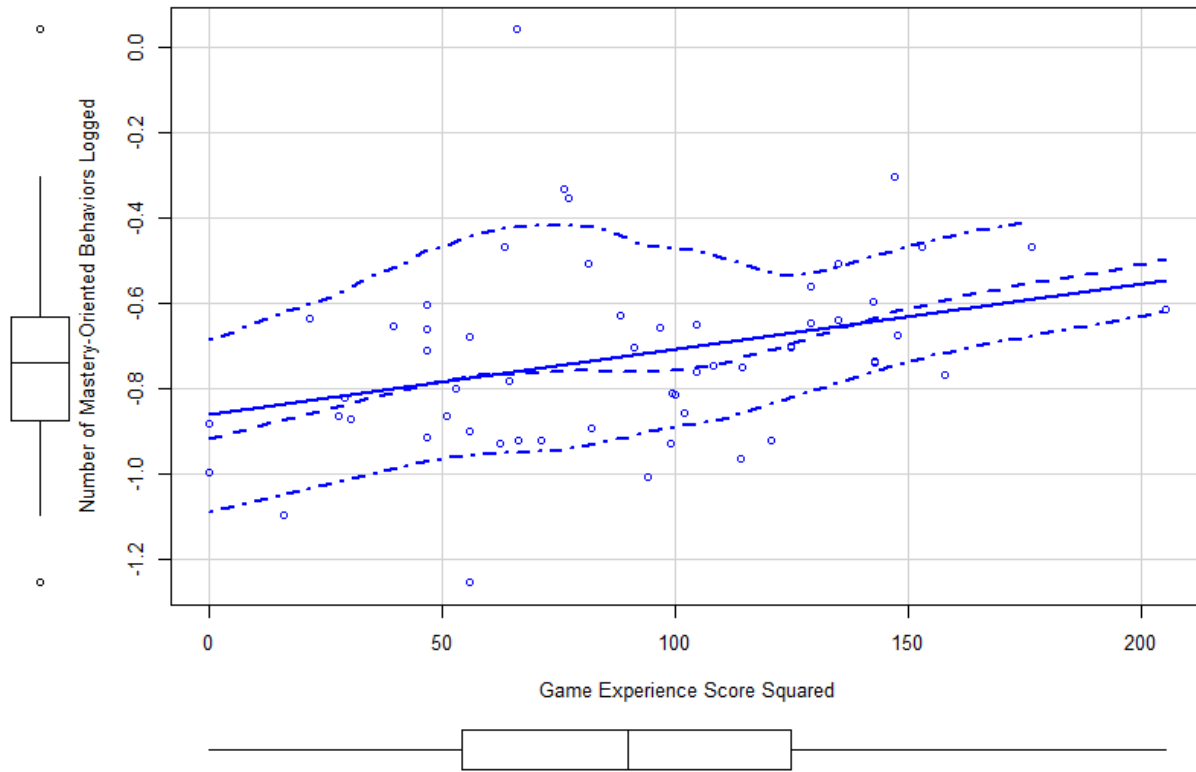
Multivariate linear modeling comparing number of helpless-oriented behaviors per hit logged with age, the square root of game experience scores, and total amount of gameplay logged show no significant factors and is summarized in table 4.32:

Table 4.32

Linear Modeling of Demographic Factors on Helpless-Oriented Behaviors

	Estimate	Std. Error	t value	p value
Age	-0.04	0.06	-1.40	0.17
Game exp score	$5.48e^{-6}$	$1.62e^{-5}$	0.34	0.74
Total gameplay (sec)	0.13	0.20	0.67	0.51

Multivariate linear modeling comparing average number of mastery-oriented behaviors exhibited before a helpless-oriented behaviors is exhibited logged with age, the square root of game experience scores, and total amount of gameplay logged show now significant factors and is summarized in table 4.33:

Table 4.33

Linear Modeling of Demographic Factors on Average Number of Mastery-Oriented Behaviors Until a

Helpless-Oriented Behaviors

	Estimate	Std. Error	t value	p value
Age	0.03	0.05	0.58	0.56
Game exp score	$-3.51e^{-6}$	$1.29e^{-5}$	-0.27	0.79
Total gameplay (sec)	-0.07	0.16	-0.42	0.67

Multivariate linear modeling comparing ratio of mastery-oriented behaviors to helpless-oriented

behaviors logged with age, the square root of game experience scores, and total amount of gameplay

logged show no significant factors and is summarized in table 4.34:

Table 4.34

Linear Modeling of Demographic Factors on Ratio of Mastery-Oriented Behaviors to Helpless-Oriented

Behaviors

	Estimate	Std. Error	t value	p value
Age	0.03	0.05	0.60	0.55
Game exp score	$1.81e^{-6}$	$1.40e^{-5}$	1.29	0.90
Total gameplay (sec)	-0.13	0.17	-0.76	0.45

Multivariate linear modeling comparing number of levels abandoned before completion logged

with age, the square root of game experience scores, and total amount of gameplay logged show a

significant negative relationship with gameplay experience scores, and a significant positive relationship

with total amount of gameplay, summarized in table 4.35 and visualized in figures 4.14 and 4.15:

Table 4.35

Linear Modeling of Demographic Factors on Number of Level Abandons Before Completion

	Estimate	Std. Error	t value	p value
Age	0.06	0.05	-1.40	0.17
Game exp score	-0.01	<0.01	-4.14	<0.01*
Total gameplay (sec)	0.45	0.20	2.23	0.03*

Figure 4.14:

Game Experience Score vs Number of Levels Abandoned
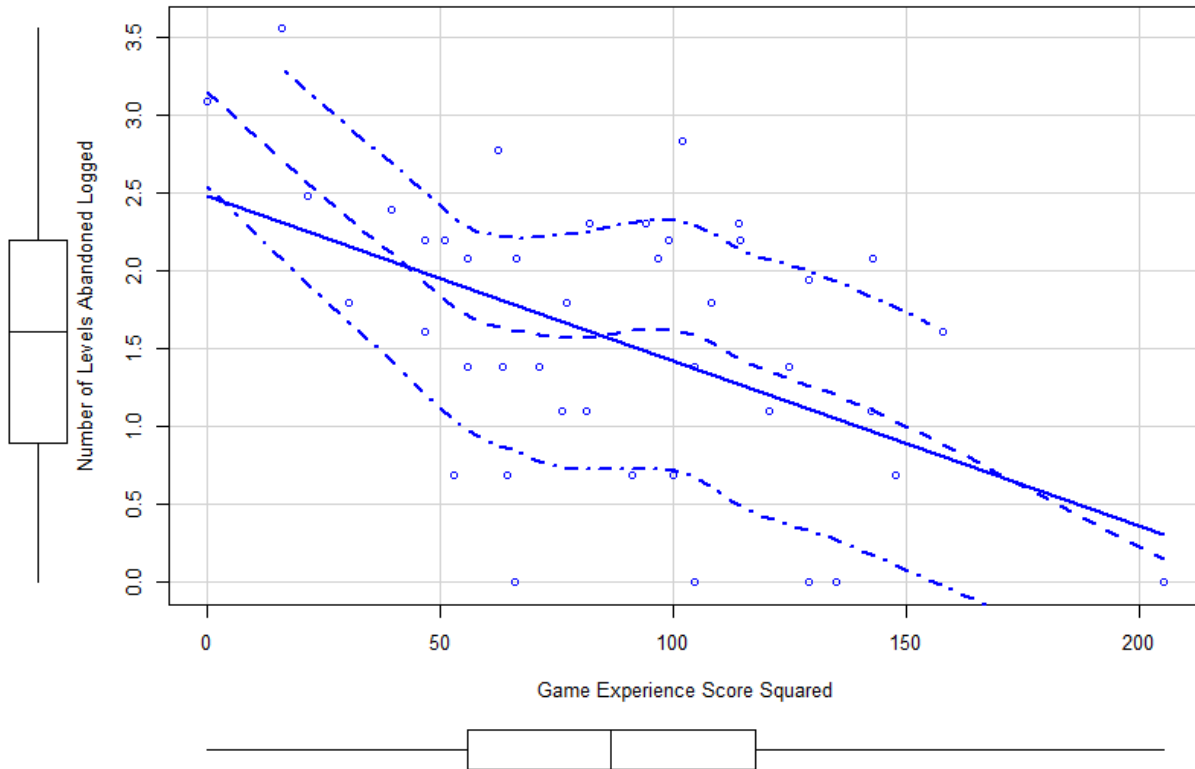
Figure 4.15:

Total Amount of Gameplay vs Number of Levels Abandoned
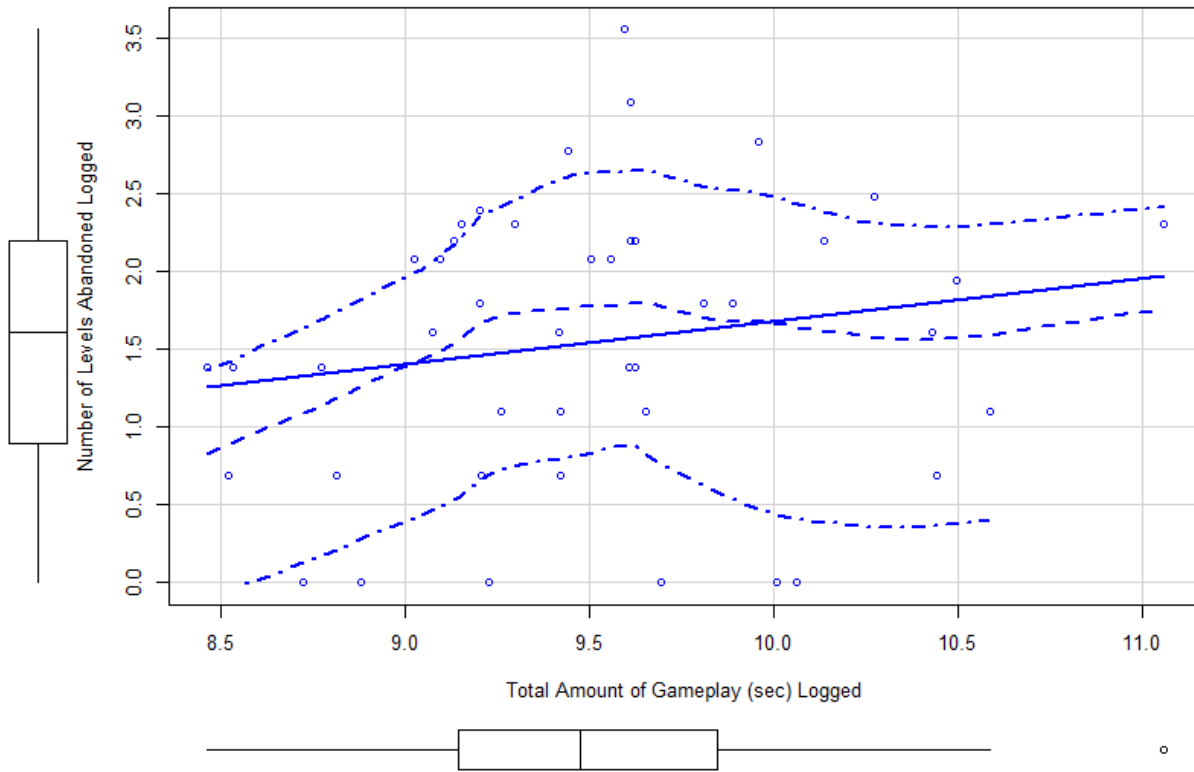
T-tests comparing pre game mastery orientation scores, pre general mastery orientation scores, post game mastery orientation scores, post general mastery orientation scores, change in game mastery orientation scores, change in general mastery orientation scores, number of mastery-oriented behaviors per hit logged, number of helpless-oriented per hit logged, ratio of mastery-oriented to helpless-oriented behaviors logged, average number of mastery-oriented behaviors exhibited until a helpless-oriented behaviors is exhibited logged, number of times a level is abandoned before completion logged, and the square root of game experience scores between men and women found that women significantly increased on game mastery orientation scores from pre to post while men significantly decreased in game mastery orientation survey scores from pre to post, and that game experience score was significantly higher for men than women. These results are summarized in table 4.36 and visualized in 4.16-4.17:

Table 4.36

T-Tests Comparing Factors Between Men and Women

	Women mean	Men mean	t value	p value
Pre Game Mastery Score	25.95	28.43	1.90	0.06
Post Game Mastery Score	26.71	26.54	-0.18	0.86
Pre General Mastery Score	26.62	27.74	1.00	0.32
Post General Mastery Score	26.10	25.94	-0.14	0.89
Delta Game Mastery Score	0.76	-1.89	-2.54	0.01*
Delta General Mastery Score	-0.52	1.91	1.18	0.24
Mastery-oriented Behaviors Per Hit	-0.78	-0.68	1.50	0.14
Helpless-oriented Behaviors Per Hit	-2.50	-2.37	0.44	0.66
Mastery-oriented Behaviors Until Helpless-oriented Behavior	1.67	1.61	0.24	0.81
Ratio of Mastery-oriented Behaviors to Helpless-oriented Behaviors	1.72	1.68	0.15	0.88
Number of Levels Abandoned	1.78	1.41	1.21	0.24
Game Experience Score	66.85	101.75	-2.96	<0.01*

Figure 4.16

Gender Differences in Game Mastery-Orientation Score Delta

Gender Differences in Delta Game Mastery-Orientation Scores
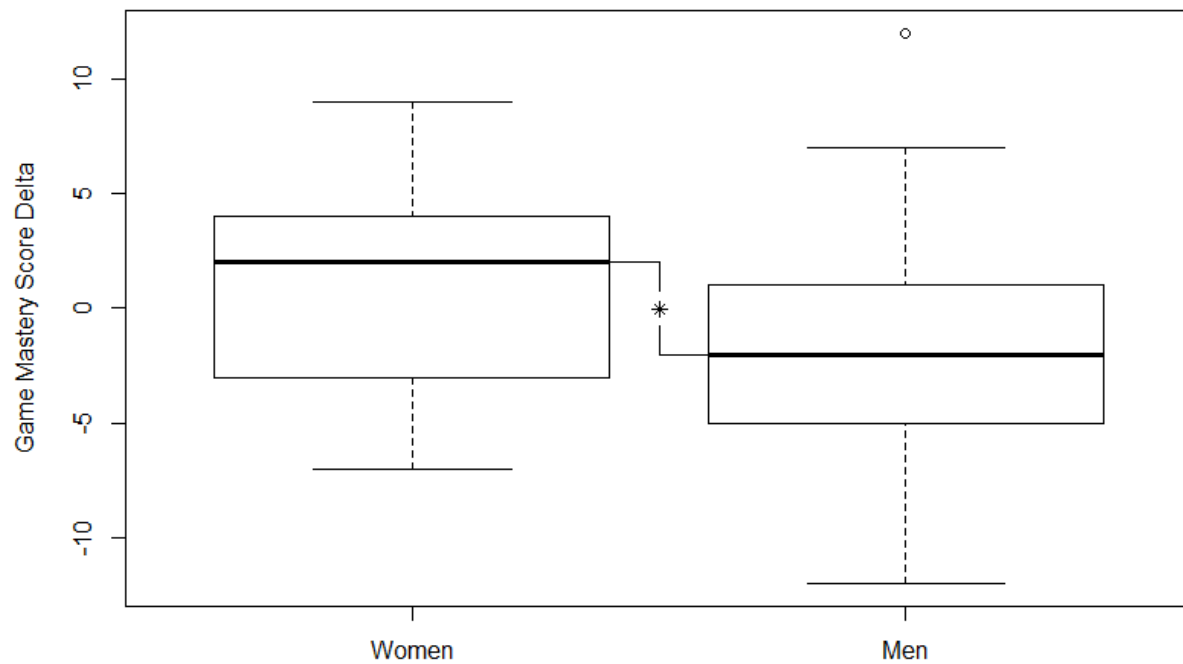
Figure 4.17

Gender Differences in Game Mastery-Orientation Score Delta

Gender Differences in Game Experience Scores
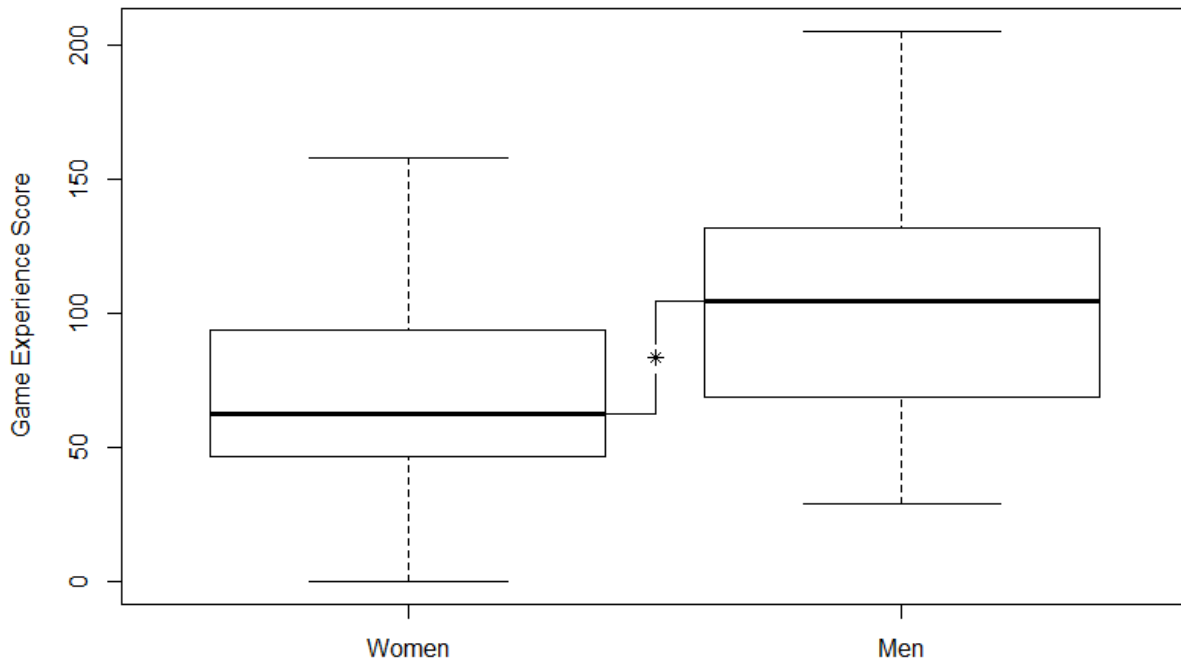
A post-hoc power test was conducted to check if power reached the desired level for t-tests investigating gender differences. Cohen's d was calculated (Cohen's d = (28.43 - 25.95) ∕ 4.751053 = 0.52199) and used to determine power level obtained and was found to be 0.38. Due to this low level of power, permutation t-tests were conducted to confirm results.

Permutation t-test with 10,000 permutations confirm the gender difference analyses results showing that game experience score is the only significantly different factor, however, change in game mastery score from pretest to posttest is marginally above alpha, as summarized in table 4.37.

Table 4.37

Permutation T-Tests Comparing Factors Between Men and Women

	Women mean	Men mean	t value	p value
Pre Game Mastery Score	25.95	28.43	1.90	0.06
Post Game Mastery Score	26.71	26.54	-0.18	0.89

Pre General Mastery Score	26.62	27.74	1.00	0.33
Post General Mastery Score	26.10	25.94	-0.14	0.91
Delta Game Mastery Score	0.76	-1.89	-2.04	>0.05
Delta General Mastery Score	0.52	1.91	1.18	0.26
Mastery-oriented Behaviors Per Hit	-0.78	-0.69	1.50	0.14
Helpless-oriented Behaviors Per Hit	-2.50	-2.37	0.44	0.64
Mastery-oriented Behaviors Until Helpless-oriented Behavior	1.67	1.61	0.25	0.80
Ratio of Mastery-oriented Behaviors to Helpless-oriented Behaviors	1.72	1.68	0.15	0.87
Number of Levels Abandoned	1.78	1.41	1.32	0.19
Game Experience Score	66.85	101.75	-2.95	<0.01*

4.1.7 Frequency Analyses

Frequency of mastery-oriented behaviors per hit are visualized in in table 4.37. Numbers in green indicate a higher proportion of mastery-oriented behaviors in that phase and level, whereas numbers in red indicate a lower proportion of mastery-oriented behaviors in that phase and level.

Table 4.38

Frequency of Mastery-Oriented Behaviors per Hit per Level and Phase

Level	Phase 0	1	2	3	4	5	6	7	8	Total
0										
1		0.87	0.15	0.21						0.48
2		0.64	0.09	0.28						0.45
3		1.01	0.11	0.13						0.51
4		0.51	0.19	0.00						0.48
5		0.51	0.20							0.46
6		0.53								0.53
7		0.50								0.50
8		0.82								0.82
9		0.54	0.11							0.50
10		0.84	0.19	0.16	0.10	0.27				0.49
11		1.13	0.05	0.13	0.22					0.47
12		0.73	0.10	0.14						0.46
13		1.12	0.11	0.15	0.25					0.50
14		0.53								0.53
15		0.57								0.57

Level	1	2	3	4	5	6	7	8	Total
16	1.07								1.07
17	0.73	0.12	0.21						0.44
18	0.74	0.14	0.24						0.49
19	0.67	0.25	0.35						0.52
20	0.51	0.25	0.18						0.44
21	0.46	0.24	0.13						0.41
22	0.69	0.08	0.24	0.15					0.41
23	0.88	0.20	0.25	0.33					0.53
24	0.43								0.43
25	0.52								0.52
26	1.40								1.40
27	0.70	0.33	0.07	0.34	0.16	0.20	0.33	0.00	0.43
28	0.61	0.14	0.14	0.20					0.47

Note. Green-yellow-orange-red denotes relatively higher to lower amount of mastery-oriented behaviors per hit across stages and across levels.

Frequency analysis of helpless-oriented behaviors per hit are visualized in in table 4.38. Numbers in green indicate a lower proportion of helpless-oriented behaviors in that phase and level, whereas numbers in red indicate a higher proportion of helpless-oriented behaviors in that phase and level.

Table 4.39

Frequency of Helpless-Oriented Behaviors per Hit per Level and Phase

	Phase									
Level	0	1	2	3	4	5	6	7	8	Total
0										
1		0.01	0.01	0.01						0.11
2		0.01	0.00	0.01						0.13
3		0.01	0.00	0.00						0.18
4		0.01	0.00	0.00						0.15
5		0.01	0.00							0.11
6		0.01								0.19
7		0.01								0.15
8		0.02								0.10
9		0.00	0.00							0.18
10		0.00	0.01	0.01	0.00	0.00				0.14

Level									Total
11	0.01	0.00	0.01	0.00					0.16
12	0.00	0.00	0.00						0.17
13	0.00	0.00	0.00	0.00					0.10
14	0.00								0.15
15	0.00								0.18
16	0.00								0.00
17	0.00	0.00	0.00						0.10
18	0.00	0.00	0.00						0.10
19	0.00	0.00	0.00						0.13
20	0.00	0.00	0.00						0.09
21	0.00	0.01	0.00						0.03
22	0.00	0.01	0.00	0.00					0.11
23	0.00	0.00	0.00	0.00					0.17
24	0.00								0.15
25	0.01								0.17
26	0.00								0.07
27	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.08
28	0.00	0.00	0.00	0.00					0.10

Note. Green-yellow-orange-red denotes relatively lower to higher amount of helpless-oriented behaviors per hit across stages and across levels.

Frequency of number of times a level is abandoned before completion were compared for each phase of each level are visualized in in table 4.39. Numbers in green indicate a lower proportion of times a level was abandoned in that phase and level, whereas numbers in red indicate a higher proportion of times a level was abandoned in that phase and level.

Table 4.40

Frequency of Number of Abandons per Level and Phase

Level	Phase									Total
	0	1	2	3	4	5	6	7	8	
0										
1		4	3	8						15
2		14	9	3						26
3		12	8	13						33
4		19	2							21
5		21	3							24

Level					Total
6	35				35
7	25				25
8	6				6
9	14	2			16
10	6	4	2	3	15
11	6	7	1	1	15
12	2	1			3
13		2	2	1	5
14	4				4
15	6				6
16					0
17		1			1
18					0
19		2			2
20		1			1
21		1			1
22					0
23					0
24	2				2
25	1				1
26	1				1
27			1		1
28					0

Note. Green-yellow-orange-red denotes relatively lower to higher amount of levels abandoned across stages and across levels.

Frequency analysis of average number of mastery-oriented behaviors exhibited before a helpless-oriented behaviors is exhibited are visualized in in table 4.40. Numbers in green indicate a higher average number of mastery-oriented behaviors exhibited before a helpless-oriented behaviors was exhibited in that phase and level, whereas numbers in red indicate a lower average number of mastery-oriented behaviors exhibited before a helpless-oriented behaviors was exhibited in that phase and level.

Table 4.41

Frequency of Average Mastery-Oriented Behaviors Before a Helpless-Oriented Behavior per Level and Phase

Level	Phase 0	1	2	3	4	5	6	7	8	Total
0										
1		0.01	0.01	0.01						0.01
2		0.00	0.01	0.02						0.00
3		0.00	0.01	0.01						0.01
4		0.00	0.02							0.00
5		0.00	0.03							0.01
6		0.00								0.00
7		0.00								0.00
8		0.05								0.05
9		0.00	0.02							0.00
10		0.01	0.02	0.04	0.03	2.03				0.07
11		0.00	0.01	0.01	0.04					0.01
12		0.00	0.02	0.02						0.01
13		0.01	0.02	0.03	0.03					0.02
14		0.00								0.00
15		0.00								0.00
16										
17		0.02	0.03	0.42						0.05
18		0.02	0.13	0.07						0.06
19		0.01	0.08	0.13						0.04
20		0.00	0.02	0.01						0.01
21		0.01	0.07	2.43						0.14
22		0.02	0.24		0.31					0.10
23		0.01	0.05	0.07	0.16					0.04
24		0.00								0.00
25		0.01								0.01
26		0.33								0.33
27		0.02	0.14	0.03	0.04	1.26	0.10			0.15
28		0.00	0.06	0.16	5.37					0.12

Note. Green-yellow-orange-red denotes relatively higher to lower average of mastery-oriented until a helpless-oriented behavior across stages and across levels.

4.2 Implications

To consider the implications of these findings, I will begin by viewing them first through the sub questions of the research question posed for this study.

4.2.1 Do Individuals Who Score Higher on the Mastery-Orientation Survey Perform More Mastery-Oriented Behaviors in Cuphead?

Linear modeling shows that pre general mastery orientation scores are positively associated with ratio of mastery behaviors to helpless behaviors. This suggests that those who report higher mastery orientation in a general context are more inclined to react to failure in-game by trying again and adapting their strategy compared to how often they react to failure by quitting or showing ineffectual responses.

Further, multivariate linear modeling shows that considering both how many mastery-oriented behaviors an individual performs as well as the average number of mastery-oriented behaviors an individual performs before performing a helpless-oriented behavior, we see a positive association with both pre game mastery orientation scores as well as pre general mastery orientation scores. This suggests that those who score higher on a game or general mastery orientation survey show more mastery-oriented behaviors overall as well as more mastery-oriented behaviors before showing a helpless-oriented behavior. This demonstrates that this methodology captures the behaviors we would expect to see through a mastery orientation lens. This effect is stronger when predicting pretest game mastery orientation scores compared to general mastery orientation scores as well, conforming to previous literature that suggests that the context of the questions presented is important and stronger when the context aligns to the questions.

Interestingly, neither total number of mastery behaviors per hit nor average number of mastery-oriented behaviors until a helpless-oriented behavior are associated at a significant level with any of the four surveys as individual factors. This suggests the importance of viewing not only if the individual typically responds to failure with persistence, but also how long they will continue to persist before giving up.

When viewing factors that predict a negative association mastery orientation, linear modeling shows that those with lower on pre game mastery orientation scores were more inclined to give up on a level before completing it. Helpless-oriented behaviors such as quitting and showing strategy deterioration in-game were not associated with a lower mastery orientation score. This suggests that the behaviors we should expect a helpless-oriented individual to perform in response to failure align with actions that clearly show a player is giving up, such as abandoning a level, rather than the moments in which they encounter hard-coded failure that developers put into the game. Further, quitting after getting hit was often paired with retrying the level or exiting the level to change the items the player has equipped. At the fine-grain level looking at reactions to hard-coded failure, helpless-oriented behaviors might be mistaken for what is a normal response to pushing the boundaries of the player's ability. This suggests that a helpless orientation is more difficult to capture, and may be best viewed through player-centric definitions of failure, such as the playing deciding to give up on a level, rather than definitions of failure that regard hard-coded failure such as taking damage or reaching the game over screen.

4.2.2 Do Mastery-Oriented Individuals Perform More Mastery-Oriented Behaviors Before Performing Helpless-Oriented Behaviors in Cuphead?

Multivariate linear modeling shows that average number of mastery-oriented behaviors exhibited before a helpless-oriented behavior exhibited along with total number of mastery-oriented behaviors is associated with higher mastery orientation scores in both a general context as well as a game context. This suggests that players who retry more often after losing all of their health and who keep trying longer before giving up have a better perception of their ability to persist through failure in game context, and that how long an individual will persist through failure is an important part of understanding how they react when they encounter failure.

Mastery orientation scores are often used to gauge likely success in classrooms, used as a measure of how well a student will react to encountering failure during instruction or exams. However,

these measures are based entirely on self-report survey measures encapsulated in a short number of questions. This has led to a dichotomy between those who are mastery-oriented and those who are helpless-oriented. This dichotomy over-generalizes individuals and does not entirely capture how an individual behaves when they encounter failure, leading to assumptions that if a person scores lower on the mastery orientation scale, they are more likely to quit or show ineffectual responses any time they encounter failure; or that the individual who scores high on the mastery orientation survey will always persist any time they encounter failure. This dichotomy leaves no room for understanding how long an individual will persist in the face of failure, or how many times an individual will try again before they quit. This finding expands our understanding to include not only if an individual will perform these actions, but for how long they will perform these actions. This allows us to think of helpless-oriented individuals in terms of persisting for shorter durations rather than not at all.

4.2.3 What Level Features Encourage Players to Persist Through Failure in Cuphead the Most?

Gameplay behavior frequencies show that more mastery-oriented behaviors per hit occur in the first phase of most levels. This suggests that players are more inclined to keep trying after failure when it is incurred earlier in a level, potentially indicating that failures encountered at this point are easier to persist through. Failures that occur earlier in a level result in less loss of time and effort invested in the attempt these failures are tied to. This may result in these early failure easier for players to persist and retry. Conversely, when a player fails later in level, they are less likely to show mastery-oriented behaviors. This may indicate a higher level of investment, making failure in these phases more impactful as you lose more progress, time, and effort. This also points towards evidence of players moving towards the investment phase of Davidson's model of investment in games, as the player becomes more likely to persist through failure the more they play.

Across all levels, the highest amount of mastery-oriented behaviors per hit occur in mausoleum levels. However, this is due to the fact that these levels only allow one ghost to hit the urn before the

game over screen is shown, resulting in more opportunities to retry per number of hits. Next to this, levels 15, 18, and 19 show the highest ratio of mastery-oriented behaviors per hit, with most levels hovering around or above 0.33, or 1 mastery-oriented behavior per 3 hits. This likely reflects the three lives the player has until they are required to retry the level at the game over screen. This could indicate that while in these levels, players are more able to keep retrying after losing all of their lives. There are no clear common features that these three levels share; level 15 is a run 'n gun style level on Inkwell Isle II, while level 18 and level 19 are boss levels on Inkwell Isle III with no clear common patterns. These levels are all far enough into the game that players might have gotten used to having to persist through many failures before completing a level. However, this is not seen in other levels at this stage in the game or later. This may suggest that at this mid-level progression of the game, players are used to the controls, the persistence that is required, and are challenged at a moderate level which is not overly frustrating. It may be the case that earlier levels are more frustrating because the player has not yet mastered the controls or become accustom to attempting a level multiple times before completion, while later levels may be more frustrating because they are the pinnacle of challenge in *Cuphead*. This further points to the player developing through the phases of investment, as they show signs of becoming more familiar with the controls.

Level 3 is of particular interest as the first phase is among the highest for mastery-oriented behaviors, but the second phase is among the lowest. This suggests that player reactions to failure in this level is highly dependent on when it occurs. If a player fails in the first phase in which the bosses shoot fireballs in a patterns that requires the players to duck, jump, duck, jump, they are likely to retry again. However, if they fail in the second phase in which the player must run against a wind created by one boss and avoid bouncing projectiles created by the other, they are less likely to retry the level. This may be due to the change in mechanics, or because the player has spent more time and effort to get to that phase, or more likely a combination of these factors that make retrying after getting to this phase

more daunting than the other phases of this level. This could also indicate the difficulty of the third phase. Many players regarded the third phase of this level to be one of the most challenging on the first island. Here, the player must avoid coins that the boss throws at them and parry a slot machine arm, triggering one of three random actions. Each of these actions are challenging to deal with and a string of bad luck might pit the player against the most challenging version multiple times in a row. Many players reported that because the phase was so challenging, if they took any damage in a previous phase, they would restart the level in order to ensure they made it to the third phase with as much health as possible. Thus, this decrease in mastery-oriented behaviors in the second phase might indicate the difficulty of the third. This change in difficulty mid-level along with changes in behaviors shows how a level changes influence how a player reacts to failure. Closer inspection is needed to better understand what mechanics influence players actions towards challenge and failure.

The level restart behavior was very common and was exhibited by most players. A level restart was defined as when the player selects the restart button from the pause screen before losing all their health. These events were coded as a quit as well as a retry in succession to capture the unique nature of the player both giving up on that attempt, but also retrying simultaneously. This strategy was employed most often when the player lost health in an area of the game that they had previously completed. During their first interview, this behavior was reflected on by participants. Many participants noted that this strategy was not used because they were giving up, but because they wanted to make sure they had enough health to survive long enough in the later phases the ensure they would be able to learn and make progress. The levels that this strategy was used in most standardized per hit were levels 3, 11, 12, 23 and 13. As mentioned previously, level 3 was noted to be particularly difficult and the steep increase in difficulty of the game. Given that this last phase presents a greater level of challenge than the previous phases, players must spend more time in the phase to eventually complete it. However, the player must still get through the first two easier phases to get this practice. If the player

loses health in these easier phases, they would be more likely to restart the level to preserve the

resources they have determined they will need in these harder phases. Each of these levels that show a

higher number of the restart strategy used represent levels that have this increase in difficulty towards a

later phase, suggesting that increasing difficulty in this way promotes players to restart the level if they

lose health in an earlier phase of the level. This change in behavior also points towards the delicate

nature of the players expectations. A change in difficulty from what players are used to elicits a change

in their responses as well as reports that the phase and level are challenging and frustrating. However,

this level was also reported as one of the most enjoyable as well, suggesting that this increase in

difficult, while frustrating, can be very rewarding to the player.

The average number of mastery-oriented behaviors exhibited before a helpless-oriented

behaviors is exhibited is lower during the first phase of most levels. This metric was recorded when a

participant exhibited a helpless-oriented behavior, showing the level and phase in which their streak of

mastery-oriented behaviors ends. Lower numbers in the early phases shows that when a player exhibits

a helpless-oriented behavior in the first phase of a level, it is more likely to closely be followed by

another helpless-oriented behavior in comparison to the second of later phase of that level. This

suggests that compared to later phases in a level when playing the beginning of levels, players are

typically more likely to show helpless-oriented behaviors in response to failing multiple times. This could

indicate that when a player advances further into a level, they are more likely to keep trying after they

fail. This could be due to the time and effort that players have invested, encouraging them to keep

trying to ensure that effort is not wasted, showing further evidence of players moving towards the

investment stage of Davidson's model of investment.

Further evidence to support this is seen in the levels in which players sequentially persist the

most. The levels with the highest average number of mastery-oriented behaviors exhibited before a

helpless-oriented behavior is exhibited are found later in the game. This points to the later phases in a

level to encourage longer streaks of retying without quitting or showing strategy deterioration. This could be because the player is more invested in completing the level after putting in the time and effort that it would take to get to the later phases of a level, discouraging them from quitting out of that level until they complete it. This could also suggest that as the player progresses through the game, they become more used to having to put in multiple attempts before completing a level. It may be the that a higher mastery orientation enabled players to make it further in the game, however there is no apparent correlation between highest level complete and any mastery orientation score.

Gameplay behavior frequencies shows that players are more likely to exhibit a helpless-oriented response in the first phase of most levels. This suggests that when players encounter failure in the start of a level, they are more likely to respond by quitting or showing deterioration of their strategy. This could indicate a player testing out a level to determine if they want to put in the resources required to develop the skills needed to complete a level. Later phases of levels show fewer helpless-oriented responses, suggesting that as players progress through the game, they are less likely to give up. This could be due to the time and effort that the player puts into the game, making them less likely to give up. It is worth noting that number of mastery-oriented behaviors was also higher in the initial phases of levels. This general trend will be discussed after considering the implications of the increase in helpless-oriented behaviors individually.

These analyses also show that fewer helpless-oriented behaviors are performed in the later levels of the game. This suggests that as players progress to the later levels of the game, they are less likely to give up or have their strategy deteriorate after encountering failure. This could suggest that players who make it to later levels of the game are more prepared to persist through failure at this point, which could show

A general trend found in the gameplay behavior frequencies shows that more behaviors of all types are found in the first phase of levels. These behaviors occur more often in the first phase of levels

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because players spend the most amount of time in these phases. These metrics are standardized by number of hits, but since players have to go through these phases and level to get to the later ones, there are more opportunities to react to failure in the early phases and levels. However, playing for longer means the player will likely occur more hits as well. This shows that players who do make it to later stages or levels are persisting through a lot of failure to reach later stages, in which they are less likely to show a helpless-oriented behavior in response to failure. This could point to player differences rather than phase and level differences. Players may have their own stopping point based on their skill level that dictates when they decide to quit. These behaviors may also show how players develop the skills they require to progress through the game.

Later levels in the game show a higher average number of mastery-oriented behaviors before a helpless-oriented behavior is exhibited. This suggests that as the player gets further into the game, they are more inclined to keep retrying and learning from their failures before quitting. It may be the case that players who are persistent enough to make it to the later levels of the game only make it there because they already possess the ability to persist, but it may also be that players when a player makes it to the later levels of the game, they are more likely to consistently keep trying after encountering failure for a longer period of time. This follows from other patterns seen in these gameplay behavior frequencies – the more time and effort a player has invested into the game, the less likely they are to give up when encountering failure. It may also be the case that the closer the player gets to the end of the level, the closer they are to success. This may spur motivation to keep trying until they finish the level. These behaviors also show how players develop as they progress through the game, learning what it takes to complete a level, including the skills required as well as the persistence needed to progress through a level.

The levels that are abandoned before completion the most are levels 6 and 3. Level 6 is available immediately upon beginning the game and is visualized as a bullseye on the group of the overworld,

making it the most obvious starting level. The other starting levels are a slightly different colored bush

and a small garden, making them slightly more camouflaged into the surrounding art. Because of this,

players often start with level 6, which is a "Run 'N Gun" level titled Forest Follies. Compared to the other

starting levels, level 6 is significantly harder and represents a playstyle that is less common to the game.

Starting with level 6 seems to have caused many participants to become overly frustrated and to lose

some enjoyment of the game. If the player was still stuck on this level after the first week of play, they

were informed that there are other starting levels for them to try out and that they were often

considered easier and more representative of how the rest of the game is played. This disparity in

difficulty is likely what caused level 6 to have the highest number of level abandons. As a "Run 'N Gun"

level, there are fewer discrete points in the level that show the player that they've made progress. This

may also have influenced players to abandon this level the most, as players likely feel less like they are

working towards success when they fail as compared to a level in which the boss transitions to a

different phase which is visualized on the game over progression screen. Regardless, this level proved to

be a challenge for most players if they chose to play it before the other starting levels. Making this

available and apparent to the players may have been a conscious decision by the developers to inflate

the players first impressions of difficulty when they start the game. The intent may have been to set

high expectations for the player so that when they do move on to another level, they feel more

confident in their ability to succeed. However, the placement of this level may have hindered players, as

this level was the most likely to be abandoned for another level and level abandons were shown to be a

negative predictor of mastery orientation scores. During their first interview, this level was the focus of

frustration for a lot of players. When the player practiced enough that they finally completed it, there

were mixed reactions. Some players were really excited that they surmounted the challenge that had

frustrated them so much, but others found it lackluster and were glad it was finally over. Starting the

game with an overly challenging level seems to have very mixed reactions, with some players enjoying the interaction, but others losing motivation to play.

Taken together, these behavior frequencies show how players develop as they play *Cuphead*. Players show more persistence over time, suggesting that as they play they become more invested. This could show some of the actions we would expect to see as a player becomes more invested in a game as Davidson's model of investment illuminates. As these players progress through the challenging levels of *Cuphead*, their expertise in the mechanics and strategies needed develops, and they begin to become more invested in completing the game. This is seen in their developing ability to show more mastery-oriented behaviors as they progress through the game. This could be showing that over time they learn that completing a level of *Cuphead* takes multiple attempts to learn the boss' patterns and reacting to failure with more mastery-oriented behaviors, enabling a more positive approach to the failures that they occur.

4.2.4 Does Mastery-Orientation Score Increase with More Game or Failure Exposure?

T-tests on pre-post general mastery orientation scores show that participants general mastery scores significantly decrease after playing *Cuphead* for two weeks. However, t-tests show that there is no change in players game mastery scores over the course of the study. This suggests that while players confidence in their ability to persist through failure generally decreased, their confidence in their ability to persist through challenging games did not significantly change. This decrease could be due to a wide range of factors. There may be external factors that coincided with the study that caused players to decrease in general mastery orientation score. For instance, this sample of players was recruited from the undergraduate population at the researcher's university. The stresses that come with going through an undergraduate degree may have played a role in this decrease in general confidence. Some participants were recruited to complete the study during the time that they were completing midterm exams for some of their classes. This could have significantly impacted participants beliefs on their

ability to persist through challenge and failure in relation to a general environment rather than a game environment.

Linear modeling shows no significant associations between amount of gameplay and game mastery orientation scores, general mastery orientation survey scores, change in these scores after playing *Cuphead* for two weeks, amount of mastery-oriented behaviors, amount of helpless-oriented behaviors, average number of mastery-oriented before a helpless-oriented behavior, or ratio of mastery-oriented to helpless-oriented behaviors.

Linear modeling shows that number of times a level is abandoned is positively associated with change in game mastery orientation scores from pre to post tests. This suggests that players who exhibit a behavior associated with a helpless orientation are more likely to increase in mastery orientation score after playing a challenging video game for 2 weeks. This may be because those players who have less confidence in their ability to persist through failure in a challenging game have the highest potential to improve. Further evidence for this is shown by the negative association between number of times a level is abandoned and pre game mastery scores. This suggests that players who have lower confidence in their ability to persist through failure in a challenging game increase towards the average after playing *Cuphead* for two weeks.

Linear modeling also shows that number of mastery-oriented behaviors is negatively associated with change in game mastery orientation scores from pre to post tests. This suggests that players who performed fewer mastery-oriented behaviors increased in their mastery orientation score more than those who performed more mastery-oriented behaviors. This finding is somewhat unintuitive, as we might expect that players who are perform more mastery-oriented behaviors would increase their mastery orientation scores the most. However, this may indicate that those who are lower on the mastery orientation scores show more benefit from being exposed to a challenging environment like playing *Cuphead* for two weeks. As such, these individuals that are less likely to persist through failure

initially may be come away from playing *Cuphead* with a greater change to their perceived ability to persist in these environments in the future.

However, average game mastery orientation scores also decreased from pre to post tests. On its own, this findings suggests that playing *Cuphead* causes players to feel less confident in their ability to persist through failure. Taken together with the finding that those who performed fewer mastery-oriented behaviors increased more pre to post, this may indicate a different story. Visualizing participant's change in mastery orientation scores shows that those who started higher on the scale tended to go down, whereas participants who started lower on the mastery orientation scale tended to go up. This suggests that those who performed fewer mastery-oriented behaviors tended to increase in their confidence that they can persist through failure whereas those who performed more mastery-oriented behaviors tended to decrease in their confidence that they can persist through failure. This points to a tightening of participant's confidence in their ability to persist through failure, with those who began playing *Cuphead* overly confident lowering their expectations and those who began playing *Cuphead* under-confident raised their expectations. This also explains why only pre test mastery scores were found to be significantly associated with mastery-oriented or helpless-oriented behaviors. Playing *Cuphead* appears to have an evening out effect on individuals' confidence to persist through failure.

Linear modeling shows that change in general mastery orientation score is negatively associated with the ratio of mastery-oriented behaviors to helpless-oriented behaviors. Coupled with the finding that participants decreased in general mastery orientation scores after playing *Cuphead* for two weeks suggests that those who performed more mastery-oriented behaviors compared to helpless-oriented behaviors tend to decrease in their general mastery orientation scores the most. Likewise, average number of mastery-oriented behaviors exhibited until a helpless-oriented behavior is exhibited is negatively associated with change in general mastery orientation scores after playing *Cuphead* for two

weeks. Together, these findings suggest that those who encountered moments in which they had to persist decreased in their mastery orientation scores in a general context.

Number of times a level was abandoned was positively associated with change in general mastery orientation, suggesting that those who abandoned levels more often saw an increase in general mastery orientation after playing *Cuphead* for two weeks. This may indicate that those who are more prone to helpless-oriented behaviors are more influenced by playing *Cuphead* for two weeks to react to failure in mastery-oriented ways than those who are more mastery-oriented.

Taking the findings related to this sub question together, we can see a general trend of players who are less prone to performing mastery-oriented or more prone to performing helpless-oriented behaviors showing more of an increase in mastery orientation scores, and those who score higher on mastery orientation surveys decreasing in their mastery orientation scores throughout play. This trend suggests that playing *Cuphead* for two weeks had a leveling effect on participants. Those who came into the game highly confident in their ability to persist through failure dropped in this confidence, while those who game less confident in their ability to persist through failure increased.

4.2.5 What Demographic Differences Appear in Mastery-Oriented Behaviors in Cuphead or Mastery Score?

The trends observed in the previous sub question are also observed between men and women. Previous literature suggests that women tend to score lower on mastery orientation surveys then men and that women typically play video games less than men. Comparing men and women across a range of variables, these analyses show that men and women of this population sample do not significantly differ in their mastery orientation scores. However, after playing *Cuphead* for two weeks, women show a significant increase while men show a significant decrease in their game mastery orientation scores. Further investigation shows that while men and women do not significantly differ when they start playing, the change after playing for two weeks represents a further equalization of their game mastery

orientation scores. This suggests that while some women began playing *Cuphead* with a lower game mastery orientation score than average and some men began playing *Cuphead* with a higher game mastery orientation score than average, playing *Cuphead* for two weeks made those women who scored lower initially more confident in their ability to persist through failure and made those men who scored higher initially less confident in their ability to persist through failure. These initial perceptions may have been rooted in gender biases around games, suggesting to some women that they won't be able to persist through the game because of their gender, and that suggesting to some men that they will be able to do better than most at persisting through the gaming because of theirs. However, once players are given the chance to experience *Cuphead*, these expectations seem to level out, showing those underconfident women that persisting through failure in *Cuphead* is part of the game, and showing those overconfident men that it still takes effort. While this finding does not erase biases inherent to video gameplay, it does show that exposure to an environment that is highly challenging and full of failure might help equalize the gender gap.

Gameplay experience was found to be negatively correlated with the number of times a player abandoned a level before completing it. This suggests that individuals who have been playing games longer are more likely to keep trying a level even through multiple failed attempts before giving up and trying something else. This could be caused by playing games over time and coming to expect failure in these environments. It may also be that individuals who are more inclined to persist already may be more attracted to playing games for years. However, given the increasingly pervasive nature of video games, it is more likely that as more people are attracted to playing games they are being exposed to the influences the environment might have on them than for an increasing number of people who are attracted to challenging environments to emerge over time.

It may be that exposure to environments like video games that frame failure as routine and a natural occurrence of eventual success in the environment could enable individuals to feel more

positively about their ability to persist through failure. This could suggest that interventions designed to expose individuals to failure-rich environments could promote persistence when failure is encountered. This could be beneficial for individuals who have a hard time reacting to failure, showing them that failure does not always mean defeat, but that it can show where they can improve and lead to eventual success.

No differences were found between age and mastery-oriented or helpless-oriented behaviors, or mastery orientation scores for the general or game-specific surveys. This suggests that in the age range we captured, there is no difference in mastery orientation scores or gameplay behaviors. However, this sample was taken from the undergraduate population, making the age range very narrow. It may be the case that significant differences exist between younger and older individuals.

4.2.6 Main Research Question

Taken together, these sub questions allow for reflection on the main research question: What is the relationship between mastery orientation and mastery-oriented behaviors in Cuphead?

Participants who scored higher on mastery orientation surveys initially showed more mastery-oriented behaviors when we consider how long they will continue to show mastery-oriented behaviors before showing a helpless-oriented behavior. Further, participants who initially score lower on mastery orientation surveys abandon more levels before completing them. This shows that a behavioral approach to gauging how an individual will react to failure effectively captures the behaviors we would expect to see from both mastery and helpless orientations. This expansion of methodology can show nuances in what individuals actually do when they encounter failure rather than view this construct by self-report aimed at gauging how an individual believes they typically respond when they encounter failure. This also opens a new method for understanding how players behave in video games, focusing on the mechanics and techniques developers use to create their game experiences.

After playing *Cuphead* for two weeks, players show a decrease in general mastery orientation scores, but not in game mastery orientation scores. It is also found that those who started higher than average on the mastery orientation scale decreased the most while those who started lower than average on the mastery orientation scale increased. This suggests that playing *Cuphead* had a leveling effect on participant's perception of their ability to persist through failure. This trend is also seen between men and women. The average mastery orientation score for women was initially lower than average than that of men, although the two groups were not significantly different statistically. After playing *Cuphead* for two weeks, the same change over time was observed and was statistically different for men and women; women's average mastery orientation score increased while men's average mastery score decreased. This suggests that some players, primarily women, began the study less confident in their ability to persist through failure in a game context but increased in this assessment after being immersed in a challenging video game for two weeks. Meanwhile, some players, primarily men, began the study with a higher level of confidence in their ability to persist through failure in a game context and decreased in this assessment after being immersed in a challenging video game for two weeks. These analyses show a gender gap that with exposure to the game environment, diminishes. This also sheds some light on the results that mastery scores before playing *Cuphead* were significant at pretest and not posttest – as players across the mastery orientation spectrum play, their confidence in their ability to persist through failure converges towards the average. This may have caused players of different play styles to show similar mastery orientation scores after play but not before. The larger implication of these findings suggest that playing a challenging game like *Cuphead* helps individuals of all playstyles and backgrounds understand that they can persist through the failure that comes with these challenging environments as long as they keep trying and put in the effort.

These analyses expand the current understanding of mastery orientation to include not only where individuals fall on the mastery orientation scale, but also shows longitudinally what they do in

response to failure when it is encountered frequently. This expands our understanding of mastery orientation to include not only if someone is more likely to persist through failure, but also how long they will continue to persist before giving up. This distinction allows for the viewing of individuals as not just exhibiting mastery-oriented behaviors or exhibiting helpless-oriented behaviors, but how long an individual will exhibit mastery-oriented behaviors, which better captures persistence through challenge.

These analyses also begin to show some of the factors that can influence how an individual will react to failure. The current survey measures capture a snapshot of how that individual perceives their general ability to persist through failure. It has been shown that modifying these questions to fit a different context changes how the individual feels about their ability to persist. This shows that the context in which an individual fails is or contains important factors to their response. The majority of studies done that capture mastery orientation are in the context of a classroom environment. In these environments, by most teaching models, students are taught material through instruction, worksheets, or demonstration. While these modalities allow for some failure, it is often in front of their peers, or graded by an authority figure that also has the ultimate power of assessing the student. These environments are less conducive to allowing failure to be a natural part of the learning experience. Following instruction, students are often asked to complete an assessment to gauge their retention. Whether through written or oral exam, the student usually has one opportunity to show that they can produce the correct result. Even though they may have demonstrated that they can do so when completing instruction, they are now expected to be able to do so again within a different timeframe, and now knowing that if they make a mistake, it will affect their grade and consequentially their future. This study shows the benefits to viewing mastery orientation not as a static quality used to predict what an individual will do in any case that they encounter failure, but as a resource that shows how long an individual can persist through failures over time. This perspective has potential to provide insights into how environments in which failure is expected should be designed. Priming individuals to expect failure

and encourage them to keep trying until they succeed promotes positive reactions to failure and leads

to eventual success.

4.3 Limitations

This work contains some important limitations to be mindful of for future research. Foremost,

the number of analyses conducted in this study might have led to some statistically spurious results. As

this work is exploratory, a wide net was cast to shed a light on what possible effects are fruitful for

further investigation. However, at an alpha level of 0.05, 1 in 20 tests is likely to present a type I error,

showing a statistically positive effect where there is none. Post-hoc multiple comparisons adjustments

were considered but would lower the alpha to a level that would likely cause many type II errors,

showing no significant results where they may exist. This higher type I error rate was accepted because

of the exploratory nature of this work. Further, these results show a pattern that is unlikely to be caused

by chance. For multiple mastery-oriented behaviors to be positively associated with mastery orientation

scores as well as quitting a level being negatively associated with mastery orientation scores and then

each of these measures to even out after playing *Cuphead* for two weeks is improbable. These results

should be investigated more closely to ensure these patterns were not caused by type I errors.

Further, as the sample was recruited through university listservs at a large public University in

the United States, the implications are limited to individuals who are represented in the undergraduate

population. This means that individuals with a lower socio-economic status who are not able to attend

University may not be represented in this study. As such, it is important to keep in mind that this study

may only include individuals who are able to persist through failure enough to be accepted to and

remain in a large public University in the United States. There may be significant differences between

these populations, although it is not to suggest that individuals with a lower socio-economic status

would necessarily score lower on a mastery orientation score or show fewer mastery-oriented

behaviors. It may be the case that these individuals have more experience in environments where failure is common, which this study suggests may be a positive factor to a mastery orientation score.

Further, the sample collected was self-selected through recruitment, and participants were informed that participation would include playing a challenging video game. This may have dissuaded individuals who are less inclined to play a game in which failure is common. A study that focuses on exposing participants to an environment which they do not know how challenging it will be beforehand could change the results significantly. The individuals in this study might have reacted very differently if they had been recruited to play a game that was easy to complete and then given a game that was actually very challenging. In summation, the expectations participants have before beginning a game or starting a study may be an important factor to how they respond when encountering failure.

While failure is common in most games, it is not as central to all. This study is limited to a single game that is well known for its level of challenge. Other genres of games that are played in very different ways what might frame failure in way that results in different reactions. Games that are designed for high level competition are often zero-sum; one player must lose. In fact, a win rate in many competitive games that is over 55%, meaning they lose just under half of their games, is considered very good. This game environment might elicit different reactions to failure considering that it occurs nearly half the time. "Casual" types of games that are designed to be low-stakes and played at the players own pace might elicit different reactions to failure. These games often set lower expectations for the amount of failure that will be encountered and may elicit very different responses when it is. This limits the findings to playing a game that is designed for players to encounter failure frequently.

It may be the case that participants felt some social pressure when talking about their reactions to failure during their interviews or played differently because they knew their gameplay videos would be analyzed in the future as part of the study. While measures were taken to prevent this, such as securing a private room for interviews, ensuring the participant that no identifying data from the project

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would not be available to the public, and that candid responses to these questions were appreciated, participants may have still felt pressured to report more positive reactions than they would have given naturally. However, this limitation is inherent in all research probing an individual's cognition and cannot be completely mitigated. Participants were also asked if they felt as if they played any differently than they would have if they bought the game for their private use because someone was going to be watching. Most participants reported that they did not change any in-game behaviors and often forgot they were recording until they stopped playing. Some participants did report that they played more often than they might have if they were not in the study, but this was to ensure that they produced as much footage as possible, and not to show more persistence. This means that some participants may have felt some pressure to play more often, but not necessarily to persist after failure more often.

4.4 Implications

This study advances our understanding of the role failure plays in video games, how we should conceptualize an individual's reactions to failure, and how environments can frame failure to elicit positive responses.

4.4.1 The Role of Failure in Video Games

Failure is an important part of the play experience. Playing a video game that is too easy can feel boring or trivial, unexciting, and unenjoyable. Even if within the first few experiences of the game, if the player does not feel challenged, they might not engage in the game enough to want to keep playing to get to the parts where the game starts to challenge them. Failure shows the player that they are working on a part of the game that is going to take some effort, some learning, and some patience. This seems to shift the players mindset into a different mode in which they set their resolve and get to work trying to figure out what they need to work on to get through the area. Sometimes this means learning how to use the abilities that their character can use, potentially consulting the instruction guide or practicing those skills in an easy section of the game. Other times, it might mean that they have to focus

on the slight movements that the boss shows right before they use a powerful attack. In both cases, the player has a task in front of them that is going to take some effort to accomplish. Keeping these tasks relatively challenging, meaningful, and something that the player learns from are essential to keeping the player engaged. Giving a player menial tasks that do not challenge them may result in them giving up before they reach the part of the game at which the difficulty increases. On the other hand, giving a player tasks that seem too difficult might frustrate players and scare many of them off. However, many games that are known for their difficulty do exactly that – present the player with a difficult challenge immediately. Dark Souls, after a short quiet hallway, starts the game by pitting you against a massive demon that destroys pillars, shakes the ground, and can kill you in 2 hits. To start this fight, you are given a broken sword and no armor. Many players first attempt at this boss is likely to end with the player getting hit after doing practically no damage and getting killed within a few seconds of the fight starting. Dark Souls is intentionally telling the player that this game is going to take your full attention and effort throughout the entire game to complete. If the player does not feel as though Dark Souls is impossible for them to beat, they might that figure out that they can roll out of the way of its attacks. If they do that, they might start exploring the area while the boss swings its massive mace, shaking the ground with every hit. This might lead to the breakthrough that allows a player to beat the first boss of Dark Souls – a small door they can escape through to find a sharp sword and a crude set of armor. Each of these steps might stop the player in their tracks, leaving them confused and frustrated that they can't continue forward. Each might cause the player to quit the game, feeling like they are simply not able to figure this boss out or perform well enough to beat it. Many players have met this fate, giving up on Dark Souls before seeing more than the first room. However, the players that do complete each of these tasks are rewarded with a sense of accomplishment; and then are met with their next challenge, equally, if not more difficult. Dark Souls, and many games known for how challenging they are structured in this

way to show players that this game is not going to be easy, exemplifying the catch phrase of the series:
"Prepare to die".

Not all games present this level of difficulty right at the start of the game, or at all. Most games start by placing the player in an area, usually referred to as the tutorial, that walks them through the actions that the player can take, the basic concepts and gimmicks of the game, and slowly yet steadily ramps up the difficulty until they reach the first area of the game that represents what the game will mostly be like. This part of the game consists of a sequence of areas or levels that typically get incrementally more difficult. Sometimes, developers will place a level or area that is significantly more difficult than the previous areas and does not follow the trajectory of increasing difficulty laid out previously. This can sometimes be a mini-boss or right before a checkpoint, and sometimes can be telegraphed by the game or a complete surprise to the player, which changes how the player goes into it. Finally, at the end of each area or level, there is often a challenge that is greater than the player has faced yet, especially at the end of the game. This is typically the final challenge that the player will take on while playing the game and is usually meant to be the climax that requires the player use every ability and technique that they learned to use while playing.

4.4.2 The Role of Failure in Game Design

These analyses have further implications for game designers. The ways that players navigate through failure has long been a central focus when developing a game. Developers aim challenge players at an optimal level, avoiding boredom from the game being too easy and anxiety from the game being too difficult. However, the nuances of how developers encourage players to keep playing through failure remain unclear. By investigating when and why an individual begins to show helpless-oriented behaviors, developers can better understand how failure is best framed in games and when players are most likely to quit playing. In *Cuphead*, we can see that the level most abandoned was level 6, Forest Follies, one of the first three available upon beginning the game. This level was considerably more

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difficult than the other starting levels and represented a style of play that deviated from most levels and was also more visually apparent on the screen and often attracted players to start playing a level that required a higher level of skill than the player would have developed. In terms of Flow theory, this level would represent the player starting high on the challenge axis and low on the skill axis, resulting in anxiety. This would explain why players were more likely to abandon this level than any other. While the placement of this level may have been purposeful to set the tone of the game similar to the first boss of *Dark Souls*, this may also have caused some players to become disengaged or feel as though they are not capable of progressing through the game. Actions could be taken to mitigate this – this more challenging level could be locked until the player has complete easier levels, showing that they have the skills they need for that level of challenge. Players could also be encouraged to try other levels if they are not progressing in the level they are attempting. This would still result in the player abandoning the level for another, but it would signal to them that there are other levels at a different challenge level that they could attempt, potentially leading them to a more appropriate level of challenge rather than to quit the game entirely.

4.4.3 Narrowing the Gender Gap

Systemically reinforced stereotypes have existed between men and women for decades. Research has shown that women are less confident in their ability to compete at a game, especially if there are men playing as well. However, research shows that there is no difference in gameplay ability when experience is accounted for. This shows that the stereotype that women are not as good at video games is only perpetuated by the cycle women are forced into when joining a game community that is predominantly men – beginning a game unfamiliar with the controls, they tend to fill a role that is suggested, leading them to learn how to play in ways that reinforce the stereotype. Over time, this may have contributed strongly to the gender gap we see in the types of games that men and women play.

This study presents some evidence that this gap diminishes through play. After playing *Cuphead* for two weeks, women who were on the lower end of the mastery orientation scale increased, while men who were on the higher end of the mastery orientation scale decreased. This shows that experiencing challenging gameplay dispels these preconceived notions, showing women that they are capable of persisting through challenging gameplay, and showing men that persistence does not come inherently and takes effort. In fact, this study showed no differenced in behaviors between men and women except for the evening out effect shown in their game mastery-scores, suggesting that the only difference seen between men and women was the lower level of confidence that women began the game with, which diminished after playing the game for two weeks. While much more research is required to tease out substantial influences and effects regarding gender, this gives some promise that the more experience an individual has playing games, the more they come to a common understanding of the effort and it takes and their confidence in completing it.

4.4.4 Persistence as a Resource

Playing at the highest levels of difficulty that require a high level of focus can be very rewarding. However, it also can be difficult to do so over a long period of time. Behaviors seen here show the importance of viewing now only if an individual will persist through failure, but also for how long they will. Shifting to this perspective changes how we can conceptualize an individual's ability to persist through failure. This study suggests that it may be the case that this ability to persist through challenging tasks is a limited resource rather than a static characteristic. The new approach this study takes shows the importance of not only the actions an individual takes, but also how long an individual will persist through failure. This lens could change how we develop failure into games or other challenging environments. The importance of breaks may prove to be a pivotal factor that allows individuals to recharge and prepare to keep trying to complete a challenging task, however understanding individuals' limits on how long they can persist needs to be better understood. Systems can be better created that

adjust not just the difficulty when a player fails, but when a player's ability to continue persisting runs

out and is likely to give up. Further, this reframes failure to only be a detriment when an individual can

no longer persist. Further research may show the importance of this conceptualization, allowing us to

think about not only the level of challenge that is implemented in games, but also how long a player can

maintain playing at a high level of challenge. This would have implications for the system that game

developers use to adjust the level of difficulty in their games. For instance, this approach could influence

dynamic difficulty adjustment systems, allowing these systems to adjust the difficulty of the game not

only to the relative skill the player possesses, but also tailoring the game's difficulty to how long that

player can persist through failure before they start to feel like they do not have the capacity to continue.

4.4.5 Failure as a Player-Centric Construct

This study shows that the ways failure is designed into a game is not always how players experience

it. Players responses to the question "what is failure in *Cuphead*?" show that players think about failure

differently depending on the goals they have and their expectations for their play. For most players, the

hard-coded failure that the designers built into *Cuphead* were treated as a natural occurrence that was

necessary and often productive towards their eventual success. This could be because of the way that

failure is framed in *Cuphead*. Players might be naturally inclined to retry a level after failing because the

cursor naturally starts on the retry button. They may also be motivated to keep trying because the

progress bar shows that they made it a little further this time than they did last time. It may also be the

case that the player really wants to beat the level after seeing the boss taunt them for failing. Most

likely, it is a combination of these mechanics plus many others that contribute to players persisting

through the challenging levels of *Cuphead*.

Interviews with participants after playing *Cuphead* for two weeks shows that players often

experience failure differently than the hard-coded failure states that developers code into their games.

While observing someone playing a game, it is tempting to view failure through the lens of these hard-

coded failure states. For instance, when watching a player get hit by projectiles until they reach the game over screen the observer might think that player failed - they did not successfully dodge everything they needed to and have to start over as a result. However, as this study shows, this may not be what the player considers failure. Depending on the circumstance, players might consider this hard-coded failure as part of the learning process that enables them to succeed or outside of their current goals. Reframing our understanding of failure in games enables us to understand better how the player will react when they encounter hard-coded failure.

This study also illuminates the importance of players expectations towards their experience regarding failure. Players can encounter the same events in a game and consider it a positive influence on their gameplay or a failure depending on what they are currently focused on accomplishing. This perspective is currently not accounted for in considering how an individual will react to failure in a game environment.

4.5 Future Research

These results shed some light on how individuals react to failure in a challenging game. Through this study, we better understand the ways that players react to failure in a video game through the lens of mastery orientation and have some better understanding of the different features and mechanics that can influence how a player reacts to failure. However, the limitations of this study point towards a wide range of areas to explore. First, widening this line of research to investigate other game genres may show different ways that players react to failure or different ways that game developers further this understanding. Cuphead is a notoriously challenging Run 'n Gun style game – different styles of games may change how players encounter failure and how they react to it. Perhaps arcade style games elicit very reactions to failure in similar ways, or perhaps when playing an arcade-style game the ways players react to failure differ greatly from what is observed in this study. One might expect that other genres that are slower-pace, and more story-driven would illicit a very different reaction to failure – as such,

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players of role-playing games might be more inclined to persist through failure because of the

investment that they build through the development of the story. They may also be less inclined to

persist through failure if there are lower expectations of failure. There are many different styles of game

that might frame failure in unique ways which that can further our understanding of what failure is in

games and how plyers react to it. Future research should focus on expanding this methodology to

investigate all different genres of games to show how different games illicit different responses.

Another aspect of games that might show very different reactions to failure are multiplayer

games. This study did not focus exclusively on a single player game as *Cuphead* could be played with

another player (and was, in fact, done so), however there was no direct comparison made between

those who played with someone else and those who played by themselves. Having another player

collaborating and working on the same goals might drastically change the ways in which players react to

failure. Not only are there multiple people sharing, performing, and diving actions, there are also

expectation set on each player by their companion. This social pressure might drastically change the way

players experience failure. Future research should investigate the influences of a collaborative play

space on players' reactions to failure.

Competitive games also produce other factors that might influence the way players react to

failure. Whether the game is a single player fighting game or a 5-person team strategy game, players

have a few common variables to produce – spectators and coaches, among others. Playing a game in a

private setting without anyone watching might illicit in very different reactions to failure than when a

player is on a stage or streaming for a large number of people excited to see a high-level of gameplay.

The stresses that come with performing at a competitive level alone are enough to warrant further

investigation in this direction. Although, competitive play also produces coaches as another factor that

might influence how a player reacts to failure. A coach might have the ability to train a player to react

differently than they otherwise would. Competitive players therefore might react to failure very

differently depending on how long they have worked with their coach and the quality of that coach. Herein lies an opportunity to explore the methods that these coaches have to influence how these players react to failure. Further, as competitive esports grow in popularity, so do the prizes that these tournaments promise. Further exploration should focus on how competitors at different-sized tournaments react to failure, taking into consideration the stakes of the tournament in terms of the prize pool on the line.

When players begin a game expecting that they are going to have to go through a lot of failure before being successful, it seems to change the way they interpret that failure. When someone expects that they will win immediately, failing feels very different than if they expected that to lose at first. How developers set the players expectation for their game remains unexplored. *Cuphead* was known to the community as a very hard game, but what made it gain that reputation? Perhaps it was the first "run 'n gun" level that players could access right when starting the game, or perhaps it was pace at which *Cuphead* ramps up in difficulty. Future work should focus on how player expectations influence the ways they react to failure when they begin, and throughout a game.

Finally, even when playing the same game, there are innumerable ways to play. It is widely accepted that there is no one right way to play, and as such the ways one might fail while playing can change depending on how one is playing. As such, further research should allow for a completely player-centric approach to failure in games. This study shows that players experience failure in ways that are dependent on the goals they are pursuing. The ways in which players experience failure could inform researchers and developers alike on how failure contributes to the play experience. Further research should be conducted on how a player's goals influence their reaction to failure. Data collected through this project may be able to address these questions through analysis of interview responses.

Likewise, studies focused on how developers view failure in the games they create would be beneficial. This could illuminate how they attempt to integrate failure into their games would be very

informative to our understanding of the tools and strategies that developers have used for decades to build games that encourage us to keep trying even when we fail. Game developers have perfected the delicate balance of challenging content that often results in failure but also the interest that engrosses players into persisting through it, yet research to document these trade secrets currently do not exist.

These avenues show an initial overview of the wide and deep array of areas that this line of research can pursue. Undoubtedly, each of these areas will spur further questions for exploration that will enable a robust and long-term research field into the nuances of failure in games.

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Pre Mastery Orientation Questionnaire

Q1 Please state much you agree or disagree with the following statements about your general gameplay preferences:

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
1. I would rather play a game at which I feel confident and relaxed than a game that is challenging and difficult. (1)	○	○	○	○	○
2. When a group I belong to plays a game, I would rather call the shots myself than just help out and have someone else call the shots. (2)	○	○	○	○	○
3. I would rather learn to play a game that is easy than one that is difficult. (3)	○	○	○	○	○
4. If I am not good at a game, I would rather keep struggling to master it than move on to a game I may be good at. (4)	○	○	○	○	○
5. Once I begin a game, I persist. (5)	○	○	○	○	○
6. I prefer to play games that require a high level of skill. (6)	○	○	○	○	○
7. I more often play games that I am not sure I can do than games that I believe I can do. (7)	○	○	○	○	○
8.I like games that keep me busy all the time. (8)	○	○	○	○	○

Q2 Please state much you agree or disagree with the following statements about your general preferences:

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
1. I would rather do something at which I feel confident and relaxed than something that is challenging and difficult. (1)	○	○	○	○	○
2. When a group I belong to plans an activity, I would rather direct it myself than just help out and have someone else organize it. (2)	○	○	○	○	○
3. I would rather learn something easy than something that is difficult. (3)	○	○	○	○	○
4. If I am not good at something, I would rather keep struggling to master it than move on to something I may be good at. (4)	○	○	○	○	○
5. Once I undertake a task, I persist. (5)	○	○	○	○	○
6. I prefer to work in situations that require a high level of skill. (6)	○	○	○	○	○
7. I more often attempt tasks that I am not sure I can do than taks that I believe I can do. (7)	○	○	○	○	○
8. I like to be busy all the time. (8)	○	○	○	○	○

Q3 Name:

_____

Q4 Email:

_____

Q5 Age:

_____

Q6 Gender identity:

_____

Q7 What year are you in your program at UCI?

   ◯ 1st (1)

   ◯ 2nd (2)

   ◯ 3rd (3)

   ◯ 4th (4)

   ◯ 5th + (5)

   ◯ Graduate (6)

Q8 Average number of hours playing video games per week:

_____

Q9 Number of years playing video games:

_____

Game Mastery Orientation Questionnaire - Exit

Q1 Please state much you agree or disagree with the following statements about your general gameplay preferences:

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
1. I would rather play a game at which I feel confident and relaxed than a game that is challenging and difficult. (1)	○	○	○	○	○
2. When a group I belong to plays a game, I would rather call the shots myself than just help out and have someone else call the shots. (2)	○	○	○	○	○
3. I would rather learn to play a game that is easy than one that is difficult. (3)	○	○	○	○	○
4. If I am not good at a game, I would rather keep struggling to master it than move on to a game I may be good at. (4)	○	○	○	○	○
5. Once I begin a game, I persist. (5)	○	○	○	○	○
6. I prefer to play games that require a high level of skill. (6)	○	○	○	○	○
7. I more often play games that I am not sure I can do than games that I believe I can do. (7)	○	○	○	○	○
8.I like games that keep me busy all the time. (8)	○	○	○	○	○

End of Block: Game Mastery Orientation Questionnaire

Q2 Please state much you agree or disagree with the following statements about your general preferences:

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
1. I would rather do something at which I feel confident and relaxed than something that is challenging and difficult. (1)	○	○	○	○	○
2. When a group I belong to plans an activity, I would rather direct it myself than just help out and have someone else organize it. (2)	○	○	○	○	○
3. I would rather learn something easy than something that is difficult. (3)	○	○	○	○	○
4. If I am not good at something, I would rather keep struggling to master it than move on to something I may be good at. (4)	○	○	○	○	○
5. Once I undertake a task, I persist. (5)	○	○	○	○	○
6. I prefer to work in situations that require a high level of skill. (6)	○	○	○	○	○
7. I more often attempt tasks that I am not sure I can do than taks that I believe I can do. (7)	○	○	○	○	○
8. I like to be busy all the time. (8)	○	○	○	○	○

Q3 Name:

_____

Q4 Do you have anything else you'd like to tell us about this project?

_____

_____

_____

_____

_____

End of Block: Block 2

APPENDIX B: Interview Question Guide

Did you record all of your gameplay?

Does any of the video contain other people playing?

What do you think of Cuphead so far?

Do you typically enjoy playing "challenging" games?

Is it as hard as you thought?

Where would you put your expectations on a scale of 1-10, 1 being going to fail, 10 being going to win?

What do you consider "failure" in Cuphead?

What do you do when you fail?

How do you feel about failure?

What strategies have you used to get through the game?

What are some of your strategies for improving?

For what reasons did you quit?

What did you think of the levels you played?

What was the most fun level so far?

What was the hardest level so far?

What did you think of it?

What was the easiest level so far and what did you think of it?

Did you consult any outside resources?

Is there anything else you want to talk about?

```
library(stringr)
library(readr)
CupheadDF <- as.data.frame(read_csv("D:/Data/Data.csv"))
MediaFiles <- list("P1 (.*?).mov", "P2 (.*?).mp4", "P3 (.*?).mp4", "P4 (.*?).mp4", "P5 (.*?).mp4", "P6 (.*?).mp4", "P7
(.*?).mp4", "P8 (.*?).mp4", "P9 (.*?).mp4", "P10 (.*?).mp4", "P11 (.*?).mp4", "P12 (.*?).mp4", "P13 (.*?).mp4", "P14
(.*?).mp4", "P15 (.*?).mp4","P16 (.*?).mp4", "P17 (.*?).mp4", "P18 (.*?).mp4", "P19 (.*?).flv", "P20 (.*?).mp4", "P21
(.*?).mp4", "P22 (.*?).mp4", "P23 (.*?).mp4", "P24 (.*?).flv","P25 (.*?).flv", "P26 (.*?).mp4", "P27 (.*?).mp4", "P28
(.*?).flv", "P29 (.*?).mp4", "P30 (.*?).mp4", "P31 (.*?).flv", "P32 (.*?).mp4", "P33 (.*?).mp4","P34 (.*?).mp4", "P35
(.*?).mp4", "P36 (.*?).mp4", "P37 (.*?).mp4", "P38 (.*?).mp4", "P39 (.*?).mp4", "P40 (.*?).mp4", "P41 (.*?).mp4",
"P42 (.*?).mp4", "P43 (.*?).mp4", "P44 (.*?).mp4", "P45 (.*?).mp4", "P46 (.*?).mov", "P47 (.*?).mov", "P48
(.*?).mp4", "P49 (.*?).mp4", "P50 (.*?).mov", "P51 (.*?).mp4", "P52 (.*?).mp4", "P53 (.*?).mp4", "P54 (.*?).mp4",
"P55 (.*?).mp4", "P56 (.*?).mp4", "P57 (.*?).mp4", "P58 (.*?).mp4", "P59 (.*?).mp4", "P60 (.*?).mov")
#Split, format, convert to epoch, and attach to df
Make_Epoch <- function(x){

  epochdatepulled <- matrix(NA,ncol = 2, nrow = length(MediaFiles))
  for(n in 1:length(MediaFiles)){
    epochdatetime <- str_match(as.character(x), MediaFiles[[n]])
    epochdatepulled[n,] <- epochdatetime
  }

  snatch <- epochdatepulled[which(is.na(epochdatepulled[,1]) == FALSE),]

  epochsplit <- str_split_fixed(snatch[2], " ", n=2)
  epochdate <- gsub("_","-", epochsplit[,1])
  epochtime <- gsub("_",":", epochsplit[,2])
  epochrejoin <- paste(epochdate, epochtime, sep=" ")
  epoch = (as.numeric(as.POSIXct(epochrejoin,tz="America/Los_Angeles", format = "%m-%d-%Y %I:%M:%OS %p")))
  return(epoch)
}

CupheadDF$FileEpoch <- apply(as.matrix(CupheadDF$`Media file`),1,Make_Epoch)
CupheadDF$Epoch <- (CupheadDF$FileEpoch + CupheadDF$`Start (s)`)

Cleandf <- CupheadDF[,c(1,3,6,7,11,14,16,17)]
Cleandf <- Cleandf[order(Cleandf$Subject, Cleandf$Epoch, Cleandf$Behavior),]

##Tag level in new column from "level start" (LEVEL COMPLETE??)
Tag_levels <- function(x){
  currentlevel <- 0
  lastlevel <- 0
  Mastery <- c("Retry", "Adaptation")
  Helpless <- c("Quit", "Deterioration")
  MtillHcount <- 0
  RestartStrat <- 0
  LevelOn <- 0
  CurrentPhase <- 0
  currplayer <- 0

  for(row in 1:nrow(x)){
```

```r
if(x$Behavior[row] == "Retry" & RestartStrat == 1){
  x$Restart[row] <- 1
  } else {
    RestartStrat <- 0
    x$Restart[row] <- 0
  }

if(x$Behavior[row] == "Level start") {
  currentlevel <- x$`Comment start`[row]
  LevelOn <- x$`Comment start`[row]
  lastlevel <- currentlevel
  x$Level[row] <- currentlevel
  CurrentPhase <- 1
  x$CurrentPhase[row] <- CurrentPhase

  } else if(x$Behavior[row] == "Quit" ){
    x$Level[row] <- currentlevel
    lastlevel <- currentlevel
    currentlevel <- 0
    CurrentPhase <- 0
    x$CurrentPhase[row] <- CurrentPhase
    } else if(x$Behavior[row] == "Retry"){
        x$Level[row] <- lastlevel
        currentlevel <- lastlevel
        CurrentPhase <- 1
        x$CurrentPhase[row] <- CurrentPhase
        } else {
          x$Level[row] <- currentlevel
          x$CurrentPhase[row] <- CurrentPhase
          }

# Adaptations out of level
if(x$Level[row] == 0){
  if(x$Behavior[row] == "Adaptation")
    currentlevel <-lastlevel
    LevelOn <- lastlevel
}

if(x$Behavior[row] == "Level complete"){
  # LevelOn <- 0
  currentlevel <- 0
  CurrentPhase <- 0
}

# Count mastery until helpless (type error)
if(as.character(x$Behavior[row]) == "Retry" | as.character(x$Behavior[row]) == "Adaptation"){
  MtillHcount <- MtillHcount +1}

if(as.character(x$Behavior[row]) == "Quit" | as.character(x$Behavior[row]) == "Deterioration"){
  x$MtillH[row] <- as.integer(MtillHcount)
  MtillHcount <- 0}
  else{x$MtillH[row] <- NA}
```

```r
  # Phase
  if(x$Behavior[row] == "Phase complete"){
    CurrentPhase = CurrentPhase +1
    x$CurrentPhase[row] <- CurrentPhase
  }

  # Restart stratagy tags
  if (as.character((x$Behavior[row]) == "Quit")){
    RestartStrat = 1
  }}
return(x)}

Taggeddf <- Tag_levels(Cleandf)


level_abandons <- function(x){
  currentlevel <- 0
  levelcomplete <- 0
  currrplayer <- 0
  for(row in 1:nrow(x)){
    if(x$Subject[row] != currrplayer){
      currentlevel <- 0
      levelcomplete <- 0
      currrplayer <- x$Subject[row]
    }
    if(x$Behavior[row] == "Level start" & currentlevel != levelcomplete){
      x$Abandon[row] <- 1
    }
      else{
        x$Abandon[row] <- 0
    }
    if(x$Behavior[row] == "Level start"){
      currentlevel <- x$`Comment start`[row]
      levelcomplete <- 0
    }
    if(x$Behavior[row] == "Level complete"){
     levelcomplete <- currentlevel
    }
    if(x$Behavior[row] == "Adaptation" & x$Level[row] == 0){
      currentlevel <- 0
    }
  }
return(x)}

Taggeddf <- level_abandons(Taggeddf)

# Phase_check <- function(x){
#   Levelmatrix <- matrix(data = 0, nrow = 56, ncol = 79)
#
#   for(row in 1:nrow(x)){
#     player <- x$Subject[row]
#     level <- x$Level[row]
#
```

```r
#    if(x$CurrentPhase[row] > Levelmatrix[as.numeric(player),as.numeric(level)]){
#     Levelmatrix[as.numeric(player),as.numeric(level)] <- x$CurrentPhase[row]
#    }
#    x$TopPhase <- Levelmatrix[as.numeric(player),as.numeric(level)]
#  }
# return(x)}
#
# Taggeddf <- Phase_check(Taggeddf)

write_csv(Taggeddf, "D:/Data/CleanedData.csv" )

#Qualtrics data

IntroSurvey <- as.data.frame(read_csv("D:/Data/IntroSurvey.csv"))
IntroSurvey <- IntroSurvey[-c(1:2),18:41]
ExitSurvey <- as.data.frame(read_csv("D:/Data/ExitSurvey.csv"))
ExitSurvey <- ExitSurvey[-c(1:2),18:35]

SurveyClean <- function(x){

  x[x== "Strongly disagree"] <- as.numeric(1)
  x[x== "Somewhat disagree"] <- as.numeric(2)
  x[x== "Neither agree nor disagree"] <- as.numeric(3)
  x[x== "Somewhat agree"] <- as.numeric(4)
  x[x== "Strongly agree"] <- as.numeric(5)
  return(x)}

CleanedSurvey1 <- SurveyClean(IntroSurvey)
CleanedSurvey2 <- SurveyClean(ExitSurvey)

Surveyflip <- function(x){
  One <- which(x == 1)
  Two <- which(x == 2)
  Four <- which(x == 4)
  Five <- which(x == 5)

  x[One,] <- 5
  x[Two,] <- 4
  x[Four,] <- 2
  x[Five,] <- 1

  return(x)
}

CleanedSurvey1[,c(1,3,9,11)] <- Surveyflip(CleanedSurvey1[,c(1,3,9,11)])
CleanedSurvey2[,c(1,3,9,11)] <- Surveyflip(CleanedSurvey2[,c(1,3,9,11)])

cols.num <- c(1:16)
CleanedSurvey1[cols.num] <- sapply(CleanedSurvey1[cols.num], as.numeric)
CleanedSurvey2[cols.num] <- sapply(CleanedSurvey2[cols.num], as.numeric)
CleanedSurvey2[CleanedSurvey2== "Nathan Dhamj"] <- "Nathan Dhami"
```

```
MergedSurvey <- merge(CleanedSurvey1, CleanedSurvey2, by="Q4")
DeIDSurvey <- merge(MergedSurvey, IDdf, by="Q4")

## Deidentify (REDACTED)
DeIDSurvey <- DeIDSurvey[,-c(1,18)]


## hits, adapts, deterioration, levels complete
GameAggs <- as.data.frame.matrix(table(Taggeddf$Subject, Taggeddf$Behavior))
GameAggs$ID <- rownames(GameAggs)
DeIDSurvey <- merge(DeIDSurvey, GameAggs, by="ID")


for(row in 1:nrow(DeIDSurvey)){
  ## Pre/post mastery scores
  DeIDSurvey$PreGameMastery[row] <- (DeIDSurvey$Q2_1.x[row] + DeIDSurvey$Q2_2.x[row] +
DeIDSurvey$Q2_3.x[row] + DeIDSurvey$Q2_4.x[row] + DeIDSurvey$Q2_5.x[row] + DeIDSurvey$Q2_6.x[row] +
DeIDSurvey$Q2_7.x[row] + DeIDSurvey$Q2_8.x[row])
  DeIDSurvey$PreGenMastery[row] <- (DeIDSurvey$Q3_1.x[row] + DeIDSurvey$Q3_2.x[row] +
DeIDSurvey$Q3_3.x[row] + DeIDSurvey$Q3_4.x[row] + DeIDSurvey$Q3_5.x[row] + DeIDSurvey$Q3_6.x[row] +
DeIDSurvey$Q3_7.x[row] + DeIDSurvey$Q3_8.x[row])
  DeIDSurvey$PostGameMastery[row] <- (DeIDSurvey$Q2_1.y[row] + DeIDSurvey$Q2_2.y[row] +
DeIDSurvey$Q2_3.y[row] + DeIDSurvey$Q2_4.y[row] + DeIDSurvey$Q2_5.y[row] + DeIDSurvey$Q2_6.y[row] +
DeIDSurvey$Q2_7.y[row] + DeIDSurvey$Q2_8.y[row])
  DeIDSurvey$PostGenMastery[row] <- (DeIDSurvey$Q3_1.y[row] + DeIDSurvey$Q3_2.y[row] +
DeIDSurvey$Q3_3.y[row] + DeIDSurvey$Q3_4.y[row] + DeIDSurvey$Q3_5.y[row] + DeIDSurvey$Q3_6.y[row] +
DeIDSurvey$Q3_7.y[row] + DeIDSurvey$Q3_8.y[row])

  DeIDSurvey$MperHit[row] <- ((DeIDSurvey$Adaptation[row] + DeIDSurvey$Retry[row]) / DeIDSurvey$Hit[row])
  DeIDSurvey$HperHit[row] <- ((DeIDSurvey$Deterioration[row] + DeIDSurvey$Quit[row]) / DeIDSurvey$Hit[row])
  DeIDSurvey$MperHit[row] <- ((DeIDSurvey$Adaptation[row] + DeIDSurvey$Retry[row]) / DeIDSurvey$Hit[row])
}

##Add aggregates to survey (Survey participants needs to match data)
NADF <- Taggeddf[,c(-6,-9)]
NADF<- na.omit(NADF)
DeIDSurvey$MtillH <- aggregate(NADF$MtillH, list(NADF$Subject), mean)

NADF <- Taggeddf[,c(-6,-11)]
NADF<- na.omit(NADF)
DeIDSurvey$Restarts <- aggregate(NADF$Restart, list(NADF$Subject), sum)

DeIDSurvey$Abandons <- aggregate(Taggeddf$Abandon, list(Taggeddf$Subject), sum)

write.csv(DeIDSurvey, "D:/Data/Surveydata.csv" )


#power analysis

library(pwr)

cohen.ES(test = "t", size = "medium")
```

```
pwr.t.test(n = NULL, d = 0.5, sig.level = 0.05, power = 0.8, type = "two.sample", alternative = "two.sided")

pwr.f2.test(u= 5, v = NULL, f2 = 0.5, sig.level = 0.05, power = 0.8)



##post hoc power

pwr.t.test(n = 21, d = 0.52199, sig.level = 0.05, power = NULL, type = "two.sample", alternative = "two.sided")


library(stringr)
library(readr)
library(dplyr)
library(ggpubr)
library(car)

Analysisdf <- as.data.frame(read_csv("D:/Data/AllDataCSV.csv"))


#check normality
ggdensity(Analysisdf$InGameMastery,
      main = "Density plot of Game Mastery Intro",
      xlab = "Game Mastery Intro Score")

ggdensity(Analysisdf$InGeneralMastery,
      main = "Density plot of General Mastery Intro",
      xlab = "General Mastery Intro Score")

ggdensity(Analysisdf$OutGameMastery,
      main = "Density plot of Game Mastery Outro",
      xlab = "Game Mastery Outro Score")

ggdensity(Analysisdf$OutGeneralMastery,
      main = "Density plot of General Mastery Outro",
      xlab = "General Mastery Outro Score")

ggdensity(Analysisdf$`Mastery/hits`,
      main = "Density plot of mastery behaviors per hit",
      xlab = "Number of mastery behaviors per hit")

ggdensity(Analysisdf$`Helpless/hit`,
      main = "Density plot of helpless behaviors per hit",
      xlab = "Number of helpless behaviors per hit")

ggdensity(Analysisdf$MtoHRatio,
      main = "Density plot of ratio of mastery to helpless behaviors per hit",
      xlab = "Ratio of mastery to helpless behaviors per hit")

ggdensity(Analysisdf$MtillHAv,
      main = "Density plot of mastery behaviors until helpless behavior average",
      xlab = "Average number of mastery behaviors before helpless behavior")
```

```
ggdensity(Analysisdf$Abandon,
        main = "Density plot of level abandons",
        xlab = "Number of level abandons")



ggdensity(Analysisdf$`Gameplay length`,
        main = "Density plot of gameplay length",
        xlab = "Gameplay length (sec)")

ggdensity(Analysisdf$GameExp,
        main = "Density plot of game experience score",
        xlab = "Game experience score")



qqPlot(Analysisdf$InGameMastery)
qqPlot(Analysisdf$InGeneralMastery)
qqPlot(Analysisdf$OutGameMastery)
qqPlot(Analysisdf$OutGeneralMastery)
qqPlot(Analysisdf$`Mastery/hits`)
qqPlot(Analysisdf$`Helpless/hit`)
qqPlot(Analysisdf$MtoHRatio)
qqPlot(Analysisdf$MtillHAv)
qqPlot(Analysisdf$Abandon)
qqPlot(Analysisdf$`Gameplay length`)

shapiro.test(Analysisdf$InGameMastery)
shapiro.test(Analysisdf$InGeneralMastery)
shapiro.test(Analysisdf$OutGameMastery) ##Non-normal (bimodal)
shapiro.test(Analysisdf$OutGeneralMastery)
shapiro.test(Analysisdf$`Mastery/hits`) ##Non-normal (skewed right)
shapiro.test(Analysisdf$`Helpless/hit`) ##Non-normal (skewed right)
shapiro.test(Analysisdf$MtoHRatio) ##Non-normal (skewed right)
shapiro.test(Analysisdf$MtillHAv) ##Non-normal (skewed right)
shapiro.test(Analysisdf$Abandon) ##Non-normal (skewed right)
shapiro.test(Analysisdf$`Gameplay length`) ##Non-normal (skewed right)
shapiro.test(Analysisdf$GameExp) ##Skewed right

Masteryperhitlog <- log(Analysisdf$`Mastery/hits`)
shapiro.test(Masteryperhitlog)

Helplessperhitlog <- log(Analysisdf$`Helpless/hit`)
shapiro.test(Helplessperhitlog)

MtoHlog <- log(Analysisdf$MtoHRatio)
shapiro.test(MtoHlog)

MtillHlog <- log(Analysisdf$MtillHAv)
shapiro.test(MtillHlog)

Abandonlog <- log(Analysisdf$Abandon)
##Abandonlog[which(is.infinite(Abandonlog))] <- 0
```

```
shapiro.test(Abandonlog)

Gameplaylog <- log(Analysisdf$`Gameplay length`)
shapiro.test(Gameplaylog)

GameExpSqrt <- sqrt(Analysisdf$GameExp)
shapiro.test(GameExpSqrt)

## Mastery scores vs behavior
summary(lm(Masteryperhitlog ~ Analysisdf$InGameMastery))
summary(lm(Masteryperhitlog ~ Analysisdf$OutGameMastery))
summary(lm(Masteryperhitlog ~ Analysisdf$InGeneralMastery))
summary(lm(Masteryperhitlog ~ Analysisdf$OutGeneralMastery))
summary(lm(Masteryperhitlog ~ Analysisdf$DeltaGameMastery)) ##sig
summary(lm(Masteryperhitlog ~ Analysisdf$DeltaGeneralMastery))

summary(lm(Helplessperhitlog ~ Analysisdf$InGameMastery))
summary(lm(Helplessperhitlog ~ Analysisdf$OutGameMastery))
summary(lm(Helplessperhitlog ~ Analysisdf$InGeneralMastery))
summary(lm(Helplessperhitlog ~ Analysisdf$OutGeneralMastery))
summary(lm(Helplessperhitlog ~ Analysisdf$DeltaGameMastery))
summary(lm(Helplessperhitlog ~ Analysisdf$DeltaGeneralMastery))

summary(lm(MtoHlog ~ Analysisdf$InGameMastery))
summary(lm(MtoHlog ~ Analysisdf$OutGameMastery))
summary(lm(MtoHlog ~ Analysisdf$InGeneralMastery)) ##sig
summary(lm(MtoHlog ~ Analysisdf$OutGeneralMastery))
summary(lm(MtoHlog ~ Analysisdf$DeltaGameMastery))
summary(lm(MtoHlog ~ Analysisdf$DeltaGeneralMastery)) ##sig

summary(lm(MtillHlog ~ Analysisdf$InGameMastery))
summary(lm(MtillHlog ~ Analysisdf$OutGameMastery))
summary(lm(MtillHlog ~ Analysisdf$InGeneralMastery))
summary(lm(MtillHlog ~ Analysisdf$OutGeneralMastery))
summary(lm(MtillHlog ~ Analysisdf$DeltaGameMastery))
summary(lm(MtillHlog ~ Analysisdf$DeltaGeneralMastery)) ##sig

summary(lm(Abandonlog ~ Analysisdf$InGameMastery)) ##sig
summary(lm(Abandonlog ~ Analysisdf$OutGameMastery))
summary(lm(Abandonlog ~ Analysisdf$InGeneralMastery))
summary(lm(Abandonlog ~ Analysisdf$OutGeneralMastery))
summary(lm(Abandonlog ~ Analysisdf$DeltaGameMastery)) ##sig
summary(lm(Abandonlog ~ Analysisdf$DeltaGeneralMastery)) ##sig

summary(lm(Gameplaylog ~ Analysisdf$InGameMastery))
summary(lm(Gameplaylog ~ Analysisdf$OutGameMastery))
summary(lm(Gameplaylog ~ Analysisdf$InGeneralMastery))
summary(lm(Gameplaylog ~ Analysisdf$OutGeneralMastery))
summary(lm(Gameplaylog ~ Analysisdf$DeltaGameMastery))
summary(lm(Gameplaylog ~ Analysisdf$DeltaGeneralMastery))


##Survey deltas
```

150

```
t.test(Analysisdf$OutGameMastery, Analysisdf$InGameMastery, paired=TRUE)
t.test(Analysisdf$OutGeneralMastery, Analysisdf$InGeneralMastery, paired=TRUE) ##sig


##Multiple factor models
summary(lm(Analysisdf$InGameMastery ~ Masteryperhitlog + MtillHlog)) ##sig
summary(lm(Analysisdf$InGeneralMastery ~ Masteryperhitlog + MtillHlog)) ##sig
summary(lm(Analysisdf$OutGameMastery ~ Masteryperhitlog + MtillHlog))
summary(lm(Analysisdf$OutGeneralMastery ~ Masteryperhitlog + MtillHlog))

summary(lm(formula = Analysisdf$InGameMastery ~ Helplessperhitlog + MtoHlog)) ##sig
summary(lm(formula = Analysisdf$InGeneralMastery ~ Helplessperhitlog + MtoHlog)) ##sig (Variables pulling in
opposite directions)
summary(lm(formula = Analysisdf$OutGameMastery ~ Helplessperhitlog + Abandonlog))
summary(lm(formula = Analysisdf$OutGeneralMastery ~ Helplessperhitlog + Abandonlog))

##demographics
summary(lm(Analysisdf$InGameMastery ~ GameExpSqrt)) ##sig
summary(lm(Analysisdf$OutGameMastery ~ GameExpSqrt))
summary(lm(Analysisdf$InGeneralMastery ~ GameExpSqrt))
summary(lm(Analysisdf$OutGeneralMastery ~ GameExpSqrt))

summary(lm(Masteryperhitlog ~ GameExpSqrt)) ##sig
summary(lm(Helplessperhitlog ~ GameExpSqrt))
summary(lm(MtoHlog ~ GameExpSqrt))
summary(lm(MtillHlog ~ GameExpSqrt))
summary(lm(Abandonlog ~ GameExpSqrt)) ##sig


summary(aov(Analysisdf$InGameMastery ~ Analysisdf$Gender + Analysisdf$Year))
summary(aov(Analysisdf$OutGameMastery ~ Analysisdf$Gender + Analysisdf$Year))
summary(aov(Analysisdf$InGeneralMastery ~ Analysisdf$Gender + Analysisdf$Year))
summary(aov(Analysisdf$OutGeneralMastery ~ Analysisdf$Gender + Analysisdf$Year))

summary(lm(Analysisdf$InGameMastery ~ Analysisdf$Age + GameExpSqrt + Gameplaylog)) ##game exp sig
summary(lm(Analysisdf$OutGameMastery ~ Analysisdf$Age + GameExpSqrt + Gameplaylog))
summary(lm(Analysisdf$InGeneralMastery ~ Analysisdf$Age + GameExpSqrt + Gameplaylog))
summary(lm(Analysisdf$OutGeneralMastery ~ Analysisdf$Age + GameExpSqrt + Gameplaylog))

summary(aov(Masteryperhitlog ~ Analysisdf$Gender + Analysisdf$Year))
summary(aov(Helplessperhitlog ~ Analysisdf$Gender + Analysisdf$Year))
summary(aov(MtillHlog ~ Analysisdf$Gender + Analysisdf$Year))
summary(aov(MtoHlog ~ Analysisdf$Gender + Analysisdf$Year))
summary(aov(Abandonlog ~ Analysisdf$Gender + Analysisdf$Year))

summary(lm(Masteryperhitlog ~ Analysisdf$Age + Analysisdf$GameExp + Gameplaylog)) ## game exp sig
summary(lm(Helplessperhitlog ~ Analysisdf$Age + Analysisdf$GameExp + Gameplaylog))
summary(lm(MtillHlog ~ Analysisdf$Age + Analysisdf$GameExp + Gameplaylog))
summary(lm(MtoHlog ~ Analysisdf$Age + Analysisdf$GameExp + Gameplaylog))
summary(lm(Abandonlog ~ Analysisdf$Age + GameExpSqrt + Gameplaylog)) ##game exp & total gameplay sig


t.test(Analysisdf$DeltaGameMastery ~ Analysisdf$Gender) ##sig Check outliers
```

```
summary(lm(DeltaGameMasteryCorrected ~ Analysisdf$Gender[-25])) ## removing influential strengthens effect
t.test(GameExpSqrt ~ Analysisdf$Gender) ##sig


##Permeation ttests
library(RVAideMemoire)

perm.t.test(Analysisdf$InGameMastery ~ Analysisdf$Gender, paired = FALSE, nperm = 10000)
perm.t.test(Analysisdf$OutGameMastery ~ Analysisdf$Gender, paired = FALSE, nperm = 10000)
perm.t.test(Analysisdf$InGeneralMastery ~ Analysisdf$Gender, paired = FALSE, nperm = 10000)
perm.t.test(Analysisdf$OutGeneralMastery ~ Analysisdf$Gender, paired = FALSE, nperm = 10000)
perm.t.test(Analysisdf$DeltaGameMastery ~ Analysisdf$Gender, paired = FALSE, nperm = 10000)
perm.t.test(Analysisdf$DeltaGeneralMastery ~ Analysisdf$Gender, paired = FALSE, nperm = 10000)
perm.t.test(Masteryperhitlog ~ Analysisdf$Gender, paired = FALSE, nperm = 10000)
perm.t.test(Helplessperhitlog ~ Analysisdf$Gender, paired = FALSE, nperm = 10000)
perm.t.test(MtillHlog ~ Analysisdf$Gender, paired = FALSE, nperm = 10000)
perm.t.test(MtoHlog ~ Analysisdf$Gender, paired = FALSE, nperm = 10000)
perm.t.test(Abandonlog ~ Analysisdf$Gender, paired = FALSE, nperm = 10000)
perm.t.test(GameExpSqrt ~ Analysisdf$Gender, paired = FALSE, nperm = 10000) ##sig



##Visualizations

InMasteryfit <- lm(Analysisdf$InGameMastery ~ Masteryperhitlog + MtillHlog)

scatterplot(Analysisdf$InGameMastery ~ Abandonlog, xlab = "Number of Levels Abandoned Logged", ylab = "Pre
Game Mastery Orientation Score") ##busy need to remove some lines
scatterplot(Analysisdf$InGameMastery ~ Masteryperhitlog)
scatterplot(Analysisdf$InGameMastery ~ MtillHlog,  xlab = "Ratio of Mastery-Oriented to Helpless-Oriented
Behaviors per Hit Logged", ylab = "Pre Game Mastery Score")
plot(Analysisdf$InGameMastery ~ Masteryperhitlog + MtillHlog)
plot(Analysisdf$InGameMastery, Masteryperhitlog, col= MtillHlog, pch=MtillHlog)
bline(a = coef(InMasteryfit)[1], b = coef(InMasteryfit)[2])
abline(a = coef(InMasteryfit)[1] + coef(InMasteryfit)[3], b = coef(InMasteryfit)[2] + coef(InMasteryfit)[4], col = 2)
scatterplot(Analysisdf$InGameMastery ~ Helplessperhitlog) ## Seperate - pulling opposite directions
scatterplot(Analysisdf$InGameMastery ~ GameExpSqrt, xlab="Game Experience Score Squared", ylab= "Pre Game
Mastery Score")

scatterplot(Analysisdf$InGeneralMastery ~ Masteryperhitlog)
scatterplot(Analysisdf$InGeneralMastery ~ MtillHlog,  xlab = "Ratio of Mastery-Oriented to Helpless-Oriented
Behaviors per Hit Logged", ylab = "Pre General Mastery Score")

scatterplot(Analysisdf$InGeneralMastery ~ Helplessperhitlog)
scatterplot(Analysisdf$InGeneralMastery ~ Helplessperhitlog)
scatterplot(Masteryperhitlog ~ GameExpSqrt, xlab="Game Experience Score Squared", ylab="Number of Mastery-
Oriented Behaviors Logged")
scatterplot(Abandonlog ~ GameExpSqrt, xlab="Game Experience Score Squared", ylab="Number of Levels
Abandoned Logged")

scatterplot(Analysisdf$DeltaGameMastery ~ Masteryperhitlog, xlab = "Mastery-Oriented Behaviors per Hit Logged",
ylab = "Game Mastery Score Delta")
```

```
scatterplot(Analysisdf$DeltaGameMastery ~ Abandonlog, xlab= "Number of Levels Abandoned Logged", ylab=
"Game Mastery Score Delta")

scatterplot(Analysisdf$DeltaGeneralMastery ~ MtoHlog, xlab = "Ratio of Mastery-Oriented to Helpless-Oriented
Behaviors per Hit Logged", ylab = "General Mastery Score Delta")
scatterplot(Analysisdf$DeltaGeneralMastery ~ MtillHlog, xlab = "Average Mastery-Oriented Behaviors until Helpless-
Oriented Behavior per Hit Logged", ylab = "General Mastery Score Delta")
scatterplot(Analysisdf$DeltaGeneralMastery ~ Abandonlog, xlab= "Number of Levels Abandoned Logged", ylab =
"General Mastery Score Delta")

scatterplot(Abandonlog ~ Gameplaylog, xlab="Total Amount of Gameplay (sec) Logged", ylab="Number of Levels
Abandoned Logged")


InOutGen <- table(mean(Analysisdf$InGeneralMastery), mean(Analysisdf$OutGeneralMastery))


boxplot(Analysisdf$InGameMastery, Analysisdf$OutGameMastery,
    main = "Pre/Post Game Mastery Scores",
    ylab = "Game Mastery Score",
    names = c("Pre Game Mastery", "Post Game Mastery"))

boxplot(Analysisdf$InGeneralMastery, Analysisdf$OutGeneralMastery,
    main = "Pre/Post General Mastery Scores",
    ylab = "Game Mastery Score",
    names = c("Pre General Mastery", "Post General Mastery"))

boxplot(Analysisdf$DeltaGameMastery ~ Analysisdf$Gender,
    main = "Gender Differences in Delta Game Mastery-Orientation Scores",
    ylab= "Game Mastery Score Delta",
    names = c("Women", "Men"))

boxplot(GameExpSqrt ~ Analysisdf$Gender,
    main = "Gender Differences in Game Experience Scores",
    ylab = "Game Experience Score",
    names = c("Women", "Men"))


scatterplot(Analysisdf$DeltaGameMastery ~ Analysisdf$`Mastery/hits`, xlab = "Mastery-Oriented Beahviors per Hit",
ylab = "Game Mastery Score Delta")
scatterplot(Analysisdf$InGeneralMastery ~ Analysisdf$MtoHRatio, xlab = "Ratio of Mastery-Oriented to Helpless-
Oriented Beahviors", ylab = "Pre General Mastery Score")

scatterplot(Analysisdf$InGameMastery ~ MtillHlog)

plot(MtillHlog, Analysisdf$InGameMastery,
    xlab = "Number of Mastery-Oriented Behaviors Per Hit Logged",
    ylab = "Pre Game Mastery",
    type = "p",
    col = "blue",
    points(Masteryperhitlog, col="red")
)
```

```
ggPredict(InMasteryfit, se = FALSE, interactive = FALSE) + labs(x= "Number of Mastery Behaviors Per Hit Logged", y=
"Pre Game Mastery Score")

InGeneralMastery <- Analysisdf$InGeneralMastery
InGenMasteryFit <- lm(InGeneralMastery ~ Masteryperhitlog + MtillHlog)
ggPredict(InGenMasteryFit, se = FALSE, interactive = FALSE) + labs(x= "Number of Mastery Behaviors Per Hit
Logged", y= "Pre General Mastery Score")
```