

# Understanding Fun

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## ABSTRACT

Fun is a fundamental aspect of life, because it motivates interaction and learning. However, it is a difficult subject to define, particularly because it is subjective and related to emotions. This paper presents a review of fun in an attempt to provide a general understanding on the subject and potentially help designers to create better products.

## Author Keywords

fun; interaction; attention; flow; curiosity; challenge; fantasy; immersion; emotions

## ACM Classification Keywords

A.1 Introductory and Survey; K.8.0. Personal Computing: Games

## INTRODUCTION

Games are definitely among the biggest human interests, as it can be verified by the many archaeological evidences showing that games have been played throughout humankind's history. Boards, pieces, dice and artwork references (like the wall painting shown in figure 1), found in Europe, Africa and Western Asia, testify that games were certainly played during Ancient History (circa 2500 BC) [1] and most probably already played during Neolithic Age (circa 5000 BC) [46]. And in a matter of fact, games are still very appealing. Video games are undoubtedly one of the most important forms of modern entertainment, composing the industry with the biggest growth of the decade [18] and currently positioned between the two other most consumed entertainment segments (of music and films) [44].

All that interest in playing games comes from very natural needs. Ancient games had in their pieces and rules symbolism of religious, war or agricultural nature, which were all important subjects for early civilizations. Notable examples include the Egyptian racing game Senet, which meant "passing" and simulated the stratagems of gods at the passage to afterlife [42]; the Indian strategy game Chaturanga, a precursor of modern Chess that simulated the actions of war

by means of different movement, sacrifice and promotion of pieces [1]; and the family of games generally called Mancala, which have been played in many regions and simulated sowing by means of counting and collecting seeds in hollows scooped into the earth [2]. So, in a sense, the motivation for playing such games is due to *innate impulses* that help people to experience and exercise real life preoccupations such as survival, competition, counting and social organization [31], albeit in a safer and playful environment. Those impulses are so basic that other animals also play, despite the absence of any cultural framing [25].



Figure 1: Wall painting from the grave chamber of Egyptian queen Nefertari depicting her playing Senet in the afterlife (1295-1255 BC) – licensed under public domain via Wikimedia Commons ([http://commons.wikimedia.org/wiki/File:Malerei\\_der\\_Grabkammer\\_der\\_Nefertari\\_003.jpg](http://commons.wikimedia.org/wiki/File:Malerei_der_Grabkammer_der_Nefertari_003.jpg))

Modern humans no longer have to worry much about hunting, sowing or surviving predators, and yet are still very interested in playing games that portray these activities just for the enjoyment obtained in doing so. This means that people play games just because they are fun. Indeed, games are just the most straightforward example of an activity in which fun is a requirement, but fun is arguably a strong motivator for humans to perform any kind of activity. No matter how important a task is from an utilitarian point of view, its achievement will always be much more difficult if it is perceived as boring. Further more, the mechanism by which humans experience enjoyment depends upon consciously focusing a limited attention [12] and hence conducts what humans are able to perceive and learn from the world they live in [32]. Therefore, fun is as important for subsistence as the fulfilment of

basic needs such as food and shelter, making it a fundamental aspect of life.

That is why designers are increasingly trying to imbue their products with fun features. The satisfaction by interacting with a product, which used to be searched by interaction designers and Human-Computer Interaction (HCI) researchers just in terms of utility and absence of physical and cognitive discomfort, now includes other non-utilitarian aspects of the *user experience* related to appeal, preferences and emotions [19, 23, 6] – all aspects of fun [10]. Also, the deployment technologies currently available (like on-line mobile markets, for instance) make very easy to have access to many functionally similar products, particularly software systems. In cases like that, in which users have several options to choose from, the use is discretionary or involves sustained activity, easy of use and simplicity is just not enough and designers must stimulate users *to want to use* their products by making the experience more fun [9].

However, even though humans are able to intuitively understand what fun is and easily differentiate when an activity is fun or not, the subject is hard to concisely define in a few words. If it is intended to design products that are fun, a proper understanding is necessary. In order to help with that, this paper offers a review on the subject initiating from an interaction point of view, followed by studies of intrinsic motivation, immersion and emotions. The study is mainly guided by the research interests of the authors related to video games, but a general use regarding product design was also intended in the preparation of the material.

## A BROAD VIEW OF FUN

### Interaction and Attention

When humans have fun there is usually some form of activity involved, like doing sports or playing with toys and games. Playing is definitely the sort of activity that is most easily related to fun, specially in the case of games. After all, games are supposed to be fun, otherwise people will simply not want to play them [49]. Games are systems with rules that offer possibilities of action by which people attempt to control an outcome [20]. This means that playing a game is done through some *interface*, which in the case of video games (games played with the aid of computers) is clearly composed of control devices, speakers and graphical displays [8]. So *being active* is perhaps the most straightforward way of having fun. However, one might have fun by just watching others playing, that is without having any direct influence in the activity outcome. Nevertheless, the experience is still due to the *perception* of the outcome obtained from others. It then seems only natural to assume that whenever someone is having fun, the experience can only happen because a person is somehow *interacting* with a task, an object or with other people.

Interaction is a phenomenon of mutual or reciprocal influence that happens when two or more entities communicate with or react to each other [51]. In the domains of Product Design and Human-Computer Interaction (HCI), which are specifically concerned with the interactions of humans and man-

made objects, this mutual influence is seen as being structured in the general form of a feedback loop: a person with goals acts in the environment to achieve them (i.e. provides inputs for a “system”, which may be an object or a person with her own goals), measures the effects of her actions (i.e. interprets feedback outputs from the system to whom she interacts with) and then compares the results with goals, restarting the cycle if judging necessary [17]. Humans, as well as other animals, are frequently interacting with objects and with each other, and this behaviour is important because the world is a very large, dynamic and stochastic environment in which identical situations are rare. This condition forces intelligent beings to have to constantly deal with uncertainty and makes the ability of perceiving, reasoning and acting upon changes very important for an effective subsistence [50].

The dynamics of interaction foster the emergence of relational properties that are primal to how humans experience the world. At the level of object interaction, humans rely on perceived physical or cognitive cues of possibilities of action, called *affordances*, in order to know how objects can possibly be used [39]. With the help of the data perceived from such sensory cues, humans also build conceptual models from existing knowledge of previous similar interactions and also consider physical or logical constraints and social or cultural conventions that may respectively limit or suggest approaches of use in current context [38, 39]. At the level of human interaction, people usually share a common environment either in the real world or in the context of product usage (the fantasy world in a video game, for instance). As agents coexisting and working for individual goals, they *always* affect each other’s results in either a positive, negative or neutral way, even if they do not acknowledge each other or each other’s goals [21]. When the acknowledgement of this *social interference* happens, that is, when the agents get to perceive each other’s goals by means of verbal or non-verbal communication and to act upon reasoning on that knowledge, many complex group behaviours arise, like competition, co-operation and coordination, among others [17, 21].

The way evolution found to fine tune this perception-action mechanism is by making such relational properties very appealing to the nervous system, particularly when novelty is involved. All the information about what is happening outside and inside the organism is represented in the consciousness so it can be evaluated and acted upon by the body [12]. This content is kept in order by intentions – other bits of information derived from biological needs or internalized social goals – which drive *attention* towards or away from the received stimuli [12]. But the capacity of information processing inside consciousness is very limited<sup>1</sup> [12], hence any patterns recognized in the sensed data focused by attention are broken into “chunks” of information so they can be hereafter used without the need of much reasoning by the autonomous nervous system [12].

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<sup>1</sup> estimations indicate that a person can only process at most 126 bits of information per second, equivalent to paying attention to a theoretical maximum of three conversations simultaneously if everything else is kept away from consciousness

Because of this way in which the nervous system works, the human brain actively avoids chaos and is constantly trying to understand the patterns it encounters. That is most likely why artefacts and situations like games and toys are commonly very *interesting*. They are abstractions of the real world in the form of a symbolic system with rules and signs that work like patterns triggering this need of understanding when presenting themselves as something different that requires new “chunking” (i.e. the solving of patterns sensed and their transformation into learnt chunks of knowledge) [12, 27]. Once the game patterns are known, they become predictable and are no longer as interesting as before.

Still, in order for any new piece of information to be interesting it must have some similarity to existing knowledge. Sensory data that is always unchanged quickly leads to predictability, but noise that conveys a lot of information (in the sense of Information Theory) causes total incomprehension [48]. In the former case, the processing of information no longer happens in the conscious part of the brain, becoming just a repetitive task that does not require attention at all. In the latter case, the amount of information rapidly overloads the consciousness capacities, the brain is no longer able to construct proper conceptual models about the subject of attention, and the information ends up causing confusion and making more difficult the decision on how to act. Therefore, in both scenarios the information is not interesting, but simply boring and undesirable [48]. Both situations are actively avoided, and hence the attention mechanism helps in filtering what is worthwhile putting effort into.

As consequence, attention is a very singular capacity of the human brain that has much to do with how humans experience fun.

### Challenges and Skills

In a very seminal work resulting of decades of interviews and analysis of how people from different cultures, socio-economic conditions, gender, age and jobs experienced their lives, Csikszentmihalyi [12] formulated a theory denominated *Flow* that explains enjoyment as being the consequence of the proper balancing between challenges and skills that is achieved by people when they are able to focus their complete attention on a given task.

By focusing attention, a person basically retrieves bits of information from memory, evaluates those bits in consciousness and then chooses the right things to do. People who can focus attention at will – something that requires cognitive effort in a way that it can be understood as the spending of *psychic energy* – are known to fully live their lives and thus enjoy it more often. The reason is that as humans interact with the world they maintain an image of themselves – called the *self* – which is a sum of all memories, actions, desires, pleasures and pains experienced so far. The self is a product of attention because only things considered relevant in past experiences are worthwhile internalizing, but it also helps driving attention in future interactions because it also contains mental representations of the entire structure of an individual’s goals and their relative importance. In that sense,

the self subsumes personal preferences and attitudinal tendencies, and in fact personality traits like extrovert, high achiever or paranoid can be described by how each person preferably allocates her limited attention.

The cyclic dependence between attention, self and an individual’s goals is connected to the quality of life. Whenever internal or external information sensed from experiences threatens one’s goals, it disrupts conscious order and thus cause a *psychic entropy*: depending on how important are the goals and how severe are the threats, some amount of attention has to be dedicated to deal with the danger, leaving less space for other matters. If experiences that cause psychic entropy are frequent, the constant disruptions of conscious order may even weaken the self and make more difficult future investments of attention on goals. The opposite condition of the psychic entropy is called the *optimal experience* (or *Flow*), and is the moment when enjoyment is felt in its biggest magnitude with people describing themselves as being “in the flow”.

That improvement on the self is what imposes important distinctions between what are pleasure and enjoyment. Pleasure is a feeling of contentment achieved when psychic entropy caused by biological or social issues is reduced through the sensing of information, like the taste of food when hungry or the sight of a beautiful (or very private) beach. Experiences involving sleeping, resting, feeding and having sex can bring pleasure and are important to the quality of life, but they do not add complexity to the self by their own. Enjoyment, on the other hand, is related to life events that occur when a person has not only met prior expectations or satisfied a need or desire, but also exceeded those expectations most probably in an unique way.

Challenges are the elements in an activity that support the improvement of the self. They are simply “opportunities for action” that require appropriate skills to be realized. Just like the activities and the skills themselves, the challenges do not need to be physical and can be simply mental representations of actions. Even though people can experience extreme joy for apparent no reason, it is far more common that those experiences happen in a context involving goal-directed activities bounded by rules, thus requiring the deliberate investment of psychic energy. Csikszentmihalyi divided the characteristics of enjoyable activities into eight components (or requirements), stating that they all contribute to enjoyment [12, 37]:

- **Challenges and Skills.** A goal-oriented task that is difficult but achievable and that requires skills to be performed.
- **Ability of total concentration.** The complete absorption of a person’s attention on the information provided just by the task in hand.
- **Merging of action and awareness.** Actions that become spontaneous and automated, feeling effortless despite the amount of concentration required.
- **Clear goals.** Indications on what is possible to be achieved and what are the benefits of success.
- **Immediate feedback.** Constant indications on the success and failures of actions and the distance from goals.

- **Sense of control.** Opportunities for perceiving that choices matter in achieving goals and that self-development is happening.
- **Loss of self-consciousness.** Temporary loss of consciousness of one's own self followed by a strong sense of self-development.
- **Alteration in time-perception.** Reduced perception of time duration.

In essence, enjoyable experiences usually have challenges that never overmatch or underutilize one's skills, meaning that people in the Flow are constantly *in a state in which the perceived action capacities match the perceived action opportunities* [37]. But it is not just that: the challenges and skills must be above the individual's average level, otherwise apathy is experienced. Also, if just one level is smaller than the other the result is yet not a positive experience: high challenge with lower skills quickly turns into worry and anxiety, and low challenge with higher skills may quickly turn into relaxation and boredom. Good experiences keep the levels of challenge and skill constantly above the individual's average, as a person improves herself in the performed activity and searches for more challenging goals [12]. That is, the challenge-skill state keeps changing from control (high challenges with higher skills) to arousal (high skills with higher challenges) and back to control again [37]. The figure 2 represents graphically the possible Flow states considering the levels of challenge and skills respectively in the vertical and horizontal axes.

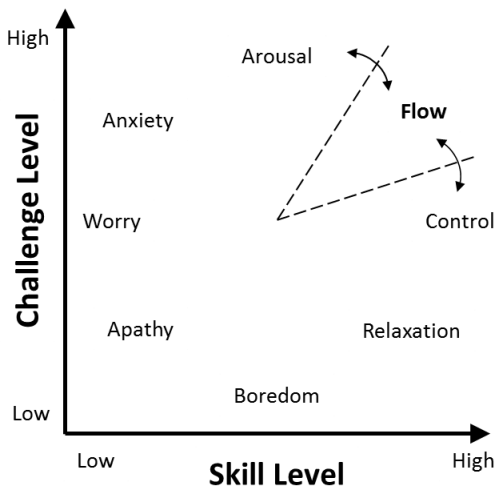


Figure 2: Current model of the Flow state. Based on [37].

Video games are good in keeping people in the Flow not so much by automatically adjusting the difficulty of challenges, but also by offering information on progress. Via the correct amount of feedback (neither too much nor too few, so to avoid frustration) a player is either rewarded for mastering challenges or presented with enough information on what and how she failed them, thus being able to try again and having more chances to improve skills [29].

### *Pleasure, Enjoyment and Fun*

At this point it is worth noticing that pleasure, enjoyment and fun are all terms somehow confusing, and commonly used interchangeably<sup>2</sup>. Nevertheless, it is quite obvious that not all pleasurable or enjoyable activities or situations are fun [15].

The Flow theory seems to handle enjoyment and fun as similar subjects, and clearly differentiate them from pleasure. In his book, Csikszentmihalyi provides a comparison example involving food, stating that everybody has pleasure in eating, but a gourmet enjoys doing it in a different and more complex way by paying attention and investing psychic energy to the various sensations received. The gourmet's intentions when eating are not just satisfying biological needs, but to discover novel flavours and interesting ingredient combinations. Also, to become fit to the culinary challenges, she needs to have her palate and nose trained. As consequence, she imposes herself some goals and tries to reach them by exploring different possibilities of interaction, so when the goals are satisfied the gourmet surely feels enjoyment *beyond the physical pleasure*. Therefore, enjoyable and fun experiences have in their contexts goals and challenges to overcome, and the intensity of the feeling depends upon the concentration put into the interaction.

Blythe and Hassenzähl [3] offer a slightly distinct view, defining both fun and pleasure as different but equally important aspects of enjoyment. According to the authors, fun is fleeting, trivial and more intense, composed of micro-flows and not as related to the improvement of self as the other. Pleasure, on the other hand, requires a deeper commitment with the activity, it is not as short-lived and may even not be spontaneous. Consequently, it is a deeper form of enjoyment. So, for the authors, fun is about distracting people from real life worries, and pleasure is about absorbing the individual and making a connection between product and person. Indeed, as this text progresses, it will be seen that fun is not only about overcoming challenges, as the optimal experience of Flow indicates.

### **Intrinsic Motivation**

Activities that produce challenging experiences are so gratifying that people are willing to do them for their own sake, no matter if they are difficult or dangerous [12]. But even activities that are goal-driven like video games do not rely only on challenges to produce fun as rewards. There are other relevant aspects that are due to the human natural desire to learn, and that help in making activities intrinsically motivated.

The mechanism of attention previously discussed involves the continuous searching for unknown patterns to decipher, and that simply means being eager to learn new things. The very notion of an active behaviour driven by pleasure from learning has also been studied as *curiosity*, though with two slightly different views [30]: a desire to know, to see or to

<sup>2</sup>a query to the Cambridge on-line dictionary (<http://dictionary.cambridge.org/>) gives: *pleasure* as "enjoyment, happiness or satisfaction", *enjoyment* as "the feeling of enjoying something" and *fun* as "pleasure, enjoyment or entertainment"

experience that motivates exploratory behaviour directed towards the acquisition of new information, or the rewarding that is obtained from the dispel of undesirable states of ignorance or uncertainty.

In other words, acquiring new information after having the senses aroused (i.e. being previously interested at something and having attention focused on it) does not seem to be the only way of getting pleasure from learning. Organisms will actively search for things that are “yet unexplained but easily learnable” even in the absence of novel or complex stimuli [30, 48]. This means that fun probably is as much about avoiding boredom as it is about maximizing internal joy, even if by overcoming challenges.

That *exploratory behaviour* is intrinsically motivated because the rewards obtained are not obvious or externally visible things like money, food or social reinforcement, but instead are a positive affect produced by performing an activity just for the sake of doing it [32, 48]. In another seminal work, Malone [32] separated the characteristics of intrinsically motivated learning activities into three major categories, named *curiosity*, *challenge* and *fantasy*. The author based his work in the Flow theory and also in Piaget’s theory of cognitive development, believing that “people are driven by a will to mastery (challenge) and to seek optimally informative environments (curiosity), which they assimilate, in part, using schemas from other contexts (fantasy)”.

According to the author, curiosity is an important motivator for learning *disregarding the fulfilment of any conscious goals or fantasies*. It only depends upon an environment with the *right level of informational complexity*, meaning that the sensed data is novel and surprising, yet not completely incomprehensible. The best environments for arousing curiosity will be the ones in which the learner has enough knowledge in order to have *expectations* about what will happen, and *sometimes* those expectations are not met. That partially explains why following narratives (in films or books, for instance) – an experience in which a person takes no particular action towards the achievement of goals – can be described many times as fun beyond the mere experience of physical or cognitive pleasure.

Challenge, on the other hand, is strongly related to the existence of goals, as described by the Flow theory. In learning environments such as games, goals directly represent the means to achieve some intended results and, in consequence, the skills necessary for doing so [32]. As consequence, goals are mostly interesting when their attainment is *uncertain*. Goals that are either certain to be achieved or definitely impossible are just not worthwhile to be attempted, but when there is some degree of uncertainty and a goal is achieved, this accomplishment is good to self-esteem, makes people feel better about themselves and helps them to learn about their own abilities [33].

Fantasy is about “mental images of things not present to the senses or within the actual experience of the person involved” [32]. Even though modern computer games can provide digital representations of fantastic beings and scenarios, the idea

is that fantasy is something just represented inside the mind of a person immersed into such a learning environment – i.e. the make-believing mentioned by Piaget as central for the development of the symbolic representation skills in children [32]. In that sense, fantasy includes representations of physical objects, people and social situations, either completely possible or impossible [33], that help accommodating to an external reality, passively repeat past experiences to achieve emotional mastery or fulfil unconscious wishes and maintain optimal levels of mental arousal [32].

### Immersion and Engagement

The observation that fun is not just about challenges and the achievement of goals is specially clear regarding playful activities. The Categories of Play suggested by Caillois [7] already described free-form (*paida*) activities that do not have clear goals (Vertigo play or *ilinx*) or to which fantasy has stronger relevance (Make-believe play or *mimicry*) and yet are commonly experienced as fun.

It turns out that the differences in playful activities occur according to the level of interactivity involved [20, 14, 22], making possible to also classify them in the manners illustrated in figure 3. Fantasy and curiosity are very basic characteristics of all forms of play, and the need of challenge starts to appear as there are more possibilities of interaction, specially from object-level to human-level interactions. Stories and narratives like the ones in books and films involve fantasy play, but can not be changed or manipulated by the person engaged in interaction<sup>3</sup>. Toys also have fantasy but can be manipulated, although without any fixed goal. Puzzles are rule-based systems with fantasy and that can be manipulated, however they have a goal of finding a solution, and so the feedback information starts to become much more relevant. Finally, games include all previous elements with the difference that they have the goal of winning, that is overcoming challenges proposed by the game itself or by other human players (mostly from competition). Indeed, modern researchers also consider an additional axis (the Whole-Parts) in this classification to differentiate whole products (like toys and games) from enjoyable activities composed of several elements (or parts) of game or playful design (like outdoor activities, interactive art installations and gamified<sup>4</sup> tasks) [14, 22], so any enjoyable experience can be understood and discussed in those forms.

This means that enjoyable activities certainly are more than just overcoming challenges and achieving internal goals, because they are also about the freedom of choice and the provision of opportunities to use imagination, fantasy, inspiration and social skills in a free form [20]. Due to this view, fun has also been studied from other concepts, the most notable one being Immersion.

Immersion is believed to be a “very important experience of interaction” [5] and as something critical to the enjoyment of

<sup>3</sup>even though the figure says “no interaction”, there are still the perceptions of text and images by the person following the story, as well as the cognitive effort in focusing attention

<sup>4</sup>gamefication is a very trendy word meaning the use of game design elements in non-game contexts

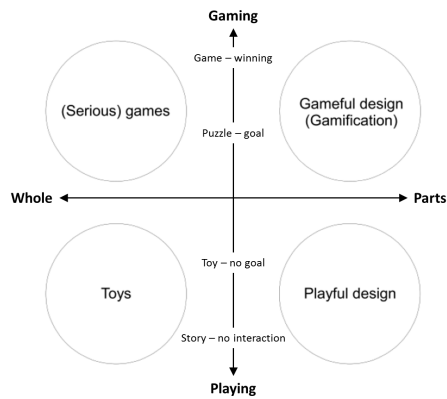


Figure 3: Types of playing and gaming. Based on [20] and [22].

playful activities like video games [26]. It is considered to be similar to the concept of Flow regarding the reduction of self-awareness and the distortion in the time perception, and yet as something different [26]. In essence, Immersion describes the feeling of being totally involved by the environment of an interactive system (like video games, interactive narratives and virtual reality environments), sometimes reaching the extreme of being completely transported into a different world and profoundly related to constructional elements like characters and their stories.

In the context of interactive drama, Immersion has been described as being the result of the use of schemas in the interpretation of content [16]. Schema theory is a recurrent topic in the analysis of narratives, as it describes how the perceptions and actions shape expectations and interactions through schemas: data structures representing generic concepts and knowledge that allow humans to understand the world and eventually act upon it [16]. So, in sum, schemas are conceptual models built from previous interactions and that are part of the self.

So Immersion is a state in which a person is completely absorbed in trying to fit the fantasy and narrative into a single known schema, with pleasure deriving from the recognition of that long-familiar pattern infused with unique or unpredictable elements [16]. That would be the reason why mystery books and horror films are continually appealing even though they usually present minor variations on the basic genre structure. Additional to that, when a narrative content subverts a single schema but still provides familiar alternatives, its audience can work out the conflicts from multiple known schemas and a state of Engagement can be achieved [16]. This state requires much more attention and cognitive effort since its comprehension involves “decision-making, superb eye-coordination, the ability to read character’s intentions and predict their actions” [16]. The pleasure obtained when in this state comes from the feeling of having the skills to solve an unusual and difficult plot, hence this is an immersive state much closer to what Flow describes: the absorption is much bigger to the point of causing the sensation of being a decision-maker or even a co-author.

In the context of video games, Immersion has also been defined from the structured analysis of data collected from interviews with players (grounded theory), resulting in a similar view but focused on the fact that the sense of involvement increases with time as people interact with a game, and also as *barriers* are removed [5]. Barriers are difficulties to immersion from both the human and the system perspectives, like the amount of concentration and the system’s construction elements, which need to be removed or resolved in order to *facilitate* the enjoyment in an experience – *but not to guarantee it* [5]. In playful activities like video games, there are three levels of involvement that may be achieved as the interaction unfolds [5]:

- **Engagement.** The first level of immersion, in which a person starts doing a playful activity and thus spending time with it. Curiosity and fantasy are much more relevant than challenge, since appeal is the first barrier that needs to be broke.
- **Engrossment.** The second level of immersion, in which a person becomes more involved with the interaction due to the structural elements of fantasy and challenge. It is what paves the path for the optimal experience of Flow to happen, since attention is almost completely consumed and only the task in execution seems to matter.
- **Total Immersion (or Presence).** The final state of total involvement, in which “a person’s cognitive and perceptual systems are tricked into believing they are somewhere other than their physical location” [5], due to total absorption. It is thus more directly related to the optimal experience of Flow.

Besides having a strong temporal characteristic, Immersion is also a multidimensional phenomenon because people experience it in different manners according to their own preferences and moods, to the characteristics of the games played and to information external to a particular interaction, like peer influence, game reviews and other sociocultural references [34].

Due to its proximity with the concept of Flow, there are still many arguments about what Immersion is and how it can be defined. But many researchers share the belief that Immersion (at least in the two initial levels before Total Immersion mentioned above) provides a sub-optimal experience that does not guarantee enjoyment *but is still valuable*. Immersion differs from Flow in the sense that the former is required so the latter can be ever achieved as an *extreme experience* [16, 5, 26, 36, 8, 34].

### Emotions

From all that has been discussed so far, an important observation is that fun is a subjective matter. A big part of its subjectivity is due to the fact that things like immersion and fantasy depend upon past experiences, preferences and current mood, and that challenges and goals have distinct appeal to people with different abilities and skill levels. But the subjectivity of fun is also due to its strong relation to human emotions. Emotions are an essential part of entertainment. Classic sports and

games have win-lose states that elicit strong emotional and ego-gratification responses, and this is also a big reason for their attraction [29].

The study of human emotions is very old, and still today there are different points of view regarding their origin and function. The major theoretical perspectives that inspired contemporary researchers can be classified in four branches [11]: the Darwinian, the Jamesian, the Cognitive, and the Social Constructivist. The Darwinian perspective is derived from the work of Charles Darwin, in which emotions are believed to be the expressions of important *communicative and survival functions* that have evolved in humans and other animals as the species suffered natural selection. The Jamesian perspective is associated with the work of William James, in which emotions are believed to be not just external expressions of internal functions, but mainly the result of *perceived* bodily responses to the environment that regulate action tendencies. The Cognitive perspective has origins in the Hellenistic philosophy in which the central assumption is that thought and emotion are inseparable because emotions, as well as the physiological responses, are the result of the conscious judgement (appraisal) of internal or external events as bad or good. Finally, the Social Constructivist perspective was originated from works on anthropology and sociology that started being applied to psychology in the early 1980's. Differing from the other branches regarding the primary biological origin, the Social Constructivist perspective understands that emotions are the product of culture and hence emerge from the appraisal of social content to serve particular purposes established by cultural rules.

The Cognitive perspective is nowadays the most dominant among the four, being commonly referred to as Appraisal Theory and including under its umbrella successful attempts of integrating aspects from the Darwinian and Jamesian perspectives [11]. In the past, emotions were considered to be obstacles to good decisions because emotional behaviour was seen just as the opposite of rational thought. But experiences and emotions are inseparable, because interaction has many affective consequences [35, 24]. The human perceptions produce "singular coloured versions of the world as opposed to objective data", and as consequence actions are not just driven by utility but also by values, needs, desires and non pragmatic goals that are unique to each situation [35]. Therefore, it is now largely accepted that emotions occur on many levels of the body and have an important role altogether with reason in influencing behaviour [41, 43, 47, 13].

According to the Appraisal Theory, emotions in humans are episodes of interrelated, synchronized changes in the states of all or most of the five organismic subsystems in response to the conscious evaluation (appraisal) of external or internal stimuli as relevant to major concerns of the organism [47].

The limbic system (including the thalamus and amygdala) is the brain structure centring memory, attention and emotions, since all external and internal sensory information pass through it *before and after* conscious analyses in the cortex [41]. However, this is not the only part of the brain involved in the experience of emotions. Many studies with patients that

suffered damages in their cortex frontal-lobe indicate that the inability to feel emotions impairs the ability to make decisions, and this is a strong evidence that emotions are just as important to the subsistence as it is rationality [13].

There are two basic ways (or "roads") by which emotions are handled in the Central Nervous System: primary and secondary. The primary emotions are understood from the Darwinian and Jamesian perspectives. They can be seen as both innate and acquired behavioural dispositions [13]. Innate dispositions are simply "hard-wired" unconscious responses to general perceptions that are a product of evolution. They can be adapted when the emotional estate caused by an experience is also unconsciously acknowledged (or "felt"), allowing the formation (acquisition) of new autonomous dispositions for specific objects or situations – what is commonly referred to as having "sentiments" towards things [4, 13]. Primary emotions, both innate and acquired, are completely handled by the limbic system (the "low road") and control visible and non-visible changes in the whole body, like involuntary facial, gestural and vocal expressions, and visceral, muscular, skeletal and glandular alterations [13]. Since they are primitive and unconsciously triggered, they produce very quick responses that help humans and other animals to rapidly detect and act upon the presence of suitable mate or eminent danger, for instance [13]. The bodily changes that accompany primary emotions serve to allow communication of intentions (posture, vocal and facial displays, very important for social interaction) and to prepare the body for action [47, 13].

The secondary emotions are understood from the Cognitive perspective. They can be seen as the result of conscious evaluations (appraisals) of objects, people and situations, as well as the internal emotional state of the body, which occur at the brain cortex (the "high road") [47, 13]. This reflective ability is mainly a human characteristic, because in this case the whole process *starts* from the deliberated consideration of a current situation and the possible consequences of actions in order to form mental representations of an experience. This higher level process is what allows, for instance, the elicitation of strong emotions in humans without any real external perceptions, that is, from just the remembrance of especial people or situations from the past. After this conscious deliberation, the cortex unconsciously reacts to the cognitive representation of the experience by producing involuntary and automatic bodily responses and eliciting and reinforcing the acquired dispositions and *feelings* [13]. Feelings are subjective experience components of emotions that reflect the cognitive patterns of appraisal as well as the motivation and somatic responses that underline emotional experiences [47].

The inducement and perception of the bodily changes relevant to the secondary emotions are expressed through the same neural structures of the primary emotions, that is the limbic system [13], and that is why both emotion roads "feel the same". Nevertheless, emotions are more complex in humans because the way the two roads interact. Norman [40] presented this view as a hierarchy of levels, renaming the innate and acquired primary emotions respectively as Visceral and Behavioural levels and the secondary emotions as Re-

flective level. The Visceral level is the most basic one, totally primitive and reactive, straightly related to the expression of bodily changes. It is triggered by internal and external perceptions, but can be *inhibited* by the Behavioural level from unconscious automated behaviours learnt from past experiences. And, by its turn, this second level can also be further *inhibited* by the Reflective level due to conscious considerations done by the person experiencing the emotion. Most importantly, information from the top most level is transmitted down to the other levels in this same hierarchy, so new behaviour dispositions can be acquired by skill training and one can intentionally control physical and mental bodily changes.

The emotional aspects of fun happen in all Visceral, Behavioural and Reflective levels, consistently with the previous studied components of intrinsic motivated activities [40]. The emotions experienced in the Visceral level are directly connected to sensory perception and arousal, hence being about physical pleasure obtained from the satisfaction of basic needs. The emotions experienced in the Behavioural level are connected with the execution of well learnt routines and tasks and the achievement of difficult goals, hence being about curiosity, learning and the development of skills. And the emotions experienced in the Reflective level are connected to the study and interpretation of things and the pleasure obtained from that, being thus about fantasy, immersion and engagement. And again, a fun experience like riding a roller coaster is complex set of events, being related to all of these levels interconnected. In one level people may feel excited about the speed and the fall, but in another they may also be thrilled by the enhanced self-image achieved after they complete a fearful task that many others are not willing to do [40].

Emotions are expressed through this iterative pattern instead of in one straight direction from perception to physical arousal and unconscious reactive action, because otherwise they would easily take over any rational thought and no human would be able to have self control in face of strong emotionally eliciting situations. Another view of the emotion experiencing process is as a dynamic chain of events originated from both external (sensory perceptions) or internal (memories, dreams and bodily changes) sources of unexpected or unusual information, that are continually handled by the different organismic systems until a state of physical and mental equilibrium is restored [43, 47]. Plutchik [43] describes this feedback loop process with examples. Joy, an emotion commonly felt when a person is having fun, is illustrated in the situation of gaining a valued object (like receiving a gift from a friend, or earning money from a slot machine or a poker game, for instance). The perception of the valued object is consciously evaluated (appraised), resulting in a cognitive inference of the emotion (the feeling), bodily changes, intentions of action and overt displays (facial expressions, vocal intonation and bodily pose), eventually causing an effect (the action itself). All physical and mental changes that happen throughout the stages of the process are continually acknowledged by the person, either consciously or unconsciously, updating the subsystems' states until an global equilibrium is achieved [43, 13].

It is hypothesized that emotions serve to mark information as more or less relevant, helping attention to converge to possible best courses of action based on experience, and thus allowing for taking decisions even in the presence of great uncertainty or a big number of options [28, 13]. In other words, "emotion is cognition's silent partner without which choices are simply impossible" [28].

The cognitive part of the emotional process, that is, the feelings, are also classified in terms of a three-dimensional space formed by valence, arousal and tension [47]. Valence reflects the attractiveness of the feeling, ranging from negative (unpleasant) to positive (pleasant). Arousal reflects the intensity of the feeling, ranging from very calm (or sleepy) to very exciting (or energized). And Tension reflects the potency or control of the feeling, ranging from relaxed to tense [47]. Since it is difficult to consistently identify the third dimension (tension) from the second one (arousal), most researchers use only the first two dimensions combined in a circular structure to map all possible feelings in this space.

Positive valance is usually preferred and considered as naturally pleasurable. However, both positive and negative valences are important for the experience of fun because they compose optimal emotional patterns consistent with the ones in real life [45]. Fear and anger, for instance, are two emotions that involve negative-valenced feelings. The consequence of conquering fear or overcoming enemies after reaching emotional equilibrium – which is important for the subsistence in real threatening conditions – is made stronger in entertainment and playful contexts because it is accompanied by the acknowledgement that it was experienced in a safer environment, detached from the risks of real life [45]. This partially explains why experiences with horror films, games and roller coasters, for instance, are considered as pleasurable despite the elicitation of negative feelings such as those.

Consequently, one difficulty of this dimensional description is that classifications of feelings using valence and arousal may be less conclusive than directly using prototypic emotions, since in cases like fear and anger (both negative-valenced, high arousal) the feelings are very close in the bi-dimensional space and yet are related to very different emotions [47]. So usually the use of discrete and basic terms are preferred to describe emotions when discussing or studying them, since even users are more accustomed to refer to their feelings in terms of prototypic emotions [47].

When people play, emotions have five roles [20]. Players *enjoy the sensations* created. Emotions also *focus attention*, helping progression. They also aid in *decision making*, so the consequences of two options can be compared. And they *affect performance*, by facilitating repetitive behaviour through the experience of negative and positive feelings. Finally, they *reward and motivate learning*. Those are all aspects studied so far as being fundamental to the experience of fun, and that is why emotions are a very important part of entertainment.



## CONCLUSION

Fun is a very important subject because it has strong relations to how humans perceived and act on the world, and it is something that must be considered in the design of any products. However, it is hard to define concisely in just a few words what fun is, especially because fun is subjective and related to emotions. Its basis are on the interaction, since enjoyment is conducted by perceptions and attention focusing. The utilitarian aspects that differentiate pleasure from fun involve the achievement of goals by learning new skills and overcoming challenges, but the intrinsic motivation is also influenced by other cognitive aspects like curiosity and fantasy. The level of absorption (generally called immersion) is also important for the experience of fun, particularly in differentiating lighter and deeper forms of enjoyment. Finally, emotions are perhaps the most essential component of fun, because they provide help in the decision making and also produce important rewards related to the innate impulses for acting and playing.

This work attempted to provide a comprehensive review on the studies related to enjoyment and fun, in the hope to provide help in understanding such a difficult and subjective topic particularly for product and game designers. But we do not claim to have the subject completely exhausted, and in fact other important studies, from disciplines like User Experience and Game Design, could have been added if it was not for space limitations. But interested readers certainly have a starting point for further investigation.

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