

A Systematic Review of Quantitative Studies on the Enjoyment of Digital Entertainment Games

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ABSTRACT

Enjoyment has been identified as a central component of the player experience (PX), but various, overlapping concepts within PX make it difficult to develop valid measures and a common understanding of game enjoyment. We conducted a systematic review of 87 quantitative studies, analyzing different operationalizations and measures of game enjoyment, its determinants, and how these were related to other components of PX, such as flow, presence and immersion. Results suggest that game enjoyment describes the positive cognitive and affective appraisal of the game experience, and may in part be associated with the support of player needs and values. Further, we outline that enjoyment is distinct from flow in that it may occur independently of challenge and cognitive involvement, and argue that enjoyment may be understood as the valence of the player experience. We conclude with a discussion of methodological challenges and point out opportunities for future research on game enjoyment.

Author Keywords

Digital Games; Enjoyment; Player Experience; Flow

ACM Classification Keywords

K.8.0 Personal Computing: Games; J.4 Social and Behavioral Sciences: Sociology, Psychology

INTRODUCTION

Digital games offer some of the most intense, rich and engaging experiences of all interactive products. Not only are they steadily increasing in popularity [1], but their growing importance as a medium for education, persuasion, and self-expression [12], as well as the different cultural practices that have formed around them (e.g., let's play videos, modding, game journalism, etc.) make games an immensely fascinating topic for the HCI community to study.

People play games for the experience they create [47]. However, the experience of being entertained through games is not well understood yet from a psychological perspective [83, 89]. Various concepts have been discussed, such as immersion [39], flow [59] or presence [78], making it difficult to

decide upon which psychological concepts are best suited to study the player experience (PX) [8]. Meanwhile, enjoyment has been characterized as the core experience of all entertainment media [83] and games in particular [58, 77], and has previously been identified as a key motive for why people play games (for an overview refer to [13]).

Unfortunately, the definition of game enjoyment is fuzzy [77] and not well differentiated from other potentially related psychological components of PX, such as flow [58]. This raises the issue of how the experience of playing digital games can be effectively operationalized and measured [16, 89]. Moreover, many models of PX often neglect previous findings and/or are based on little empirical grounding [58, 89]. For these reasons, a common terminology for discussing and measuring PX and game enjoyment is still lacking, making it difficult to compare study findings and assess which factors contribute most to enjoyable game experiences.

Synthesizing and building upon existing knowledge on game enjoyment may improve the validity of measures, which in turn strengthens our understanding of what makes games so enjoyable. Hence, the present paper aims to provide a comprehensive review of previous quantitative research on game enjoyment. We take stock of the different conceptualizations and operationalizations of game enjoyment currently employed, in order to gain a clearer understanding of how the experience of enjoyment when playing digital games may be adequately measured. We also investigate how other psychological components of PX relate to game enjoyment, in order to further clarify the concept. Finally, we identify and categorize relevant determinants of game enjoyment and uncover opportunities for further research. We believe that by elaborating what constitutes game enjoyment, we may not only get more insights on how to properly measure the construct, but also gain a clearer understanding of the overall player experience.

RELATED WORK

Enjoyment describes an individual's positive response towards media technology and its content [83] and has become a central concept within HCI research [11], as well as one of the most frequently assessed dimensions of user experience [5]. The enjoyment of websites, for instance, has already been well conceptualized and operationalized [49], but may not be readily applicable to assess players' enjoyment of digital games, as websites generally serve some utilitarian goal, whereas the *single most important goal of games* is enjoyment [77].

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Similarly, Boyle et al. [13] distinguish between different stages of the engagement process in digital games and consider the subjective experience of enjoyment key to engagement. They define the subjective experience as moment-to-moment feelings of enjoyment that players experience while gaming. In contrast, enjoyment as a motive for playing games denotes the more enduring reason to play. In other words, people are motivated to play games, because they wish to experience enjoyment.

Many models and concepts have been proposed to explain this subjective experience of enjoyment in games (for an overview see [78]). For instance, game enjoyment has often been equated with the experience of flow [77, 85]. Flow describes the subjective experience of engaging in challenging, yet manageable activities (e.g., digital games), further characterized by complete cognitive absorption, time distortion and enjoyment [61]. But some argue that flow is too restrictive, as it is only concerned with extreme experiences [39, 78] and may not adequately cover more casual experiences of enjoyment, such as gaming on the phone while waiting for the bus. And indeed, Nakamura and Csikszentmihalyi have shown that enjoyment may occur independently of the flow experience [61].

Others still, consider flow and enjoyment distinct concepts. The Game Experience Questionnaire (GEQ), for instance, defines enjoyment as a multi-dimensional construct, made up of challenge, competence, (minimal) frustration and positive affect, whereas flow constitutes part of the involvement construct, which also includes immersion and (lack of) boredom [29]. In contrast, Jennett et al. [39] define immersion as the key component of good game experiences. However, in one experiment involving a non-game task they found that high immersion could also be accompanied by anxiety and negative affect, which makes it difficult to infer whether the task was not enjoyable or whether participants simply felt tense due to the task's increasing challenge. In short, these inconsistent, often overlapping conceptualizations make it difficult to form a common definition of game enjoyment, which poses serious challenges to effectively measuring the construct, thereby hampering our understanding of PX [16, 58, 89].

METHOD

The aim of this paper is to clarify the concept of *game enjoyment*, in order to better understand how the construct may be operationalized and measured. To do so, we analyzed 87 quantitative studies measuring game enjoyment. The selection of the publications was done according to an adapted QUOROM procedure, which has previously been employed by Bargas-Avila and Hornbæk for their review on empirical studies in user experience research [5].

Data collection

Source selection. Relevant publications on PX are spread across multiple scientific journals and conferences, so we chose not to limit our search to a pre-defined set of venues, lest relevant sources be missed. Instead, the following

three publication databases were searched: ACM Digital Library (DL), ScienceDirect (ScD) and ISI Web of Knowledge (WoK). A time frame of five years (2008 to 2012) was set to restrict the search and because research on PX grew considerably in the last few years [89].

Search procedure. In all three databases, the terms *game* and *enjoyment* were combined to search all publications. Although many different terms, such as *liking*, *fun* or *preference*, are used synonymously for *enjoyment*, it has been argued that the aforementioned terms do not cover the exact same meaning [11, 57]. *Liking*, for instance, reflects reactions to the media message only, whereas enjoyment reflects reactions to both the media message and the media experience (i.e., the situation and context in which the media message was received) [57]. Similarly, Blythe and Hassenzahl [11] consider *fun* and *pleasure* two distinct forms of enjoyable experiences (i.e., enjoyment in terms of distraction or absorption respectively). We argue that games may provide both absorbing experiences and be played for distraction, and thus settled for the general term *enjoyment*. The search resulted in a total of 3'036 publications (DL=977, ScD=1'716, WoK=343).

Screening criteria. Four screening criteria were defined to narrow the entries: The papers had to be about (1) digital games and (2) more specifically, about entertainment games, that is, games, whose “only” intended purpose is to generate enjoyment [58, 77]. Enjoyment is without doubt crucial for games with specific purposes, such as serious games or exergames (e.g., [53]), but – for the sake of manageability, – they are beyond the scope of this review. Similarly, papers studying pervasive and augmented reality games were not taken into account, because it has been suggested that they differ from more “traditional” digital entertainment games in several dimensions and thereby require their own criteria for enjoyment [38]. Lastly, the publications included for analysis had to be (3) original full papers and (4) written in English.

Note that these categories are not mutually exclusive – as exclusion criteria the first obvious category was chosen. The screening was done in entirety by the first author. To control for interrater effects, an independent rater performed the same categorization using 20% of the entries. Interrater reliability was found to be Kappa = 0.928 ($p < .001$), 95% CI (0.788, 1.067). A Kappa value of .8 and higher is considered *almost perfect*.

Selection criteria for inclusion in the final analysis

As we were concerned with the conceptualization and subsequent operationalization of game enjoyment, it had to be measured in some form. For this reason, papers that did not contain quantitative empirical user data (e.g., theoretical papers) were excluded. Furthermore, only publications in which the authors explicitly mention that they measured enjoyment were included. Concepts such as *liking* or *fun* were only included, if the authors explicitly equated them with enjoyment (e.g., [76]). Exceptions were made if a study employed the GEQ [29] or based its questionnaire on the GameFlow model [77], as the original authors explicitly link these to game enjoyment. Lastly, only studies about the subjective experience

of enjoyment were considered for analysis, resulting in a final sample of 68 publications.

Again, the screening was done by the first author and an independent rater. The interrater reliability was found to be $Kappa = 0.873$ ($p < .001$), 95% CI (0.701, 1.045). Then, all papers were coded in terms of aim of the study, measures, results, measuring times, study designs, participants, game genre, duration of gameplay, and if provided, definition of enjoyment. Note that some papers contained two or more studies, each containing measures of enjoyment. In this case, we treated those experiments as individual studies. Thus, a total of 87 studies were included in the final analysis. A table containing the collected data for each study is available online at ACM Digital Library <http://dx.doi.org/10.1145/2556288.2557078>.

RESULTS

In the following, the results of the analysis of the 87 studies are reported. Due to the current lack of a common terminology for game enjoyment research, we structured the results section into general methodological observations, followed by a more in-depth look at the measures employed. Next, we summarize the current state of research on determinants of game enjoyment and compare how enjoyment has been operationalized in relation to other PX components.

General methodological observations

Purpose of the studies. The majority of studies analyzed specific determinants of game enjoyment ($n=49$). Seventeen studies were about the evaluation of a particular game and 15 studies developed or compared methods for assessing game enjoyment and/or the overall player experience. The remaining studies were concerned with other aspects of gaming, such as the impact of violence on aggressiveness (e.g., [4]).

Participants. In more than half of the studies ($n=44$), participants' mean age ranged between 20 and 29 years, whereas in 14 studies participants were 19 years or younger. There were only 3 studies, where the mean age lay above 40 years. Moreover, 7 studies provided only the range of participants' age and 19 studies did not state any information on participants' age. Most studies ($n=56$) featured students as participants. Regarding gender distribution, the majority of studies had more female than male participants, apart from 10 studies where only male participants were present.

Most studies ($n=52$) did not assess game expertise in any form. Twenty-three studies asked players about the frequency of game-play, 2 studies let participants rate their expertise and 10 studies used other methods (e.g., Fang et al. [27] assessed the number of years participants have been playing digital games).

Games and Genre. First-person shooter games were by far the most frequently studied genre ($n=22$), followed by racing ($n=13$) and sports games ($n=12$, including bowling, boxing, football and tennis games). These three genres represent more than a half of the entries ($n=47$). Twenty-four studies did not provide any explanation on why they chose a certain game title or genre for their study.

Study setting, gameplay duration and game metrics. The time participants spent playing a game ranged between 2 to 60 minutes, with a median of 10 minutes. Apart from the online surveys, only 3 studies investigated game enjoyment outside of the lab setting [56, 63, 66]. Out of the 87 studies, 26 looked at game metrics, that is, the quantified measures of in-game data (e.g., time spent playing, actions taken by the player).

Measuring point of enjoyment. More than half the studies ($n=46$) assessed enjoyment after participants interacted with the game. Twelve studies measured enjoyment in-between the different gaming sessions or experimental conditions and 8 studies measured enjoyment during game-play. Thirteen studies did not provide any information on the time of measurement.

Measurement of enjoyment

Techniques used to measure enjoyment. Overall, three groups of measures were identified: Subjective self-reports in the form of questionnaires ($n=82$), physiological measures ($n=11$) and other ($n=2$), which includes one study which let participants rank the games they played according to their preference [9] and another study that observed the amount of player behavior that expressed enjoyment [74]. We categorized the latter along with physiological measures as a more objective means to assess game enjoyment, seeing how participants have less direct control over their responses compared to self-reports [55, 60]. Most studies employed only subjective measures ($n=75$), 4 studies used only objective techniques, and 8 studies employed both subjective and objective measures to assess game enjoyment.

The most frequently used standardized questionnaires were the Intrinsic Motivation Inventory (IMI; $n=15$), the GEQ ($n=8$, including iGEQ) and the self-assessment manikin scale (SAM; $n=2$) [66, 82]. Several studies referenced and adapted other questionnaires (e.g., [20, 75]). Except the GEQ and the scale developed by Fang et al. [27], all questionnaires were uni-dimensional. Out of 82 studies that used questionnaires to assess game enjoyment, only 31 provided psychometric properties. As illustrated in Table 1, most studies ($n=29$) that investigated determinants of game enjoyment utilized self-developed questionnaires.

We also took account of the individual items used to measure game enjoyment. As seen in Table 2, *enjoy* was by far the most frequently used term. Strictly speaking, items measuring the subjective experience of enjoyment were the most common ($n=54$; e.g., "I enjoyed playing Madden very much" [73]), the remaining items measured the "enjoyability" of the game itself (e.g., "The game was enjoyable" [69]) or some individual aspect of it (e.g., "This interface made the game play more enjoyable" [19]).

There were some differences when comparing subjective and objective measures. Overall, facial electromyography (EMG) corresponded the most to subjective reports [18, 59, 66, 82], as game enjoyment was associated with an increase in activation of the zygomaticus major, orbicularis oculis and decrease in activation of the corrugator supercilii region. Other physiological measures, such as electrodermal activity, electrocar-

Table 1. Enjoyment measures employed by study purpose

				self-developed				
Purpose	IMI	GEQ	referenced other	single item	items unknown	all listed	partly listed	objective measures
Determinants of enjoyment	15	2	6	12	6	6	5	3
Game Evaluation	–	1	2	6	–	3	1	3
Method Validation	–	3	–	–	–	7	1	4
Other	1	2	6	6	1	3	–	2
Total	16	8	14	24	7	19	7	11

Note. Data do not sum up to 87 because some studies use more than one measure or serve more than one purpose.

Table 2. The 11 most frequent terms used to measure game enjoyment.

Term	Examples and sources	N
Enjoyable, Enjoying	"How much did you enjoy the game?" [30]	77
Fun	"Playing the game was fun" [81]	30
Interesting	"I thought playing Madden was interesting" [73]	17
Good	"I felt good" [18]	17
Future play intent	"Would you like to play the game again?" [39]	16
Boring	"I thought the game was boring" [67]	13
Happy	"I feel happy when playing this game" [27]	11
Frustrating	"I felt frustrated" [60]	10
Challenge	"I felt challenged" [29]	10
Entertaining	"This game was entertaining" [80]	9
Irritating	"I felt irritable" [71]	9

diography or electroencephalography were not as clearly related to game enjoyment, even though they correlated significantly with different dimensions of the GEQ [18, 24, 45, 60].

Determinants of game enjoyment

We grouped the factors that potentially predict game enjoyment broadly into game system, player and context variables, as suggested by Nacke and Drachen [58].

Game System. Challenge was the most frequently examined factor ($n=21$) and was found to be an important determinant of game enjoyment, although this effect was further determined by player skills [3, 41] and motives [76]. Game outcome yielded mixed results, as some studies showed that winning a game increased enjoyment [41, 65], whereas others did not [3, 48, 75]. However, winning only by a bit was experienced as particularly enjoyable [3, 65]. Intuitive control schemes facilitated feelings of being in-control and self-efficacy [48, 72, 81], which in turn also contributed to game enjoyment. This was further reflected in some of the evaluation studies, as players enjoyed interfaces that were easy to control and allowed for best performances the most [15, 42, 51].

Quick et al. [68] found that fantasy was an important determinant of game enjoyment, and several studies confirm this notion, as narrative [64], avatar resemblance [23], as well as identification with the avatar [44, 50] and other playable characters [22] all significantly contributed to enjoyable game experiences. Sound and music also enhanced enjoyment to a certain degree [17, 60].

Of the 12 studies that examined violence in games, most found that violent game content did not or only marginally enhance enjoyment (e.g., [6]). In fact, there was some evidence that players enjoy games less, when they contain violence against humans, as they cause moral distress [30]. However, players that were already familiar with a violent game

experienced less guilt and negative affect, as well as more enjoyment [34].

Player. Player types and motives were important determinants of game enjoyment [2, 21, 68, 76]. Similarly, personality traits, such as sensation seeking and self-forgetfulness were found to correlate positively with enjoyment of games [28]. Mental imagery capability had no influence on enjoyment [88]. Two studies found that game enjoyment of certain genres was dependent on the player's gender [48, 50].

Various psychological outcomes were also associated with enjoyable game experiences, such as feelings of being in-control, self-efficacy and need satisfaction [67, 79, 80]. Further, Downs and Sundar [23] found a strong positive correlation between winning, ego-enhancement and game enjoyment. Similarly, Reinecke et al. [69, 70] found that enjoyment was significantly related to mood repair and recovery experience, that is, allowing for the satisfaction of psychological needs that were previously thwarted. On the other hand, there were some indications that feelings of guilt are negatively correlated with enjoyment [34, 50].

Context. Context factors were rarely examined ($n=5$) and yielded mixed results. For instance, there was no clear indication that the co-presence of other players increases enjoyment (e.g., [35]). Lack of communication between players had little impact on enjoyment [9], as did location (i.e., playing at home vs. in a laboratory) [18].

Enjoyment in relation to other PX components

Twenty-four studies measured flow in some form (Abuhamdeh and Csikszentmihalyi never mention "flow" and refer to "optimal experience" instead [2, 3]), with varying definitions of how enjoyment and flow relate to each other. Some use the terms "flow" and "enjoyment" interchangeably (e.g., [40]), a notion which was further reflected by the activation of reward-related midbrain structures during flow experiences [43].

Others [21, 51] refer specifically to the GameFlow model of player enjoyment [77], whereas studies that rely on the GEQ argue that flow is a dimension of player involvement rather than enjoyment (e.g., [29]). Lastly, some state that the two constructs share similarities and that enjoyment results from the flow experience (e.g., [86]).

These inconsistent definitions stem largely from the different aspects of flow that the studies chose to focus on. Several studies associate flow with focused attention [40, 85] and the balance of skill and challenge [41, 43, 59]. However, Shim

et al. [76] found that the balance of skill and challenge – arguably a defining factor of flow – did only partially account for game enjoyment on its own. Rather, this was further dependent on players' motivations for game-play. In contrast, Limperos et al. [48] found that the experience of control – an aspect also associated with flow – was related to players' enjoyment, but not to other characteristics of flow.

Notably, several studies found a strong positive relation between presence and flow [40, 59, 87]. While presence seemed not to affect enjoyment directly [72, 86], Weibel et al. found that it increased enjoyment indirectly through flow. They concluded that being immersed in a virtual environment may facilitate cognitive involvement and subsequently, enable the experience of flow.

Similarly, Jennett et al. [39] consider immersion key to a good gaming experience, characterized by real world dissociation, as well as cognitive and emotional involvement. Unfortunately, although their measure of immersion also includes enjoyment as a subconstruct, they do not report how it relates to the aforementioned aspects. In contrast, Nacke and Lindley [59] offer an alternative definition of immersion in terms of the sensory experience that a game provides and found that immersive level design was associated with positive affect and feelings of competence, most likely due to providing a sense of spatial presence.

DISCUSSION

On the basis of the 87 studies reviewed, we compare the various operationalizations of game enjoyment and differentiate it from related constructs, in order to establish a working definition of the concept and consider its relevance for PX. Moreover, we discuss what implications our results have for future PX research.

Conceptualizing game enjoyment

As illustrated in Table 2, game enjoyment was frequently associated with fun and interest, as well as being the opposite of boredom, especially in studies that operationalized enjoyment as intrinsic motivation and hence employed the IMI (e.g., [67, 73]). This is in line with previous conceptualizations of enjoyment as a positive cognitive appraisal of media [57, 83]. Game enjoyment was also operationalized as positive affect, using both self-reports and biometrics (e.g., [66]). However, only Fang et al. [27] attempted to distinguish between affective and cognitive aspects of enjoyment. Notably, all studies that employed measures of frustration either assessed it as a separate dimension of game enjoyment, or acknowledged that it should not be considered the antipode of enjoyment [23], because even though many games provide moments of frustration, the overall experience may still be enjoyable.

Interestingly, game enjoyment was often associated with feelings of being in-control (e.g., [72]), competence (e.g., [41]) and improved mood after game-play, due to the satisfaction of psychological needs [70]. It has been stated that need satisfaction may in part explain how game enjoyment comes into being [67, 79]. In fact, several of the reviewed studies indicated that this aspect of enjoyment is more pronounced

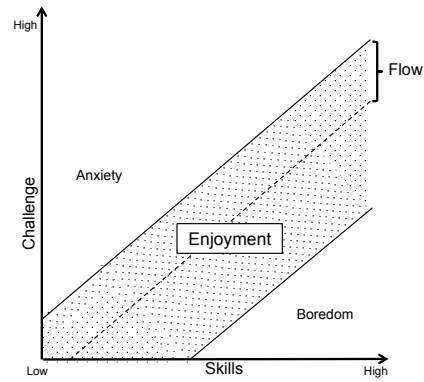


Figure 1. Flow results from the balance of game challenge and player skills. Less challenging gameplay may still be experienced as enjoyable.

for games than for non-interactive media [69, 70, 80]. Concurrently, game enjoyment was to certain degree negatively correlated with feelings of guilt [34, 50], and Gollwitzer and Melzer even operationalized it as the opposite of moral distress [30]. This was further reflected in some of the items used to measure enjoyment, such as in the instrument developed by Fang et al. [27] (“The activities in this game [...] are respectable”). It seems that – beyond ‘mere’ fun, – game enjoyment not only denotes a positive cognitive and affective appraisal of the gaming experience, but is in part also characterized by certain psychological outcomes, namely need satisfaction and the absence of guilt. This recalls the concept of serious fun proposed by Lazzaro [47], which suggests that players experience enjoyment when a game reflects their values (e.g., the absence of guilt) and positively affects their thoughts and feelings (e.g., through need satisfaction).

This raises some interesting research questions. For instance, whether it is more enjoyable if a game, albeit less challenging, provides ample opportunities for competence need satisfaction, or whether players experience more enjoyment when they achieve a rare moment of triumph in an extremely challenging game, and how this differs with regards to player motives. On the other hand, researchers may look into how games that were intentionally designed as non-enjoyable – such as *Torture Game 2*, which seeks to elicit disinterest by “allowing” players to commit atrocities [12], – induce guilt, and compare them to popular (i.e., enjoyable), albeit controversial games, such as *Grand Theft Auto V*, in order to clarify the relationship between need satisfaction, identification, guilt and enjoyment.

Relationship between enjoyment and other PX components

Presence did not impact game enjoyment directly, but facilitated flow experience, which itself gave rise to enjoyment [40, 86]. Arguably, game enjoyment shares many similarities with flow. But even though enjoyment is a crucial aspect of the flow experience [61], they still differ in specific ways: It seems that the experience of challenge, enjoyment and deep concentration are the main characteristics of flow (e.g., [43]), while other aspects, such as a sense of control, facilitate flow and make games more enjoyable, but do not trigger flow by

themselves [48]. Put differently, flow encompasses both enjoyment and involvement, triggered by the optimal balance of challenging gameplay and player skills [41], but players may experience enjoyment independently of flow [48, 76], if their skills exceed the challenges posed by the game [59, 61] (see Figure 1). Therefore, we conclude that limiting game enjoyment to the experience of flow would fail to account for the variety of enjoyable experiences that games may provide. Nevertheless, more empirical research is required to further probe under what circumstances game enjoyment and flow occur and whether the flow experience is characterized by particularly deep enjoyment.

This conceptualization of game enjoyment has some potential theoretical implications for PX research, namely that game enjoyment may be understood as the valence of the player experience. In contrast, the intensity of the player experience may perhaps be best represented by players' immersion, involvement or engagement, that is, the extent to which players' attention is held by gameplay challenges and the game environment (i.e., presence) [14, 39]. Put differently, the more immersive a game, the more intense the player experience, eventually culminating in cognitive absorption and time distortion. While it is beyond the scope of the present paper to establish a working definition of this concept, flow may thus be explained in terms of a very intense, yet positive experience (see Figure 2).

This framework supports previous conceptualizations of flow as effortless attention [16] and immersion as a graded experience [39]. However, more research is needed to empirically assess its validity. For instance, whether a non-intense gaming experience may be just as enjoyable as an intense one, and how the valence and the intensity of the player experience relate to each other. Moreover, in order to deepen our understanding of PX, it is necessary to consider how the intensity of the player experience can be operationalized and measured, how it is affected by challenge and presence and how this relates to need satisfaction, as well as to cognitive and affective aspects of game enjoyment. Unraveling this issue is especially relevant in light of the increasing realism of digital games, the upcoming resurgence of VR technology, such as the Oculus Rift, and for research on the negative effects of gaming [14].

Methodological challenges

Our review uncovered some methodological issues currently present in research on game enjoyment. Firstly, few studies employed standardized questionnaires, although validated and standardized questionnaires are easier to compare and may be taken with more confidence [36]. As illustrated in Table 1, many studies on the determinants of game enjoyment relied on self-developed scales, which makes it difficult to compare results and also adds to the problem of distinguishing the different components of PX. Additionally, many studies omitted item descriptions, as well as information on the reliability and validity of the scales. To facilitate interpretation of study results and advance PX research, future studies on game enjoyment would be well advised to provide as much information as possible on the measures used.

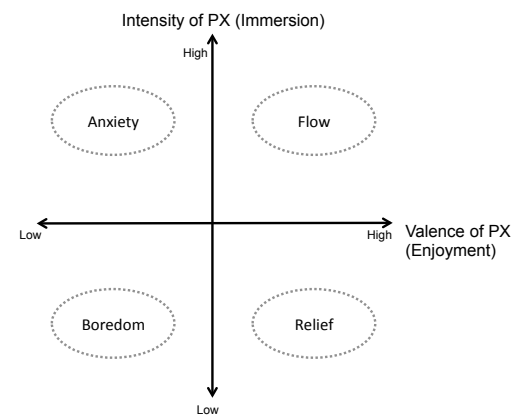


Figure 2. Valence and intensity of PX framework. Enjoyment describes the valence of the player experience, whereas immersion may denote its intensity.

Interestingly, physiological measures seem to be more common in the study of PX than in user experience research [5]. However, apart from EMG, physiological measures yielded mixed results with regards to game enjoyment. But due to the low number of studies, it would be foolhardy to dismiss physiological measures as not suitable, as they show a lot of promise, given that they allow the objective measure of player experience without interrupting the player-game interaction.

Next, the majority of studies recruited students between 20 and 29 years, although this represents only around a third of the gaming population [1]. And even though game expertise and familiarity has been found to affect enjoyment (e.g., [34]), most studies ($n=52$) did not take this into account. Notably, FPS games were the most frequently studied genre, even though they are mostly popular with the 21 - 29 year old male demographic [26], while other popular genres, such as casual or computer role-playing games [1] were underrepresented. To establish a more comprehensive understanding of game enjoyment, it would be beneficial to study a wide spectrum of game genres and player demographics.

Lastly, as of now, there is scant quantitative evidence on what characterizes long-term game enjoyment, as well as how players experience games before actually engaging with them [16, 58]. Seeing how some players are willing to invest hundreds of hours into a game, it would be interesting to study what aspects of the player, game system or context determine game enjoyment, how it changes over time and how this affects other components of PX.

Further research

Strikingly, although the importance of the context surrounding the player experience has been emphasized time and again [35, 58], only little attention has been paid to how contextual factors affect game enjoyment. Yet many players enjoy gaming with others [1], indicating that social aspects are indeed an important determinant of game enjoyment [47].

Moreover, Lazarro's 4 keys to fun model [47] associates many of the aforementioned determinants with particular

emotions, such as challenge and *fiero* (i.e., pride). Further research on how aspects of the game system, player and context elicit these emotions, and how this impacts overall game enjoyment, would benefit both game designers and PX researchers alike. Also, many recent games strive to provide more complex experiences than mere “fun”. Seeing how previous research on non-interactive media showed that sad or frightening media content is often experienced as enjoyable [57], future studies should look into games that, for instance, inspire negative affective experiences, such as when the plot of a game demands for the death of a character, in order to study how these affect players’ overall experience of enjoyment, whether they impact the cognitive and affective aspects of enjoyment differently, and how they relate to need satisfaction and player values.

Finally, it has been argued that enjoyment may facilitate media effects such as learning, aggressiveness or behavior change [57]. Not only is more research necessary to examine how game enjoyment and the intensity of the player experience are linked to negative effects, such as aggressiveness or addiction [14], but in light of the steadily increasing interest in games as a medium for expressing ideas, teaching and behavior change [12, 53], it would be especially valuable to study in what ways game enjoyment is related to these beneficial outcomes of game-play.

Limitations of the present paper

The present paper features several shortcomings. First, while our review procedure attempted to cover the gamut of quantitative studies on game enjoyment, we might have missed out on relevant studies that studied enjoyment under another term (e.g., fun). Secondly, we solely focused on studies that employed quantitative measures. For a more comprehensive understanding of enjoyable game experiences, it is necessary to also consider qualitative studies – which may in turn inform the development of quantitative measures [16], – and multi-method approaches [16], such as the biometric user studies conducted by Mirza-Babaei et al. [55]. Also, we only included studies examining “traditional” entertainment games. More research is required to find out whether the present findings may be extended to serious games and pervasive games. Thirdly, due to the nature of the review, we discussed a wide array of studies, but as a consequence, discussed individual studies only briefly. Finally, although our conclusions were founded on substantial amounts of empirical data, they in turn await empirical scrutiny.

CONCLUSION

This paper sought to investigate the concept of game enjoyment and its various operationalizations and measures. Based on the review of 87 recent quantitative studies, we found that game enjoyment is commonly understood as the positive cognitive and affective appraisal of the game experience, and is in part associated with need satisfaction and the absence of guilt. Moreover, we provide a clearer outline of how enjoyment, flow, immersion and presence differ and interrelate, and suggest that the player experience may be studied in terms of its valence, that is, how enjoyable it is. Correspondingly, we discuss the strengths and shortcomings of both objective and

subjective means by which the extent of game enjoyment can be measured. More research is needed to tackle the challenge of further disentangling the different psychological components of PX, especially immersion, and elaborating upon how other relevant components, such as need satisfaction and affect relate to game enjoyment and the overall player experience.

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* Denotes a reference among the reviewed studies.