A Little Bit of Frustration Can Go a Long Way

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Abstract. Player engagement with video games is widely discussed. The apparently contrasting phenomenon of frustration is less widely researched. Frustration is reported to impede player engagement but it is unlikely that a game which never frustrated at all would be enjoyable. In that context, further work is needed to identify, understand and model the character, timing and context of frustrations which help rather than hinder a positive gaming experience. This paper investigates the relationship between frustration and engagement over time in a carefully selected video game. We find that engagement often falls as frustration rises (and vice versa) but also report upon situations in which a rise in frustration can give rise to an increase in engagement. We consider the implications of these results for both game developers and the wider community of HCI researchers interested in gamification and user engagement.

1 Introduction

When considered in gaming literature, frustration is often described as the antithesis of engagement [1], mirroring the understanding in wider HCI literature, where frustration is seen as a consequence of undesirable system design.

Frustration can, however, also be a necessary element of a gaming experience. Previous researchers have noted that "[frustration] can easily be a positive force to inspire and motivate" [2]. Others have found that games can be fun and frustrating [3], but have not specified whether this can happen simultaneously. Cox et al. acknowledge the necessity of challenge in an enjoyable gaming experience [4]. Yet for challenge to exist, one must be able to fail at a task, and failure is frustrating [5]. Indeed, many popular games have built reputations on their difficulty level (*Dark Souls*, *FTL*, *Spelunky*), while others offer optional, extremely punishing alternate modes of play (*Diablo 3*, *X-COM*). Allison et al. surveyed 1704 players and found that some of *Day-Z*'s most frustrating features were key to its appeal [6]. Moreover, Bopp et al. noted that negative emotions such as grief and sadness could lead to positive experiences [7] in games, so we conclude that frustration might also do so.

Our long term aim is to develop a greater understanding of frustration in video games and its effect on player engagement. More specifically, we aim to build a causal understanding of frustration and its effects, in order to understand

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where, when and how frustration will positively affect player experiences. We will also consider the ways in which careful interaction design can enhance player experience by temporarily increasing and/or decreasing frustration. This paper contributes to those aims by reporting on an empirical study investigating the development of engagement and frustration in a video game over time. In it, we identify moments in the game where the relationship between frustration and engagement is different from the one anticipated in previous literature.

2 Related Work

Much of the work reporting on frustration in video games describes frustration as a factor influencing the player's willingness to engage. One body of research has focused on detecting and avoiding frustration. Gilleade and Dix [5] identified "Physical Failures" and "Mental Failures" as indicators of frustration, though the work does not consider the possibility that these signs may not necessarily be a negative. IJsselsteijn et al. [8] investigate measuring the experiences associated with gameplay, defining frustration as occurring when "the challenge becomes too great" [8], yet they do not elaborate on the causes of this beyond Gilleade and Dix's notions of Physical and Mental failures.

Canossa considers the importance of qualitative and quantitative measures of player experience, and the extent to which in-game metrics can be used to identify frustration. He stops short, however, of modelling the underlying gameplay and design features causing frustration [2]. Likewise, Pagulayan et al. [9] and Yun et al. [10] demonstrate ways in which a player might become frustrated or show frustration, observing that frustration is best avoided.

Beyond the different measures of frustration introduced above, a number of researchers have also developed candidate explanations of those frustrations. Engeser and Rheinberg describe frustration as a consequence of failure to maintain a challenge-skill balance [11], while Hazlett et al. report that negative emotions during challenging moments in games are typically followed by positive ones once those challenges are overcome [12]. This highlights the potential for frustration to lead to a fall in engagement in the short term but cause it to rise in the longer term.

Further studies note that overwhelming players to the point that they feel their progress towards in-game goals is hindered can drive frustration [13]. Frustration can also arise when "progress a user is making toward achieving a given goal is impeded" [5]. Cheung et al. also report on events causing frustration to arise from a barrier preventing the player from carrying out their desired actions, e.g., bugs and overwhelming challenges [14,15]. Likewise in an investigation into player engagement in video games, Parnell [16] identifies a relationship between hindrance of player progress and feelings of anger and upset. This aligns with Gilleade and Dix's suggestion that failures both cause and indicate frustration.

The dominant view of frustration is that it represents the antithesis of engagement and immersion [1,13,14,17–19]. Many studies report that immersion is an essential ingredient for a satisfying gaming experience [4,19–21]. One such model

presents immersing players in a game as an ongoing process [1]. The model suggests balance must be found between a game's external complexity and the player's internal model of the game's mechanics. This balance creates a cycle, in which the player continually learns from the game and makes progress in order to provide a continuously evolving challenge. We believe, however, that some level of frustration must also arise from challenging players in this manner, drawing upon research indicating that challenge is necessary to achieve immersion so long as the player feels they can overcome it [4].

Rauterberg observes a fundamental human need for variety, noting that we struggle to tolerate monotonous environments [22]. He also notes that people will seek to manually increase task complexity to stave off boredom—an observation that corresponds with our own observations that some gamers prefer harder difficulty settings. Rauterberg also notes that interest in a context decays over time; an activity which only ever generates one emotion, however positive, will become tiresome, whilst one that generates many emotions (including frustration) will break monotony.

Lankveld et al. identify the importance of "incongruity" [23] (the difference between an environment's complexity and a subject's mental model of that complexity), noting that excessive or insufficient incongruity over the course of a game affects enjoyment. Providing short term fluctuations in this incongruity can drive variety and, by extension, positive gamer experience. Though Lankveld et al. stop short of suggesting frustration as a positive generator of variety, this paper considers the possibility that appropriately designed frustration can be used to avoid monotony. With this in mind, our work investigates contexts in which frustration might enhance rather than diminish player experience. In order to do so, we seek to understand the complex relationship between frustration and enjoyment. In this sense we build upon and extend both Lankveld et al.'s and Rauterberg's work.

Whilst the research, introduced above, identifies both indicators and causes of frustration (notably hindrance and failure to reach in-game goals) that frustration is reported as having an entirely negative effect on player experience. This account does not explain the essential role of frustration in creating varied, engaging gameplay. It does not, for example, allow for the likelihood that a game which provides no hindrance or possibility of failure will also fail to engage players. The development of causal explanations of frustration and its *positive* effects is of great potential value to game designers. Such explanations can be used to answer questions about when, where and how to use frustration to maximize engagement.

3 Hypotheses

With our interest in the potential use of hindrance and frustration as drivers of variety and engaging gameplay, this paper reports on a study, investigating the relationship between those phenomena and engagement. More specifically, it reports on a study in which we asked participants to play a well-known video

game and report upon the extent to which they felt they were frustrated by, engaged with, and hindered within the game.

Our belief was that more subtle relationships existed between engagement, frustration and hindrance than those of consistently negative correlations between engagement and frustration/hindrance. More specifically, we believed:

- (H1) that participants would, on occasion, report *negative* correlation between frustration/hindrance and engagement,
- (H2) that participants would also, on occasion, report a *positive* correlation between hindrance and engagement, and
- (H3) that participants would, on occasion, report *positive* correlation between frustration and engagement.

We define frustration in this study as the result of a hindrance or player failure within a game. We note that a hindrance is not precisely the same as a challenge: challenges might be hindrances but hindrances might not be challenges. Hindrances might take the form of natural gameplay limits on the player's ability used to create challenges (such as movement speed) or even unintentional ones (unresponsive controls).

4 Design

To test these hypotheses, we observed participants while they played a 2D platform game, "Limbo", a game that reviewers had noted for its strong potential to be both highly enjoyable and frustrating [24]. The game's simple controls and visuals made it easy for participants to acclimatize to style and gameplay. The game also features noticeable rest moments between challenges, a characteristic that made it ideal for an approach of pausing whilst participants completed a questionnaire.

Mindful of participants' limited appetite for observed gameplay, we limited our study to six challenges within the game. We asked each participant to complete one challenge at a time and then to use 7-point Likert scales to rate their enjoyment, hindrance and frustration during the most recent challenge. Several studies have found a strong link between enjoyment and engagement [25–27]. When recording player frustration, we drew upon Parnell's work [16], asking players whether they felt hindered from making progress in the game and whether they felt frustrated as a result. This three-factor design enabled participants to report their enjoyment separately from both their frustration and their sense that progress through the game was being blocked.

5 Methodology

Seventeen participants took part in this study in a controlled environment with only the participant and researcher present. Participants were sourced through email advertisement at the University, and no participants had played the game

before. Participants played the game on a laptop setup sufficiently powerful to run the game at HD resolutions and 60 frames per second while capturing footage without introducing input lag. A wired Xbox 360 controller was used for input.

Participants were asked to play through the game from the beginning but stop at predetermined points to complete Likert scales before continuing. Each participant played the same 6 "phases", in the same order. Breaking the gameplay into phases allows us to monitor participants' feelings continually rather than just a snapshot at the end. After pilot runs, we chose to split the phases such that they would take a roughly equal time (limited to 10 min to prevent egregiously long attempts) to complete, ensuring players experienced a sufficiently significant chunk of gameplay to register a meaningful change in engagement and frustration levels. The intervals were sufficiently long to prevent ourselves introducing frustration by interrupting too frequently. One participant (P4) failed to meet a time limit (completion of phase 1 within the ten minutes allowed). Others met every time limit and participant P4 met all other time limits.

The first phase featured jumping and climbing obstacles, as well as introducing pushing and pulling objects. Phase 2 featured a section in which the player avoided traps and found a route that bypassed a gap too wide to jump. Phase 3 saw the player combine previously learned skills to scare away a giant spider. Phase 4 featured traditional platforming challenges with reduced player control. Phase 5 featured more traditional platforming with full control. It also introduced problem solving. Phase 6 was a chase sequence.

Following initial pilot testing we chose to advise those with sensitivity to spiders to abstain from participation. Before commencing the study, each candidate was informed about the procedure that they would be asked to follow: the segmented nature of the gameplay, the time limits imposed upon them and the fact that they would be asked questions at set points. In addition, they were informed that gameplay footage was being recorded. Players were given a short printout listing the game's controls as a reference and some basic advice, e.g., not to backtrack to previous phases of the study. They were also told that once the study began we would not be able to offer help. The full protocol followed by each participant as well as the questions used in the study is available at http://bit.ly/2cR5Di7.

6 Results

Our results (reported in the appendix) did not contradict our belief that the chosen game would be well received and also provide sufficient hindrance that some level of frustration would be observed. Table 1 shows the mean values for engagement, hindrance and frustration.

Overall, the mean engagement was 5.706 (standard deviation 1.460), whilst mean frustration was 2.353 (standard deviation 1.211) and mean hindrance 3.255 (standard deviation 1.910), with occasional spikes to 6 or 7 for some individuals. A potential ceiling effect was observed for some participants; P5 and P7 recorded maximum scores for engagement throughout, and so care should be taken with the interpretation of these results and in designing future studies.

We found significant results not contradicting H1 (e.g., frustration and engagement were negatively correlated in Phase 6 with $\rho = -.683$ and $p < 0.01$). However, we found a contradiction for H3, i.e., participants did not report situations in which frustration and engagement were positively correlated.

Interestingly, however, participants reported engagement alongside some degree of both hindrance and frustration throughout their time playing the game. This aligned with our belief that games can simultaneously engage and hinder or frustrate. We also found significant, positive results with respect to H2. A one-sided Spearman ranked order test of the correlation between hindrance and engagement for all participants during Phase 3 showed that participants reported increasing engagement and an increasing sense of being hindered, i.e., a positive correlation between hindrance and engagement ($\rho = 0.522$, $p = 0.013$). This result indicates that hindrance can coincide with engagement.

Closer examination shows that many participants felt highly hindered during phase 3, with nine participants scoring a 5 or higher (P4–7, P10, P13–15, P17). Of these nine participants, all either maintained or increased their engagement during this phase. Two participants (P4, P5) are particularly interesting as they returned a (maximum) 7 score for engagement in spite of a hindrance increase from 3 to 7 in the same phase. Participant 10 also jumped from 2 to 6 hindrance while also maintaining engagement. Furthermore, participants 13 and 6 increased hindrance from below to above the midpoint (3–5). It is interesting that so many participants reported high levels of hindrance during phase 3 while their engagement did not suffer as a result. These results suggest that further investigation of game design choices during this phase would yield insight into the use of hindrance as a positive influence on participant experience.

What immediately stands out about the gameplay underpinning these results is that Phase 3 contained only one, large, multi-faceted challenge (driving away a spider) rather than multiple smaller challenges (avoid the enemy, jump the gap). This presented players with a greater period of time, in which to experiment and learn. Game design in other phases provided multiple, smaller challenges, focusing on a single requirement per task. Instead of simply traveling left to right, this phase presents a more concrete goal to work toward. These differences in game design may explain the positive reaction (in terms of engagement) to high levels of perceived hindrance—a possibility that can be explored in more detail in future work.

It is important to note that other examples of individual participants reporting high engagement whilst severely hindered in their progress towards in-game goals can be found beyond Phase 3. In Phase 5, for example, four participants (P5, P7, P8, P10) reported increases in hindrance yet did not report drops in engagement. Furthermore, P2 and P10 recorded an increase in frustration without loss of engagement in Phase 5. Phase 5 combines multiple small challenges which can be navigated quickly (for example, determining how to avoid a swinging boulder) rather than a single challenge of long duration. The nature of this phase contrasts with that of Phase 3, which is made up of one, large, longer-lasting challenge. However, these smaller challenges combine multiple elements

similar to Phase 3, but on a smaller scale. For example the player must first work out how to avoid a swinging boulder as they jump a gap, rather than only having to jump a gap as in other phases. As a result some participants may have found these challenges simultaneously hindering and engaging, as they did the larger ones in Phase 3—a possibility we will also investigate further in future work.

In Phase 1, four participants (P8, P11, P12, P14) also reported noticeably higher scores for frustration than others before dropping in Phase 2 to be more in line with other participants. These users' hindrance scores remained largely consistent between phase 1 and 2, as did their engagement. This unusual combination of frustration and engagement raises the possibility that users may have changing tolerance for frustration at different times (possibly being more forgiving at the start of the game). Their frustration may also have stemmed from unfamiliar controls and a need to acclimatise. These time based effects may be interesting for future study.

Elsewhere, several participants (P3–4, P9–10, P13) reported increases in frustration in phase 3 without a corresponding drop in engagement. Similarly four participants (P1, P3, P8, P12) showed a decrease in frustration between phase 1 and 2 without corresponding increases in their high levels of engagement. In these cases, we question the possibility that players who are already experiencing high levels of engagement may have a greater tolerance for increases in frustration, something we can test for in the future.

Each of these results contributes questions about our understanding of the relationship between frustration and hindrance in video games. More specifically, they challenge the uniform understanding of frustration as the antithesis of engagement and hindrance as the direct (and potentially only) cause of that frustration. Though this study was designed only to identify specific moments where frustration, engagement and hindrance can behave in a manner opposing their expected relationships, we intend to investigate the extent to which these results are replicated in other games and whether a generalizable conclusion can be reached surrounding problem solving, hindrance and engagement.

7 Discussion

There are, of course, limits to the conclusions we can draw from these results. This study considered only the frustration, perceived hindrance and engagement reported by 17 participants in a single game. We do not yet know whether these results can be generalized to describe other games both within and outside this genre. Additionally, while this initial study allowed us to observe unexpected relationships between hindrance, frustration and engagement, it stopped short of providing causal explanations for those results. Other studies are needed to develop these causal explanations. This study's results will inform the approach in our future work; for example we will consider the difficulty of analyzing results in which participants rated their engagement with a game at the maximum score (the potential ceiling effect). One solution is to ask players how their feelings have changed from the previous phase rather than asking for a flat score repeatedly.

These results allow us to make initial contributions to the scientific discussion and understanding of frustration introduced in Sect. 2 and feed back into the body of research from which we have drawn the design of this study. Our results provide some support for observations made in previous papers, i.e., they provide evidence that engagement does often rise as frustration and perceived hindrance fall. Importantly, however, those results also provide evidence that frustration and hindrance cannot simply be considered the antithesis of engagement and that we need to extend our understanding of each one.

Our participants reported a significant, positive correlation between a rising sense of being hindered in their progress towards in-game goals and rising engagement in Phase 3. Furthermore, when examining results on a participant-by-participant basis, we found other instances in which individual participants reported increasing engagement at the same time as rising frustration and/or perceived hindrance. These results demonstrate that frustration and hindrance can have positive as well as negative impact on gamer engagement. Consideration of gameplay features in phases where these results occurred allowed us to develop candidate explanations of the ways in which a game's design could contribute to a more positive reception of frustration and hindrance. Examples include giving players time and space to experiment and learn about a game during a hindrance, and the benefits of larger multi-faceted challenges over smaller sequential ones—areas that we will consider further in future work.

Importantly, however, our results also highlighted the fact that we need to understand more about the individual differences that caused some but not all participants to report a positive correlation between hindrance and engagement. We also need to understand the game design choices that caused hindrance of participants' progression towards their objectives to have a clear positive impact upon participant engagement in Phase 3 but not elsewhere. In this context, a first contribution of the work presented here is the identification of further research questions that can be fed back to the community on whose work we drew upon.

A second contribution is to the designers of games, both within our own studio and beyond. Our results emphasize the care that must be taken when hindering or frustrating players, since each one can lead to a drop in player engagement. Those same results, however, suggest that carefully designed hindrance and frustration can be experienced as an engagement enhancing intervention. These findings support a more nuanced approach to the deliberate introduction of hindrance and frustration than is implied by much of the previous literature.

This work also raises questions in areas outside of our own focus. Researchers and practitioners with an interest in gamification will ask whether frustration can also support engagement with serious games as well as entertaining ones. For the wider field of HCI, we question whether frustration is always a negative outcome for interaction designs, or whether there are other areas, in which frustration can be harnessed as a positive influence on user experience. Just as the results reported here raise questions about the relationships between frustration, hindrance and engagement in computer games, it is equally important to consider the extent to which gamified smart meters, healthcare applications and training tools will also be less engaging if they never hinder or frustrate their users.

8 Conclusion and Next Steps

In conclusion, we found the relationship between hindrance/frustration and engagement in one video game to be more varied than had been suggested by previous work. More specifically, we identified an example of gameplay that elicited a positive effect on player engagement as a result of hindering progression towards player goals. We also found multiple examples of individual players reporting that their sense of being hindered or frustrated rose without causing the engagement with the game that they were playing to fall. Additionally, we found that some level of frustration was present throughout the gameplay experience. We discussed the implications of this work for the growing body of researchers with interests in the frustration caused by video games, for designers of those games and for a wider HCI community. We also discussed limits to the claims that we could make as a result of this initial study.

The next step in our work will be to investigate the game design choices that caused hindrance to rise at the same time as engagement at some points (phase 3) but not others. We will also investigate the individual differences that underpin the different responses to frustration and hindrance reported above, the contexts in which those responses include an increase in player engagement and the principled, predictive design guidance that we can offer to games designers as a result.

Appendix

Table 1. Mean engagement, hindrance and frustration

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	All
Engagement	5.765	5.588	5.647	5.765	5.706	5.765	5.706
Frustration	2.471	1.941	2.529	2.353	2.471	2.353	2.353
Hindrance	2.882	3.118	4.176	2.824	3.588	2.941	3.255

See Tables 2, 3 and 4

Table 2. Participant scores for engagement

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6
P1	5	5	5	5	6	5
P2	5	4	4	4	4	4
P3	6	6	7	7	7	7
P4	6	7	7	7	7	7
P5	7	7	7	7	7	7
P6	5	4	5	5	5	4
P7	7	7	7	7	7	7
P8	5	5	6	6	6	6
P9	5	5	4	5	6	6
P10	6	6	6	6	6	6
P11	6	7	6	6	7	7
P12	4	1	1	1	1	1
P13	6	6	6	6	6	6
P14	6	7	7	7	6	7
P15	5	5	6	6	4	4
P16	7	7	6	7	6	7
P17	7	6	6	6	6	7

Table 3. Participant scores for frustration

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6
P1	2	1	1	1	2	2
P2	2	2	2	2	4	3
P3	2	1	2	1	1	1
P4	3	1	6	2	2	1
P5	2	1	1	1	1	1
P6	2	2	2	3	2	2
P7	1	1	1	1	1	2
P8	4	2	1	2	1	2
P9	3	3	4	3	2	3
P10	2	2	3	3	4	3
P11	4	2	3	2	2	2
P12	4	2	2	4	2	3
P13	1	2	4	6	4	3
P14	4	1	2	2	3	2
P15	2	5	4	4	5	5
P16	1	1	1	1	3	3
P17	3	4	4	2	3	2

Table 4. Participant scores for hindrance

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6
P1	2	1	2	1	1	1
P2	1	3	3	2	2	3
P3	3	1	2	1	1	1
P4	7	3	7	6	7	6
P5	2	3	7	1	5	3
P6	3	3	5	5	3	3
P7	6	7	7	5	7	7
P8	3	3	2	2	5	2
P9	4	3	4	3	2	2
P10	4	2	6	4	6	4
P11	1	1	2	1	1	1
P12	2	2	2	2	2	2
P13	3	3	5	5	5	4
P14	1	6	6	2	6	3
P15	4	6	5	5	5	5
P16	1	1	1	1	1	1
P17	2	5	5	2	2	2

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