Game on: Mastery Orientation Through the Lens of a Challenging Video Game

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Abstract

Video games are failure-rich spaces that provide a unique lens into how individuals react to failure in challenging environments. In this study, we utilize *Cuphead*, a notoriously challenging video game to demonstrate a unique behaviorally driven approach to understanding how an individual reacts to failure. Using measures of mastery orientation and data-driven retrospective interviews, we show that individuals who exhibit more mastery-oriented behaviors and more mastery-oriented behaviors before a helpless-behavior are more likely to show a higher game mastery orientation score, and that individuals that abandon a level before completion are more likely to show a lower game mastery orientation score. This introduces video games as a fruitful environment for understanding mastery orientation, a behaviorally driven approach to understanding how individuals react to failure, and provides a glimpse into how individuals react to failure in a challenging video game.

Keywords: Mastery orientation, failure, video games, behavior

Introduction

In video games, failure is a common outcome that elicits unique reactions, making them a fruitful space to investigate how individuals react to failure. Players start a game knowing that they will likely fail multiple times before reaching the conclusion. In fact, playing a game without failing at all is often criticized as trivial. Players seek games that are challenging, but beatable. For example, video games like *Dark Souls* (From Software, 2011), *Super Meat Boy* (Team Meat, 2010), and *Cuphead* (Studio MDHR, 2017), are known for their difficulty, ensuring a plethora of failed attempts before eventual completion.

Many players take on the challenge of these games, giving life to a community of players who find, play, and design challenging game experiences. This community has even encouraged players to not just complete these games, but sometimes artificially increase the difficulty beyond the game settings by using unconventional controllers such as the Nintendo Bongo Controller made for *Donkey Kong Jungle Beat* (Nintendo, 2004). These players relish in the challenge that the game presents and take failure as a sign that they are pushing the limits of their ability.

The embrace of frequent failure in video games that we see from players is unique and could be utilized to understand how individuals might react differently in other failure environments. The mechanics and strategies that game developers use might illuminate how a challenging environment can be created to encourage individuals to persist through failure more.

Mastery Orientation

Mastery orientation is part of a suite of behaviors used to describe how an individual reacts to failure, characterizing individuals as either mastery-oriented or helpless-oriented (Dweck & Reppucci, 1973). When mastery-oriented individuals encounter failure, they are more likely to retry, use positive and self-focusing language (Diener & Dweck, 1978), and show heightened affect and effort in response to failing a difficult problem (Dweck & Leggett, 1988). When these individuals fail, they are more likely to consider it as a moment of reflection that ultimately helps them succeed (Elliott & Dweck, 1988). Conversely, when helpless-oriented individuals encounter failure, they are more likely to show deterioration of their strategy and increase in ineffectual responses, show an absence of progress after failure, report negative self-conditions, and report negative affect such as boredom, aversion, and anxiety (Diener & Dweck, 1978). While these individuals do not differ in behavior when they succeed, when confronted with failure, mastery-oriented individuals are invigorated, while helpless-oriented individuals are devastated.

Failure in Video Games

Play theorists and game researchers have argued for decades that failure is an important part of the play experience (Gee, 2003, Juul, 2009; Squire, 2006). Juul argues that while we typically avoid failure, in games we often desire it (Juul, 2013). In fact, Juul found that players who complete a video game without failing at all report lower satisfaction (Juul, 2009).

As the impact of video game research widens to other fields of study, understanding how players react to failure becomes increasingly important. In education, video games are used frequently to help students understand a variety of topics, resulting in entire game development companies devoted to making games for educational impact. Education and games are a natural pairing as both the learning process and the game experience rely on iterations of failure and feedback (Turkay et al., 2014).

Educational games are designed not only to help players understand the embedded material, but also be fun and challenging. This is partially due to the structure that games create - “Experienced players enter a new game space assuming that they must learn the rules of the environment

Figure 1: *Cuphead* gameplay. Players are depicted as a characters with cup-shaped heads as seen on the left and top right. Players must fight "boss" characters such as the clown balloon depicted in the center.

and the ways of interacting and that failure is inevitable for ultimate progress" (Boyan & Sherry, 2011), suggesting that players receive in-game failure as a positive influence on their learning experience. In fact, in an educational game-based event, Anderson, et al. (2018) found that players who failed more actually showed better learning gains than those who failed less. This was shown to be due to the discourse that resulted from these moments of failure. Individuals consulted their peers to elicit advice on how to complete challenging levels, leading to robust discourse on the embedded material. Due to the engaging nature of the game, these students were more inclined to ask their peers for advice and to think critically about the embedded material.

While failure remains an important aspect of the play experience in a video game, currently to our knowledge, no research has been conducted to investigate how individuals react to failure in these environments, and how those reactions relate to an individual's mastery orientation. Using these constructs as a base, we ask the following research questions:

1. Do individuals who exhibit more mastery-oriented behaviors in-game score higher on the mastery orientation scale?
2. Do individuals who exhibit more helpless-oriented behaviors in-game score lower on the mastery orientation scale?

Methods

To investigate these research questions, we asked undergraduates of a large United States University to play a notoriously challenging video game, *Cuphead* for two weeks. *Cuphead* is a "run 'n gun" platformer video game in which players are primarily tasked with fighting a single enemy on each level. Players must decipher the patterns the enemy uses while dodging their attacks and use their abilities to progress through multiple phases (Figure 1).

Participants

60 undergraduates were recruited through departmental email lists. 23 recruited participants identified as female and 37 as male. The average age of the participants was 20 years (SD = 2.24). Number of hours playing video games per week ranged from 0 to 50, averaged 15 hours, with a standard deviation of 12.45. Number of years playing video games ranged from 1 to 21, averaged 11.45 years, with a standard deviation 4.65.

Tasks

Participants were asked to come into the researcher's office to go over the study details and to complete the study setup. During that meeting, the participant was asked if they had played *Cuphead* before, if they knew the game, and if they were excited to play it. Participants who had completed the game previously or were uninterested in it were excluded. This was done to ensure players were encountering the game for the first time, and to ensure participants were representative of the population who would play *Cuphead* on their own volition. Following explanation of the study, participants were given a copy of *Cuphead* through a video game distribution software, Steam, and were instructed to play as if they purchased the game themselves. This meant that there were no minimums or maximums to how much

they played, where they played, or the way they played. This flexibility was used to ensure a natural play environment so that if players became frustrated with the game, they would not feel the need to keep playing for study requirements.

Participants were asked to play *Cuphead* for two weeks, and to record all of their gameplay via video recording software such as the Xbox video recorded native to Windows 10 OS, or Open Broadcast Software (OBS). Participants were also asked to attend two 45-minute interviews, after one week of play, and again after two weeks of play. Participants were asked to hand in their gameplay videos during these interviews.

Mastery Orientation Surveys During their setup interview and at the conclusion of the study, participants were asked to complete two surveys on general mastery orientation and game-context mastery orientation adapted from the mastery section of the Work and Family Orientation Questionnaire (Helmreich & Spence, 1978). The questionnaire was designed to gauge a participant's mastery orientation through self-report of eight Likert-scale questions from strongly agree to strongly disagree. For the game-context mastery orientation survey, the questions were modified to fit a game context; e.g. "I would rather play a game at which I feel confident and relaxed than a game that is challenging and difficult.", and "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." Answers were scored from 1-5 and summed to create a mastery score for game contexts and general contexts pre and post experiment.

Gameplay Gameplay videos were coded for moments of hard-coded failure (hits) as well as player reactions to failure (quit, retry, strategy adaptation, strategy deterioration) using behavior-analysis software, BORIS (Friard & Famba, 2019).

Hits were defined as any moment the player lost health. Quits were defined as any moment the player selected "Exit to map" or "Quit Game" from the pause menu or game over screen (Figure 2). Retry was defined as any time the player selected "Retry" from the game over screen. Strategy adaptation was defined as any time a player changed their strategy in response to failure. For example, if a player encounters a projectile and a hit was recorded, then on their next encounter with the same projectile if the player changes their behavior to avoid it, an adaptation was recorded. Strategy deterioration was defined as any time a player began to use ineffectual strategies in response to failure. For example, if the player collides with a projectile and a hit was recorded, then begins to jump in front of other projectiles or run into the boss, a deterioration was recorded.

Strategy adaptation and retrying a level was used to capture mastery-oriented behaviors in-game. These behaviors align with the descriptions of how mastery-oriented individuals react to failure in the literature cited previously. Likewise, deteriorations and quitting a level was used to capture helpless-oriented behaviors in-game as these behaviors align with the descriptions of how helpless-oriented individuals react to failure in the literature cited previously. The motivations for the changes in these behaviors were confirmed during the participant's data-driven retrospective interview.

The gameplay data were cleaned by removing duplicate events and removing or modifying impossibilities in the data. These events pointed to mistakes in gameplay coding, and when in question were reviewed manually and compared to the source video to modify to the proper coding. Game metric data were also explored for patterns not captured by the coding system, including the number of times a player abandoned a level before completing it, and restarting a level before reaching the game over screen. Abandons were defined as starting a level, quitting to the overworld, and then starting a different level before completing the initial level. Restarts were defined as selecting the restart button while in the pause menu in a level. Restarts were tagged as both a quit and a retry, signifying that the participant was exhibiting both a mastery-oriented behavior in trying again, but also a helpless-oriented behavior in giving up on that attempt.

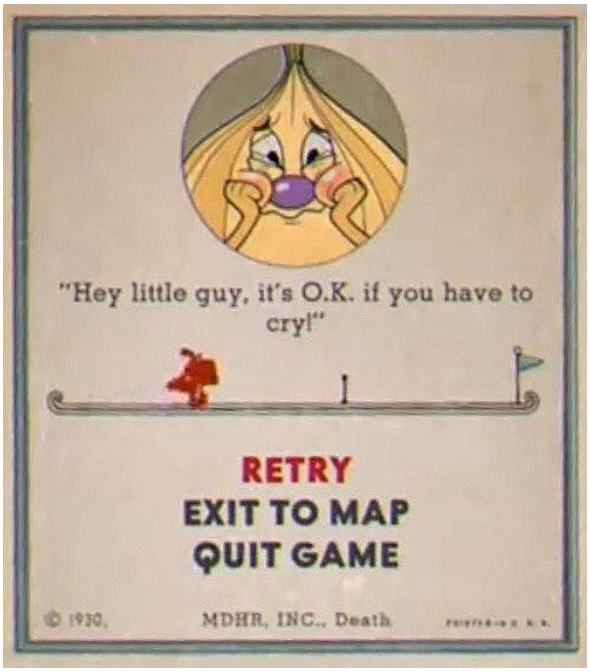

Figure 2. A "Game Over" screen in Cuphead.

Interviews The first round of interviews was semi-structured. Participants were asked questions with follow up questions to probe their experiences with failure while playing *Cuphead*. These questions were used to uncover patterns in players understanding of failure in *Cuphead*. As this paper is focused on the behavioral coding and traditional survey measures, these questions are outside the scope of this paper.

Participants second interview was structured as a data-driven retrospective interview (El-Nasr, et al., 2015). This involved tailoring the interview questions based on that individual participant's current data. As such, the interviewer

played most clips from the participant's first week of gameplay to ask about specific moments where the player seemed to react to a moment of failure. Where players handed in too much gameplay to cover in this interview, a representative sample of clips was taken. This was used to confirm the coding of gameplay aligned with the players motivations for these changes in behavior. If the participant reported that the moment was incorrectly interpreted, the code was removed, and coding was adjusted to reflect their behavior patterns.

Analysis

Linear Models Linear modeling was conducted on pre mastery scores to create two models: gameplay behaviors predicting higher mastery orientation scores, and gameplay behaviors predicting lower game mastery scores. These gameplay behaviors and survey scores were found to be skewed and were subsequently log transformed to achieve normality. The model investigating positive associations included number of mastery behaviors per hit, average number of mastery behaviors exhibited until a helpless behaviors is exhibited, ratio of mastery-oriented behaviors to helpless-oriented behaviors, and total amount of gameplay in seconds. The model investigating negative associations included number of helpless behaviors per hit, average number of mastery behaviors exhibited until a helpless behaviors is exhibited, ratio of mastery-oriented behaviors to helpless-oriented behaviors, number of times a level is abandoned before completion, and total amount of gameplay in seconds. Non-significant factors were removed from the models until the best fit was found. This was done to ensure the highest accuracy of significant factors.

Interview Discourse Reponses to interview questions were reviewed and transcribed for relevant analyses. However, as this paper focuses on the behavioral coding methodology, these results are outside of the scope of this paper.

Results

Survey Results Mastery orientation scores from the surveys are summarized in table 1:

Table 1: Mastery survey scores

Survey	Average	Std deviation
Game pre	27.50	4.79
General pre	27.32	4.02
Game post	26.61	3.48
General post	26.00	3.97

Linear Models Linear modeling shows that pre game mastery orientation scores are positively predicted by number of mastery behaviors and average number of mastery-oriented behaviors exhibited before a helpless-oriented behaviors is exhibited ($F(2, 53) = 9.51$, $p<0.001$, $R2 = 0.26$). Individual values are summarized in table 2 and visualized in figure 3.

Linear modeling also shows that pre game mastery orientation scores are negatively predicted by number of times a level is abandoned before completion ($F(1, 42) = 5.9$, $p = 0.02$, $R2 = 0.12$). The final model is summarized in table 3 and visualized in figure 4.

Table 2: Linear model of mastery-oriented behaviors on pregame mastery score.

Game Mastery Score	Estimate	Std. Error	t value	p value
Mastery per hit (log)	13.54	3.35	4.04	<0.001
Mastery until helpless (log)	3.38	0.90	3.77	<0.001

Table 3: Linear model of helpless-oriented behaviors on pregame mastery score.

Game Mastery Score	Estimate	Std. Error	t value	p value
Level abandons (log)	-1.82	0.75	-2.43	0.02

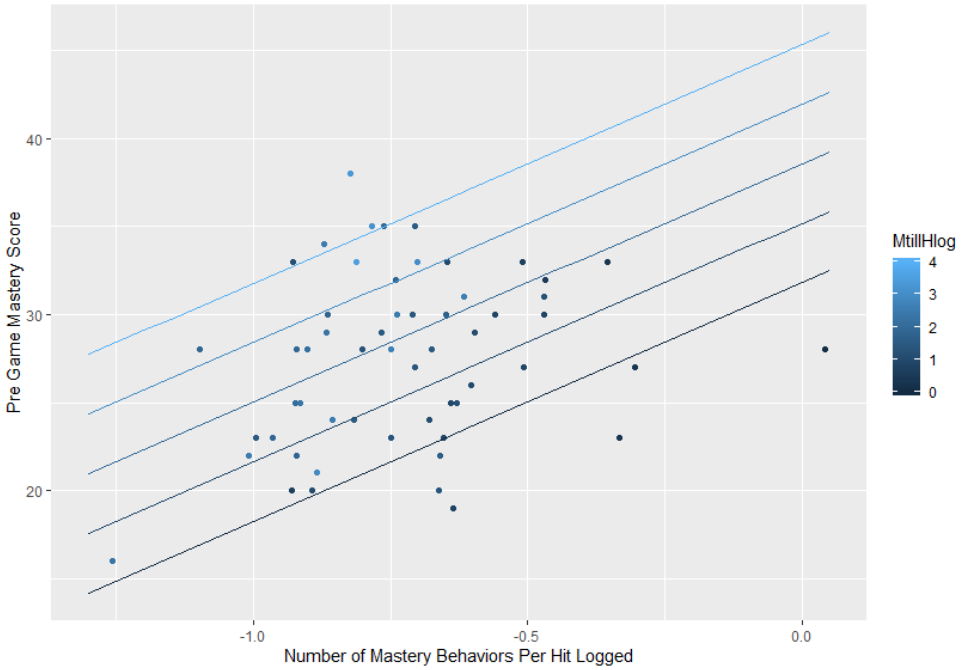

Figure 3: Multiple regression analysis of number of mastery-oriented behaviors and average number of mastery-oriented behaviors before a helpless-oriented behavior versus pre game mastery orientation scores.

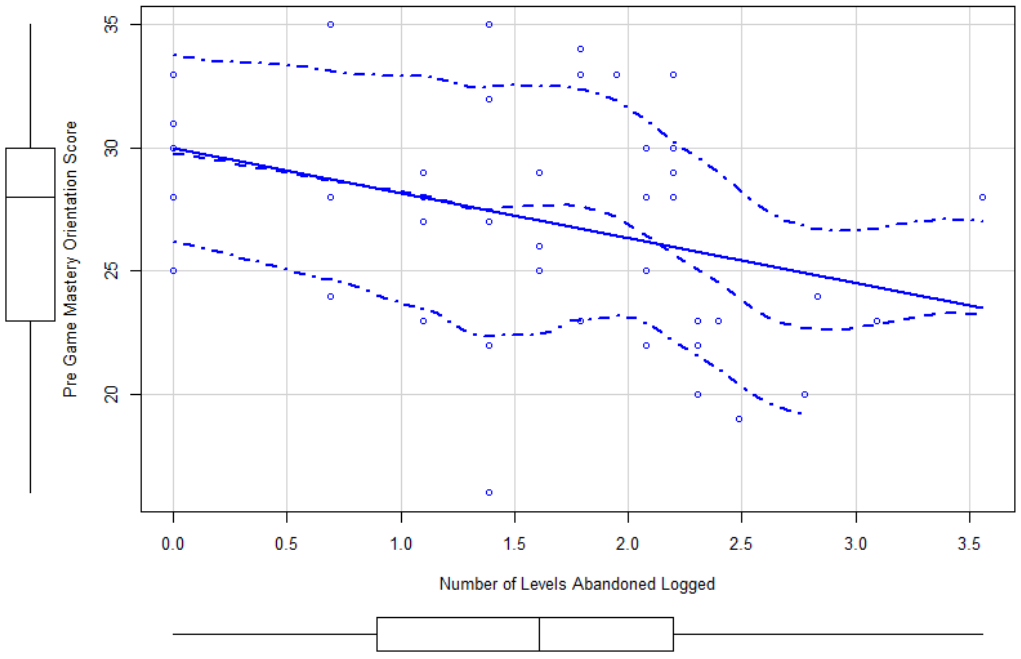

Figure 4: Regression analysis of number of levels abandoned before completion versus pre game mastery orientation scores.

Discussion

This study expands our understanding of how individuals react to failure, introduces new methodology to facilitate its measurement, and introduces video games as an environment in which to study challenging spaces in which individuals routinely fail.

Understanding Mastery Orientation

This study shows a different perspective of mastery orientation compared to traditional survey measures on how individuals react to failure. By conceptualizing their reactions through behavioral analysis, we see different patterns than traditional survey measures show. Particularly, focusing on

the average number of mastery-oriented behaviors an individual will exhibit before exhibiting a helpless-oriented behaviors shows the importance of measuring not just if an individual persist through failure, but also how long they will continue to persist before showing signs of giving up. The perspective that the traditional surveys take does not allow us to view or understand what actions an individual might take during the moments that they encounter failure.

Moving forward, this understanding can contribute to a better understanding of how we should view individuals' reactions to failure. Rather than conceptualizing it in how an individual feels about how they generally respond when they fail, this shows what an individual does in the moments in which they fail. This understanding can lead to deeper research on how the conditions that lead to an individual to give up and how interventions might be able to help them persist. This may contribute to identifying common factors that cause individuals to quit, environments in which individuals are more likely to quit, or patterns in the sequence of going from trying to quitting.

Methodology

This methodology also expands our conceptualization of mastery orientation and how an individual reacts to failure by focusing on the behaviors that an individual takes when failure is encountered. Through data-driven retroactive interviewing, we can confirm with participants that their behaviors are driven by the cognitive constructs captured through traditional surveys. This provides us with a closer look at the behaviors players exhibit during the moments traditional surveys aim to capture.

This methodology may be useful beyond this study. Through data-driven retrospective interviews, we can craft questions to probe patterns of cognition from observed behaviors to understand better what individuals are doing. This might give insights into an individual's cognitive processes that result in behaviors of interest.

Failure in Video Games

Video games provide a unique space in which to study failure. Considered an important part of the learning experience of play, failure is expected in video games. This shows how individuals react to failure when they know that they are likely to encounter it, when they are engaged in a task that is challenging, and when they are in a play space. This work not only shows how failure is perceived in games, but also gives some insight into how failure can be framed to elicit positive responses outside of them; video games encourage players to retry when they fail, to learn from their mistakes, and to keep going until they reach the end of the game. These mechanics can be used to encourage individuals to persist through failure in other challenging environments such as school and athletics, among many other areas of daily life that might prove to be challenging.

Limitations

While this work presents a new methodology and understanding of how individuals react to failure, there are some limitations to keep in mind. First, the number of analyses may have resulted in a higher type I error rate. This was deemed acceptable for this exploratory work but requires more investigation to confirm.

Second, the sample obtained for this study comes from a large public University in the United States of America. This group of people have already shown they are able to obtain acceptance into postsecondary school. While this does not necessarily mean they have encountered failure often in doing so, it is possible. These individuals might naturally score higher on the mastery orientation scale and might also naturally be inclined to show mastery-oriented behaviors. While this study shows that those within the sample that score higher on the mastery orientation scale exhibit more mastery-oriented behaviors overall and exhibit more mastery-oriented behaviors before exhibiting a helpless-behavior, individuals who are on the lower end of the mastery orientation scale might show different behaviors than captured here.

Third, this study was conducted in a video game environment that is well-known for the level of challenge it presents. It may be that simply playing a video game that is known for its difficulty might prime individuals to show more mastery-oriented behaviors. The individuals in this study may exhibit very different behaviors in a different context.

Finally, individuals of this sample were recruited to play a challenging video game. The sample collected may be self-selected to a higher mastery orientation, and more likely to exhibit mastery-oriented behaviors. Presenting participants with a video game or other environment in which they are unaware of the level of difficulty might elicit different reactions as well.

Future Work

Moving forward, many avenues are open for exploration. The limitations presented each represent areas of inquiry. Future work might reflect on different populations to compare how individuals with a lower mastery orientation respond to failure in a challenging video game. This might illuminate further differences in these populations or commonalities elicited by the nature of a play space. Other work can focus on other similar environments that have varied levels of difficulty. Perhaps individuals react very differently to failure when the task presented is less likely to result in failure. Research on other challenging spaces can also be compared to this work to see if the structure of the video game has any influence on how individuals react when they encounter failure. Third, future work might focus on the expectations of failure as a primary topic. It may be the case that individuals react very differently to failure if they do not expect it. Finally, many factors common to video game spaces might influence how individuals react to failure. Future work might focus on video games that are played competitively, where the individual has a coach, an audience, and a human opponent. They might also focus on video

games that are played more casually and passively, where failure is much less common.

Conclusions

This study introduces a challenging video game as a unique space to understand the behaviors individuals take in reaction to failure. Through behavioral analysis and data-driven retrospective interviews, this study shows a glimpse of how video games frame failure and how individuals react. 60 participants were recruited to play a notoriously challenging video game, *Cuphead*, for two weeks. Prior and following, they were asked to fill out mastery orientation surveys gauging their reactions to failure in both general and game settings. Gameplay videos were coded for mastery and helpless-oriented behaviors and interviews were conducted to probe further into participants motives and cognitive patters when they failed. Results show that individuals who score higher on a game mastery orientation prior to playing exhibit more mastery-oriented behaviors overall and average more mastery-oriented behaviors before exhibiting a helpless-oriented behavior.

Analyses also show that individuals who score lower on the mastery orientation scale are more likely to abandon levels before completing them. These results give a glimpse into how video games frame failure and how the principles and mechanics they use might be leveraged to encourage individuals to persist thought challenging environments elsewhere. A plethora of work is ahead of us to understand how these challenging spaces, rich with failure, influence how an individual reacts and how those principles can be leveraged.

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