Engaging Casual Games That Frustrate You

An Exploration on Understanding Engaging Frustrating Casual Games

Melvin Roest University of Amsterdam Faculty of Science, Game Studies Laboratory Amsterdam, The Netherlands melvinroest@gmail.com

ABSTRACT

This paper is an exploration on why is it possible to have gameplay experiences that are perceived to be simultaneously engaging and frustrating. Particularly, the paper leverages psychological theories on rewards, frustration, and its neurobiology. In the paper (1) distinct types of (positive) frustration are informally classified. (2) The neurobiology of rewards is explained in the casual gaming context, in combination with the idea that neurobiologically wanting something does not imply *liking* it. (3) The game-design principles of slot machines are stated in the context of addiction, and linked to design principles in casual games. (4) The previous perspectives are synthesised into a case study in which the casual game FLAPPY BIRD is analysed through the lens of neurobiology and findings from research on cognitive biases. Derived from the presented perspectives and the investigated psychological theories, we suggest that a potent explanation for some games being perceived as simultaneously engaging and frustrating, is a (purposely?) dissociated neural activation of the liking- and wanting-pathways. That is, the current state of psychological literature suggests that in engaging frustrating casual games, the neurobiological conditions may be created in which, informally speaking, the dopaminergic wanting-pathways are being stimulated (e.g., via operant conditioning and the effects of near misses), while the liking-pathways are not being stimulated. We discuss that such behavioural conditioning may be enforced via several important cognitive biases. Indeed, this calls for drawing another parallel between drug addiction, and play behaviour in which liking may be barely exhibited (cf. [16, 38, 40]).

Keywords

Psychological foundations, Neurobiology, Engagement, Frustration, Casual Games

Sander Bakkes University of Amsterdam Faculty of Science, Game Studies Laboratory Amsterdam, The Netherlands s.c.j.bakkes@uva.nl

1. INTRODUCTION

The present paper aims to contribute to the psychological foundation of game design principles, by providing an understanding on the interplay of engagement and frustration. Particularly, the paper provides an exploration on why is it possible to have gameplay experiences that are perceived to be *simultaneously engaging and frustrating*.

Indeed, in the field of psychology this is a still underexplored phenomenon. The literature in this field has the – almost exclusive – perspective that frustration is a negative emotion (i.e. negative affect) (*cf.* e.g., [30]). Furthermore, and interestingly, while so-called flow states have been well investigated [11], frustration in itself is not a widely studied phenomenon. That is, frustration is primarily considered for the frustration-aggression hypothesis [30, 6, 27, 22], which states that aggression is the result of blocking, or frustrating, a person's efforts to attain a goal.

However, numerous recently released games have demonstrated – seemingly paradoxically – that simultaneous engagement and frustration can positively affect the gameplay experience. Examples of such engaging frustrating games are DARK SOULS, FLAPPY BIRD, and SWING COPTERS. The popularity of these games is not new. Even games that are foremost frustrating can become popular and a commercial success. For example, in 1986 the game TAKESHI NO CHŌSENJŌ (TAKESHI'S CHALLENGE) was released in Japan; it became a commercial success (it sold 800,000 copies), and gathered a cult following around its reputation of being one of the worst games in history [15]. Because of this cult status, numerous game players purposely set out to beat the game.¹

In terms of scope, the exploration on engagement and frustration that is given in this paper, is focussed on *simple casual games* (such as FLAPPY BIRD). Indeed, these games are more readily analysable than the generally more multifaceted AAA titles (such as DARK SOULS).

The exploration that is presented next is structured through various perspectives. First, we provide a working definition of engagement and frustration (Section 2). Second, we present the types of positive frustrations that a player can experience (Section 3). Third, we discuss how rewards are related to certain areas in the brain (Section 4). Fourth,

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 $^{^1\,\}rm{An}$ impression of this highly frustrating game is available on http: //www.youtube.com/watch?v=m6MIIJYiJUs

we explore the relevant similarities between slot machines and casual games (Section 5). Fifth, we synthesise our theoretical findings via an analysis of the simple casual game FLAPPY BIRD; leveraging established psychological theories (Section 6). Finally, we suggest a psychologically-founded explanation on the seemingly paradoxical engaging frustrating game phenomenon (Section 7).

2. DEFINING ENGAGEMENT AND FRUS-TRATION

For the present exploration we first provide a working definition on engagement (2.1) and frustration (2.2). Subsequently, we give a precise characterisation on what constitutes an engaging frustrating casual games (2.3).

2.1 Engagement

There appears to be no general consensus on what constitutes an engaging game experience. Some researchers relate the term to intrinsic motivation and flow [41], without giving a formal definition. Other researchers have conducted factor analyses to distinguish high engagement from addiction, and find very subtle, almost indistinguishable differences [37]. Indeed, numerous researchers do not clarify their use of the term at all; it seems to be assumed that the reader knows what engagement means.

For the purpose of this paper, engagement is considered to be the first level of immersion as defined by Brown and Cairns [5]. By using grounded theory they found that immersion – otherwise known as involvement – has three levels: engagement, engrossment and total immersion. In the first level, the player exhibits a need to invest time and efforts in the game, while having a willingness to concentrate. This need does not arise when the genre is aversive to the player or when controls are unintuitive. In other words, "an engaged gamer is interested in the game and wants to keep playing. What this experience lacks is the emotional level of attachment that is seen in later levels of immersion" [5]. For more complex games high immersion might be necessary (e.g., games with a strong narrative component), which is typically not the case for simple casual games (e.g., FLAPPY BIRD). For full descriptions of the second and third level, we refer to Brown and Cairns [5].

2.2 Frustration

As written before, in psychology frustration is well-known in terms of the frustration-aggression hypothesis [30, 6, 27, 22]. For example, according to [30] frustration occurs when an effort of goal-attainment is thwarted; it induces an aggressive drive that motivates someone to injure the object or person being the obstacle to the goal. According to this hypothesis, frustration causes aggression.

A common definition of frustration in the context of gaming is given by Gilleade and Dix as "that which arises when the progress a user is making towards achieving a given goal is impeded." [14] While the definitions are very similar, Gilleade and Dix do not mention frustration causes aggression. This definition of Gilleade and Dix is empirically supported by Chumbley and Griffiths [8] who found that players who experienced more failure in the game Micromachines felt more frustrated. In other words: within a game, frustration is the feeling that occurs after a perceived failure. As an aside, they also found frustration has no association with willingness to play, frustrated players are just as willing to play Micromachines as non-frustrated players.

There is one more nuance. But in the context of gaming, the empirical foundation of this nuance seems to be difficult to interpret. According to marketing researcher Gelbrich who studied frustration in hotel customers after service failures, frustration mostly tends to occur when situational factors can be blamed [13]. Anger, for example, tends to occur mostly when another person can be blamed - which, according to Gelbrich, is a distinct third category from the other two categories situational factors and oneself. While this clearly explains why players can be frustrated by: glitches, lag or other bugs, it is harder to understand *if* and *why* failure in a game could be perceived as a situational factor. According to the study of Juul [20], players prefer to feel responsible for their failures, but compared to successes they tend to attribute failures more to external circumstances (i.e. situational factors). Players who feel responsible for their failures tend to rate a game higher than players who believe they failed due to external circumstances [20]. This begs the question: do players feel frustrated when they blame themselves after a failure? If this is not the case, then frustration could be defined in a more nuanced way as: frustration is the feeling that occurs after a perceived failure due to external circumstances. Yet, in this paper, the definition of Gilleade and Dix will be used, because the empirical support is more straightforward than the proposed nuance.

Now that frustration is defined, we want to caution that it does not imply that it could be characterized as a negative emotion and nothing else. We will show this view to be incorrect (in Section 3).

2.3 Engaging frustrating casual games

While casual games defy a standard definition because of the diverse nature of the games [33], they can be understood as games that require simple rules, and do not require long-term term commitment or special skills to play.

As such, engaging frustrating casual games can be understood as games that: (1) are categorised as casual games (i.e. very easy to play, hard to master and supports short gameplay sessions – see [23] for a discussion on the term), are generally experienced as being simultaneously (2) engaging, and (3) frustrating. A prototypical example of a game that fits this definition is FLAPPY BIRD.²

While this is a seemingly redundant definition, we will point out – building upon psychological literature – that the specific interplay between engagement and frustration is not well understood, particularly in the context of different types of frustration (discussed next).

3. TYPES OF FRUSTRATION

Qualitative studies show that frustration does not have to be negative *per se* [12]. It may always be a negative feeling to a particular individual, but that does not mean that the con-

 $^{^2}$ We refer the reader that is unfamiliar with this game to the following gameplay video: https://www.youtube.com/watch?v=UloBiVGtAP4

sequences are always negative. Hence, we explore different types of frustration that people may experience. Particularly, we explore positive frustration (3.1) as resulting from (a) hierarchical goals, (b) presenting goals from a different perspective, (c) narrative frustration, (d) holdouts, (e) nearmisses, and briefly explore negative frustration (3.2).

3.1 Positive Frustration

3.1.1 Hierarchical goals

This type of frustration entails that the progress of a less meaningful goal is impeded while the progress of a more meaningful goal is not. Since a more meaningful goal subsumes a less meaningful goal, a hierarchy exists. Hence we call it hierarchical goals.

In [12] it is stated why frustration is a meaningful introspective experience. "Indeed, a successful workshop leaves people frustrated because of the recognition of how much effort is called for individually and communally in order eventually to be able to do authentic spiritual discernment. This is a good frustration, however, because it moves persons and communities to undertake the labour of true spiritual renewal in order one day to be able to do communal discernment" [12].

Another similar example is presented in [39] where students learned software engineering principles via a simulation. "Although incorporated into a series of larger group projects, Polack-Wahl [32] also utilised students roleplaying as the clients in systems development. This experience enabled the students to gain a valuable first-hand insight into the viewpoint of clients, and in particular their frustration when systems developers did not listen to their requirements."

3.1.2 Presenting goals from a different perspective

When a goal is presented in a different perspective (e.g., presenting dying repeatedly as part of training a specific skill, and not so much as the result of being a bad game player), the frustration of a player might be re-framed. For example, the authors in [15] created a game that normally would frustrate any player. It aims to teach fledgling game-design students which bad practices exists in game accessibility. The authors did this by creating a normal game and after its development there was a second development phase where they broke all the game accessibility requirements. The students responded that they believed the game was a lot of fun to play. Most of them stated, however, that this was only the case because they knew that the bad practices were meant to teach them something about game accessibility.

3.1.3 Narrative frustration

Frustration may also be (purposely) embedded in narrative frameworks. For instance, in The Art of Game Design, Schell explains the hero's journey, which could be viewed as a structure or framework in order to create a good story. The hero's journey was first discovered as a pattern. The pattern itself is seen in almost every mythological story [36].

In the hero's journey there are twelve distinct phases. The seventh phase is one of frustration. In this phase the hero endures setbacks directly or indirectly from the main antagonist in the story. This is argued to be necessary in order to make the story more meaningful. Without setbacks, a story is believed to be less meaningful, because the one reading the story is less invested in the character. Since humans have a natural tendency for loss aversion [21], more meaning is created by giving the reader the feeling of potentially losing someone.

3.1.4 Holdouts

A mixed form of frustration (partially positive and negative) are holdouts. When a player is frustrated with a game but is willing to wait until she has seen a certain segment, then she is holding out. In the prototypical example the player is curious enough to see a certain special segment or turning point in the game. If that segment or turning point is fun in the experience of the player, then she will continue playing. Otherwise she will quite the game [7].

3.1.5 Near-misses

Another type of frustration which could be viewed as positive is the near-miss. A near-miss occurs when a player almost reaches a certain goal but ultimately fails. A classic example is a gambler getting two bars in the first and second slot but no bar in the third slot. This leads to frustration, and an almost compulsive like behaviour to continue playing [9, 2].

The idea of a near-miss is similar to the psychology of shaping [30]. So in the experience of the player, near-misses could be perceived as an indicator for skill-development. Just missing a target is a lot better than completely missing a target. [9] presents a somewhat similar idea. As will be presented in the remainder of the paper, explaining a game in terms of variable rewards and near-misses, might be a substantial part of the answer to the question of why casual games could be experienced as frustrating and engaging.

3.2 Negative Frustration

Concisely speaking, negative frustration has the consequence of the player quitting or developing a tendency towards quitting the game. This is what most psychologists and gamedesigners assume frustration (as a general concept) does. Examples are: unexpected bad controller design, lag, or so-called campers that repeatedly kill a re-spawning player within seconds.

Scholarly textbooks in the field of psychology generally depict negative frustration in relation to the frustration-aggression hypothesis. However, negative frustration itself remains largely ill-defined. Yet, working definitions generally place negative frustration in the following framing: "whenever a person's effort to reach a goal is blocked, an aggressive drive is induced that motivates behaviour intended to injure the obstacle [30]."

4. REWARDS, FRUSTRATION, AND ITS NEUROBIOLOGY

Here, we go deeper into relevant psychological theories on rewards, frustration, and its neurobiology. Particularly, we discuss operant conditioning (4.1), near-misses (4.2), liking and wanting (4.3), and the neurobiology of frustration (4.4). We will highlight the relevance of each theory to the gaming domain in the text.

4.1 Operant conditioning

The relevance of operant conditioning (i.e., a method of learning that occurs through rewards and punishments for behaviour) in the gaming context may be evident: much if not all of the learning processes that take place within game environments may be regarded as operant conditioning (albeit, in distinct layers).

Indeed, it can be said that B.F. Skinner and other behaviourists have done ground-breaking work on reinforcement learning. They showed that variable-ratio and variable-interval schedules produce new habits that are more resistant to extinction compared to the fixed-ratio and fixedinterval schedules [30]. This means that when rewards are given in a variable amount of time or after a variable amount of tries, the (newly) learned habitual response will stay active. Bateman and Nacke [2], have surveyed that this is associated with the nucleus accumbens in the brain. Whenever a reward is received, dopamine is released in the nucleus accumbens [2].³

The nucleus accumbens is popularized as a part of the pleasure center of the brain, and situates itself in the limbic system. The limbic system used to be known to be the emotional center of the brain. However, more recent research in neuroscience revealed that the neocortex and reptile brain also have influence on the emotional experience of an individual. Still, the substructures of the limbic system are the most related to emotional experiences [22, 2].

4.2 Near-misses

When a near-miss has occurred (i.e., an unplanned event that did not result in injury or damage – but had the potential to do so), dopamine is released in related dopaminergic reward structures such as the mesolimbic pathway [9, 2]. Clarke *et al.* [9] suspect that the dopaminergic neurons fire at the time when a win is very likely to occur. So neuronal reward structures of the brain fire when a player wins, but are also likely to fire when a player *anticipates to win*.

More specifically, the study of [9] researched this effect with slot machines. Table 1 presents the brain structures associated with winning (as opposed to losing) and near-misses (as opposed to other full-misses). Indeed, there are strong indications that near-misses and wins are neurobiologically related [9].

The most likely explanation is that near-misses result in experiencing positive affect in anticipation of the reward; at the end of this process the player will not get it and negative affect is experienced. Another proposed explanation would be that near-misses are a form of illusion of control. In any case, the literature on near-misses supports the notion that rewards are experienced by their subjective interpretation and not by their objective value [9].

4.3 Liking and wanting

The wanting-and-liking theory states that liking and wanting have partially different neural correlates in the brain [22]. Their most pronounced difference is that they are governed by different neurotransmitters. The wanting pathway is akin to feeling and acting on desire or cravings. When an individual wants an object, dopamine is being released in the mesolimbic pathway (as stated with the near-misses). These neurotransmitters do not amplify pleasure, but do reinforce behaviour [3].

As such, liking is behaviourally akin to enjoyment. When an individual likes an object, μ -opioids and endocannabinoids are being released in limbic forebrain structures, such as the nucleus accumbens. These neuromodulatory peptides and lipids act as neurotransmitters, and are natural versions of heroin and marijuana and amplify pleasure [3]. This does not occur when an individual solely wants something.

The wanting-and-liking theory explains the effect of how people could want something, but not like it. A prototypical showcase of this theory would be to look at drug addicts. When people build tolerance for drugs they like the experience less than before, but their addictive behaviour does not decrease, creating a mismatch in wanting and liking.

With regard to games, it gives an idea of why players could be engaged in games they perceive as frustrating. For example, players could be engaged, because they want to achieve their goal. At the same time, they might not like it. While some literature is cautious on whether or not reinforcement learning occurs when people show activation in their socalled liking hotspots (e.g., [3]), it is plausible that reinforcement learning does *not* occur, as Bateman and Nacke [2] found that reinforcement learning occurs with dopamine, a neurotransmitter that is not associated with liking.

As such, it is likely that near-misses are solely associated with parts of the wanting system, and not the liking system. While we did not find neuroscience literature on the subject, questionnaire ratings do indicate that participants felt more unpleasant when they experienced near-misses compared to experiencing full-misses, which are experienced as unpleasant in the first place (with no reward activation in the brain) [9].

4.4 The Neurobiology of Frustration

Concisely speaking, it is hypothesized that triumphing over hardship produces dopamine in the brain. This would imply that the moment a frustrated player achieves her goal, a dopamine release occurs in the brain. Such a release would further segment the behavioural pattern in the player [2]. For example, if a frustrated FLAPPY BIRD player changes the way she taps against the screen by tapping with the index finger instead of the thumb and (perhaps by chance) obtains a higher score, then the player is likely to play with her index finger for a while.

This finding, however, has to be met with some caution. The study of [25] did not find this association when players killed other players in a first-person shooter. They did see phasic activation patterns of striatal activity, but could not relate the activation patterns to a specific element of the game. However, they did find less striatal activation than usual when a player was killed, which means it is likely that less dopaminergic neurons fired. Furthermore, they found

³While outside of the scope of the present paper, it is interesting to note that the release of dopamine in the nucleus accumbens is not directly linked to hedonic impact (liking) [4], but is suggested to be directly linked to *wanting* [35]; via the meso-limbic pathway.

Table 1: Brain areas of winning situations and near-miss situations

Win - all non-win	Near-miss - full-miss
Bilateral ventral striatum	Bilateral ventral striatum
Bilateral anterior insula	Right anterior insula
Rostral anterior cingulate cortex	Rostral anterior cingulate cortex [*]
Thalamus	-
Dopaminergic midbrain neurons	-

In the near-miss condition it was only activated during a specific near-miss. The brain area activated when the relevant last winning symbol stopped briefly as a winning condition in the middle (e.g. three bananas in the middle), and then fully stopped at the place beneath it (e.g. two bananas and a cherry with the banana underneath the cherry).

that the negative feeling of not obtaining a goal is being associated with the right temporal pole, and to a lesser extent the left temporal pole. Unfortunately, it is still relatively unknown what the temporal poles precisely do [25].

Here, the suggested implication to gaming is that the more unexpected a full-miss (generally leading to frustration due to goal blocking), the less activity there will be in the striatum. The less activity in the striatum, the less dopamine and/or opioids will be released. Naturally, the precise sensitivity to this phenomenon differs from person to person.

5. DESIGN PRINCIPLES FROM SLOT MACHINE GAMES

Indeed, insights from the gambling domain are invaluable to the modern video gaming context, in order to support the neurobiological perspective from a more pragmatic point of view. That is, before the digital games industry existed, designers of slot machines have developed their own best practices to keep players engaged. Some parts of gambling could indeed be experienced as quite frustrating. We highlight seven design principles from slot machines games below, and will utilise these principles in our analysis of the case study (discussed next).

Rewards are the first principle of keeping players engaged. It appears that next to real money pay-outs, sound is the biggest reward that keeps the player engaged [17]. Visual cues help as well. The second principle are *reinforcement schedules*. Slot machines almost exclusively use a variable ratio-ratio rewards [17]. Third, the *frequency of near-misses* is artificially heightened. By artificially heightening the frequency, players will play more often [17]. Fourth, *losses are disguised as wins*. For example, if a player needs to pay two coins for a spin, and wins one coin back, then this is a loss of one coin disguised as a win. Physiologically players experience these types of losses as wins [17].

The next principle is a well studied cognitive bias called *illusion of control*. Gamblers experience this when they are given the power to hold a few slots. They have the feeling they control the game, which is mathematically not true, the probabilities remain the same [17]. The sixth principle is *bonus rounds*, which often occur entirely random in gambling games. Players rate these experiences as one of the most compelling elements of a gambling game [17]. The final principle is *competition*, even though players cannot re-

ally compete, the illusion of control bias lets them believe they can [17].

These seven principles could be applied to designing a casual game – and to a large extent already are. Furthermore, principle 1, 2, 3, 4 and 6 are also supported by the neurobiological theory of frustration explained in Section 4.4. This is because principle 1, 2, 4 and 6 can be considered to be related to operant conditioning. Principle 3, on the other hand, can be considered to be related to the neurobiology of near-misses.

Despite that principles 5 and 7 are not supported by neurobiological theory surveyed in this paper, they are supported to be motivating by the competence aspect and relatedness aspect of self-determination theory [34]. Indeed, one may claim that the illusion of control gives a feeling of competence, and that competition fulfils the need of relatedness. For further reading on the topic of determination theory, we refer the reader to Ryan and Deci [34].

6. FLAPPY BIRD AS A CASE STUDY

Now that we have (1) an informal classification of distinguishing different types of frustration, (2) a neurobiological background, and (3) a more pragmatic background on design principles, we can apply these theories to an engaging frustrating game. For this case study, we investigate a prototypical example of an engaging frustrating game, namely FLAPPY BIRD (Figure 1).

A characteristic of FLAPPY BIRD is that it is easy to understand. So players do not need a tutorial, players only need to experiment the first few tries in order to understand the rules of the game. Research shows that there is no evidence that game tutorials give a more productive, effective or efficient learning experience in simple games; game tutorials only appeared to become relevant with complex games like FoldIt [7]. Hence, the lack of a game tutorial in FLAPPY BIRD may be considered to be a design feature.

6.1 **Profiling the Players of Flappy Bird**

A study by Poels, IJsselsteijn, and de Kort showed that a substantial amount players play video games because they are bored. However, this is less the case for gamers that game more frequently [31]. With regards to FLAPPY BIRD, it is likely that a considerable number of player engage with the game because they are bored.



Figure 1: Flappy Bird. Some players die within milliseconds.

Despite that players may start out being bored, it is suggested that casual gamers consider competence and autonomy to be the greatest need they want to have fulfilled [29]. Furthermore, it is suggested that casual gamers consider relatedness to be the need they want to have least fulfilled.

Why FLAPPY BIRD became viral is not well understood. Research findings show that reading negative reviews 15 minutes before playing a game will not physiologically affect a gaming experience [7]. So it could be that the game got popular via word of mouth (among other means), and even when people would review it in a negative fashion, players might still be drawn to try it out.

6.2 Potential Cognitive Biases for Flappy Bird

There are some potential cognitive biases that we need to consider. First, the effect of a player being overconfident (6.2.1) may be introducing a bias (i.e., the overconfidence effect; a well-established bias that nevertheless has recently been subject to academic debate). Second, the illusion of control may include a bias (6.2.2), and third, so may a fundamental attribution error (6.2.3).

Finally, the generalizability of effects remains an issue to consider. That is, there are cultures where cognitive biases and even brain activations differ substantially compared to people born and raised in a western culture [19]. This finding hints to the idea that a designer is only able to design for an experience for a particular prototypical player [18].

That said, while these biases may occur when people play FLAPPY BIRD, it is not certain if they do occur. The idea of the following paragraphs is to present some possible ways in which players could be tricked into believing that the game is more easy than it really is, for instance.

6.2.1 Overconfidence

Overconfidence is defined in three ways. The relevant definition for us is that people tend to overestimate their skill-level compared to their real performance. In the comprehensive literature review of Moore and Healy [26], the pitfalls in the current research of overconfidence are presented. The background of this theory is that humans estimate their skill-level via an irrational Bayesian probabilistic process. Moore and Healy conducted an experiment with a trivia game about facts of the United States. They showed that when a game is experienced as hard, people tend to overestimate their skill level, and believe they performed worse than other people. So for example, if a player gets a hard question, then, on average, she might estimate her probability of answering it correct to be 10%, in reality she would answer it 5% correct of the time, and would guess her peers would have answered it 12% correct of the time [26]. In FLAPPY BIRD, this effect could also occur, which would mean that players would consistently overestimate their future performance.

6.2.2 Illusion of control

While it is hard to argue that the illusion of control provides a cognitive bias in the FLAPPY BIRD game (i.e., the tendency for people to overestimate their ability to control events), we posit that it is an applicable bias. Particularly, in this context of illusion of control, the *hot-hand fallacy* could be applicable.

The hot-hand fallacy is informally defined as believing that people are better in scoring points when they are on a winning streak, while successful outcomes are in fact based on randomness or luck (statistically speaking). The hot-hand fallacy occurs when people believe that a certain winning streak has a causal effect on later outcomes, and has been demonstrated with gambling and basketball throws. Indeed, game players generally do not score more or less points after a hot streak of successful actions. With FLAPPY BIRD, this fallacy could occur when players have a certain number of good runs in a row, which would excite the player as a result [10].

Inversely, the hot-hand fallacy may apply with a notable streak of near-misses.

6.2.3 Fundamental attribution error

The fundamental attribution error occurs when the characteristics of an event are too much attributed to the person or the environment [27]. An example is blaming a newly hired CEO for causing a company to fail, when the company had terrible financial forecasts to begin with.

There are cultural differences. In one study Japanese and American participants were shown a cartoon character with a sad or happy face while there were four cartoon characters who had the same facial expression or the opposite facial expression. On average, Japanese people claimed that the main cartoon character was influenced by the other characters to agree or disagree with their emotions (attributing the emotion to the environment). American participants claimed, on average, that the person had a sad or happy face, because of the character his own will, thus attributing the emotion to the main character, not the environment [24].

If these finding are generalizable to FLAPPY BIRD, then this could mean that compared to people from an eastern culture, people from a western culture would blame their own skill more than the game and vice versa. So with regards to this bias, people from a western culture are more inclined to believe that the outcome of any game is in their control. This may have an impact on their intrinsic motivation to continue to play more.

6.3 Reinforcing Effects in Flappy Bird

The following analysis is based on actual FLAPPY BIRD gameplay sessions by the investigators, and Youtube recordings of gameplay session by third parties. Two assumptions are being made: there is no social activity during gameplay and there is no social activity after gameplay. If the reader is not familiar with operant conditioning, then we would recommend any introductory psychology textbook, such as [30].

6.3.1 Positive reinforcement

In the game FLAPPY BIRD, there are multiple ways of positive reinforcement. First, there is a *fixed-ratio of reinforcement* with scoring a point. This occurs via visual and audible events. Every time the bird passes through the empty space between the pipes the score increases with one point (visual) while a small high-pitched sound plays (audible).

A variable ratio reward occurs with regards to getting a high-score. From the described theory in this paper, the frustrating but still reinforcing part occurs with a near-miss. When the player is getting a higher high-score it is reinforcing and likely to be arousing. It is unlikely the player will get into a so-called flow state [11] – which we assume the reader to be familiar with – when she is obtaining a higher score, because of the difficulty of the game leading to high arousal [28]. This reinforcement scheme occurs solely via visual means. The medal, high-score and even the small star at the beginning when a medal is obtained in the previous try all play a role in this reinforcement scheme. Most of these visual cues are very salient, except for the star, which is subtly visible at the beginning of the next try.

6.3.2 Negative reinforcement

When passing through the empty space between the pipes, the bird does not die. So not having the frustration yet is a reward in itself. It is a form of *negative reinforcement*, because although the punishing sounds are anticipated, they do not occur.

6.3.3 Negative punishment

When the bird dies, the player has *no more control* over the player character (the bird). Control over the bird could arguably be seen as something positive. Hence it is negative punishment if this positive element is taken away.

6.3.4 Positive punishment

The bird dies every try. While every death could be seen as a punishment, not all deaths are equal. When the bird dies before a near-miss occurs, the punishment is at its greatest.

The *punishment* happens mostly *via audible means*. First there is a punch sound, which is louder than most other sounds in the game. This sound is quickly followed by a small, softer and more melodic sound. Visually the bird falls to the ground.

It is suspected by us that the frustration is the highest at the moment when the punch sound occurs, and lowers with the smaller and softer sound. So in FLAPPY BIRD it is clear that the game *is strictly speaking not simultaneously engaging and frustrating*, but alternating in engagement and frustration. However, since the frustration happens in small durations spaced with quite some time in between, it might be experienced as simultaneously engaging and frustrating by the player when he talks about the game.

6.4 Other Effects in Flappy Bird

We briefly discuss three other effects that may account for the investigated engaging / frustrating effects, namely intrinsic motivation (6.4.1), variety (6.4.2) and types of positive frustration (6.4.3).

6.4.1 Intrinsic motivation

In the gaming domain, the relationship between extrinsic and intrinsic motivation is difficult at best. Indeed, the overall effect of offering a reward (e.g., points) for a previously unrewarded activity is a shift to extrinsic motivation and the undermining of pre-existing intrinsic motivation (i.e., the overjustification effect). We refer the reader to Akin-Little [1] for a deeper investigation on this effect.

In the case of FLAPPY BIRD, the most salient external reward is the high-score. This high-score is likely related to social comparison and perceived status. One would assume that in FLAPPY BIRD most gamers will probably not take high-scores too seriously (except for a small group of gamers). So even if the over-justification effect would decrease intrinsic motivation, it would not happen much. Furthermore, an inverse of the effect is also possible. This occurs when an individual receives a reward that is too little to justify the work done. As a result the individual attributes his actions to intrinsic motivation [27].

So we believe that the extrinsic motivation adds to the intrinsic motivation experienced in the game, because our assumption is that the rewards do not justify the time invested in the game. It is a game in which competence (how good a player performs) increases very slow. Moreover, because the game mechanics have easy to understand causal relationships, autonomy (events are caused by a gamer her own actions) is present as well. Even relatedness (connection with others) might be present to some extent, via social cognitive processing that occurs in the brain by seeing, e.g., a favourite character. So casual gamers that keep playing the game might experience a slow but steady increase in their intrinsic motivation.

6.4.2 Variety

In the game the color of the birds change. The background changes as well. Levels are randomly generated. These elements introduce variety in the game and cause a slower habituation to the game, compared to if these elements would not vary. This means that the desensitization of dopamine will happen at a slower rate [6], which in turn suggests that the player will stay more aware during the game.

6.4.3 Types of positive frustration

One type of positive frustration is directly apparent, the near-miss. For instance, when the player has the same amount of points compared to the high-score, but alas, the bird dies and the next round begins with zero points. According to the investigated theories on near misses, game players will want to play the game, despite their negative feeling of it. A holdout could also occur. An example is that a player who has a high-score of 47 really wants a highscore of 50. Or maybe she wants to beat the high-score of her friend and do everything it takes.

Finally, when a game such as FLAPPY BIRD is framed from a different perspective (e.g., mindfulness training), the potentially frustrating in-game experiences could be perceived as being part of the mindfulness training itself.

7. CONCLUSIONS

This article provided an exploration on how casual games such as FLAPPY BIRD can be engaging while simultaneously being frustrating. From numerous psychological studies we attempted to distill generic insights for the casual gaming domain with regard to the interplay of engagement and frustration. The exploration focused on the following perspectives:

- Informally classifying types of (positive) frustration that could occur in any experience,
- Understanding the neurobiology of rewards in the casual gaming context,
- Understanding the design principles from slot machine machines in the context of addiction and linking the design principles to casual games,
- Analysing an engaging frustrating game through the lens of neurobiology, while trying to explain the mechanics, dynamics and aesthetics of the game through additional literature from related domains.

Derived from the presented perspectives and the investigated psychological theories, we suggested that a potent explanation for some games being perceived as simultaneously engaging and frustrating, is a *(purposely?)* dissociated neural activation of the liking- and wanting-pathways. That is, the current state of psychological literature suggests that in engaging frustrating casual games, the neurobiological conditions may be created in which, informally speaking, the dopaminergic wanting-pathways are being stimulated (e.g., via operant conditioning and the effects of near misses), while the liking-pathways are not being stimulated.

It is surmised that conditioning is enforced via several cognitive biases that trick a player into expecting euphoria (likingpathway), when instead frustration is yielded – with conditioning being iterated to a point that the player is motivated to interact with the game on a foremost instinctual level. We posit that these stimulations of the wanting-pathway may lead to players interacting with the game not only without actually liking it, but also without knowing why they are interacting with the game. Indeed, this calls for drawing another parallel between drug addiction, and play behaviour in which liking may be barely exhibited (cf. [16, 38, 40]).

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