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ÚSTAV JAZYKŮ

COMPUTER GAMES AND THE HUMAN BRAIN
POČÍTAČOVÉ HRY A LIDSKÝ MOZEK

BACHELOR'S THESIS
BAKALÁŘSKÁ PRÁCE

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VEDOUCÍ PRÁCE

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Počítačové hry a lidský mozek

POKYNY PRO VYPRACOVÁNÍ:

Proveďte rešerši literatury zabývající se psychologickými faktory, které se vztahují ke hraní počítačových her a diskutujte jak pozitivní, tak negativní vliv počítačových her na lidský mozek s ohledem na design her.

DOPORUČENÁ LITERATURA:

1) Hodent, C. (2018). The gamer's brain: How neuroscience and UX can impact video game design. Boca Raton: Taylor & Francis Group.
2) Baek, Y. (2013). Psychology of gaming. New York: Nova Science Publishers, Inc.
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Abstract

This bachelor's thesis deals with computer games and their influence on the human brain. The aim of the first chapter is to describe fundamental properties of the human brain and its abilities, which computer game developers consider when designing a game for their target audience. The second chapter focuses on human emotions and their manifestations, and how it might help developers comply with potential gamers' requirements. Furthermore, the chapter describes how developers can trigger human emotions via different game aspects, in particular music, narrative, graphics and game mode, and how they use them to make the players subconsciously feel the atmosphere of the game. Besides, the influence of these aspects on the human behaviour is described. The last chapter of the theoretical part of the thesis deals with an addiction to games and the problems associated with it. The practical part of the thesis is concerned with research whose purpose was to either support or reject claims in the theoretical part. Moreover, it shows differences between genders in computer gaming and shows respondents' preferences, which could help developers to improve the quality of their games.

Key words

computer games, brain, gender differences, emotions, mind, gamers, game developers, music, narrative, graphics, addiction

Abstrakt

Tato bakalářská práce se zabývá problematikou počítačových her a jejich vlivu na lidský mozek. Cílem první kapitoly je popsat základní vlastnostmi lidského mozku a jeho schopnosti, které developeři počítačových her využívají při vytváření her pro jejich cílovou skupinu zákazníků. Druhá kapitola se zaměřuje na lidské emoce a projevy, které developerům pomáhají, aby mohli vyhovět všem potencionálním uživatelům. Dále tato kapitola popisuje, jak mohou developeři prostřednictvím různých herních aspektů, jakými jsou hudba, narativ, grafický design a herní mód, v člověku evokovat určité emoce a donutit je podvědomě vnímat atmosféru hry. V práci je také popsán vliv těchto aspektů na lidské chování. Poslední kapitola teoretické části práce se zabývá závislostí na hrách a s tím spojenou problematikou. Praktická část práce se věnuje dotazníkovému průzkumu, jehož účelem bylo potvrdit nebo vyvrátit tvrzení v teoretické části. Dále poukazuje na genderové rozdíly v průmyslu počítačových her a ukazuje preference respondentů, které by mohly developerům umožnit zdokonalit kvalitu počítačových her.

Klíčová slova

počítačové hry, mozek, genderové rozdíly, emoce, mysl, hráči počítačových her, vývojáři počítačových her, hudba, narativ, grafický design, závislost

Rozšířený abstrakt

Tato bakalářská práce se zabývá problematikou, jak videohry působí na lidský mozek, emoce a chování a jak toho developeři her mohou co nejlépe využít k tomu, aby jejich hra byla úspěšná a dokázala potencionálního hráče zaujmout. Práce poskytuje podrobný popis herních aspektů ovlivňujících hráče a jejich rozhodování, náladu a intuitivní signály. V neposlední řadě také řeší problematiku závislosti na hraní her a jakým způsobem herní developeři docilují toho, aby jejich hra byla návyková.

První část práce se zabývá způsoby, jak funguje lidský mozek při hraní videoher, jaké jsou rozdíly mezi pohlavími, národnostmi a na co si developeři musí dávat pozor, když vyvíjí hru, aby někoho nevědomky neurazili a nespustili zbytečnou kontroverzi týkající se jejich hry. Dále se bakalářská práce sleduje, jaké emoce může hra v hráčích vyvolat a co dané emoce spouští.

V další kapitole je popsáno, jaké aspekty hry nejvíce ovlivňují lidský mozek a jak je využít k vytvoření správné atmosféry k dané situaci či nátuře hry. Tato kapitola řeší i stinné stránky tohoto odvětví a jak např. špatný příběh dokáže hru znehodnotit.

Poslední kapitola teoretické části řeší, jakým způsobem developeři docilují toho, aby byla hra návyková a hráči se k ní rádi vraceli. To ovšem přináší řadu problémů se závislostí a zanedbáváním důležitých situací v reálném životě.

Teoretická část bakalářské práce je psána formou rešerše literatury, kde jsou evaluovány názory různých autorů, kteří se daným tématem zabývají ve svých publikacích. První a nejvíce citovanou autorkou je Celia Hodent a její publikace *The gamer's brain: How neuroscience and UX can impact video game design*, která se zabývá fungováním mozku při hraní her a jakým způsobem videohry lidský mozek ovlivňují. Hodent je citována a evaluována hlavně v prvních kapitolách bakalářské práce, které se věnují základním funkcím lidského mozku a vlivem video her na něj, ale není opomenuta ani v dalších částech práce, např. v kapitole Addiction, kde jsou vyzdviženy její názory ohledně motivace a odměn, které hráče drží u hry. Druhým nejčastěji citovaným autorem je Nick Yee, jehož názory společně s dalšími spoluautory jsou rozebírány v oblastech chování uživatelů ve hrách a způsobu, jakým si vybírají své podobizny ve hrách a co je k tomu vede. Posledním často zmiňovaným autorem je Ernest Adams, jehož publikace jsou

využity k hlubšímu porozumění vlivu příběhu a grafických elementů na to, jak hráč danou hru prožívá a na co hra klade důraz.

Cílem praktické části této bakalářské práce je odpovědět na kontroverzní otázky v teoretické části a potvrdit tvrzení, která jsou zde uvedená. Výzkum v praktické části práce byl realizován prostřednictvím online dotazníku, který byl rozmístěn po různých místech internetu, kde se shlukuje hráčská komunita.

Praktická část zkoumá poznatky teoretické části za pomocí online dotazníku a klade následující výzkumné otázky:

- Kolik času stráví respondenti hraním her a jak je to ovlivňuje?
- Jak některé aspekty herního designu ovlivňují emoce hráčů?
- Jak herní funkce působí na hráče a jak moc je důležité se ve hře socializovat?
- Jak hráče ovlivňuje virtuální svět?

Výsledky dotazníkového průzkumu ukazují, že podle názorů 74,70 % respondentů videohry výrazně snižují stres z reálného života, ale také že respondenti zanedbávají svůj reálný život kvůli videohrám. Dále se dotazník věnuje vlivu herních aspektů na emoce hráče, kde bylo zjištěno, že výrazná většina hráčů si nedokáže videohru představit bez zvuku, ale nezáleží jim na provedení grafiky. Dotazník dále zjišťuje, že hráči raději tvoří příběh svými rozhodnutími ve hře, než aby je hra vedla daným směrem.

Další část dotazníku řeší osobní preference a socializaci hráčů, kde velká část respondentů dbá na to, jak jejich virtuální charakter vypadá pro "zbytek světa" a ukazuje, že rozdíly mezi pohlavími nejsou příliš markantní. Dále ukazuje, že přesná čísla a statistiky jsou velmi důležité aspekty hry, které by neměly být opomenuty.

Poslední část dotazníkového výzkumu se zabývá vlivem virtuálního světa na lidské chování. Zde se potvrzuje, že někteří respondenti se v reálném světě chovají podobně jako jejich postava ve světě virtuálním. Podle odpovědí v dotazníku někteří dokonce věří tomu, že mají v reálném životě stejné nadpřirozené schopnosti jako jejich postavy z videohry.

Praktická část bakalářské práce také řešila již zmiňované problémy se závislostí a to, že hráči, kteří tráví hraním her hodně času, mají větší sklon být závislí a zanedbávat svůj reálný život a povinnosti. Další zjištění odhalilo, že když je pro respondenty těžké najít motivaci a odměny v reálném životě, tak se uchylují k videohrám, kde to je o mnoho snazší a zábavnější.

Veliká část respondentů tvrdila, že se cítí emotivně když hrají hry a nejčastější emoce, které pociťují jsou zloba a štěstí, což jsou prakticky dvě protikladné emoce, ale obě jsou nezbytné a poukazují na cestu k úspěchu, která není jednoduchá.

Z výzkumného zjištění vyplynulo, že by developeři měli nejvíce věnovat tomu, aby jejich hra poskytovala dostatečné emoční uspokojení a také propracovaný systém odměn, který bude hráče přitahovat a nutit ho ke hře se vracet. Zároveň by ale neměli za každou cenu nutit hráče stát se na dané hře závislým.

Hanuš, M. (2020). *Počítačové hry a lidský mozek*. Brno: Vysoké učení technické v Brně, Fakulta elektrotechniky a komunikačních technologií. 68 s.
Vedoucí bakalářské práce Mgr. Ing. Eva Ellederová.

PROHLÁŠENÍ

Prohlašuji, že svou bakalářskou práci na téma *Počítačové hry a lidský mozek* jsem vypracoval samostatně pod vedením vedoucí bakalářské práce a s použitím odborné literatury a dalších informačních zdrojů, které jsou všechny citovány v práci a uvedeny v seznamu literatury na konci práce.

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V Brně dne ....

Marek Hanuš

PODĚKOVÁNÍ

Děkuji vedoucí bakalářské práce Mgr. Ing. Evě Ellederové za účinnou metodickou, pedagogickou a odbornou pomoc a další cenné rady při zpracování mé bakalářské práce

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INTRODUCTION

In the modern world where a significant source of entertainment is electronic devices, we can hardly imagine life without them. About one hundred years ago electronic devices like mobile phones, desktops and laptops were almost unreachable for the public, but nowadays everyone owns at least one of them. Life without electronic devices is almost impossible in contemporary society since they make our lives easier and more comfortable. They are usually used for shopping, watching videos, listening to music, and playing computer games.

In the recent twenty years playing computer games has become a dominant trend. Gaming is on the rise and people play computer games more often than before, but what makes us come back and play the game again? Why do we prefer a specific genre of computer games to the others? This bachelor's thesis will concentrate on specific ways and aspects that make us enjoy playing them.

The thesis is divided into a theoretical and practical part. The theoretical part frames the basic concept of the human brain and its functions, which is vital for better understanding of the issues addressed in the thesis. Then it focuses on gender differences including illustrative examples, human emotions and the ways different cultures use facial expressions and react to the initiatives, which is crucial in computer games production. Furthermore, the essential aspects of the computer games, such as sounds, narrative and graphics, and their influence on the human brain are examined. The theoretical part of the thesis also discusses the differences between single-player and multi-player games and the process players must go through when they realise that a single-player game is insufficient to meet their needs. It also attempts to analyse the obstacles and potential consequences players must face when they play against more experienced players and the emotional impact of such a situation on their mindset. The last chapter of the theoretical part gives the reasons why players get addicted to gaming. This chapter deals with the motivation and reward phenomena that influence players' subconscious thinking and can lead to addiction and the problems related to it.

The practical part of the thesis deals with qualitative research based on an online questionnaire survey conducted to support or reject the claims made in the theoretical part. The research findings also reveal gender differences in decision-making and the respondents' interests, which might help developers to design their games and avoid unnecessary errors that might discourage the potential players.

THEORETICAL PART

1 Concept of the human brain

The brain is described as "a three-pound organ that controls all functions of the body, interprets information from the outside world, and embodies the essence of the mind and soul" (Hines, 2018, p. 1). It is the centre of intelligence and Hines (2018) also states that the brain receives information through five senses that interpret signals to the brain and those senses are smell, touch, sight, taste and hearing. Besides, it controls human behaviour and determines our character. NIH (2018) points out that the brain itself "lies in a bony shell, washed by protective fluid" which prevents dryness or tension of the brain. The brain is said to be "the crown jewel of the human body", and it is a source of all human qualities that define who we are. NIH (2018) claims that

> … for centuries, scientists and philosophers have been fascinated by the brain, but until recently, they viewed the brain as nearly incomprehensible. Now, however, the brain is beginning to relinquish its secrets. In the past ten years, scientists have learned more about the brain than in all previous centuries thanks to the accelerating pace of research in neurological and behavioural science.

There are also new technologies in neural science which have helped scientists to learn more about the brain. The brain is like an all-star team made up for the world championship. All the parts of the brain work perfectly together, but each region has its unique properties, and a different part of the brain reacts to impulses from the outer world individually.

1.1 Parts of the brain and its functions

As NIH (2018) notes "The brain can be divided into three basic units: The forebrain, the midbrain, and the hindbrain". It also provides information about those parts of the brain separately. The hindbrain controls the body's vital functions, which humans could not live without. Those functions work "automatically" without conscious control of them, such as grabbing an object to the hand. Flynn (2018) adds that "it handles the 'subconscious stuff' we tend to take for granted. With it, you wouldn't be able to move, to swallow or to breathe". The cerebellum, the upper part of the hindbrain, controls our fine movement, sense of balance, posture and motor learning. For example, it tells the body where it should move its body parts and how much power use to hit the football ball. The midbrain is

closely related to cerebellum-because it controls eye movement and reflex actions such as sneezing or yawning.

The human memory (n.d.) claims that there are billions of neurons and each neuron may be connected to more than 10,000 other neurons in the brain, and they can pass signals between each other, which determines our actions. One thousand trillion synaptic connections pass those signals.

Cloer (2004) states that neurons do not touch each other by their bodies, but synaptic connections connect them. “Those connections connect neuron cells by long fibres with finger-like projections at both ends”. One end is called a transmitter, which sends the information to another end called “antennae” and space between antennae and the transmitter is called synapses.

Processes in the brain are stimulated by the central nervous system located in the spinal cord and the inner layer of the brain cortex. Simply put, it makes the whole body vulnerable. Every time we hit something with any part of our body, or even touch something, we feel it, and that is what the central nervous system does. It makes us vulnerable to outer impulses. However, it makes us vulnerable even to inner impulses, feelings such as love, success, failure and others. According to Robertson (2018), “the central nervous system is made up of two types of tissue: the grey matter and the white matter”. Grey matter serves to process information in the brain via the spinal cord. This information is crucial for a human to be able to coordinate their movements. That is why people, who heavily damage their spinal cord are not able to move some part of their body, or they must learn it again with so much effort. In the worst case, they are not able to move anything but their head and must lay on the hospital bed for the rest of their life relying on the other people’s help. White matter is a little helper of grey matter. It collects neural signals all over the body and carries them to the spinal cord, where grey matter takes over it.

Hodent (2018) observes that every day, every hour, every minute, our brain is rearranging its neural network. Every simple thing does that even without us realising it, for example, reading a book or watching the news. The brain is mainly fixed to some stereotype we all have such as our daily routine. Hodent (2018) further asserts that the brain is not hardwired at all so “rewiring” is not the right term to use. However, every action makes our brain learn, adapt, overcome some problem like moving abroad or getting divorced. Then do

games rewire our brain? Simple sitting in front of the computer makes the brain rewire. When it comes to playing the game in a single-player game we make some progress that put us through harder challenges or in multi-player games, where we compete against other gamers, we “rewire” or learn our brain to get better. Games even can lead us to “rewiring” our brain so much that we can get addicted to it. Furthermore, when games catch our attention, we tend to play them more often, spend more time or even money on playing them.

2 Human abilities, feelings and computer games

The reason why the parts of the brain and their functions were mentioned in the previous chapter is that they are crucial for understanding how the brain of a gamer works. The gamer, a person who plays computer games, could be anyone. It could be a ninety-year-old grandmother, whose grandson showed her how to play solitaire on the computer, or a young girl who plays games on Facebook. However, without any computer skills, for example, how to turn it on, use a mouse or keyboard, we would not be able to play computer games at all.

Imagine someone seeing a computer game for the first time in their life. They will have to figure out what to do. The first thing they must do is to familiarise themselves with the interface of the game and then slowly learn the basics of the computer game. Learning is a process that humans go through throughout a lifetime, even without realising it. Everybody has someone who taught them how to use a computer. It could be a friend who invited them to their place and showed them what they could do with the computer, or it could be a teacher who taught them the basics of computer science and programming. Therefore, everyone is supposed to find their way how to do it.

Learning to play a game might be easy if the game is not so challenging, or it could be difficult in the case of more sophisticated games. Also, the skills of the person play a significant role. If somebody has played games since a very young age, they are more experienced than the beginners.

2.1 Difference between male and female gamers

Hodent (2018, p. 25) reports that every human in a calm state uses 10% of the brain, and it goes up to 15% at the maximum when we are concentrated on the specific task. Even though our brain is only 2% of body weight and we use only a small part, our brain consumes about 20% of all body energy through a day. Our brain never sleeps and is active, even when we are asleep; otherwise we would not be able to dream.

We could assume that without dependence on gender, our brains work the same, and it is basically a correct statement, despite the fact, there is still some divergence. There are slight differences that make us alter, and the game developers usually try to comply with both genders in some way. Jantz (2014) emphasises that “male brains utilise nearly seven

times more grey matter for activity while female brains utilise nearly ten times more white matter". These findings can be explained as males are more stubborn in doing tasks, and they can fully concentrate just on one specific task, but they do it precisely. Once they get deeply engaged in the task, they do not pay much attention to their surroundings and suppress other senses. On the other hand, females who have more white matter which connects and passes signals to grey matter, tend to shift attention between one task and another unconsciously, therefore, they are better at multitasking (Jantz, 2014). Furthermore, females have a more extensive memory centre than males, and they are more sensitive and emotional.

Females remember adverse emotional situations that happened to them better than men. Chentsova-Dutton and Tsai (2007) explain that females do appear to react more negatively to unpleasant experiences in experimental settings. Females respond with more sadness to sad films and with more fear-disgust to fearful-disgusting movies than males do (Kring & Gordon, 1998). In conclusion, developers know these differences are there and try to put in their game aspects that benefit both genders. For example, females might not enjoy brutally killing hundreds of enemies repeatedly as males usually do, so to attract a women's community into the game they add some things that pleasure the female brain and emotions, such as furnishing a house for their character, choosing different types of clothes or making the game emotional to attract them to play the game.

2.2 Developers' mind versus gamers' mind

Developers' and gamers' minds differ a lot. When the game has high ambitions, the group of developers is usually smaller than the gamer' base that is going to play the game. In the developers' group, it is much easier to agree on what they want to do with the game. This does not always correspond with the gamers' reactions that differ in most ways. There is already a great deal of pressure on developers to deliver what they promise and even when they are quite happy with the product they made; gamers might see it differently. For example, when the Hello Games studio introduced their new game *No Man's Sky* (2016), people were so excited that they could not wait and to support the studio they started to pre-order the game. Pre-order means that people who buy the game for the full price can play the game for a short time before it is released. *No Man's Sky* (2016) was a bestseller on multiple platforms for a month (Kuchera, 2016). The gamers, who pre-ordered the game

had some benefits which the gamers that bought the game after the release could not get. When developers finally released the game and made it accessible for those who bought it a terrible disaster occurred since it turned out to be a different game than the one some players had expected. After two days the game had been released, the people who pre-ordered the game requested to refund their money. The member of the developer team, MacDonald (2018) confirms that "there are a lot of things around launch that I regret, or that I would do differently". Developers gave the gamers who pre-ordered the game an option to refund their money if they did not like the game.

The same happened with *Mass Effect Andromeda,* which was highly awaited continuation of the previous three games. The publisher of this game, BioWare, a well-known game developing studio that achieved international recognition for developing highly praised and successful games, learnt from their mistakes and did not release the game whose quality was not as expected (Ashaari, 2018).

Mistakes can be made not only in the gameplay and the narrative branch of the video game but also in the optimisation and understanding the human limits. Whenever gamers cannot distinguish between the real and virtual world, they might encounter several psychological problems.

2.2.1 Importance of tutorials

There are no tutorials for games like solitaire. Those games are based on the real-life card games, and the only possible way to master it is to click with the mouse and transfer the cards in order. However, more sophisticated games such as *The Witcher 3: Wild Hunt* have more to offer. In these games, it is necessary to learn skills and movements that the particular character can do, which requires many keys to be pushed in the right time or even at once.

Hodent (2018) describes how people inexperienced in the specific computer game genre were made to play a game. They sat down, started a game and a white screen appeared in front of them. The experienced computer gamers had certain information encoded in their brain that instructed them to push a specific key to continue, but people who did not know what was going on waited thinking that the game had frozen. Even some experienced hardcore gamers did not know what they were supposed to do as in the case of game

Overwatch where the character has a superpower that can be used once at a given time. For the inexperienced players was impossible to deduce that there is such a mechanic that allows them to release it. For this reason, well-made tutorials are crucial in sophisticated games. As Snyder (2015) explains,

> … tutorials are absolutely needed to help address the diversity of games, the multitude of input methods and the growing complexity most games bring. Without a tutorial that eases the player into a new combat system, or a daunting item crafting menu, many great games would never be experienced because players would simply give up.

Tutorials must be made for non-experienced gamers so that they could understand the game correctly, which developers must carefully consider. Hodent (2018, p. 68) warns against including all "mechanics and features" at the beginning of the game, since it "less efficient and also usually not appreciated by gamers". He further recommends game developers to give reminders to players and repeat some instructions throughout the game. Human memory is a temporary thing that needs to be "reminded of" such processes; otherwise they would be forgotten.

2.2.2 Knowing the audience and human limits

Developers must be careful when making games for virtual reality because they are entirely different from computer games played while sitting in front of the computer and having a sense of what is going around in real life. In virtual reality, gamers have no idea what is going on around them. Their eyes are covered by a particular device which shows them the game itself; thus, gamers are forced to focus on the game without being distracted. LaMotte (2017) emphasises the statement from the safety information page for HTC's Vive that "while wearing the product's headset, you are blind to the world around you". Since the game can seem realistic, it can make gamers sick while playing it. Besides, the device is attached close to the players' eyes, so it might confuse their brain. In the game, things move fast and may seem farther or closer than they are, even though they are not moving at all. The distance between the device and the eyes is still the same. There is a "game" for virtual reality made by Google Maps, where gamers can rotate with the digital world map and choose a place which they want to see. When the first version of the game was released, it received many complaints because people get sick while playing it or even passed out. It was because when the gamers chose a place which they wanted to see; it

started an animation which looked as if they were falling straight down at incredible speed. The s who were not aware of this felt panicky. LaMotte (2017) adds that “you can trip and hit your head or break a limb and get seriously hurt, so someone needs to watch over you when you are using VR. That’s mandatory”.

To make it even more realistic, there is a game called *Richie’s Plank Experience*, where gamers are supposed to take an elevator to the roof of a skyscraper, then the elevator stops, and they are supposed to jump from plank, about one and a half meter long, to free space falling next to the skyscraper. Since gamers are staying on the plank and they are presumed to jump down, the gamer’s brain thinks that they are over one hundred meters up from the ground, making them feel they should jump, close eyes, free all muscles in body expecting a long freefall. From my point of view, the reality is often different. The players are just a few centimetres above the ground, which can cause a desorientation. One of my friends was playing this game, she panicked and broke her leg when she stepped out of the plank.

Another issue of virtual reality is that if the game is running lower than 90 fps, it can make the gamer feel sick because the real world does not have a delay. Our eyes can see the difference, and that makes our brain feel sick. Hodent (2018) notes that it is caused by delay of smooth frames from the device and our mind starts to feel exhausted like when we are having bad flu.

The way our mind or body feels do not need to be caused only by the disorientation and unconsciousness for a brief moment. There is also another aspect that influences game players’ behaviour and feelings, and it is emotions that we are experiencing during the gameplay.

2.3 Emotions

Accurately describing emotions is not an easy task nor even possible at all. To illustrate what emotions are, they are described as the behaviour of a person and how a person reacts to things heavily influenced by perception and cognition. Hodent (2018) sums up this behaviour changes as “feelings”. Our feelings trigger our reflexes, for example, when someone is just calmly sitting in the living room, watching their favourite TV series and suddenly something massive hits the ground behind them. They immediately turn around; their heart rate rises and the moment of not knowing what happened turns on. They feel

scared until they discover it was just a cat which dropped a vase from the shelf. When nothing scary or unexpected happens, we often talk about our feelings consciously with our friends or colleagues. Hodent (2018) sheds light on the feeling when we are under pressure, she claims that emotions make us think in tunnel vision when we are experiencing extreme stress, mostly when our life is at risk (p. 97–98). For instance, when somebody is chasing you with a knife trying to kill you. We do not think about possible outcomes that could help us shake off the attacker. However, we keep running straight hoping that we endure more than the attacker and escape alive. To understand the emotions more and how developers can use the knowledge about them in their favour and how they drag the player into the game, we must examine how specific emotions affect us.

Kavanagh and Bower (1985) research claim that specific emotions can have a negative or positive influence on us. All emotions can be influenced and even strengthened with some stimulant which we insert in our body for example, via alcohol. Hodent (2018) describes these emotions as follows:

> … joy heightens openness to experience and signals readiness for friendly interaction in a social context. Sadness slows the cognitive and motor systems and can be useful in carefully looking for a source of trouble. Anger mobilizes and sustains energy at high levels that can lead to aggressive behavior. Fear, of course, motivates escaping from a dangerous situation. (p. 98)

These emotions highly reflect our concerns when it comes to game testing. The scale of emotions launched by human body expressions, when they start to play a game, can reveal how the game affects them. That can bring a lot of problems for developers misunderstanding these expressions and making them infer hasty conclusions.

Hodent (2018) notes that game developers are usually not present when it comes to testing their game by the unrelated public. Because every developer can understand the players' reaction differently. During testing a group sits behind the computer, sometimes, their facial expression looks like as if they were bored, and some developers might feel stressed because they think that they are not enjoying the game as developers thought they would. On the other hand, some developers find bored face as a success. It indicates that players are not angry from finding some glitch or bug. Hodent (2018) adds that it is better to keep developers out of this testing phase to prevent mixed emotions at a workplace.

Eukman (1980) has identified six basic facial expressions that every person on the earth can recognise, and those are fear, anger, sadness, happiness, disgust and surprise. These

expressions differ depending on the culture of the community people live in. Some cultures are better in controlling those expressions in front of other people or the people that they do not know well enough to get relaxed while talking to them.

Unfairness is one of the feelings that people hate most (Hodent, 2018). For example, not being appreciated for work you have done or staying in work overtime without any reward meanwhile, somebody mess around not doing anything useful and getting the same salary as we make us trigger the most. However, being on the other side of the table does not bother us at all. Reynolds (2011) states that "when we feel something is unfair, we respond as if it were a threat". From the game developer perspective, it could be a devastating fact. In the game industry developers have to reward somehow players that feel mistreated because if they do not, they will quit the game out of jealousness that other people, who play the game more often or are better at it, are treated better than them. That is the reason why developers came out with "win in loss" system, which rewards even the gamer who loses. For example, in *League of Legends* game from Riot Games studios, they came out with honour system previous year. This system allows each gamer to give one gamer from their team an honour point at the end of the game if they think that he/she played well and deserves it. If the gamers get enough honour points over the time they play, they get honour rewards including some valuable items as well as a badge over their name. Honour can be stacked up at five levels and at each level the gamer gets more useful things. Honor (n. d.) assumes that this effect makes the gamers at least a bit happy even though they lose the game and make them continue playing the game.

3 Aspects of game design and their influence on the human brain

Emotions, reflexes, feelings are aspects we are experiencing during the gameplay via various approaches. To make a successful game, developers need to understand how each element of the game influences the gamer and what are the pros and cons of them. When appropriately executed the composition of all the aspects of game design subconsciously makes the gameplay more intensive and enjoyable. Game design affects all human senses except taste and smell and profoundly influence us.

3.1 Music and sound signals

The sound is omnipresent. If there were no sounds, people would go crazy. Even ten minutes in completely resonated place could damage our hearing. Without making a sound, we could not communicate other than sign language or writing. The sound is an essential aspect of our life. Imagine you are deaf and crossing the street, but car riding down the road towards the crosswalk has a brake issue and cannot stop. The ordinary human sense is to start honking, but you cannot hear it. There are types of sounds that inform us about some danger, or things we must do, for example, to pick up the phone. Music can evoke many feelings in us just by words used in it or the melody that the specific song has. It can make us happy, excited, amused, nostalgic or sad.

Music and sound signals are an essential aspect of the game. Almost every game has a sound mechanism that makes everyone realise that they are in danger or achieved something. However, the first games that came out for the computer like *Tennis for Two* (1958) had no sound, and that lead these games to be forgotten because gamers did not enjoy playing a game that is entirely silent (Liebe, 2013). Later, the game included primitive types of sound like beeping or drumming, and even this small change made gamers enjoy the game more than without any sound. The first time in history game *Space Invaders* (1978) came with rhythmic sound during playtime. Since then, every game uses sound or music (Liebe, 2013).

Music in games can be linear, reactive and proactive. Linear music is not affected by any change in action that the gamer makes in the game. It is background music that may change just by getting to milestones in the game, but not by micro-actions of the gamer

(Austin, 2016). For example, in game *Grand Theft Auto V,* you can ride a car with a radio in it, and you can change channels on the radio (Liebe, 2013). In this case, it does not change if the player is peacefully driving through the city or you are getting in road rage.

Reactive music is connected to micro-actions that the gamer performs in the game. Getting into action, collecting a quest and others. Everything has its specific music and mentally prepares the gamer to what is going to happen or what is happening. The last type, proactive music, is the type where the gamers have a selection of music entirely in their hands. This type of music usually occurs in music-based games where you play with the music. The game plays the gamers a song, and they must move to the sound or collect the points. Also, the music or sound is closely related to the game genre, for example in the game dedicated to the western genre, country music from the 19th century would be played rather than rap songs from the 21st century (Austin, 2016).

3.2 Narrative

A narrative is an essential part of most games on the market. It gives the impulse, emotiveness, addictiveness to the game itself. Skolnick (2014) indicates that without good storytelling, the game would be like an American sports car without gas. You could go inside the car, feel the interior, grip the steering wheel, but you cannot start the engine or drive the vehicle. You can imagine riding it, wind blowing hair to your face, but it is never going to be as good as real.

Writing a good narrative takes a lot of effort; it is not a single person thing. For a successful story, there need to be a good twist or conflict. All good stories, written or even filmed, depend on a good theme. When talking about a story written in a book, there are just black letters on white paper. The rest depends on our imagination. Lee (2013) points out that "whereas literature can be characterised by using words to present ideas over the course of time, cinema builds on that by adding a second dimension of expression". This dimension omits human imagination and instead, let people see the story how they want to which causes a problem. The simple scene from a movie, such as a beautiful sunset over the landscape, might be described in a book by a big paragraph, meanwhile, in movie it might be just a split second not allowing the person to catch what that scene supposed to mean.

Nevertheless, there are also bright sides of the "vision dimension". Lee (2013) further suggests that "a conversation between characters is now enhanced by their body language, their tone of voice, and the cinematography". Those aspects are used by developers to draw gamers deeper into the game and make the characters more human-like. Unlike cinematography or books, games add an extra dimension.

As was mentioned before, videos, films, movies (3D movies excluded) are two-dimensional "literature". Games add one more dimension which is interactivity. Interactivity is basically a way how the player experiences the story of the game (Shehrozeameen, 2017). Interactivity shifts the ways how people can entertain themselves to another level. Hoguet (2014) quotes from Kevin Spacey's speech "they want the freedom. […] Give them what they want, when they want it, in the form they want it in". This is what developers need to execute flawlessly whenever they are designing a game. With a lack of interactivity, the game would basically play itself, bringing no joy for the player. Interactivity can be described in many ways.

Steuer (1992) explains the concept of interactivity in the following way. Interactivity is composed of three elements which are: speed, mapping and range. Speed is the response time of the virtual world, and it usually depends on the computer configuration and the speed of the internet connection. Mapping is a function of the controllers used to interact with the game environment. It ranges from standard keyboard and mouse to a specialised controller for each console distributor. Even a human finger can be a controller. The range is a number of attributes that can be somehow manipulated by the player. The manipulation attributes often greatly vary. They can be simple as pressing three keys to launch the pinball ball into the playing field and then shooting him back up with other two keys which manipulates the flaps. They can also be very sophisticated for example, from massive multi-player interfaces, where the player can interact with almost everything and must use wide variety of keys and mouse to maintain all of it.

This description is very general and omits the real experience of a player when it comes to the gameplay. Some developers make their games less interactive on purpose. The games which rely on storytelling and many cutscenes usually are closely related to the decision-making gameplay. In these games, players are not able to travel around the world freely, but only "answer the questions" while watching what their decisions change in the story. Bowring (2017) claims that games "allow you to make far more choices in regard to the

narrative. Making the narrative itself interactive".

3.2.1 Narrative structures

Picucci (2014) states that there are four narrative structures: "pre-established, discovery, sandbox and computer-generated. Sometimes they appear individually, sometimes a combination of two appears, sometimes the game is a mix of all". Furthermore, Picucci (2014) describes the following structures, which are crucial for developers in the early stages in the game design. If they choose the wrong format of the narrative for their game, it could ruin the whole experience of playing.

Pre-established type of narrative is probably the most common type of storytelling. The pre-established term means that when the gamer finishes one part of the story and complete certain checkpoints, the next sequence of events, which belong to the primary plot, triggers and the gamer is forced to follow the unchanging path of the story till the end. In this type of narrative, a gamer's options are minimal. There is no side-stories or new things to discover, and freedom of the gamer is considerably limited (Picucci, 2014). As was mentioned before by Bowring (2017), a pre-established type of the narrative is mainly used for the games that tell the story and guide the gamer through the game.

Discovery narratives, unlike the pre-established narratives, allow gamers to experience plenty of side-stories and side missions which develop their character and its story. There is still one pre-established main story that guides the player through the game, but the player is not forced to take that way and do only the main storyline. The player can explore the environment of the game at free will and is not held by the game (Picucci, 2014). Discovery narratives are often represented by "open-world" maps, which gives the player the freedom. Those maps allow the player to discover parts of the maps freely, without any restriction (Picucci, 2014). Discovery narratives are often used for the game that wants to tell a story, but also let the gamers feel free in their decision. The narrative part is wholly omitted in the sandbox type.

Adams (2010) reports that "in sandbox storytelling, the idea is to give the player a big open world populated with opportunities for interesting interactions," which means that the players are not fixed to any main plot or whatsoever and can do whatever they want. The principal idea is to motivate players to spend hours learning about the environment they

were put in and interacting with NPC's (Picucci, 2014).

Not everybody likes the sandbox type of storytelling. Developers need to be careful when choosing to design their game in a sandbox-style of the narrative and give gamers a reason to play the game. Otherwise, they will get bored and leave the game. Adams (2010) suggests that adding some type of a multilinear story that tests the player in specific chokepoints can make the gameplay much more enjoyable and gives the player a reason to finish the game.

The last type is a computer-generated narrative. This type lacks any pre-established story plot. The storytelling includes randomly generated events by a computer (Picucci, 2014). The core characteristic of the computer-generated narrative is that plot of the game story is represented as links and tensions between the characters and those stories progress over time (Pérez y Pérez, Sosa, & Lemâitre, 2007). When the outer environment somehow influences a character in the game, the current emotional and tension links are updated. Thus, the gamers write the story by themselves (Pérez y Pérez et al., 2012). Developers use this kind of narrative when they want to do a sandbox type of game where every time the gamers start playing, their experience from the game is different. This makes the game more enjoyable over time because experiencing a new scenario every time does not become stereotypical.

3.2.2 Tension in a narrative

Another reason why players are drawn into the game is the tension caused by a narrative. Rose (2010) determines the basic emotions released by tension and these are conflict, stress, pressure, and anxiety. It is basically an animal emotion, a reflex. People usually try to keep those emotions at a minimum level because nobody likes to be stressed or feel anxious.

Paradoxically, tension is what people need to enjoy the game at most. When the player is drawn into the story and everything goes well, they know that something terrible is going to happen. Even though the players are probably not looking forward to this stressful moment, deep inside they need it to happen and make their character overcome it (Rose, 2010). Tension pushes players further through the game and developers should include it in every type of narrative that supports it, most importantly in the pre-established and

discovery types of narrative.

These types of narratives are mostly used in horror games, where the danger is lurking behind every corner. Pruett (2015) adds that "we want the player to be thinking as if he is his avatar rather than a third party solving a puzzle". Means which developers use to achieve that feeling is well described by Frome (2007) who points out that they use "actor-ecological" emotions. For example, in the game *Slenderman*, which is made around controversy about a mysterious tall man in a business suit, with abnormally long arms and blank face, who stalks his victims for years and mentally torture them until they turn crazy. In this game, the player is sent to the dark park with only flashlight that barely produces any light. Also, the flashlight battery eventually runs out if the player does not collect eight pages with drawings in time, which is the objective of the game. Pages contain information about Slender is following the player around the park, always being behind their back. Whenever he is close, and the players look behind themselves, the screen starts to snow. The intensity of the snowing comes from how far from the player Slender is. When player's stares at Slender for too long, he appears right before the screen with unpleasant loud screaming sound, and the screen starts to blink white, making a "jump scare".

Meanwhile, "actor-ecological" emotions make players feel like Slender is haunting them. Their battery is running off, they are nowhere near collecting all the pages the tension emotions, which were mentioned earlier, start to rise knowing the "jump scare" is near. In that case, Pruett (2015) notes the "player's heart rate is up, adrenaline is pumping, and he's starting to sweat".

On the other hand, even when the player gets scared by the "jump scare" or with any other aspect in the game, they never run out of the room thinking that they really get caught by Slender. According to Frome (2007), it is caused by "ecological" emotions, which occurs when a player responds to the game in the same way as they respond to the real world. It is because in our mind are systems that distinguish between what is real and what is not. However, those systems do not always cooperate with each other (Frome, 2007). For example, when we see an illusion picture on the internet, we know that the picture is an illusion and what we are supposed to see even when we are not able to. That means our systems do not cooperate properly. The same thing happens in the games, we are aware that the game is not happening in real life, but even when the "jump scare" comes, we get scared for a moment.

3.2.3 Problems with narrators

A narrative is a crucial part of game development, and most of the games could not go without it. However, there are many games that the inadequate or incomplete narrative cost their reputation. This can happen to either small developer studios, where it is more likely that they do not have enough money to afford good narrative or even to the big developers' studios, which underestimate the situation.

Sometimes writing a game story does not go as well as expected. There are plenty of reasons why this happens. For example, when game managers try to save money where they can, they hire a low-quality narrator who is not able to write a story good enough for their game. Another aspect which can ruin the whole story is the lack of communication between the narrator and the actual developers of the game. They must work as one team, otherwise, the entire game would be devalued. Unfortunately, all those mistakes made in decision making are usually discovered after the release, and there is no way back.

Narration closely cooperates with graphic design. When narrators write a story about a hunter who travels around the world, killing his enemies or monsters, it would not be suitable to pair that story with cartoon graphics where the players are only able to design their hut instead of upgrading the weapons and other necessary equipment.

3.3 Graphics

Game graphics is something everyone is going to judge when they start to play a game. It gives the first impression and suggests players how the game is going to work and how it will look like. From a computer user's point of view, it is a part of the computer industry that evolves the fastest. Considering graphics-wise, what games looked like ten years ago and what they look like today is almost incomparable.

Many developers try to get as close as possible to make genuinely photorealistic graphics that could not be recognised from real life. Even though contemporary graphics are stunning and barely recognisable from the real world, it is not the deciding factor in the game quality. Masuch and Röber (2005) confirm that "mediocre graphics does not ruin a great game, whereas on the other hand outstanding graphics typically does not make a bad game any better". Graphics is a broad area which each person can perceive differently and

have a different taste for. Developers should design their game depending on the players' taste and adapt to the trend that is currently on the market.

3.3.1 Graphical elements

Humans perceive graphical elements of the game with one sense which is a vision. Vision is the most dominant sense that humans have, and it provides 70% of the information human perceive. With vision, humans can distinguish between colours, facial expressions, gain information and so on. It is probably the most critical sense in the game industry. With vision, we judge everything that is happening on the screen and developers need to adjust their game to satisfy this sense as much as they can.

Masuch and Röber (2005) mention five graphic elements that are crucial for developers when making a video game to satisfy the visual sense. Only four of the elements will be described here since the perspective element covers everything necessary. These elements are:

1) Dimensionality
2) Perspective
3) Colour
4) Presentation
5) Realism

Dimensionality is a difference between 2D and 3D graphics. Games that are made in 2D graphics cannot provide a first-person and third-person view because those viewpoints require a 3D engine (Adams, 2009). Therefore, many game developing studios prefer 3D engines because they provide more options and look more realistic. So why developer studios keep on making games in 2D? The reason is described by Eden (n. d.) who says that benefits of the 2D design are simple controls, easy making and simple instructions.

When playing a 2D game, the players use only a few buttons to control the game since there is not the 3D dimension that would allow them to rotate inside game environment freely. For the human brain, it is not "hard to process" to play games where the players are supposed to click few buttons, so the players who prefer the 2D games usually play to relax and do not deal with stress. Besides, it is financially beneficial for developers. The game development does not take too long, and a big team is not needed, thus it does not cost much.

That is why developers make those games predominantly on smartphones. The smartphone community is vast and diverse. In our society that is always in rush and people do not have much time to be at home and play at their computers or consoles, the smartphone is the most portable device among all gaming devices, and that is why developers bet on them. Therefore, Eden (n.d.) highlights "hyper-casual" games which use simple "tap to play" mechanics and have good looking simple design with clean visuals. That is certainly simple for the players to access the game since they are usually free on the mobile store. However, that does not mean that mobile phone games are the only way. Masuch and Röber (2005) point out that "gameplay is what happens and how it is achieved in a game from the viewpoint of the player". That means the players' approach to the game and their overall feeling about the game is what defines if the game is good or not. Adams (2009, p. 8) confirms that "gameplay consists of the challenges and actions the game offers the player". Players will enjoy gameplay when a game has a lot to offer. If the player performs one action repeatedly without any good rewards, they become bored quickly.

Perspective means how a video game is viewed and how players can interact with the game. Game developers should decide what perspective they want to use a long time before they start to design the game. It significantly affects all aspects of the environment of the game. According to Unknown (2015), there are four types of perspectives:

1) First-person
2) Third-person
3) Aerial
4) Side-scrolling view

First-person games allow players to see the game environment from the view of their character, making it super realistic, thus making players feel as if they were living the action (Former, 2015). This perspective is probably the most influential since the players see directly what their avatar sees, which creates a charged atmosphere and overall feeling from the game. Although the first-person game connects the player with his avatar in the most efficient way, this perspective has its drawbacks. Unknown (2015) claims that "although this perspective makes gameplay look more realistic, the field of vision is very limited, thus creating a tunnel vision effect; making your character to become more vulnerable to attacks from the back", which can make players feel uncomfortable, for example when they are playing a horror game and they are not able to see everything that

is happening around. Developers should not use the first-person perspective in the games where it is neither obligatory nor game-breaking otherwise, players might feel anxious or limited.

Third-person games, in contrast with first-person games, allow players to see a whole body of their avatar. The camera that shows the players' avatar is usually facing its back, so the player can see whatever is happening around him. The disadvantage of this viewing angle is that the player often does not feel involved in the game and feel more like they are controlling someone (Unknown, 2015). This perspective lacks the authenticity and developers mainly use it in action "battle royale" games, where the full range of vision is necessary to stay alive.

An aerial or bird-eye viewpoint is a basically view from above the player's character. This type of angle is commonly used in 2D games where the camera does not have to rotate and still showing good amount of terrain around player avatar (Unknown, 2015). The aerial viewpoint cannot be used in 3D games. Even though this perspective shows most of the terrain it usually cannot be rotated, thus not allowing the 3D point of view.

The last viewpoint mentioned is a *side-scrolling view*. Games in this view take place in a 2D environment. The movement of the avatar is limited to only left and right and the surroundings change in dependence on avatar movement. The side-scrolling view is not being used nowadays. It is a type of perspective that was used for low effort games, mainly Arcade jumping games. This kind of viewpoint was primarily used in the 90s when the game devices were not ready yet to fully support 3D graphics. Nonetheless, the games were fun to play (Rob, 2017).

Neither of these perspective types could work without the right choice of colours implemented. Tulleken (2015) points out that "colour is a powerful way to evoke emotion". Colours subconsciously trigger human emotions. Colour triggers are necessary to distinguish between reflective emotions.

Colour is an essential aspect of the game. It establishes atmosphere, conveys moods and makes some unique situation more trusted (Masuch & Röber, 2005). For example, it would be weird if the player enters a cave and there would be shiny bright colours everywhere. The primary function of colour is to make it easier for the player to distinguish between objects. Colour is defined in wavelengths, and when the human eye receives specific wavelength, it immediately starts processing it and causes a reaction. Humans have

different responses to different colours, but most importantly, responses to colours differ between cultures. Developers need to take into account that different cultures react differently to the same colours (Disruptedlogic, n.d.). According to Kyrnin (2016) "in the East, white is the colour of funerals while in the West white is the colour of weddings". It can be quite upsetting for the players when they think that they are at the wedding, but it is a funeral instead. This can happen on several occasions which are not even mentioned, but developers need to take into consideration for what audience they are developing the game so as not to upset them. Perception of colour does not differ only between cultures, but also age is essential factor. Kyrnin (2016) adds that "young children tend to prefer brighter, more solid colours, while adults tend to prefer more subdued colours". That is another critical factor for developers to process, whether they are targeting the older or younger generation.

Apart from society's reaction to colours, the games can also represent progression. It can give the players a sense that they are moving from the place and getting further through the game (Tulleken, 2015). A great example of the use of colour to evoke emotion was not actually in any game, but in popular movie *Matrix: Revolutions.* Kantor (2012) states that "the colour palette: most everyone seems to recall the sickly greens used inside the Matrix, contrasted with the stark blues for the "real world"". Green represents the mind and it is the colour of the virtual world controlled by machines, Matrix. Whenever movie characters appear in Matrix, the whole image is tinted in green, making movie spectators subconsciously realise that. Blue evokes in human sadness, cold and misery and that why it is chosen for the real world because the real world in the movie is harsh and unglamorous (Geoff, 2013). Yellow represents heaven and spirit. Since machines control the real world in the movie and they use humans as their fuel, the machines are considered as gods. That is why they are pictured as yellow particles. The red colour is a symbol of corruption, anger and evil. In the movie, it is the colour of sentinels, which were the main enemies of humans. Also, when the main character *Neo* gets to choose between blue and the red pill, the blue one represents for him "normal" world, where he lived before without knowing he was connected to the Matrix. Meanwhile the red pill represents knowledge and curiosity while white colour in this film does not have a clear state. However, it most likely represents *Neo's* shift and gain of intellection (Geoff, 2013).

Games works basically on the same principle. Whenever the player approaches a new destination, enters a house, gets attacked by an enemy and so on, the colour of the

environment usually changes — that trigger player reflex emotions which were mentioned above.

Distinguishing between environments with the help of colours is one of the most efficient ways how to target players emotions and cognitive thinking. Developers should not underestimate it and use wide ranges of colours to differentiate particular occasions in the game with them. It helps to make the environment more exciting and realistic.

Realism in games, depending on their visuals, is divided into the photorealistic and non-photorealistic game environment. Developers in small studios rather use non-photorealistic setting, since it is easier for development and they can focus more on the story and gameplay of their game. Despite the fact, the non-photorealistic environment can quickly get popular among the players due to its natural approach. Masuch and Röber (2005) claim that it has the potential to "emphasize certain parts of an image without disturbing the image or breaking the atmosphere". On the other hand, well-known developers rather make their games in photorealistic environments since it is much more realistic than doing a non-photorealistic environment. Developers who make photorealistic games try to make the environment and characters look as they look like in real life. The graphics nowadays almost reached that point in movie renders, where humans can barely distinguish between what is real and what is made by computer graphics. For example, in the Star Wars movie, *Rogue One* people were asking where the producers get the exact same looking person as young *Carrie Fisher* (representative of Princess *Leia)*. When the movie was filmed, *Carrie Fisher* was already old and could not play her role in the prequel, where she is supposed to be young, so the studio decided to computer render her character with the help of computer graphics. Cotter (2019) reports that "a Norwegian actress Ingvild Delia was hired to play the role for the brief cameo" to play the human part in the movie production. Thanks to that the animators were able to swap her face and mimic with the young version of *Carrie Fisher*.

Unfortunately, this realistic appearance is nowadays possible only in the movie industry. These scenes, with computer aspect, render for days and it is not possible to replicate them in smooth gameplay. Lal (2019) emphasises that "photo-realistic environments would take need about 40 TFlops of computing power to render in real-time". However, the best computer components a common user can get nowadays can do about 30TFlops. Even though the humans are getting closer to the 40TFlops border, the development of the

computer parts and making them more powerful is slowing down because the components are already so close to each other that putting them even closer might cause that the signals transfer incorrectly.

The problem with photorealistic games is when the player starts interacting with in-game characters. Despite the fact, the NPC look almost as real person, their interaction with player character are quite limited. If a player demands an action from an NPC that is not in their competence, simply nothing will happen, and the NPC won't answer (Lal, 2019). That might cause a disappointment for the player that the NPC does not allow the lead a normal conversation. Also, the mimic of the NPCs is often limited to their purpose in the game and does not support any additional actions. This fact cannot be much affected by the developers, especially in single-player games. They would need to make a game, where every character would act like a human being, which is not possible nowadays. Maybe in, probably, far future there will be a game, where every NPC in the game have its personality and can express its emotions as people do in ordinary life.

Graphical elements are an essential part of every game that cannot be omitted. Developers need to know their gamers' desires and try to fulfil them. They should study carefully what their gamer base wants and how they can impress them. On the other hand, gamers cannot expect from a single-player game to act like a multi-player game and do not have excessive claims, otherwise, they would not enjoy the game.

3.4 Single-player vs multi-player games

People play games for many reasons, to release stress, to relax, also to be the best. People sometimes play games to achieve what they cannot in real life, to escape annoying stereotype they must live in every day and explore the unknown. All that computer games can offer. You can be whoever you want, do whatever you want in the way you like. Both single-player games and multi-player games can satisfy those human needs, but each has its pros and cons and affect people differently.

Single-player games can offer narrative, emotion and characters that multi-player can never achieve (Rectifygaming, 2019). They are universal, so the player can play them basically at any situation without internet connection and is not frustrated when someone tells him to pause the game and leave, they can get back to the progress anytime they want.

Rectifygaming (2019) emphasises that “the single player world is filled with thousands of stories, set on intricately created and beautifully rendered worlds, rife with all kinds of conflict and heroism”. That is something multi-player games can hardly achieve. Till nowadays nobody has ever made a multi-player game, where characters have a deep story, personality and backstory that make players feel emotional, cry when their character dies or something terrible happens to him or her. When playing multi-player games and players’ character is killed, it just respawns after a while, and the game continues, in single-player games, it may mean an end of the whole story. So why there are so many multi-player games on the market and the single-player games are slowly fading away? Imagine, the players have already done everything they could in the single-player game but loves the game so much they do not want to leave it. Thus, the first what happens is that players start to play the game on harder difficulties, beating their friends but what after that? There come the multi-player games. The unlimited options for interaction with real people hiding behind their avatars. That gives players the missing aspect of interaction with real people, which can react on players actions and questions and suddenly the conversation is not scripted like for NPCs. Also, the lack of competitiveness is omitted. The real people factor gives to the game another dimension of difficulty.

One of the reasons why multi-player games are so popular is the competitive aspect. People like to compete against other people, and even when they are not successful in real life, they can be someone in multi-player games (Admin, 2018). The next reason is that multi-player games draw all kind of people. It is a release from the outer world and a form of socialisation for players. Multi-player games also connect people. Players can find their new friend or potential partners from all around the world (Evans, 2019). The reason why people tend to play games might be because some of them have social anxiety that makes them avoid direct contact with other people in real life and they tend to in virtual reality, where the connection with other people is far more comfortable and does not bring any consequences when something goes wrong. This type of contact is mainly achievable in multi-player games, where the people hide behind their virtual characters and their avatars. Furthermore, single-player games allow people to experience stories that would be unrealizable in real life broadening their fantasy.

When the satisfaction from the single-player game fades away and the player wants more interaction with real people playing, there might occur some issues with the level of the multi-player game, and instead, for getting the desired interaction with other players, they

might get disappointed.

3.4.1 The Dunning-Kruger effect

Switching from the single-player game to a multi-player game is not always easy. A lot of games have an option to play a single-player mode where player compete against the computer or a multi-player mode where player face real people. Games, which have this possibility usually let the player play the single-player mode to introduce the mechanics of the game and get him or her ready for multi-player. However, sometimes, it does not end well. A player who is pumped from the single-player tutorial is expecting the same level of gameplay in multi-player, but that is not what usually happens. When a player faces the multi-player for the first time, in most cases, they get crushed by the players that have enough experience playing multi-player (Madigan, 2015). It is because long-time players are more familiar with the game and have enhanced skills. Griffiths (2015b) describes that there are "measurable differences between novice and expert game players, the latter group often demonstrating enhanced short-term memory, executive control/self-monitoring, pattern recognition, visual-spatial abilities (e.g., object rotation), and task-switching efficiency, along with more efficient problem-solving skills". That gives experienced players huge advantage above those, who just entered the multi-player mode of the game and have no experience or whatsoever playing against players that have spent significantly more time on multi-player mode. It may cause the players to give up on game completely, try to persevere and get better or start cheating to help themselves to improve and enjoy the game.

3.4.2 Reasons why gamers cheat

Cheating is an unpleasant behaviour of gamers that do not enjoy playing the game itself anymore and tries to find another way how to enjoy the game, despite the fact they might ruin the experience for the others. It is like social disease, Madigan (2015) comments that "people are more likely to try cheating when they see others around them cheat first". When gamers observe someone else is cheating, the first thing that goes through their mind is why should not they cheat too? It gives them the ability to even with the other gamers who cheat as well and regain the feeling of enjoying the game. Unfortunately, when more people cheat, the game starts to be unplayable for fair-play gamers.

Another reason why gamers cheat may be the Dunning-Kruger effect. When they are tired of losing and they need a tool that would help them to get an advantage above others. People hate losing and when they do, it irritates them. For example, sometimes gamers would rather pay to avoid the loss than do the whole thing again. The same thing can happen in the real world. Madigan (2015) points out an apt comparison "pressure to avoid getting an 'F' in a class leads many students to smuggle cheat sheets into exams more so than does the possibility of getting an 'A'".

This kind of behaviour usually ruins the game, but people also differ in other aspects that define their approach to the game and show the diversity between individual people.

3.4.3 Gamers' behaviour

In the real world, there are several descriptions of human behaviour and approach to other people. Computer games, especially MMORPGs, unlock another cluster of possible responses since there is everything possible. This wide range of possible behaviours Bartle (1996) clusters in four main groups. Those are:

1) Killers
2) Socialisers
3) Achievers
4) Explorers

Killers prefer to compete with other players (highly PvP oriented), they are the players that usually do not achieve much in real life or even were bullied and try to release their anger and social distraction in the game. *Socialisers* prefer to interact and socialise with other people. Socialisers are usually people who like to interact with others and were missing the personal contact either in real life or single-player games. *Achievers* try to complete every aspect of the game on a hundred percent, and *explorers* like to wander and explore the virtual world. That might be caused by a lack of available funds that do not allow them to travel the world in real life, so they tend to fill their desires at least in the game.

There are also other aspects in which people differ such as gender differences. While men prefer interaction with or against other people, women tend to like exploring and in-game work professions more. Younger gamers also prefer PvP and raids, whereas older people prefer doing quests (Yee et al., 2012). Behaviour in games is closely related to real life

acting. Worth (2015) highlights that “personality traits are perhaps even more important to consider as predictors of in-game behaviour. Personality traits have a strong influence on how people think, feel, and behave in the real world, and should, therefore, influence virtual (i.e., in-game) behaviour as well” (p. 37). Furthermore, some abilities are impossible for a human in real-world (such as flying) that may make people behave differently as they would act in the real world.

In conclusion, the way games try to look realistic should not cross the line, where there will be no difference between the game and the real world. That might confuse players to the point, where they cannot distinguish between the real and virtual world, causing them to blend these worlds together. The confusion could cause that players might feel, for example, like in the action shooting game and draw real weapons in the real world not realising the consequences because in the game it does not mean anything.

3.4.4 Avatars

To support the feeling of exploring something new, developers let people make their own avatar in some games. Avatars serve to represent players in the game world virtually. Those avatars, when wandering through the game world act according to their programs, rather than controlling their emotions and body movements by a player. They are being used mainly in shooter games and MMORPG games. How much a player can influence the appearance of their avatar is decided by developers. Some games let a player only choose from predesigned characters that cannot be modified any further, some games allow the player to unleash their imagination. Some gamers prefer to create avatars that match their sex, whereas others use the opposite sex avatar (Yee et al., 2011). The reason why people use avatars of the opposite sex is not entirely apparent, but some studies deal with this phenomenon. Gerson (2016) points out some valuable reasons that were made by Pamela Livingstone. She says that “ask a man who plays video games why he might opt for a female avatar and the answer is usually simple — aesthetics”, whereas some players may react more favourably to a female avatar than to a male one. It is due to the opposite gender attraction. Yee (2014) supports the fact in the study published at “Information, Communication and Society” where researchers found that “the men were more than three times as likely as the women to gender-switch (23 percent vs. 7 percent)”. The reason might be that the men who lack women attention try to infiltrate through the game to the

women community and their avatar helps them to get there more easily, but the other men might have the same idea. This causes controversy about where there the line between sanity and insanity is.

Imagine two straight men in public comforting each other and making compliments to each other. It would be strange and none of them would probably do it. However, this is precisely what happens in an online game when a man courts an attractive female character. Yee (2014) also mentions that "these men strongly preferred attractive avatars with traditional hairstyles – long, flowing locks" and "used more emotional phrases", which means that men tend to create stereotypically beautiful and emotional female avatars. From another perspective, overweight or obese people create for themselves more physically idealised avatars, which are taller or thinner and more appealing to them. And people who are depressed or have low self-esteem create avatars with more idealised traits, such as being more gregarious and conscientious (Yee & Bailenson, 2007). Avatars basically let players raise their self-esteem by the ability to create their ideal themselves.

The possibility of choice, how players want to look in the game and the way they affect other players of the virtual community is controversial. This freedom attracts the players to play the game, but they should still stay within reality. The problem is when players spend more time in the game than doing things in the real world. Then detecting how they should act in real world and the virtual world might get confusing for them. It may cause unpleasant situations in the real world, where the subsequent impact is far more embarrassing, crucial. Players then might switch to spend their time only in the virtual world, neglecting important real-life situations and closing themselves in the virtual reality.

4 Game addiction

When a human is born, they depend on their parents to feed them, take care of them, otherwise, they would not survive. As time goes by, every human probably experiences a kind of addiction. From harmless habits, which could also be defined as a passion to the addictions we maybe do not even realise such as addiction to mobile phones and social media.

Hodent (2018) explains that:

> Each time we refresh our applications on our phone, maybe we will discover some "likes" on our latest post (social recognition is important to humans), or maybe we will discover a message that feels rewarding (e.g., a congratulatory e-mail from your boss, a loving text message from your significant other, etc.). Just like with slot machines, we get junk most of the time we check our phones; but every now and then we are unpredictably rewarded with something we really care about, and that's what feels compelling. (p. 87)

Getting a reward is an essential thing for our motivation, and when we get a reward, we feel pleasant and satisfied. When the need for reward switch from occasional pleasant feeling to urge, the problem starts to rise.

Doing things that motivate us with some rewards is one of the best feeling humans can possibly experience but doing something at the expense of important things that have to be done may be already an addiction. PsychGuides (2019) notes that "there are two major types of video games, and therefore, two major types of video game addictions", the first one is addiction on single-player games. This addiction is not that crucial because once the players finish the game, the addiction will fade away since there is nothing, they could do in the game anymore. It is like finishing a cup of coffee, players feel good for the time being and can move along until some time passes and they feel like having another cup (game). A much worse type of addiction is when a player is addicted to a multi-player game. Since multi-player games usually do not have an ending the addiction persists. The player keeps playing the game more and more, making connections with people and may feel more accepted in the virtual world than in real world (PsychGuides, 2019), which makes them like it more, take it as the leading world to focus on because they can get more rewards there.

Games are made to be rewarding, thus addictive. Developers usually try to put as many rewards as possible for relatively easy tasks, which guide players to an unreachable end of

the game. Why developers do that? The intention is not primarily to make people addicted, but like any other part of the industry, to make money. Game addiction is a tool for developers to get as much money from the gamers as possible. Developers usually include an online shop in their games where players can purchase "motivational rewards" which makes them stronger and accelerates their progress. It relates to the players' behaviour that was mentioned above. Players are trying to be better than the others and it can be achieved either by the time spent in the game or money. However, these two variables do not collocate with each other. Either a player spends time in the real world making money or plays the game resulting in spending the money and when addicted and neglecting work, do not have any money at all.

Ongoing addiction to gaming may cause several problems. A player might lose interest in doing anything else than playing the game. Griffiths (2015a, p. 3) states that it can cause "hyperactivity disorder, symptoms of generalised anxiety disorder, panic disorder, depression, social phobia, school phobia, and various psychosomatic symptoms". When the players are addicted to a game, they barely leave the room, never mind leave the house. The lack of social contact from a real world could cause sacrificing work, education, hobbies. Also, long hours of staring to a monitor lead to lack of sleep and eye burning.

Even though it may seem odd, there are also positive effects of "being addicted". The games release stress, reduce fatigue, increase self-confidence and improve visual attention skills (Irmak & Erdoğan, 2015). From the improvement point of view, some games improve problem-solving and logic, planning and management, multitasking and quick thinking (Tumbokon, 2019).

To summarise the issue of addiction, gamers should reconsider their personal values and find what is vital for them. They should find the right balance point so as not to become addicted.

PRACTICAL PART

5 Research objectives and research questions

The practical part of the bachelor's thesis consists of quantitative research based on an online survey. It is the most efficient way to quickly obtain a large amount of data from a particular group of people. The reason why the survey was not distributed in a paper form is mainly because it takes significantly more time and, moreover, most respondents are available on the Internet.

The main objective of the research was to find out how computer games affect the people who play them. The intermediate objectives of the research were:

- to find out what game genre the respondents prefer;
- to find out how much time the respondents dedicate to the computer games and how it affects them;
- to define what emotions respondents experience during the gameplay;
- to determine what aspects of game design the respondents prefer;
- to identify the respondents' approach to the game mechanics and play style;
- to analyse the effect of computer games on the behaviour of the respondents in the real world.

The research questions were the following:

- How long do the respondents spend playing games and how it influences them?
- How do some aspects of game design influence players' emotions?
- How do game features affect the players and how important it is to socialise in the game?
- How does the virtual world influence players in real life?

6 Research design

The research is divided into three main stages: preparation stage, realisation stage and evaluation stage. First, I prepared the basic concept of my survey with questions that were, in my opinion, relevant to the topic of my bachelor's thesis or, more precisely, to its theoretical part. The reason why I chose the questionnaire survey as a method was to collect data in a quick and organised way. The online questionnaire allows respondents to answer questions on their own schedule, and moreover, it ensures their anonymity, so they feel more comfortable providing open and honest feedback. Google Forms was chosen for this purpose. It is a well-known platform for surveys and people are more familiar with it than with other survey platforms. It relates to Google Tabs where all data from the questionnaire are stored and instantly backed up. After all data are collected, Google Forms easily exports data to an Excel format for further evaluation.

The realisation stage aimed at selection of appropriate questions and a template for the questionnaire. The beta version of the questionnaire was distributed among a few private respondents whose opinions helped me detect unclear questions, missing alternatives of multiple-choice questions and add some additional open questions under the ones which needed extra information.

After the necessary improvements of the pilot version of the questionnaire, I published its final version (see Appendix) online. The original aim was to get at least 100 respondents to make the results relevant. I used various methods of sharing the survey. Firstly, I posted it on my Facebook wall, but unfortunately, the number of completions was not as satisfactory as I had expected. Eventually, I tried to post it on subreddit website SampleSize, where people all around the world post their surveys and help each other by completing it. It helped me to get valuable and sophisticated answers from students all around the world, who form most of this website. Unfortunately, the post of the survey dismissed in a few hours, so I was not able to get much from there. Finally, I managed to find a famous "streamer" of the games on the *twitch.tv* website, which is in Stephenson's (2019) interpretation "a popular online service for watching and streaming digital video broadcasts". I asked him if he could complete my survey, and consequently, many people started to repost my demand, until he eventually noticed it. Then he completed it in front of 700 people watching him, which made part of his audience complete it as well. That gave me around 250 answers in 10 minutes, and there was no point to spread it even further. The

only disadvantage was that his audience mainly consisted of young males, which resulted in a high disproportion of males to females.

The evaluation stage aimed to analyse the collected data. The questionnaire consists of multiple-choice questions where respondents had to choose from available options, closed questions with an additional open question to justify their answer and fully open questions. Answers to the open questions were evaluated and divided into categories according to their meaning. Only the most frequent categories were included, irrelevant categories or categories with a small number of answers were merged into the category “other”. Answers with no or irrelevant response to the additional question related to the previous topic were not included.

7 Data presentation and interpretation

The survey was divided into five sections, including General information about the player, Gaming passion, Effect of games on the player, Socializing and preferences, and Player behaviour. All data were analysed in Microsoft Excel. The following chapters present, describe and interpret data.

7.1 Characteristics of a research sample

For the purpose of this survey, simple random sampling was used. The questionnaire was posted on the Internet websites where everyone had the same chance to complete it if they wanted. It is the most straightforward method for collecting data from a large number of people.

The first section of tables and figure shows the general information about the respondents, and moreover, their preferences for the game genre and developer studios.

Gender	Absolute value	Percentage
Female	44	13.25%
Male	288	86.75%
Total sum	**332**	**100%**

Table 1. *Gender of respondents.*

Table 1 shows that most respondents were men consisting of 86.75% compared with 13.25% of female respondents. Even when females were in the minority, enough data were collected to make conclusions.

Age	Female	Male	Total	Percentage
under 18	9	96	105	31.63%
18-24	25	160	185	55.72%
25-34	8	26	34	10.24%
35-49	1	4	5	1.51%
50+	1	2	3	0.90%
Total	**44**	**288**	**332**	**100%**

Table 2. *Age groups of respondents.*

More than half of the respondents belonged to the category of 18–24 years old, while only eight respondents were older than 35 years (see Table 2). The reasons why most respondents were young people are two: the respondents completed the questionnaire on

the Internet websites where it was published, and gaming is more popular among the young generation.

Answer	Absolute value	percent
Very often	134	40.36%
Often	124	37.35%
Sometimes	64	19.28%
Rarely	10	3.01%
Total	**332**	**100%**

Table 3. *Respondent's self-assessment of how often they play.*

The data in Table 3 show that 40.36% of respondents claimed that they played computer games very often, and more than a half of the total 56.63% answered that they played often or sometimes.

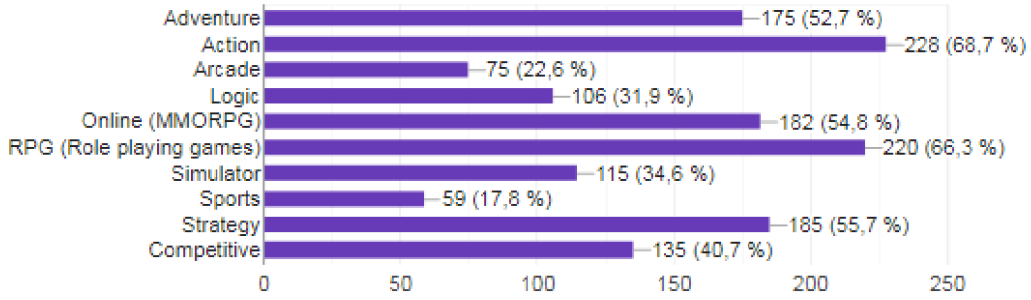

Figure 1. *Respondents' preference of game genre.*

Figure 1 illustrates the answers to the multiple-choice question considering the game genre the respondents preferred. The respondents could select more options here. Most respondents declared that they played Action and RPG games, which were selected most frequently. Some of them selected Adventures, MMORPG, and Strategy games in addition to other preferences. The minority of respondents preferred Competitive, Sports, Arcade, Logic, and Simulator games.

Answer	Absolute value	Total
Yes	Expectation of the quality	24
	Fame	9
	Other	19
	Total	52
Sometimes	I do not care	15
	Depends	33
	Other	40
	Total	88
No	I do not care	24
	The budget does not matter	13
	Other	10
	Total	47
Did not answer		145
	Total sum	**332**

Table 4. *Respondents' preference of developer studios in open questions.*

Table 4 shows answers to a closed question regarding the respondents' preference of well-known developers and the additional open question to express their opinion. Over one half of the respondents believed that the name of the developer is not relevant to the quality of the game itself. The respondent, who answered "Yes" mostly supported their opinions with the expectation of quality games from well-known developers and they rather trusted the company they had experience with.

Most people who answered "Sometimes" were not sure with their answers and their answers were either irrelevant or they considerably varied. The respondents who said it depended usually hesitated and picked their games depending on their taste. Some of them did not care what genre they played as long as they enjoyed the game.

Most respondents answering "No" claimed that they felt good playing no matter what genre it was. Meanwhile, 13 respondents said that the budget and large team for developers was no warranty of a quality game.

7.2 Time spent in front of the computer and its consequences

Tables in this section show how much time respondents spend in front of the computer and how it affects their mind and behaviour.

Answers	Female	Male	Total	Female percentage	Male percentage	Total percentage
1-2 hours	17	69	86	38.64%	23.96%	25.90%
3-4 hours	18	103	121	40.91%	36.00%	36.45%
5-6 hours	5	63	68	11.36%	21.88%	20.48%
7-8 hours	2	34	36	4.55%	11.81%	10.84%
9-10 hours	0	13	13	0%	4.51%	3.92%
11+ hours	2	6	8	4.55%	2.08%	2.41%
Total	**44**	**288**	**332**	**100%**	**100%**	100%

Table 5. *Time spent on playing computer games.*

Table 5 shows that 62.35% of respondents play less than 4 hours a day, which is still not alarming. On the other hand, 37.65% of respondents play more than 5 hours a day and 6.33% of them even more than 9 hours. That should be considered as a serious problem unless playing games is their job. The tables in this chapter show how much time respondents spend in front of the computer and how it affects their mind and behaviour.

Answers	Absolute value	Percentage
1-2 hours	**86**	**100%**
Yes	37	43.02%
No	49	56.98%
3-4 hours	**121**	**100%**
Yes	76	62.81%
No	45	37.19%
5-6 hours	**68**	**100%**
Yes	47	69.12%
No	21	30.88%
7-8 hours	**36**	**100%**
Yes	22	61.11%
No	14	38.89%
9-10 hours	**13**	**100%**
Yes	13	100%
11+ hours	**8**	**100%**
Yes	6	75.00%
No	2	25.00%
Total	**332**	

Table 6. *Respondents' answers related to the time spent on playing games every day.*

Table 6 shows alarming percentages related to the discussed problem. Apart from the respondents who spend 1–2 hours playing daily, all other categories indicate that more than a half of the respondents answered that they did not think about doing anything else than

playing computer games all day long. While 13 of them who replied they played 9–10 hours daily claimed that they had thought about doing anything else.

Answers for „Have you ever felt addicted to a game? “	**Answers for „Do you neglect the others? “**			
	Yes	**Sometimes**	**No**	**Total**
Yes	51	86	61	198
No	8	50	76	134
Total	**59**	**136**	**137**	**332**

Table 7. *Impact of addiction on time spent in real life.*

All the respondents were asked whether they would neglect their friends, family members or even duties at the expense of playing games. As Table 7 indicates, 51 out of 59 respondents, who admitted feeling addicted, claimed that they did neglect their real-life responsibilities, while only 8 respondents, who never felt addicted to a game, said they would do the same thing.

Answers	**Absolute value**	**Percentage**
Yes	248	74.70%
No	84	25.30%
Total	**332**	**100%**

Table 8. *Games as stress relievers.*

Respondents were asked if the games make them feel relaxed and help them release stress. Table 8 shows that 74.70% of respondents confirmed that they felt more comfortable when playing games, while the minority of 25.30% respondents denied it. These results might be related to the time spent on the computer. The respondents who spent less time in front of the computer were happier with their real-life than those who preferred the virtual world.

7.3 Impact of the game aspects on human emotions

The following text deals with emotions that the respondents feel while playing the game and the aspects that might be the most influential factors of this phenomenon.

Answers	Absolute value	Percent out of the total	Anger	Percentage related to anger	Happiness	Percentage related to happiness
Never	11	3.31%	0	0.00%	0	0.00%
Occasionally	78	23.49%	33	42.31%	58	74.36%
Sometimes	144	43.37%	111	77.08%	112	77.78%
Often	65	19.58%	56	86.15%	52	80.00%
Very often	34	10.24%	31	91.18%	25	73.53%
Total	**332**	**100%**	**231**		**247**	

Table 9. *Emotions the respondents feel while playing games and the most frequent emotions depending on the amount of emotions released.*

The purpose of the section "Impact of game aspects on human emotions" (see Appendix) was to find out how many respondents feel emotive when playing games. Table 9 illustrates that almost a half of the respondents claimed that they sometimes felt emotive and about 70% of them said that they were mostly experiencing either anger or happiness when playing. These emotions are practically antonyms and still coexist together. This finding might mean that developers do the right work when they can satisfy as many human feelings as possible to make a successful game. However, it could also be a matter of the emotiveness of the respondents. The percentage of anger exponentially grew depending on how often the respondents became emotive when playing, while happiness stagnated on the similar percentage numbers (see Table 9). This could indicate that no matter how emotive the respondents are the fundamental emotion they need to experience whenever playing game is happiness.

Answers	Absolute value	Percentage
Yes	313	94.28%
No	19	5.72%
Total	**332**	**100%**

Table 10. *Importance of sounds in the games.*

Table 10 shows that most respondents (94.28%) thought that sounds in games were an essential factor, whereas the negligible minority of 5.72% respondents denied the influence of sounds.

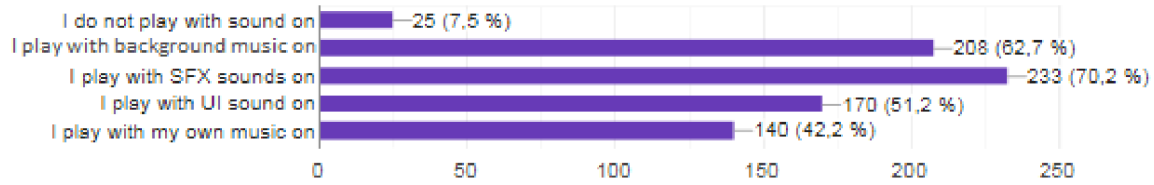

Figure 2. *Respondents' preference of sound signals in the game.*

The distribution of respondents in Figure 2 shows their preference of music they listen to either in the game or as an external source. Since the majority of respondents answered in that they find sounds important (see Table 10), Figure 2 clarified their decision. The majority of respondents answered that they played with the SFX sounds on, which are the sounds of their character and all the special effects in the game that gives the players clear response that they pressed the right button and the command entered by them was carried out. The second option selected by respondents was the background music which usually creates the atmosphere of the particular situation in the game (see Chapter 3.1 Music and sound signals). Slightly above a half of the respondents (51.2%) selected the option that they played with UI sound on, which is the sound of the user interface. This is also an essential sound feature of games. If the players change the interface, for example adjust the game graphics, the sound signals let them know that the game does not freeze, and their request is made. 42.2% of respondents did not find the in-game sounds significant enough and they prefer playing their own music, and 7.5% of respondents did not play with any sounds turned on.

Answers	**Absolute value**	**Percentage**
Yes	175	52.71%
No	157	47.29%
Total	**332**	**100%**

Table 11. *Importance of graphics.*

Respondents' opinion on whether they prefer high-quality graphics of games unexpectedly did not vary by a large margin. It was expected that the high-resolution photorealistic graphics would be highly favoured in contrast with the low resolution non-photorealistic old fashioned graphic (see Chapter 3.3.1 Graphical elements), but it seems that the other aspects of games are more important.

Answers	**Absolute value**	**Percentage**
The narrative that arises from the player interaction with the game world	246	74.10%
The pre-generated narrative that cannot be affected by player	86	25.90%
Total	**332**	**100%**

Table 12. *Respondents' preference of narrative styles.*

One of the main deciding factors, whether the game is satisfying enough for the player might be its narrative gameplay. The respondents' answers for the question if they like to be guided or rather play on their own differed considerably. 74.10% of respondents said that they would rather play a game, where the narrative of the game arises from their actions than being strictly guided through the game and not being able to make their own decisions, while 25.90% of respondents thought the exact opposite.

Developers should not omit either of those two groups of players since not everyone likes to make their own decisions and prefers to be guided.

Answers	**Absolute value**	**Percentage**
The Witcher	44	21.26%
Detroit: Become Human	14	6.76%
Life is Strange	11	5.31%
Fallout	6	2.90%
Assassins Creed	5	2.42%
Mafia	5	2.42%
I do not know	17	8.21%
Other	105	50.72%
Total answers	**207**	**100%**
Did not answer	125	
Total	**332**	

Table 13. *Respondents' opinion of the narrative-wise best game.*

Respondents were asked to justify their opinion related to the question in Table 12. Since it was an open question, respondents were able to fill in whatever they wanted. The most frequent answers were put into clusters and are illustrated in Table 13. Responses whose number was less than five were clustered under the answer "Other". One hundred twenty-five respondents missed this question and did not put any answer into the question box.

The most significant percentage of respondents (21.26%) who had a definite opinion, answered that they liked the game *The Witcher* most. *The Witcher* is one of the most famous action-RPG games known. It is an open-world game where players can do whatever they like, and it has a backstory made entirely from books published with the same name before the game was released. These aspects might be the reason why most of the respondents mentioned that game. The idea that they can witness the book in an interactive form where the players are the story-makers might have enhanced the enjoyment from the story. Also, when the actual visuals are added instead of human imagination, it makes it far more enjoyable (see Chapter 3.2 Narrative).

7.4 Respondents' socialising and personal preferences

Vision is a crucial sense that enables gamers to process what takes place in the game, therefore the respondents were asked in this section what type of visuals influence them most. Furthermore, the importance of socialising in games was examined.

Answers	Female	Female percentage	Male	Male percentage	Total	Total percentage
Not important at all	4	9.09%	41	14.24%	45	14.24%
Slightly important	6	13.64%	56	19.44%	62	19.44%
Somewhat important	19	43.18%	78	27.08%	97	27.08%
Very important	9	20.45%	72	25.00%	81	25.00%
Extremely important	6	13.64%	41	14.24%	47	14.24%
Total	**44**	**100%**	**288**	**100%**	**332**	**100%**

Table 14. *Importance of the game character's appearance.*

When players dedicate a significant amount of time to a game where they play as a specific character, the game usually allows them to personalise avatar according to their preferences (see Chapter 3.4.4 Avatars). Table 14 shows the difference between males and females regarding the character's appearance. The only answer where the percentage of total answers differed by a large margin was that females found the character's appearance "somewhat important" in 43.18%, while males only in 27.08% of cases. That neglected the claim (see Chapter 2.1 Difference between male and female gamers) that females rely on the character's appearance more than males while playing computer games.

Answers	Female	Female percentage	Male	Male percentage	Total	Total percentage
Item that makes you unique	18	40.91%	98	34.03%	116	34.94%
Item that makes you stronger	26	59.09%	190	65.97%	216	65.06%
Total	**44**	**100%**	**288**	**100%**	**332**	**100%**

Table 15. *Item preference depending on the gender.*

Respondents were asked if the items that they seek for vary (see Table 15). The main aim was to distinguish between the item visage and its power. The findings show that either male or female prefer to get an item that is stronger at the expense of its visage. That somehow rejects the claim that females prefer having the items that look better than in real life.

Answers	Yes	Percentage "Yes"	No	Percentage "No"	Total	Total %
Not interested at all	17	8.59%	19	14.18%	36	10.84%
Slightly interested	36	18.18%	24	17.91%	60	18.07%
Somewhat interested	74	37.37%	55	41.04%	129	38.86%
Very interested	50	25.25%	28	20.90%	78	23.49%
Extremely interested	21	10.61%	8	5.97%	29	8.73%
Total	**198**	**100%**	**134**	**100%**	**332**	**100%**

Table 16. *Respondents' interest in the precise numbers shown in the game with an impact on their addiction.*

To confirm the assumption from Table 14. *Importance of the game character's* and Table 15, the next question the respondents were asked was if they were interested in precise numbers in the game. The meaning of precise numbers is that the game gives players numerical information about, for example, how much damage they have dealt with or how fast they were. The higher (better) numbers are a reward for the players since it subconsciously makes players improve the numbers and be better (see Chapter 4 Game addiction).

Answers	Yes	Percentage "Yes"	No	Percentage "No"	Total	Total %
Not interested at all	17	8.59%	19	14.18%	36	10.84%
Slightly interested	36	18.18%	24	17.91%	60	18.07%
Somewhat interested	74	37.37%	55	41.04%	129	38.86%
Very interested	50	25.25%	28	20.90%	78	23.49%
Extremely interested	21	10.61%	8	5.97%	29	8.73%
Total	**198**	**100%**	**134**	**100%**	**332**	**100%**

Table 16 provides a piece of evidence that the precise numbers might influence the respondents' addiction. The percentage of the answers to which the respondents answered that they are "somewhat interested" or "slightly interested" is similar or lower in connection with game addiction. However, the number of answers related to "very interested" or "extremely interested" is different. 25.25% of respondents said that they felt addicted and are "very interested" in precise numbers, while 20.90% of respondents said they did not feel addicted, and almost the same difference occurs in the case of the answer "extremely interested", where the margin is 4.64% in favour of game addiction.

Precise numbers seem to be a powerful tool for developers to generate the players' motivation and keep them playing the game.

Answers	Absolute value	Total percentage
Much rather solo	44	13.25%
Rather solo	87	26.20%
Neither group nor solo	126	37.95%
Rather group	49	14.76%
Much rather group	26	7.83%
Total	**332**	**100%**

Table 17. *Respondent's opinion of playing in a group or solo.*

Table 17 shows the respondents' preference for playing alone or in a group. While 37.95% of respondents did not care if they played in a group or solo, 39.45% of respondents in total preferred playing the games alone and 13.25% of them did not like to play in a group at all. This is by 16.86% more in total than the percentage of respondents who preferred

playing in a group (22.59%), which might indicate that the rise of multi-player games is not as significant as was assumed (see Chapter 3.4 Single-player vs multi-player games); and it also shows that the urge to make the game multiplayer at all costs might not be the right way in all cases.

Answers	Absolute value	Total percentage
Not important at all	132	39.76%
Slightly important	81	24.40%
Somewhat important	77	23.19%
Very important	35	10.54%
Extremely important	7	2.11%
Total	**332**	**100%**

Table 18. *The respondents' fame in the game.*

Table 18 deals with the need of respondents to be somehow famous in the game. Only 2.11% of respondents said that they found it "extremely important" and 10.54% "very important", which is overall just 12.65% of all respondents who think that being famous in the game matters. On the other hand, 39.76% of respondents, which is the highest percentage output in Table 18, said that they did not need to be famous in the game at any cost. This might suggest that the game developers do not need to design the games where the players are the heroes of the whole situation and can achieve the fame they cannot gain in real life. The data in Table 18 could also indicate that the respondents who answered that they did not need to be famous might be introverts and do not want to change it even in the game because it might make them feel uncomfortable.

Answers	Not at all	A little	Some	A lot	A great deal	Total
Playing the game to 100% completion	4	21	33	53	34	**145**
Doing the main quest line and some side quests that interest me	11	30	62	50	17	**170**
Doing just the main quest line	4	4	0	4	0	**12**
Total	**19**	**55**	**95**	**107**	**51**	**327**

Table 19. *Respondents' need to finish all the quest lines in the game depending on pursuing locations, objects, etc. that the others did not find.*

The game developers who design open-world games sometimes try to make the game narrative more interesting by adding an Easter egg to their game. Gouskos (2005) adds that Easter eggs are "hidden properties of games that can be revealed by button combinations or by accessing remote areas in the game or on the disc itself". Table 19 shows the respondents' interest to find these Easter eggs, thus achieving 100% completion of the game because they are usually the last thing that separates the players from 100%

completion. Table 19 proves that a large number of respondents (145) like playing their game to 100% completion at any cost, and 170 respondents want to seek for a side quest, or maybe Easter eggs, they like to finish. Respondents, who answered on these two mentioned questions also show a higher interest in finding a hidden location that other players did not find (see Table 19).

Developers should not leave out the outside quests and Easter eggs from the main story because according to Table 19, it makes the majority of respondents motivated to play their game and rewarded that they had found something that the others had not.

7.5 Influence of the virtual world on human behaviour

This chapter focuses on the respondents' awareness of distinguishing between their real-life abilities and the abilities they can use only in the virtual world.

	Answers					
Hours played each day	**Never**	**Occasionally**	**Often**	**Sometimes**	**Very often**	**Total**
1-2 hours	46	20	1	17	2	86
3-4 hours	53	37	8	20	3	121
5-6 hours	16	19	6	25	2	68
7-8 hours	12	13	3	6	2	36
9-10 hours	3	3	3	4	0	13
11+ hours	2	2		4	0	8
Total	**132**	**94**	**21**	**76**	**9**	**332**

Table 20. *Respondents' awareness of how often they act in public in the same way as in the virtual world with hours played each day taken into consideration.*

The gamers' behaviour can be reflected in their real life. The more time players spend in front of the computer playing games, the more it will influence them. Table 20 shows that the time spent in front of the computer does not affect the respondents in their real life.

	Answers					
Genders	**Never**	**Occasionally**	**Sometimes**	**Often**	**Very often**	**Total**
Female	28	7	8	0	1	44
Male	104	87	68	21	8	288
Total	**132**	**94**	**76**	**21**	**9**	**332**

Table 21. *Gender differences related to the respondents' conviction that they are capable of having the same powers as their character in the game.*

Even though the data in Table 20 indicate that the hours spent in front of the computer do not influence the respondents' real-world behaviour, it might influence their inner feelings (see Table 21). Fortunately, a large number of respondents said that they had never felt the same powers as their characters (132) or only occasionally (94). Nevertheless, there were respondents who sometimes felt they had the same powers (76) or often felt they had the abilities of their in-game characters. Only one female and 29 males felt they had the powers of their character often or very often, which could emotionally influence them to miscalculate their capabilities and do something that they would regret. This disproportion in the female and male number might be because the main character in the games is often a male when the gamers do not have the option to make their own character; and males see an idol in the given character due to his narrative or powers trying to be like him. This might also be the reason why male gamers prefer the gender swapping when it comes to the character design in games which have that option (see Chapter 3.4.4 Avatars).

8 Discussion

The questionnaire has shown that respondents are aware of how often they play computer games and what consequences it can cause. Even though the gap between the number of males and females was rather wide, it did not affect the overall relevance of answers. The findings have shown that the choice of computer games made by respondents highly depends on their mindset and actual feeling from the game. It has been confirmed that emotions play a significant role in the overall impression from the game and can be a deciding factor for respondents.

According to the findings, the respondents who spend more time on the computer might tend to fall into addiction, thus neglecting their responsibilities and real-life duties that are crucial for them. Next, the findings have shown that the reason might be the high rewards the games provide that generate the respondents' motivation. When respondents do not find the motivation and rewards easily, they might suffer from stress in real life. Moreover, the findings have proved that games do release tension via the gameplay.

A large number of respondents feel emotive when playing the game and the most occurred emotions that were voted jointly were anger and happiness, which might indicate the road from pursuing the reward until they get it.

In the next part of the questionnaire, respondents should recognise aspects of the game that make them interested in the game such as a narrative. Most respondents claimed that the narrative that lets them make their own story and does not strictly guide them is far more enjoyable. The idea of freedom gives respondents the ability to be whoever they want, but in accordance with the findings, fame is not what they seek for.

The long time in front of the computer can profoundly influence people's mind and rewire their brain into the state where they are not able to clearly distinguish between the real and virtual world. The findings have shown that some respondents might have experienced occasions where they were not fully aware of their movement and behaviour in public. Males, in particular, often felt that they had the abilities of their virtual character in the real world.

Game development is a growing industry which is getting more attention every day. To make a successful game, developers should listen to their gamer base and know the audience they are targeting. The aspects of the game such as sound or graphics might have

a great impact on the character of the game. The main thing that developers should implement into their games is the motivation-reward system because this is what players subconsciously seek for, and gamers' addiction can ensure the permanent gamer base. Although all the aspects can make gamers satisfied, they can also make them addicted and even dangerous for themselves and their surroundings. For this reason, developers should find the right balance between what is useful and what can be harmful.

CONCLUSION

This bachelor's thesis discussed the influence of the computer games on human emotions, feelings and behaviour and how each aspect of the game plays its crucial role in the players' perception. Firstly, the thesis showed that the differences between males and females exist and can have an impact on the perception of the game. In the practical part, the findings have shown that it is not the case in all circumstances and the difference between genders is not as comprehensive as expected.

The thesis also examined the important aspects that influence the process of the game development. The assumptions that were made in Developers' mind versus gamers' mind chapter and Problems with narrators chapter that the games from big developer studios do not always have an obvious advantage over the small developers' groups or individuals were confirmed in the practical part. The respondents' answers supported the fact that the main deciding factor is the playability of the game, thus everyone has the chance to make a successful game, but it depends on how well the developers know their audience.

The main aspects of the game such as music, narration and graphics were further described. It was found that they strictly rely on each other and could not be omitted in most cases. The importance of them was evaluated in the practical part where music and narration proved to be the necessary aspects. Meanwhile, the graphical design was the least significant in terms of graphic resolution. Even though the graphic resolution was found as the least impactful, the developers should pay the same attention to all these aspects since the meaningfulness and the gameplay of the game are crucial factors.

The players' problems with switching from a single-player game to a multi-player game were specified, and the research results in the practical part of the thesis have shown that developers should not succumb to the rise of multi-player games because not everyone is ready for it. Socialising in games has been found as a problem which many players prefer to avoid.

The last part of the thesis dealt with the potential addiction problems and the consequences associated with it. It was revealed that addiction could cause more significant psychical issues than those which players have in real life. Furthermore, the virtual world can influence our behaviour in real life, making us act unnaturally.

Developers should reconsider each step they make in their development and they should not underestimate each mentioned factor that could influence the potential gamer. The research findings have shown that the motivation-reward system for the players is the efficient method which is frequently employed in the games. Nevertheless, developers should try to impress the players with alternative methods such as designing interesting game aspects instead of making them addicted to the game for no particular reason.

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Appendix

Questionnaire

General section

What is your gender? *

- Male
- Female

How old are you? *

- under 18
- 18-24
- 25-34
- 35-49
- 50+

How often do you play games? *

- Never
- Rarely
- Sometimes

What kind of a gameplay do you prefer? *

- [ ] Adventure
- [ ] Action
- [ ] Arcade
- [ ] Logic
- [ ] Online (MMORPG)
- [ ] RPG (Role playing games)
- [ ] Simulator
- [ ] Sports
- [ ] Strategy
- [ ] Competitive
- [ ] Other...

Do you prefer to play games from well-known game developer studios? *

- ( ) Yes
- ( ) Sometimes
- ( ) No

Give reasons for your answer to the previous question, please.

Time spent in front of the computer and its consequences

How many hours do you spend playing computer games every day? *

- ○ 1-2 hours
- ○ 3-4 hours
- ○ 5-6 hours
- ○ 7-8 hours
- ○ 9-10 hours
- ○ 11+ hours

Have you ever thought about playing a game all day long? *

- ○ Yes
- ○ No

Have you ever felt addicted to a game? *

- ○ Yes
- ○ No

Do you neglect others (e.g. family, friends) because of playing games? *

- ○ Yes
- ○ Sometimes
- ○ No

Do you play games to release stress? *

- ○ Yes
- ○ No

Impact of game aspects on human emotions

Are you emotive when playing a game? *

- ○ Never
- ○ Occasionally
- ○ Sometimes
- ○ Often
- ○ Very often

What emotions do you experience when playing games? *

- ☐ Anger
- ☐ Sadness
- ☐ Disgust
- ☐ Fear
- ☐ Happiness
- ☐ Joy
- ☐ Surprise

Do you think sound effects are important in the game? *

- ○ Yes
- ○ No

What in-game sound effect do you use? *

- ☐ I do not play with sound on
- ☐ I play with background music on
- ☐ I play with SFX sounds on
- ☐ I play with UI sound on
- ☐ I play with my own music on

Is the high resolution graphics of the game important to you? *

- ○ Yes
- ○ No

Is a good narrative important to you? *

- ○ Yes
- ○ No

What type of a narrative do you prefer? *

- ○ Pre-generated narrative that cannot be affected by a player
- ○ Narrative that arises from the player interaction with the gameworld

Socializing and personal preferences

Are you interested in precise numbers in game mechanics? (i.e. how much damage you have dealt, chance to block the attack, magic resistance, etc.) *

- ○ Not Interested At All
- ○ Slightly Interested
- ○ Somewhat Interested
- ○ Very Interested
- ○ Extremely Interested

Would you rather be grouped or play solo? *

- ○ Much Rather Group
- ○ Rather Group
- ○ In-Between
- ○ Rather Solo
- ○ Much Rather Solo

How important is it to you to be well-known in the game? *

- ◯ Not Important At All
- ◯ Slightly Important
- ◯ Somewhat Important
- ◯ Very Important
- ◯ Extremely Important

How much time do you spend customizing your character during character creation?

- ◯ None
- ◯ A Little
- ◯ Some
- ◯ A Lot
- ◯ A Great Deal

What would you rather have? *

- ◯ Item that makes you stronger
- ◯ Item that makes you more unique

What type of a gameplay do you prefer? *

- ◯ Doing just the main quest line
- ◯ Doing the main quest line and some side quests that interest me
- ◯ Playing the game to 100% completion
- ◯ Other...

How much do you enjoy pursuing quests, NPCs or locations that most people do not know about?

- ◯ Not At All
- ◯ A Little
- ◯ Some
- ◯ A Lot

Influence of the virtual world on the human behaviour

Do you think you are capable of doing things in real life that your character can do in the game?

- Never
- Occasionally
- Sometimes
- Often
- Very often

Do you end up doing things in real life like your character in the game? (i.e. using the same language, the same type of clothes, etc.)? *

- Never
- Occasionally
- Sometimes
- Often