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"Cognitive Load and Flow in Multiplayer Online Battle Arena Games"

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Abstract

Nowadays the computer games became part of our lives. It's important to study the cognitive load of the game and the flow experience of users because this factors either may lead the user to quit playing the game or can help to improve the game experience further and become more enjoyable for the user. This study examines the theoretical as well as practical notions of cognitive load and flow state that the users may experience in a MOBA (Multiplayer Online Battle Arena) gaming environment. The main goal is to evaluate the cognitive load and state of flow by utilizing the classical data collection tools, tracking devices as well as the advanced software and technology such as FaceReader for detection of emotions from facial expressions and the Q sensor, which is a wearable device that records skin conductance. Consequently, a general goal is to provide important information that could be missing from the studies that use traditional methodology for data collection.

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Chapter 1

Introduction

MOBA (Multiplayer Online Battle Arena) are real time battle games, sub-genre of real time strategy (RTS) genre. The battle usually takes place between two teams in a fantasy environment. The player can choose only one hero and control him using RTS-style interface. Every hero has different abilities and he is a part of team strategy. The strategy include the responsibility to choose members that match the requirements and can complete competitive team. The player must undertake a specific role and job in the game and cooperate with other players to achieve a goal

The goals may slightly differ from one MOBA to another, but the main goal is to defend their base and to destroy the enemy's base. Except that, as a general rule, the player has to kill the enemy and among others, to destroy enemy's buildings. The player after certain achievements in the game (i.e. winning a battle, killing an enemy) will get to a higher level and increase hero's powers, experience and skills.

In this thesis, I aim to study the cognitive loads that may occur in MOBA, the flow state of players, and the emotions they express during the game play. For this research purpose, I will study the massively multiplayer online role-playing game "League of Legends" which is a free MOBA. It became popular over the last few years, decreasing in popularity the commercial MMORPG World of Warcraft and MOBA Defeat of Ancients (DotA).

Necessity of current research

It's important to study the cognitive load of the game to indicate which cognitive load problems may occur and what is the cause of these problems. Thus, the game experience can be improved further and become more enjoyable for the user. Many times the cognitive load issues lead the user to fail winning the game, which leads to frustration or even quitting the game. Thus, it's important to research what dimensions of flow the user may experience

while playing, what makes the user to keep playing that certain game and what emotions the game may evoke.

To this day, there were few academic and published studies held concerning cognitive load in online video games and none about cognitive load in MOBA genre games, because it is a relatively new game genre (sub-genre of Real Time Strategy genre). The most similar study to the current thesis, provided a basis for cognitive load in MMORPG gaming environments is named "A model of cognitive loads in MMORPG" (Ang, Zaphiris and Mahmoud 2006). The findings of study revealed 5 types of cognitive overloads in MMORPGs: the multiple game interaction overloads, the multiple social interaction overloads, the parallel game and social interaction overloads, the interface overloads and the identity construction overloads. In the present study, we are going to examine if these types of cognitive overloads can be applied in the Multiplayer Online Battle Arena games (such as League of Legends in this case). Other studies about cognitive load that were conducted, were not related to online games. One example is study about the effects of metaphorical interface on germane cognitive load in Web-based instruction (Cheon and Grant 2012). This research paper studied learning performance of different web interfaces.

Several studies were conducted about the flow in video games and virtual worlds. The study by Faiola et al. (2013) examined the effect of flow and telepresence in virtual worlds like Second life, and how they can enhance the game based learning. Another related research was done by Kostiew (n.d.) who evaluated the game flow of two MMORPGs: Warcraft and Lords of Everquest). Some other studies go further than the traditional methods of collecting data for evaluation of a user's experience with entertainment technology (Hazlett, 2006; Mandryk, Inkpen, & Calvert, 2006;Ravaja et al., 2004) . These studies have used physiological measurements such as electromyography, electrodermal activity and electroencephalography to evaluate the effect of flow more efficiently.

This thesis, has the goal to evaluate the cognitive load and cognitive absorption by utilizing both classical data collection tools such as questionnaires along with tracking devices like video capture. In addition to that, the present study also investigates the insights of participants by using advanced software and technology. For the current research purposes

was used FaceReader which is a device that allows the detection of emotions from facial expressions. Another technology that was utilized was the Q sensor, which is a wearable device that records skin conductance. This device records physiological measurement called electrodermal activity in order to provide important insights to what is going within the person. The skin conductivity responses changes accordingly to the different internal or external stimuli the brain receives which are psychologically arousing. Consequently, a general goal is to provide important information that could be missing from the studies that use traditional methodology for data collection.

In this thesis, we will attempt to investigate the following research questions:

- What kinds of cognitive overloads users of MOBA experience?
- What dimensions of flow do players of MOBA show?
- What insights can be provided from Electrodermal activity of LOL players?

Chapter 2

Literature review

Introduction to MMORPGs and MOBA genre games

Over the last few decades, the video games industry has made a huge progress in terms of graphics, game development as well as a new kind of interactions and social interaction between the players-. In the late 1970s the first multiuser games appeared- the called MUD (Multi-User Dungerons) - which were text based. Some of them, had very simple graphics and others didn't have any graphic elements at all. The whole concept of the environment, depended on the or player's imagination. The players were describing their appearance with words as well as the environment where the game took place, creating a narrative story about the game.

Due to computer hardware and software advances and especially the World Wide Web, the new kind of video games made their entrance in the digital era-the famous "massively multiplayer online role playing games" (MMORPGs). The first MMORPG was the Meridian 69 which appeared in 1976. Early in 1997, the term MMORPGs appeared; it was firstly used by Richard Garriot describing the launch of a new multiplayer game, called "Ultima Online". In the late 90s the MMORPGs begun getting commercialized and having good quality graphics. Later on, during the first decade of 2000, some other MMORPGs appeared with higher quality graphics and 3D type of graphics. The most famous commercialized MMORPG was the "World of Warcraft (WOW)" which got popular since it was released in 2004 and still remains one of the most popular multiplayer games. In 2009, a new free MMORPG was released, called "League of Legends" (LOL) which became also very popular. The League of Legends had the highest amount of gameplay hours in US/EU for a period of one year (July 2011 until June 2012). It took the first place with 1,292,502,456 hours of gameplay, the World of Warcraft was in second place with 622,378,909 hours of gameplay (DFC Intelligence, 2012). People from all over the world (from more than 145 countries) play daily in battles and tournaments. According to various sources, the amount of monthly

users of League of Legends reached 32 million active monthly users in October 2012 (Riot Games 2013)- a number larger than the World of Warcraft subscribers, which already hit its peak reaching over 12 million monthly subscribers. The amount of users of World of Warcraft continues to drop; Characteristically, in June 2013 the total number dropped to 7.7 million active subscribers (Games spot 2013) whereas "League of Legend" has more than 12 million users on a daily basis and every month the worldwide users spent more than 1 billion hours in total playing the game. On March 2013 the stats have shown a 5 million concurrent players at peak. According to the player demographic stats, more than 90% of players are male, 85% of players are aged between 16 and 30 years old, and 60% of players enrolled state that they have completed some college. The League Of Legends game has also succeeded to make a memorable entrance in the world of social media- In the beginning of December 2013, the official League of Legends Facebook fan page counted 7,712,390 likes. Also the official League of Legends Cyprus group members were 1,825.

MOBA (Multiplayer Online Battle Arena) are real time battle games, sub-genre of real time strategy (RTS) games. Briefly, the history of MOBA genre games starts in 1989 with a game called, Herzog Zwei. This game was something between the RTS (Real Time Strategy) and a MOBA genre game. The main difference with modern MOBA was that the game could control an army of units, whereas in modern MOBA genre games the player controls only one hero. After this game the other games that followed were Starcraft: Brood War, Warcraft III: Reign of Chaos, Warcraft III: Frozen Throne. The MOBA sub-genre, begun to get universally accepted in the 2012. The battle usually takes place in a fantasy 3D environment between two teams. The environment of the game remains the same- it is a persistent virtual world that continues to exist even when the user logs out of the game. The player can choose only one hero and control him using RTS-style interface. Every hero has different abilities and it's a part of the strategy of teams to choose their members to match the requirements and complete a competitive team. The player must undertake a specific role and job in the game and cooperate with other players to achieve a goal. The goals may slightly differ from one MOBA to another but the main goal is to defend their base and to destroy the enemy's base. The two bases are usually located in opposite corners on a mini map and they are joined with lanes (specified paths). The base may or may not have tower defenses and may spawn non player characters (NPC) that attack the enemies to help the team. Except that for the most part, the

player has to kill the enemy and among others, to destroy enemy's buildings. Usually in this genre games the player after certain achievements in the game (i.e. The battle is won, killing an enemy) will achieve a higher level and increase hero's powers, experience and skills.

The main difference between MOBA and MMORPGs with a classic computer game, is the ability to play and cooperate online in real time with other people regardless of their location while socializing and meeting new people. For this reason, the MOBA and MMORPGs have built huge communities from all over the world which consist of different people who cooperate for the accomplishment of a goal. However, this kind of games require from the player a lot of attention during the game play, as well as due to their complicated nature which results in creating cognitive load problems for the user. This sometimes may lead the player to give-up the game. MOBA as well as MMORPGs, are complicated strategy games that require from the user the ability to multitask in order to succeed in the game. The main tasks that the user is challenged to succeed are: concurrent interaction with the players as well as interaction with the game interface and the game objects. More specifically, the user has to communicate, cooperate, socialize with other users, and think at the same time about the game strategy. Apart from that, the user must be well-oriented, know well the user interface, and observe the notifications for the progress of the game. Another phenomenon that arises in MOBA, MMORPG games and generally in computer games, is "flow"-a state in which the player is totally absorbed by the game and "nothing else matters" for the player (Agarwal and Karahanna 2000). Subsequently, the main terms of "cognitive load" and the "cognitive absorption" will be discussed.

League of Legends

To get a better understanding of what the current thesis is studying, it’s important first to understand the game plot and the terminology used in the game. The League of Legends studied in this thesis, is a Multiplayer Online Battle Arena (MOBA) genre video game. It was developed by Riot Games and first released on 27th of October, 2009. It is free to download and play.

The game looks pretty easy at first glance but it has a set of complex rules and demands from the player. Mainly the player must have good knowledge of basic rules and information about the champions. Champions are in game characters which the player can choose before the game starts, each one of them possessing unique abilities and traits. There are 116 released champions in total (until now) and the player must have a basic understanding and knowledge about the champion before selecting him/her to know what abilities he/she has and how to use them wisely as part of the game strategy. New players can choose a champion to play with, from some free champions that change every week, before the player can buy his/her own ones with influence points or from Riot points. Also with Riot points the player can enhance convenience and allow extra customization options or diversity to the experience of their champion. There are 3 kinds of in-game currencies: the account bind ones, which are the influence points that a player earns from each game, the Riot points, which the player purchases with real money, and the in-game one currency, which is the gold that a player earns during the game.

In the standard game mode, the players are formed in two even teams of 3 or 5 team members in each one. The players can invite their friends to play or get matched with unknown players. They have the opportunity to choose also whether they are going to play against other players (humans) or bots, which are computer controlled opponents with beginner or intermediate artificial intelligence (Bot, n.d.). The two teams start playing in their base, the two bases are located on opposing sides of the map. There are paths (or "lanes") that join the two opposite bases. A main goal of the team is to destroy the nexus of opponent team, which is a main turret that spawns minions. Minions are non-player characters that can attack the enemies in order to give support to their team. In order the team to destroy the enemy nexus they must progress through the lanes (paths) by killing the enemy minions/champions and destroying the enemy turrets-turrets are towers that automatically targeting the enemies if there are no ally minions nearby and begin shooting them doing heavy damage to them. The turrets will continue attacking the enemy team until it dies, so the enemies have to destroy first the turrets in order to go through the path.

All the members of the team must undertake specific roles and know their jobs, which they agree prior the beginning of the game. The roles and jobs have distinct differences and must

be clear for each player in order for the team to succeed. The player must undertake a certain task for a long period of time till the game ends, so the job it's not something temporary. It depends on the player's character and which position he can fulfill, but some of them can be used for multiple positions so it's important that the player informs others which position he will fill. On the other side, the role is usually temporary-an example of such a role is the "Jungler". Jungler's main job throughout the game, is to secure major tasks in the jungle as Dragons. Other than that, junglers are also responsible, especially in the early stages of the game, to provide help to their teammates in the lanes when help is needed. At the late stages of the game (after 30 minutes of the game) junglers can undertake other roles such as" tanks" or "assassins" etc.

Within the game, the players are ranked according to the experience points they gain. Usually they gain experience by killing enemies, minions, neutral monsters and destroying turrets. After each game, the users account gains experience when the account reaches the 30th level the users can become a ranked player. The ranking system divides the players in 6 different tiers (bronze, silver, gold, platinum, diamond and challenger). Each tier (except of the challenger) is divided in 5 sub-divisions. The challenger is the ultimate tier where only the top 50 players can get into.

Cognitive Load theory in MMORPGs

The human cognitive architecture consists of the long term memory which interacts with working memory. The long term memory is unlimited and it stores a huge amount of knowledge and previously acquired information. On the contrary, the working memory is very limited in capacity and duration as the information it receives is new and short-term. It processes the information before or after it has been stored as long-term memory. The person is more conscious when the information is processed from working memory.

Cognitive load refers to any demands on working memory storage and process of information (Schnotz and Kürschner 2007). Especially in MMORPGs, the user is required to multitask: concurrent interaction with the players as well as with the game interface and the game objects, can lead to cognitive overload. Accordingly to one study (Ang, Zaphiris and

Mahmoud 2006) there are 5 different types of cognitive overloads that the user may experience in MMORPGs. The *multiple game interaction overloads*, in case the user has to interact at the same time with multiple objects of the game i.e. enemies, coins, game problems etc. Another one is the *multiple social interaction overloads*, where the user has to interact and chat with other players. This overload occurs especially when the player interacts or communicates with more than one player at the same time. The third type is the *parallel game and social interaction overloads*, which appears when the user interacts with other players and the game at the same time, i.e. chatting with other players while trying to kill the monster. The fourth type is that of *user Interface overloads* where the user is required to keep track of all the information and the notifications appearing in the UI which distract his attention from the game. Finally the fifth type is called *identity construction overloads*-this overload occurs when the user is not able to identify himself or another player among all the players participating in the game. This type applies also, in case the user is not able to construct his own identity. All these types of cognitive load were found from a study of MMORPGs named "Maple Story". In the present study, I will attempt to check if these types may be applied to League of Legends game and what other types or subcategories can be found from the research findings.

Cognitive absorbance and flow in computer games

The term of cognitive absorption can be constructed from three concepts: the trait of absorption, the state of flow and the notion of cognitive engagement (Agarwal and Karahanna, 2000). The **trait of absorption** refers to the state in which one person's attention is absorbed by object of attention. In this state someone is in state of engagement and all the attention recourses are consumed by something. The **state of flow** is stronger than the state of absorption. According to theory of flow of Csikszentmihalyi (1990), flow is "the state in which people are so involved in an activity that nothing else matters". The state of flow includes many different dimensions, some of dimensions are: intense concentration, a sense of being in control, a loss of self-consciousness and a transformation of time (Agarwal and Karahanna, 2000). According to this theory, the state of flow can occur in interactions with symbolic systems, mathematics and programming languages. The third concept of cognitive

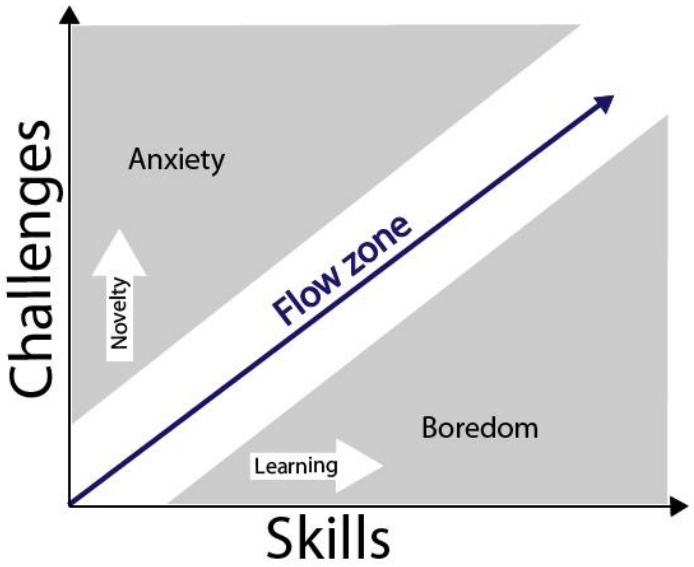
absorption is the **concept of cognitive engagement**, according to Webster and Ho (1997), the cognitive engagement is associated with playfulness and the state of flow, and it was presented as state of flow without the notion of control. In this theory the engagement have multiple dimensions such as intristic interest, curiosity and attention focus.

In this current study we will take into consideration all the above concepts of cognitive absorption, but we will pay more attention on the concept of the state of flow as it is more relevant to evaluation of games. We will study extensively the "theory of flow". We can assume that this theory can be applied also in the case of computer gaming and especially in the case of MOBA genre games where cognitive load is higher than in case of simple computer games. Firstly, we have to understand the dimensions and factors of flow to construct the full concept of flow theory. Later in the current study, some of the flow dimensions will be evaluated in the experiment with a number of players of League of Legends. Furthermore, it will be interesting to investigate whether there are any other categories or subcategories of flow in MOBA.

The construct of flow is used to describe the psychological experience that someone has. Flow is the state between anxiety and boredom and is widely used in computer-mediated research. In the state of flow, the person experiences a feeling of loosing sense of time and self.

According to Csikszentmihalyi (1975), "flow occurs as the balance between perceived skills and challenges". According to Chen (2007), when the game is too challenging the player becomes very anxious and when the game is not challenging enough the player becomes bored- both cases could lead player to quit the game. Contributing to this theory Chen (2007) introduces the term of "Flow zone" which is a state located between boredom and anxiety and it grows or falls depending on challenges and skills of users. The following diagram is created based on Chen (2007) and Csikszentmihalyi (1975) theories. As shown in the diagram, there are three separate dimensions of experience: anxiety, flow and boredom. Extending that theory, we can assume that the more experienced and skilled the player of the game is, the less challenging the game will be for the player. As a result, the player might feel less stimulated and get bored quickly. Additionally, the more novel the person is, the more anxious he/she will be during game play. This occurs particularly because the game will be

more challenging for the new players; However, when the challenges are consistent with the skills of someone, the person will then have the flow experience. To sum up, in order for the player to experience the flow and to get into the "Flow zone" he/she must achieve a balanced match between the person's skills and the challenges associated with the task (both of them must be over a certain level). Otherwise the player, might get anxious or bored and eventually quit the game.



Three dimensions of experience (anxiety, flow and boredom)

Gamer types

Every gamer is different and has different goals and factors that affect his/her levels of enjoyment, experience and consequently the flow. Consequently, it's important to determine first in what category/type the gamer belongs to, in order to analyze the state of flow. The classification of the gamer type can be done before the game play from his/her profiling. The data for profiling can be gathered from questionnaires. Usually the gamers belong in more than one category. The typology is based on the Demographic Game Design (DGD) model. At first level the classification can be done by analyzing the fragrance of playing the game and the involvement in the game. Based on that, the gamers can be classified in "hardcore",

"casual" and "combined" categories. The main difference between a hardcore and a casual gamer, is that the hardcore gamer is more dedicated and game-literate than the casual gamer. Also the hardcore gamers are more involved in "meta-gaming"; in other words they enjoy learning about the game as well as talking and creating communities associated with the game. The second level is a classification the gamer type. Accordingly to DGA typology there are four sub-categories of gamers described below:

Conqueror: these kind of gamers are very competitive, they are goal-oriented and always strive to win the game. They want to feel dominant in the game or in social circles associated with the game. This kind of gamer prefers *games of agôn*, where they can prove them self and their capabilities in front of an equal opponent.

Manager: the gamers of this type are logical, they are process-oriented and their main goal is to develop mastery in the game. They want to feel everything under control and usually they prefer competitive games and role playing games.

Wanderer: this kind of gamers are less challenge-oriented than the other two. Their main goal is fun and the gain of game experience. They enjoy different types of games but usually they prefer an unstructured playing mode.

Participant: they enjoy the " vertiginous immersion" in an activity within the game or the game world. Also they prefer the social play and the "meta-gaming" such as chat/forum discussions around the game.

Dimensions of cognitive absorption.

Agarwal and Karahanna (2000) have mentioned five dimensions of cognitive absorbance of software which are: 1) temporal dissociation or the loss of time associated, 2) focused immersion or the total engagement while everything else is ignored, 3) heightened enjoyment or pleasure, 4) control over the interactions and 5) curiosity.

Flow factors

To understand the construct of flow we need first to analyze and describe the main factors of it. There are a lot of flow factors but in the current study we present only the ones that are applicable to computer games. Below we present the flow factors that were used in the current research for flow measure.

Skills: The skills must be developed during the game play in a fun and easy way without the user having to read any manual or tutorials. Also the user must be rewarded for the progress in the development of skills (Sweetser and Wyeth, 2005). According to Csikszentmihalyi (1975), the skills and the challenges must be in balance to achieve the flow state.

Action/Awareness: The players are always ready for action and awareness of what is going on in the game. According to Csikszentmihalyi (1993) because of the deep involvement within the game, players' actions become spontaneous, and become almost automatic. Also, the persons consider themselves and the actions they perform as one.

Clear Goals and feedback: A Game with clear goals is more enjoyable for players than the one that has ambiguous goals (Habgood, Ainsworth and Benford, 2005). In order to keep the player interested, there must be clear game goals such as clear missions of game, levels, collecting of points, gathering of objects etc. Clear goals also give the player motivation and communication needed in order to keep the player engaged with the game.

The feedback gives the user an idea how well he is going as well as how the game is impacted by his actions. Thus, it's important to give appropriate feedback to user at appropriate times (Sweetser and Wyeth, 2005) and it must be immediate so the user knows what to do next. Also it's important to give immediate feedback about the progress towards player's goals, progress of skills development and feedback about the score or status of the player. According to Dickey (2007), another way to engage the user to the game, is to use an avatar which gain experience points after completing some goals, in such a way the avatar is cabable of improving skills and attributes. In that way, the player gets emotionally attached to their avatar and the game.

Concentration:

The user must be able to concentrate easily on the game. The game should provide motivation for the player. The game should grab player's attention and keep the player focused. Also it must require concentration from him to achieve specific goals. In the game there shouldn't be unimportant tasks or any other elements/objects that will distract the players' attention from important tasks. The workload should be high enough to keep the players attentions and interest, but it should be in balance with their skills and abilities. When someone is concentrated to the game all irrelevant to game the worries and concerns are suspended. (Fang, Zhang and Chan 2013).

Control: There are different parts of control in the game:

Game controls: the user must master the game controls such as mouse and keyboard combinations. When the user is familiar with the game controls then he will use them automatically, this will not distract the user from flow state. Also the user must be familiar with genre conventions and game-play mechanics (Cowley et al. 2008).

Game world and gameplay control: The player must be able to control his characters movements and interactions easily with game objects within the game. They must feel control over the actions they do in the game and feel the freedom in the way they use their strategy and skills to play the game. Also feedback on players' actions must be given so the user can see and feel his impact onto the game world (Sweetser and Wyeth,2005).

Interface and game shell control: The user should feel the sense of control over the game interface and input devices (Sweetser and Wyeth,2005). Additionally, the player must be able to avoid easily the errors; in case an error is done the player must be able to easily recover from errors. It must be easy for the user to start, stop, save e.t.c. the game.

The loss of self-consciousness and Immersion: The environment of the game should be different from the real world. In this kind of environment the player can be totally immersed in the game and emotionally involved in it. They have an illusion that they are located in the game world which is completely separate from the real world. They can escape from reality into the game world in which "nothing else matters". The involvement with the game should

be deep but effortless for the player (Jones 1998). If the player is immersed into the game world, he becomes less aware of himself and his/her surroundings. Also, the player gets less worried and frustrated about self or everyday life. During the game, the player loses a concern for self and a sense of identity. Usually in state of immersion and flow the sense of time is altered (Jones 1998), either it passes very quickly or very slowly.

Transformation of time: As I mentioned above, the sense of time is altered during the flow experience (Jones 1998). Usually the player lost awareness and sense of time during game play. For for some players the time appears to move in slow motion while for some others it goes very quickly. People get so involved in a game that they feel the time has frozen and many hours played seemed like they played for a few minutes.

Autotelic experience: This is a key element of an optimal experience is that it is an end in itself. The activity of gameplay becomes intrinsically rewarding. The user just plays for experiencing his passion about the game without having any particular reason . Also, the player doesn't seem to care about any rewards or recognitions within the game.

Challenge: This is one of the most important flow factors which keeps the user interested and attached to the game. The challenge must match the players' skill levels, otherwise the game becomes either boring or it causes anxiety to player-both of them may lead the player to quit the game. If the challenges meet the skills of the player, the player possibly may experience the game flow. However, in order to keep the player interested in the game, the challenges must be changed accordingly to his skills levels progress (Sweetser and Wyeth,2005). In other words, the challenges must be differentiated according to the player's level, which are then categorized in three groups: hardcore, normal and novice. Hardcore players have a high challenge in the game and they possess high level skills. The normal players have a medium challenge and a medium level of skills and the novice players have low challenges and basic skills. In this case, the players may be continually in game flow.

Social Interaction: The game should support and encourage the social interactions within the game. Additionally it should support competition as well as cooperation between the players. Also the game should encourage and support the creation of social communities inside the game as well as outside the game (forums etc.)

In the following table we present different flow factors for measuring the flow by previous researchers.

Flow dimensions	**Flow Construct in previous research**			
	Jones (1998)	**Csikszentmihalyi (1990)**	**Csikszentmihalyi (1993)**	**Sweetser and Wyeth (2005)**
Skills			-Challenging activity that requires skill	-Player skill development and mastery
Action/ Awareness			-Merging of action and awareness	
Clear goals and feedback	-Clear goals -Immediate feedback	-Clear unambiguous goals -Immediate feedback	-Clear goals and feedback	-Clear goals at appropriate times
Concentration	-Concentration on task	-Complete freedom to concentrate on task		-Concentration
Control	-Sense of control	-Full control	-Paradox of contol	-Sense of control over actions in game
The loss of self-consciousness and Immersion	-Involvement -Lost of self concern	-Full immersion -Sense of identity lessens	-Loss of self-consciousness	-Immersion
Transformation of time	-Altered time duration	-Less conscious of time passage	- Transformation of time	

Autotelic experience			-Autotelic experience	
Challenge	- Task that we can complete	-Challenging task	-Challenging activity	-Challenge that match players skill level
Social interaction				-Opportunities and support for social interactions

Table 1.1: Pivot table of flow factors and construction

Chapter 3

Methodology

For the main purpose of this research, I studied the game “League of Legends” which is a very popular Multiplayer Online Battle Arena (MOBA) genre video game with 32 million active monthly players all over the world including a growing community of players in Cyprus. It is free to download and play. In League of Legends the players are formed in two even teams and have as a main goal to destroy the nexus of the opponent. Meanwhile, they have to destroy enemy's turrets and kill the enemies, dragons, wolfs e.t.c.

The purpose of the current master thesis is to study the game players and their behaviors within the game. The methodology that is used for the research is based on social science methodologies and both qualitative and quantitative research methods are used for collecting the data. The main goal of the research is to define what types of cognitive load the user experiences while playing the game. Also another goal is to define what types of cognitive absorption and what feelings the user may experience, while playing the game. Such complicated terms as the "cognitive load" and the "cognitive absorption" are studied using qualitative research methods. The data were collected from observation, screen capture data, webcam video, q sensor and the two questionnaires. A total of 15 League of Legends players participated in this study, and while playing approximately 10 hours, screen recordings were captured as well as webcam recordings of the same number. The actual game play duration of 15 participants was approximately 7 hours.

The classification of gamers into different types will be done, from pre-game profiling, the information about gamer habits, experience and goals that was gathered from the pre - questionnaire. After that, the LOL player participated in an experiment, which included the calibration, the game login, game setting process and the actual game play, the experiment is described below in more detail. After the experiment, the participant was given the Post-questionaire, which included all questions about the feelings that the player experienced during the gameplay, the levels of cognitive load and the flow factors.

Description of experiment

All the data were collected from the experiment which was approximately 1 hour long for each participant. Prior the experiment, the user had to answer the pre-questionnaire with general questions about demographics, the user experience level, and general questions about the game related preferences. For experimental purposes, the participant was requested to play one game session (for approximately 30 minutes long). During the game play, the screen and the webcam were recorded for further analysis. The observation of game play was without intervention from the researcher- the researcher just explained the basics of the experiment. The participants were allowed to choose the League of Legends game settings they wanted and to play in the way they wanted to play. After the playing session, a post questionnaire has been given to the user, which included questions about their emotions and the experience they just had during the game play.

Prior to the beginning of the experiment, the user was asked to view some images for a few seconds so as to use this data for calibration purposes. More Specifically, based on this data I could determine the emotional profile for each user to determine the level of arousal he/she had when exposed to images that evoke emotions. The user viewed a black screen, images related to League of Legends and some other images that were not related to the game but they could evoke certain emotions. During the experiment the user was been recorded on webcam, also the screen also was recorded using Morae software. To ensure that all this data is recorded parallel to Morae software I was using also other softwares, the Debut software to record the camera and the Camtasia software to record the screen.

During the gameplay, the user was wearing on his/her wrist the Q sensor technology which was recording the electodermal activity (EDA) and some other data such as electrode temperature and acceleration. In the case of this study, we are interested only in EDA since the other data are not important for measurement of cognitive load or flow.

Tools used for data collection

Q sensor

The Q sensor is " a wireless device that allows the wearer to conveniently record skin conductance as function of sympathetic nervous system activity" (Q sensor manual). The EDA data are measured by Q sensor from the capture of electrical conductance across the skin- In this case the measurement unit is microSiemens (μS). This data are frequently studied in case of cognitive workload and stress related research (Picard and Scheirer, 2011).

Electrodermal Activity (EDA)

The electrodermal activity (EDA) can be assessed only by direct psychological measurement. In this case, we used a Q sensor to measure the EDA. Psychological responses such as sweaty palms and rapid heartbeat, are signs of arousal that can be detected from the electodermal activity which refers to electrical changes measured at the surface of the skin. The Q sensor measures the EDA with skin conductance, which is measured by sending a very fine current of electricity between two electrodes which are areas on skin's surface that are heavy with eccrine glands (palms of hands, soles of feet). The skin is a resistor of current bit but when sweating, the skin resistance decreases and the skin becomes conductor of electricity (Klebba 1985). The skin (due to sweat glands) becomes a better conductor of electricity when higher levels of arousal are present. The measures can be changed accordingly to the signals that skin receives from the brain. More specifically, the skin conductivity responses change according to the different internal or external stimuli the brain receives which are psychologically arousing. When the person is experiencing a high arousal state (for example anger, frustration or mental workload), the arousal level tends to be high. On the contrary, when the person is relaxed or sleeping, the level will be low.

The recorded data can detect and measure the arousal level that someone is experiencing. The arousal is one of the most important measures and dimensions of emotion as well as an indicator of emotional activation. According to Reeves and Nass (1996) from the arousal measurement we can predict the attention and memory, which are the two important aspects

of cognition. According to Picard and Scheirer (2001) the high arousal events attract more attention and they are more memorable. The recorded data by Q sensor were observed in real time using the "Q Live" software and later they were analyzed using "Q" software.

FaceReader

For the validation of the data collected from Q sensor I used the method of triangulation.The data were received from other sources, such as questionnaires, interviews, and FaceReader software. The FaceReader software is a tool that allows the detection of emotions from facial expressions. This software automatically detects the facial reactions and movements, creates the 3D model of the face and puts markers to the face which helps to identify the user's facial expressions. However, this tool has a few limitations because it is analyzing the human face from the movements of markers, but doesn't take into consideration the different face proportions. For instance, the rotation of eyebrows of a person may alter the results and even if the person is neutral the tool might analyze that he/she is angry because the software detected that the eyebrows are frown.

Arousal and valence

Arousal and valence are two dimensions of emotions classifications. Arousal is " a broad term referring to overall activation, and is widely considered one of two main dimensions of an emotional response" (Picard and Scheirer , 2001). To clarify the difference between arousal and emotion, the arousal is important component of emotion but it doesn't measure the emotion itself. Arousal can be an indicator of emotional activation. The intensity of arousal can be either high or low, usually in case when the person is sleeping the arousal level tends to be low and in case of activated states (for example cognitive load) it tends to be high.

The valence can be negative or positive emotion, from two different scopes. The first is the positive or negative character of emotion. The second interpretation is that valence is an aspect of emotion-for example behavior, affect, evaluation e.t.c. (Colombetti, 2005).

According to Charland (2005), the valance can be classified as *emotion valence, which refers to* positive/negative character of emotion (for example positive or negative fear, anger, joy) and *affect valence*, which refers to emotion experience, in other words if the certain emotion evoke good or bad feeling to someone.

Facial expressions valence

According to Colombetti (2005), The 'valence' of a facial expression usually refers to the positive and negative nature of the experience that the face (allegedly) expresses. Colombetti refers to three approaches on how someone may interpret the facial expression's valence. The first one is *purely categorical* approach, according to which is believed that there are basic emotions that can be expressed by every person in a similar way; in this approach, the valence can be measured from the whole face. The second one is *componential* approach, which takes into consideration the individual components of face, which in this case are valenced, and the valance is the whole face. According to this approach the facial expressions consist of different components each one expressing a different type of emotion. According to Reinman *et al*. (2000), facial zygomatic muscle (located on the cheeks) which draws the angle of the mouth superiorly and posteriorly, is associated with pleasure emotions (for example smiling). The corrugator muscle (medial end of eyebrows), which draws the eyebrow downward and medially, is associated with negative emotions (for example eyebrow frown). The third approach is called the *dimensional* approach, according to which the facial expressions have few dimensions-in this case is pleasantness or unpleasantness dimension (valence). Additionally, according to Davidson (1984) facial expressions depend on the brain neural structures. Davidson believes that the neural structures in the left hemisphere are associated with positive emotions and the right hemisphere with negative emotions.

According to Picard, Vyzas, Healey (2001), human emotions can be affected from different factors that are not necessary independent from each other. The five factors that can elicit emotion are the following. *Subject-elicited versus event-elicited,* where the emotions are elicited on purpose from the subject or they are elicited by other stimuli or situations that are not related to the subject. *Lab settings versus real-world,* where the participant is located in

lab/ room with special settings or in his/her natural environment. *Expression versus feelings*, where some people's feelings can be easily recognized from external expressions (usually facial expression or body language) and even though some people express less their external emotions, they may have more intense internal feelings. *Open-recording versus hidden-recording*, where we can choose either to inform the participant that the data (screen capture, biometrical data etc) will be recorded and he/she will be recorded on camera, or we can hide it from the participant (to ensure that the data will not be altered because the participant may change his/her behavior for example in front of camera or voice recording).

In the present experiment, the user had event-elicited emotions and the emotions were evoked from events stimuli that were happening within the game. Most of the participants were doing the experiment in a lab environment (in two university computer labs) but some others were participating in a real-word environment (participant's house and internet cafe). Mandatory was to use the laptop with all the data recording software installed; the participants were not allowed to use their own laptops. This caused frustration in some participants, because the laptop or the internet connection was slow in comparison to laptop/desktop they used for gaming. Both expressions and feelings, the facial expressions were analyzed using FaceReader software and the internal feelings were measured from the skin conductance using Q sensor and analyzed using Q software. Because of privacy and ethics concerns, the users were informed from the beginning of the experiment that they would be recorded on webcam and the screen would be recorded. The participants signed the consent form with a description and purpose of experimentation. This didn't affect the user behavior because all the data was recorded using a laptop, without any other visible technology, so after a while the participant had forgotten that he/she was being recorded. Also, because the participants were hesitant about wearing the Q sensor on their hand, they were informed that the sensor measured their arousal level and it's not risky for their health.

Measurement of cognitive load

Cognitive load is multidimensional-it refers to the load which is imposed from one task to person as well as the effort perceived by a person for execution of the task/s.

There are several research works that introduce different measurement methods of cognitive load (Pass, Tuovien, Tabbers and Van Garven 2003).

Analytical method: in this case the subjective data are collected from expert opinion also analytical data are collected with techniques like mathematical models and task analysis.

Empirical method: the main data of empirical method are mental effort and performance. To have a better performance, the person must invest more mental effort, so when the mental effort is increasing, the performance is also increasing and vise-versa. The data on the cognitive load level, can be collected using rating scale techniques; in this case, people self-rate their cognitive load level through a questionnaire. Usually the questionnaire includes different dimensions of cognitive load with scale, where the person was expected to self-rate each one depending on his/her experience.

The performance data can be collected using task techniques. There are two kinds: the primary task, which measures the task performance, and the secondary task in this case the person must perform the primary task and the secondary task concurrently, then the performance of secondary task will reflect the cognitive load imposed by the primary task. (Pass, Tuovien, Tabbers and Van Garven 2003).

Furthermore, psychological data can be collected using psychological techniques; the data collected are heart activity, brain activity and eye activity. These kinds of data are user for the detailed trend and pattern of load. (Pass, Tuovien, Tabbers and Van Garven 2003).

Flow Factors

After examination of previous research methods and flow measuring tools, I have concluded to flow factors that can be used for evaluating flow in League of Legends. These flow factors can be applied also on other MOBA, MMORPGs and online games. The flow factors that have been used for measure flow, are presented in the following table. Also, the tables present the questions from pre and post questionnaires for flow measurement.

Factor	**Content**
Skills	I am interested in experimenting with new abilities of champions
	I enjoy trying out new skills
	I feel I am competitive enough to meet the high demands of game
	Playing LOL provides good test of my skills
	I am very skilled at playing LOL
	I find that playing this game stretches my capabilities to my limits
	I had confidence when I played
Action/Awareness	I'm always ready for action and I am aware of what happens in the game
	When I play LOL I feel that all my feelings are in vigilance or alert
	I played spontaneously and automatically without having to think
Clear Goals and feedback	I know well what I have to do in game
	I know clearly my goals in game
	I get feedback for actions I do in the game (e.g. the enemy disappears when I kill it)
	I knew what I wanted to achieve in this game
	I was aware of how well I was performing

	I received immediate feedback on my actions
	While playing the game, I had a good idea about how well I was doing
Enjoyment	Playing LOL is a very enjoyable experience for me
	I enjoy trying out new skills
	Playing LOL is very interesting
	I feel pleasure when playing the game
Concentration	I was completely focused in the game
	I'm always very focused in the game
Control	I have a sense of control, I know how to handle well my summoner
	I had complete control of the game
	I have difficulties in handling the controls and my champion
	I feel comfortable with the controls of game
	When playing this game, I felt in control over what I was going in the game.
The loss of self-consciousness and Immersion	When I play I don't understand what is going on in my surroundings (in real world)
	During the game play I am immersed and I feel like I am located in the game environment.
	When Playing LOL I feel like it is the extension of the real world
	When I play I do not care about what happens around me
	I identify with my champion and I feel as it is an extension of myself
	I lost consciousness of my identity and I felt like I was one with

	the game
	I kind of forgot about myself when playing the game
	When I play I don't feel the need for something else e.g. thirst, hunger
	I didn't felt engaged/ involved with the game
Transformation of time	I had a good sense of time when I play the game
	When I played, time passed very quickly
	I felt that time freezed/stopped
	The way time passed seems to be different from normal
	While playing this game I sometimes felt like things were happening in slow motion
Autotelic expirience	Playing this game is rewarding in itself
	I loved the feeling of that performance and I want to capture it again
Social Interactions	The interactivity functions (chat, notifications e.t.c.) in game satisfy my communication requirements
Challenge	Playing LOL challenges me
	The game is challenging, it leads me to need to play often
	I felt like "nothing else matters"
	The communication via chat with other players is very easy
	The games I play are mostly difficult
	I often feel anxiety when I play LOL
	Often I feel bored when I play LOL

Sources: Fu, F., Su, R., & Yu, S. (2009), Jones (1998), Csikszentmihalyi (1990), Csikszentmihalyi (1993) and Sweetser and Wyeth (2005).

Chapter 4

Results-Analysis

In the present study, 15 League of Legends players participated in total. 12 players were male and 3 players were female, all aged from 17 to 27 years old. There were players with different levels of experience in the game, but most of them were of intermediate level (self-evaluated). 13.3% of the total participants were beginners, 46.7% intermediate and 40% classified their selves as expert gamers. Moreover, 40% of the participants were playing this game for a period of 1 to 3 years and 53.3% of all participants were playing League of Legends on a daily basis.

Below there is a table with more details about the player's experience level accordingly to the duration of playing the game (see table 1.2). Approximately, 80% of current research participants reached level 30, which is the last level of the game. In current research the 30th level players, weren't split further into groups (ties and divisions) for simplicity purposes. Apart from the 30th level players, a small minority (20%) of participants reached lower levels (level: 17, 19 and 24) at that time.

Regarding the frequency of participation, the participants claimed to play from 2 to 9 games per day with mean of approximately 4 games per day (see table 1.3). The maximum amount of games someone played in one day was 20 games, and the mean of maximum gapes played per day was approximately 12 games (see table 1.3).

Player Experience level

How long have you been playing LOL?	Percent	How many days do you play per week ?	Percent	How many hours per day are you playing (approx.)?	Percent
from 6 months to 1 year	26.7%	1-2 days	6.7%	2 hours	26.7%
from 1 to 3 years	40.0%	3-4 days	20.0%	3 hours	26.7%
from 3 to 4 years	26.7%	5-6 days	20.0%	4 hours	6.7%
more than 4 years	6.7%	everyday	53.3%	5 hours	26.7%
				6 hours	13.3%
Total	100.0%	Total	100.0%	Total	100.0%

Table 1.2: Variable percentages of player experience level and time

Games played per day

Games played per day	Percent	Maximum number of games played in one day	Percent
2 games	20.0%	3 games	6.7%
3 games	26.7%	4 games	6.7%
4 games	20.0%	5 games	6.7%
5 games	13.3%	7 games	13.3%
7 games	6.7%	10 games	13.3%
8 games	6.7%	11 games	6.7%
9 games	6.7%	15 games	13.3%
		20 games	33.3%
Mean: 4.27 games		**Mean: 12.47 games**	
Total	100.0%	Total	100.0%

Table 1.3: Variable percentages of games played per day and Maximum number of games played per day

The participants were asked to choose the activities they do while playing League of Legends. To cover any possible answers, there was an option named "other" with a blank space to fill any other activities not mentioned in the questionnaire. The results have shown that only 6.7% were just playing the game without doing anything else at the same time. Furthermore, the same percent of players were watching TV or DVD at the same time. The majority of participants prefer to eat or drink during the gameplay (80%). In addition to that, a high percentage of players were habitually surfing websites not relevant to LOL (60%) and talking on phone or Skype (66.7%). The 40% of participants were surfing websites related to LOL and 40% selected "other" specifying that they were smoking, playing other online games and doing university assignments.

Other activities during gameplay

Activity	**Percent**
Nothing else, just playing	6.7%
Surfing websites about LOL (i.e. forums, blogs)	40.0%
Surfing websites with not relevant to LOL content (i.e.facebook, youtube)	60.0%
Talking on phone/skype	66.7%
Watching TV/DVD	6.7%
Eating/Drinking	80.0%
Other (Smoking, playing other online games, doing university assignments)	40.0%

Table:1.4 Percent variables of other activities during game play

Accordingly to gameplay, the players were generally preferred to kill the enemy or destroy the tower (turret) with teammates (mean 4.27) but in some cases they prefer to do it alone without teammate's help (mean 3.27). The participants were agreeable with the statement that they are interested in experimenting with the new abilities of their champions (mean 4.07) and enjoying trying out new skills (mean 4.13).

Questionnaire question	**Mean**	**Std. Deviation**	**Absolutely disagree**	**Disagree**	**Neither**	**Agree**	**Absolutely agree**
I like to kill the enemy / destroy the tower with the help of other players	4.27	1.163	6.7%	0%	13.3%	20.0%	60.%
I like to kill the enemy / destroy the tower alone	3.27	1.486	13.3%	20.0%	26.7%	6.7%	33.3%
I am interested in experimenting with new abilities of champions	4.07	0.961	0%	6.7%	20%	33.3%	40.0%
I enjoy trying out new skills	4.13	0.743	0%	0%	20.0%	46.7%	33.3%

Table:1.5 Mean and std.deviation values of gameplay variables

As was described in Chapter 3, we measured the flow of League of Legends based on the flow factors from previous researches. In the following figures each flow factor will be analyzed based on collected data.

As shown in the table below, players in general seem to enjoy trying out new skills, abilities and champions (4,13 and 4.07 mean) but feel that LOL provides a good test for their skills and stretches the capabilities to their limits in a lesser degree. This tendency can also be confirmed upon studying the std.Deviation scores which are lower in statements expressing new skill experimentation and higher in statements expressing stretching or testing of capabilities within player's limits. This means that the users tend to feel positive about trying new sets of skills and characters but they feel that the game does not support their capabilities fully.

Flow factor: Skills		
Questionnaire question	**Mean**	**Std. Deviation**
I am interested in experimenting with new abilities of champions	4.07	0.961
I enjoy trying out new skills	4.13	0.743
I feel I am competitive enough to meet the high demands of game	3.67	0.900
Playing LOL provides good test of my skills	2.73	1.163
I am very skilled at playing LOL	3.47	0.990
I find that playing this game stretches my capabilities to my limits	2.87	1.407
I had confidence when I played	3.87	1.060

Table 1.6: Mean and std. deviation values of skills as a flow factor

Studying flow factors in regards to action and awareness, here we can see that most users tend to feel ready for action and express being aware of what happens in the game; However, when asked to rate their agreeability to the statement " I played spontaneously and automatically without having to think", the mean revealed that most users are somewhere in between which means that they do not fully agree or disagree with the statement, and playing might involve a little thinking, as opposed to complete automatic playing.

Flow factor: Action/Awareness		
Questionnaire question	**Mean**	**Std. Deviation**
I'm always ready for action and I am aware of what happens in the game	4.07	0.884
When I play LOL I feel that all my feelings are in vigilance or alert	3.80	0.862
I played spontaneously and automatically without having to think	3.67	0.900

Table 1.7: Mean and std. deviation values of Action Awareness variables

In regards to clear goals and feedback, in this table below, we can see clearly that the users studied, revealed that they knew clearly their goals in the game (4.47) and what they had to do (4.33 mean) but report receiving appropriate feedback of their actions in a lesser degree (3.00, 3.33 mean). In the statement "I received immediate feedback of my actions" the relatively high std. deviation indicates that the tendency was not exactly clear as some users deviated from the general mean tendency.

Flow factor: Clear Goals and feedback		
Questionnaire question	**Mean**	**Std. Deviation**
I know well what I have to do in game	4.33	0.900
I know clearly my goals in game	4.47	0.743
I get feedback for actions I do in the game (e.g. the enemy disappears when I kill it)	3.00	1.069
I knew what I wanted to achieve in this game	4.00	1.309
I was aware of how well I was performing	3.93	1.223
I received immediate feedback on my actions	3.33	1.543
While playing the game, I had a good idea about how well I was doing	4.33	0.816

Table 1.7: Mean and std.deviation values of Clear Goals and feedback variables

When it comes to enjoyment as sub-genre of flow factors, in this table we can see that users in general (4.00 mean) feel that playing LOL is an enjoyable experience but this tendency is not exactly clear or unanimous because the std.deviation is higher than other statements measured on this table.

Flow factor: Enjoyment		
Questionnaire question	**Mean**	**Std. Deviation**
Playing LOL is a very enjoyable experience for me	4.00	1.195
I enjoy trying out new skills	4.13	0.743
Playing LOL is very interesting	4.00	1.000
I feel pleasure when playing the game	3.93	1.033

Table 1.8: Mean and std. deviation values of enjoyment variables

In this table here, we can identify a general tendency of users feeling completely focused on the game they played (while being monitored) but feel that they are always focused in the game to a lesser degree.

Flow factor: Concentration		
Questionnaire question	**Mean**	**Std. Deviation**
I was completely focused in the game	3.80	0.862
I'm always very focused in the game	3.53	1.060

Table 1.9: Mean and std. deviation values of concentration variables

As shown in the table below, most users studied tend to feel in control over what was going on in the game and reported experiencing difficulties handling the control of the champion to a much lesser degree-which means in this case that controlling their champion is relatively easy and not a hard task. However, when asked if they felt comfortable with the controls of the game in general, a high std.deviation revealed that some users deviated from the mean general tendency of feeling “somewhat” comfortable with the controls of the game-which means that some users either felt uncomfortable with the controls of the game or feeling fully comfortable with the controls of the game.

Flow factor: Control		
Questionnaire question	**Mean**	**Std. Deviation**
I have a sense of control, I know how to handle well my summoner	4.20	0.775
I had complete control of the game	3.73	1.280
I have difficulties in handling the controls and my champion	1.87	1.187
I feel comfortable with the controls of game	3.87	1.407
When playing this game, I felt in control over what I was going in the game.	4.33	0.724

Table 1.10: Mean and std. deviation values of control variables

In the present table,we can see that users tend to feel immersed and located inside the game environment, but don't express feeling a loss of consciousness, identity and immersion, in a considerable degree.

Flow factor: The loss of self-consciousness and Immersion		
Questionnaire question	**Mean**	**Std. Deviation**
When I play I don't understand what is going on in my surroundings (in real world)	2.80	1.320
During the game play I am immersed and I feel like I am located in the game environment.	3.40	1.352
When Playing LOL I feel like it is the extension of the real world	1.80	1.207
When I play I do not care about what happens around me	2.53	0.990
I identify with my champion and I feel as it is an extension of myself	2.00	1.195
I lost consciousness of my identity and I felt like I was one with	1.47	1.125

the game		
I kind of forgot about myself when playing the game	1.93	1.163
When I play I don't feel the need for something else e.g. thirst, hunger	2.53	1.302
I didn't felt engaged/ involved with the game	2.73	1.223

1.11: Mean and std. deviation values of loss of self- consciousness and immersion variables

According to the findings of this table, there is a clear tendency of users reporting that time passes quickly (4.20), instead of freezing/stopping during gameplay.

Flow factor: Transformation of time		
Questionnaire question	**Mean**	**Std. Deviation**
I had a good sense of time when I play the game	3.73	1.033
When I played, time passed very quickly	4.20	1.146
I felt that time freezed/stopped	2.27	1.280
The way time passed seems to be different from normal	3.33	1.234
While playing this game I sometimes felt like things were happening in slow motion	2.20	1.265

1.12:Mean and std. deviation values of transformation of time variables

When users asked to express their agreeability in autotelic experience statements, users in general tend to feel that they loved their performance and want to capture the feeling again (4.00 mean). There is also a relatively high tendency to feel that the game is rewarding in itself although to a slightly lesser degree comparing to the other statement.

Flow factor: Autotelic experience		
Questionnaire question	**Mean**	**Std. Deviation**
Playing this game is rewarding in itself	3.87	0.990
I loved the feeling of that performance and I want to capture it again	4.00	0.845

1.13: Mean and std. deviation values of autotelic experience variables

In regards to social interactions as a a flow factor, the mean value reveals that the interactivity functions are satisfactory in general, although not fully.

Flow factor: Social Interactions		
Questionnaire question	**Mean**	**Std. Deviation**
The interactivity functions (chat, notifications e.t.c.) in game satisfy my communication requirements	3.47	1.187

1.14:Mean and std. deviation values of social interaction variable.

As for challenge as a flow factor, here we can see that users tend to find the game challenging and need to play often (3.93 mean) and feel bored to a much lesser degree (2.00). However, in regards to player difficulty, there is a relatively high tendency of the game being difficult in the most part (3.47 mean)

Flow factor: Challenge		
Questionnaire question	**Mean**	**Std. Deviation**
Playing LOL challenges me	3.27	1.280
The game is challenging, it leads me to need to play often	3.93	1.163

I felt like “nothing else matters”	2.07	0.884
The communication via chat with other players is very easy	3.27	1.110
The games I play are mostly difficult	3.47	1.246
I often feel anxiety when I play LOL	2.53	1.302
Often I feel bored when I play LOL	2.00	1.134

1.15: Mean and std. deviation values of challenge variables

In this table here, we can conclude that there is no clear tendency regarding anxiety levels, (2.53 mean/ 1.3 std.deviation), most users don’t feel bored often (2.00 mean), they find the game challenging (46.7% / 3.93 mean), they don’t feel that their champion is hard to control (60%/1.87 mean), the interactivity functions are satisfactory, (3.47 mean) , and the controls of the game make them feel comfortable in general.

In some statements, the high std. deviation and mean values don’t exactly reveal a clear tendency. For example, in the statement “ Playing LOL provided a good test of my skills”, most the answers were within the intermediate range while a few answers either expressed strong agreement or strong disagreement with the statement.

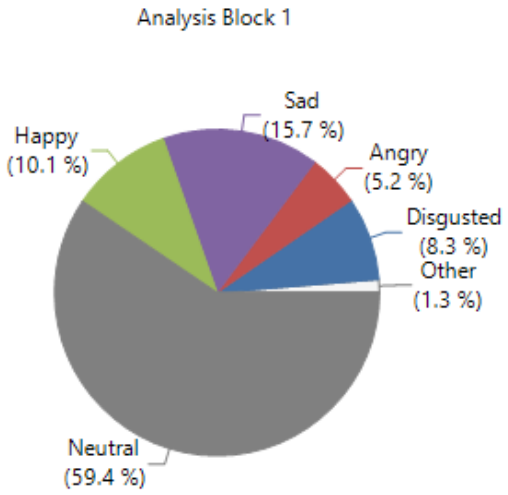
Questionnaire question	**Mean**	**Std. Deviation**	**Absolutely disagree**	**Disagree**	**Neither**	**Agree**	**Absolutely agree**
I often feel anxiety when I play LOL	2.53	1.302	26.7%	26.7%	20.0%	20.0 %	6.7%
Often I feel bored when I play LOL	2.00	1.134	40.0%	40.0%	0%	20%	0%
The game is challenging, it leads me to need to play often	3.93	1.163	6.7%	6.7%	6.7%	46.7 %	33.3%
I have difficulties in handling the controls and my champion	1.87	1.187	60.0%	6.7%	20.0%	13.3 %	
The interactivity	3.47	1.187	0%	26.7%	26.7%	20.0	26.7%

functions (chat, notifications e.t.c.) in game satisfy my communication requirements						%	
I identify with my champion and I feel as it is an extension of myself	2.00	1.195	46.7%	26.7%	6.7%	20.0 %	0%
Playing LOL provides good test of my skills	2.73	1.163	13.3%	26.7%	46.7%	0%	13.3%
I am very skilled at playing LOL	3.47	0.990	0%	13.3%	46.7%	20.0 %	20.0%
The communication via chat with other players is very easy	3.27	1.100	6.7%	20.0%	20.0%	46.7 %	6.7%
The games I play are mostly difficult	3.47	1.246	6.7%	13.3%	33.3%	20.0 %	26.7%
I feel comfortable with the controls of game	3.87	1.407	13.3%	0%	20.0%	20.0 %	46.7%

1.16 pivot table: Mean, std. deviation values of user experience variables

FaceReader-Facial expressions analysis

During the experiment, the players (mainly face and shoulders) were recorded on webcam and later on they were analyzed using FaceReader 4.0 software, which allows the detection of emotions from facial expressions. The FaceReader software produced graphs with the emotions that has been captured during the gameplay that shows the percentage for each emotion accordingly to duration of facial expression that corresponds to it. Below is an example of a graph created from video analysis through FaceReader.



Graph 1.17: User facial expression analysis

There were created in total 15 graphs using FaceReader, each one for each participant. From observing these graphs, we can see clearly that most users (13/15) showed neutral facial expressions (absence of negative or positive emotions), followed by negative facial expressions such as sadness, fear, anger and disgust. Happiness and totally positive emotions seem to be the minority here, as only 2 of 15 of the subjects (user 10 and 12) studied, showed a significant level of happiness or any other similar emotion during gameplay.

This is something that contradicts with the questionnaire results indicating a level of enjoyment and accomplishment, but can be explained with the following hypotheses: a.) The users felt slightly uncomfortable due to them knowing they were being monitored and couldn't relax and express themselves completely. b.) The users operated a foreign computer for the first time and didn't feel they had full control of the game (there have been a few cases that complained about losing control, freezing and web connectivity problems) c.) FaceReader is not reliable in the sense that it captures only outer facial expressions and can't read any inner emotions which are more accurate indicators of the user's true emotions and their intensity. For this reason the Q sensor was used for monitoring the biometrical data.

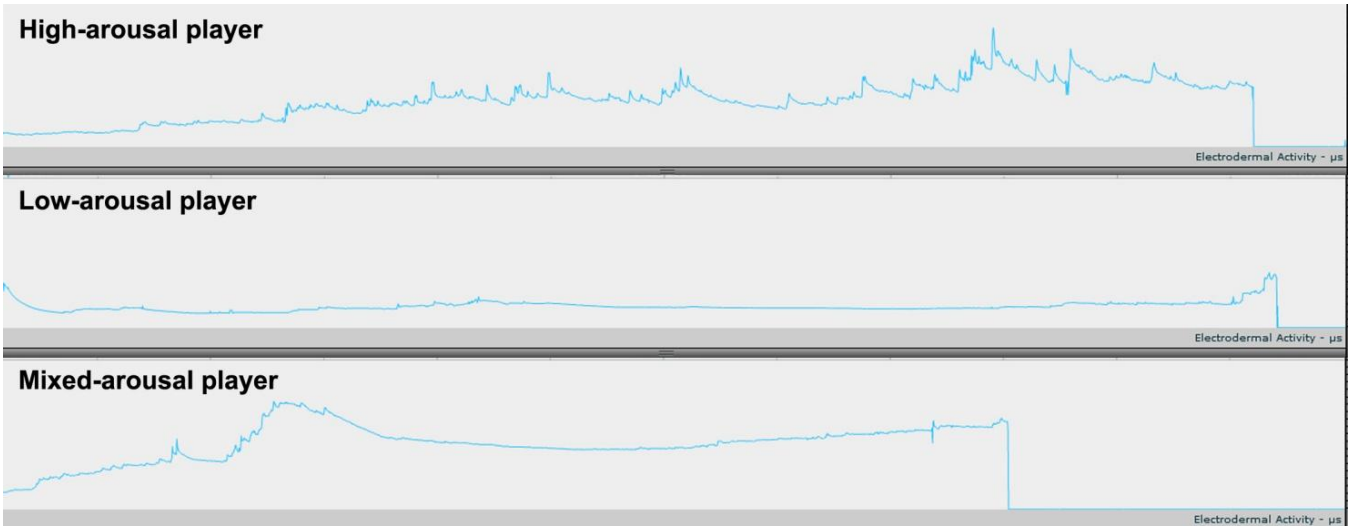
Electrodermal data Analysis

The electrodermal data was gathered using Q sensor technology which can detect and measure the arousal level that someone is experiencing. From this data, were extracted some important insights that cannot be gathered from questionnaires or video analysis alone. The Q sensor detects the arousal level from the electrical changes measured at the surface of the skin which changes accordingly to the different internal or external stimuli received by the brain. On the current research, the players received mainly the stimuli from game events and some external stimuli from the teammates located in the same room or the researcher (involved in case of verifying the data was recorded correctly from software or answering the questions of participant). Some events within the game that were played a role of stimuli were: attacking the enemy, the enemy attacking the player, the player getting killed etc. Moreover, the periods of waiting were arousal for example, waiting the game to load, waiting to join other teammates, waiting for resurrection from death etc. In this case, the person might be possibly having extra internal stimuli-- perhaps thinking about something relevant or irrelevant of the game.

According to Picard and Scheirer (2001), when the person is experiencing high arousal state (for example anger, frustration or mental workload) the arousal level tends to be high, when the person is relaxed or sleeping the level will be low. Extending that theory and based to the electrodermal activity of participants of this research, we can conclude that the players can be classified in three arousal level related types. The High-arousal players, Low-arousal players and Mixed-arousal players. As seen in the example below, there are presented typical players of each category, based on participant's data. The *High-arousal players* have electrodermal activity chart looking like waves or curves. These kinds of persons get aroused more often others and their arousal level has pulsation-the level either grows and falls quickly or it remains high for periods of time and drops down slowly. In the first case of wavy arousal level, the person's mood changes rapidly whereas in the second case of curly arousal level, the arousal changes smoothly but remains on a high level for longer periods of time. Probably, this kind of persons are more easily distracted and often get stressed, angry etc, during the game or they are paying too much attention in the game/are in state of flow.

The Low-arousal players electrodermal activity looks like almost straight line, with very slight waves or curves. Here, the arousal levels remain very low and change very smoothly. Low—arousal players tend to be calmer during the gameplay and express emotions of little depth.

The third type, mixed-arousal players, are characterized by both high and low arousal levels with varying duration. The arousal levels change depending on the events happening at that period of time. In this case the player may be very relaxed at some periods of time and at some other be very vigilance and emotional.

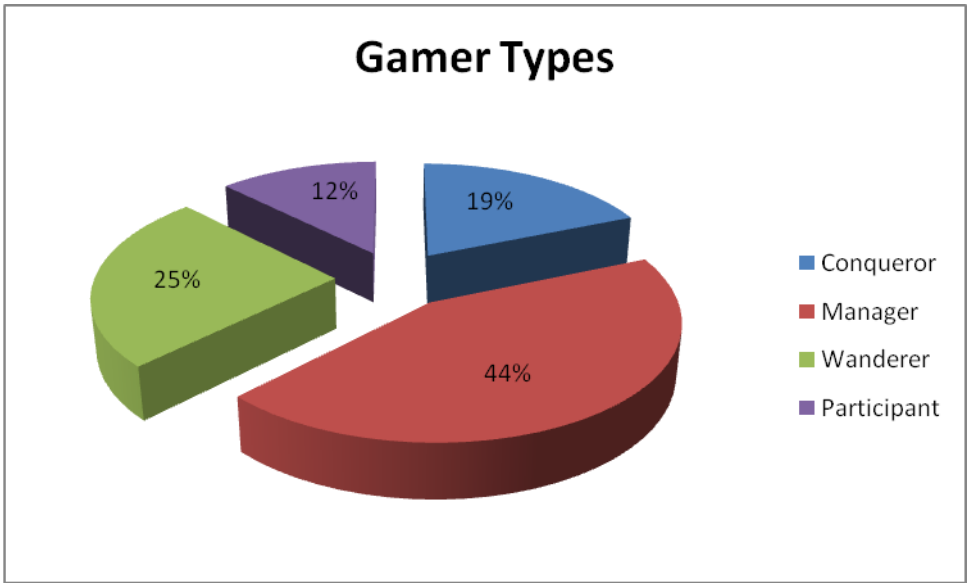


Shown below, is the table depicting the arousal level of participants and their dominant, self-evaluated, feelings during the game play (in the certain experiment). These data confirms the above assumptions. The High arousal level players had reported that they felt mainly stress, irritation and absorption during the game play. The low arousal players reported that they felt mainly relaxation and a mixture of other similar emotions. The Mixed type of players expressed mainly irritation, enthusiasm and absorption. Also, a small minority reported feeling some sort of happiness or disappointment.

Participant	Arousal level type	Feelings		
2	High	Stress	Happiness	Absorption
4	High	Irritation	Disappointment	Absorption
8	High	Stress	Sadness	Absorption
9	High	Relaxation	Boredom	Absorption
12	High	Stress	Irritation	Confusion
5	Low	Stress	Happiness	Relaxation
10	Low	Enthusiasm	Relaxation	Boredom
13	Low	Irritation	Confusion	Disappointment
1	Mixed	Happiness	Enthusiasm	Absorption
3	Mixed	Confusion	Boredom	Absorption
6	Mixed	Happiness	Irritation	Enthusiasm
7	Mixed	Irritation	Fear	Enthusiasm
11	Mixed	Irritation	Confusion	Disappointment
14	Mixed	Disgust	Relaxation	Absorption
15	Mixed	Stress	Sadness	Disappointment

Table 1.18: Participant arousal level type and feelings expresses during game play

As mentioned in the literature review, (Chapter 3) there are four types of gamers: Conqueror, Manager, Wanderer and Participant. Each type of gamer has different goals, priorities and things that makes him enjoy playing the certain video games. The Conqueror type players want to feel dominant and they are competitive, goal oriented and their goal is to win the game. Manager type players are process-oriented and strive to achieve mastery and keep everything under control. Wanderers are less challenge-oriented and their main goal is to have new and fun experience of the game. Finally the Participant type players prefer to enjoy the immersion in the game and they enjoy more the "meta-gaming". Below, the graph with the participant gamer types of this research is shown. As shown below, the majority of them belong in the Manager type (44%) , followed by Wanderer (25%), Conqueror (19%) and Participant (12%).



Graph 1.19: Gamer types percentages

To indicate the gamer type of each participant the questionnaire included 3 statements for each gamer type and the participant must rate in what extent he agree or disagree with the statements. The answers was in scale from 1 (absolutely disagree) and 5 (absolutely agree). In analysis the answers for each statement was add up and the highest sum were corresponding to gamer type. After summing up the answers, the following table was created stating the trends of each participant.

Participant	Conqueror	Manager	Wanderer	Participant
1	11	**15**	**15**	8
2	8	9	**11**	10
3	9	**13**	11	7
4	9	11	9	**13**
5	11	10	8	**13**
6	**10**	9	9	9
7	12	12	**14**	8
8	13	13	**14**	10
9	13	**15**	6	6

10	7	**15**	12	9
11	6	**10**	9	6
12	**15**	9	10	9
13	**15**	11	8	7
14	9	**13**	7	3
15	*9*	*11*	*8*	*6*

Table 1.20: Total sum of user classification points per participant

It is interesting to investigate whether the gamer type and the experience level is related to the arousal level of player. In the table below, the participants are categorized based on the arousal level type, the gamer type and the game experience level. Because in the research participated 15 people, I cannot generalize the results completely, but I can assume some tendencies which could be confirmed or rejected with study of more participants. It seems like the participants of current research with high arousal level belong in the wanderer gamer category and they are intermediate level gamers. The low arousal level participants tend to be expert level gamers regardless of the gamer type they belong to. Finally, the Mixed arousal level type players tend to be manager type gamers with intermediate or expert level of experience in the game.

Participant	**Arousal level type**	**Gamer type**	**Game experience level**
2	High	Wanderer	Intermediate
4	High	Participant	Intermediate
8	High	Wanderer	Intermediate
9	High	Manager	Expert
12	High	Conqueror	Intermediate
5	Low	Participant	Beginner
10	Low	Manager	Expert
13	Low	Conqueror	Expert
1	Mixed	Manager and Wanderer	Expert

3	Mixed	Manager	Intermediate
6	Mixed	Conqueror	Intermediate
7	Mixed	Wanderer	Beginner
11	Mixed	Manager	Intermediate
14	Mixed	Manager	Expert
15	Mixed	Manager	Expert

Table 1.21: Participant's arousal level , gamer type and level of game experience

As described above from analysis of EDA which revealed three types of arousal such as the high arousal, low arousal and mixed arousal, each participant belongs to one type and has similar behavior during the gameplay with slightly changes due to arising events in the game. Generally speaking, despite the fact that every participant belongs to a different type of arousal level, they shared some similarities about the events that caused some sort of change in arousal level. Usually when they were irritated or enthusiastic about something, (one event) the arousal level grown creating peak (peaks) in the EDA diagram. But when the event passed and the player was relaxed, the level of EDA seemed to drop.

I was analyzing the EDA data that were collected from Q sensor in parallel with the events happening in the game which was captured in video and screen recording. Basically only the visible changes in EDA graph were analyzed (the peaks and drops) and assigned to the events happening in the game. At the begging of the experiment, the participants were shown calibration images (images that evoke different emotions to the participant) to identify how much emotional is the each participant. After that, the participant logged in the game and the user begun to select the preferences of the game he/she would be playing such as team chat, waiting period the game to load and all the players to connect to game, the actual game play, game end and team chat. All the participants were passing through all these stages but some of them were skipping the chat (prior of after game). The majority of participants tended to have gradual growth of EDA level during the calibration and after finishing the calibration there was an obvious drop. Also, some other events evoking grow of EDA were during the matching period, when there were problems with q sensor connection, external sources

(speaking with others, telephone calling, loud sound), when the player was killed by enemy, during the battle and when the player was in the process of recovering from death and was getting readyfrom the battle. Overall, the majority of participants tended to have a growing level of EDA during the game, with some minor points showing lower EDA activity.

Events and EDA

Below is presented the main game events that evoked change in EDA levels. In the Appendix section, there is detailed table with EDA measure (μs) of events. The table includes only the highest or lowest level of EDA for each event. The majority of participants had the electrodermal activity in the range from 0 until 10 μs,. There was only one case of a participant, where the EDA was from 0 to 48 μs. For analyzing purpose, the "peaks" describe the sudden growth and then drop of μs level, which look like spikes in the EDA graph. The "drop" describes the sudden drop and then grow of μs level (the inverse of "peak"). The "grow" describes a gradual increase of μs level, which resembles a curve in the graph whereas "decrease" of EDA refers to the gradual decrease of μs level, which looks like a curve in this case.

1. Waiting the Q sensor to connect/ reconnect

When the q sensor was moved slightly on the hand, there were significant drops and after it was reconnected,the levels spiked again. This occurred mainly because the two sensors on Q sensor were not touching the skin surface, in this case the drop was until 0 μs. Also if the participant took off the Q sensor and wear it on the other hand the connection was lost and there were continues drop in EDA data. When we thought that the Q sensor was diconectted and we were trying to connect it again the participants had growth of EDA.

2. Calibration/end of calibration

The participants were shown during the calibration, images that are were related to League of Legends and others that were not relevant- the ones that were not related were intended to evoke certain emotions to participant (such as happiness, fear, sadness e.t.c.). During the calibration process, there wasn't any big differences in EDA levels tracked. Some users had

very tiny peaks or little bid bigger peaks when they were viewing the images. The images that were most emotion-evoking for the players were the following: default black image for calibration, congratulation summoner image, victory image, image with one person full of blood, image with dead dog in middle of road, rabbit image. In some cases, the participants had also reached peak levels when they experienced the end of callibration, probably because they got excited about the fact were ready to play.

3. Logging into the game

Many participants showed a growth of EDA levels, when they were logging into the game. Also when they failed to login, then they reached a peak level which indicates that they were probably irritated because they didn't succeed to login.

4. Changing settings/ waiting to match with players/ Waiting the game to load

When the player was changing the settings the arousal level seemed to grow a little bit because they were irritated by default settings and wanted to apply settings that were more suitable for them. In some cases, while the player was waiting to be matched with other players to form a team the EDA level grew significantly.While the players are waiting the game to load they have some peaks that were probably evoked by internal stimuli, thoughts that may have the participant at that certain time. But it is unknown whether the thoughts are related to the game or not.

5. Chatting with other players before the game/ after the game

Usually in the event that the players were chatting with other teammates, the graph lines were gradually increased or created a peak point. The participants chatted before the beginning of the game to share the roles/jobs. After the end of game, the majority of participants weren't discussing the gameplay or the results, they just logged out from the game.

6. Beginning of the game

Most of the participants got excited when the game begun, after waiting for the game to load. That was obvious from changes in EDA, whether they expressed high or low intensity of arousal.

7. External stimuli

From the electrodermal analysis, it seems like the external stimuli that was not relevant to the game, had a bigger impact on changes in EDA data. Usually due to external stimuli, there were higher peaks than the ones evoked by game events. Some examples of external stimuli were the following: While the participant was logging into the game, he remembered that he was logged in from another laptop. There was also a peak also when something dropped down one object and it made loud noise. Also in case of telephone conversations or when the players were talking with each other in the room, there were peaks recorded. Also when there were technical issues with internet connection or the game freezed, there were high peaks at that certain moments. Finally, after the end of game, the players showed growth of EDA level and reached a peak point.

8. The player attacking enemy/minion/turret or killing the enemy

During battles within the game, the participants usually had continuous small peaks or growing big peak points, that usually stopped growing at the moment the player got killed. When there is a battle between the player and the enemies, there are varying peak points (in different level) until the enemy or the player get killed or the player abandon the battle and moves somewhere else. Also when the player was following the enemy to kill him he had grow of EDA. In case when the player was attacking the minions he was more relaxed, despite that this event evoked some peaks they were not high as the ones in case of attacking the enemy or tower. The most probable reason is because minions are not human players also they don't do big damage to their health.

9. The enemy attacking the player

When the enemy was attacking the player and the player was trying to avoid getting killed the arousal level was higher, which caused higher peak points as a result.

10. The player getting killed

Usually when the player got killed there was a peak and after that, the level of EDA went back to normal. In case the player got killed suddenly, there was a big peak whereas when the player gets killed after a while, then there were gradually growing peak points and a slightly bigger peak when he got killed, has been spotted. In addition to that, the peak points were higher when the player got killed compared to just fighting the enemy.

11. Waiting to recover from death/after death

Usually that event didn't have any significant affection on EDA data. During the waiting period of recovering from death, the participants were relaxed (in most of the cases). Usually they were buying items from the store but sometimes they were watching the battle that was going on after their death. In the majority of cases, the EDA level was decreasing during the waiting period of recovery from death. Only in some cases, when the battle was very important (at end of game) the participant had increased EDA levels. After the death recovery, the EDA level was restored in high levels and reached a peakpoint because the player was feeling ready to play and enter to battle.

12. Participating in battle / Abandoning the battle

In one case the player was fighting in the battle and after he decided to abandon the battle there was drop of EDA levels.

13. End of game

All the participants reached peak points or "growth" of EDA at end of the game, irrespective of whether they won the battle or were defeated. This can be attributed to the fact that they probably got excited about the victory or irritated about their defeat. However, in some cases when the game ended, the peaks were very small compared to other game events.

After the experiment, the participants were given a questionnaire. In one of the questions, they were asked to evaluate the mood they had during the game play experiment. In the majority of cases, the participants seemed to have a positive mood during the gameplay as it can be seen from the table 1.22. In particular, 40% of participants were quite happy or cheerful during the gameplay, and 46.7% felt that they were quite strong. The participants had evaluated that more than 80% (in total) had experienced in different intensity each one of the following moods: alert, strong, happy, active and excited. A high percentage of participants were not experiencing at all certain moods such as feeling sociable/lonely (46.7%), proud/ashamed (53.3%) and involved/detached (60%). The lowest percentage of players reported feeling in varying degrees, drowsy (6.7%), sad (6.7%) weak (0%), passive (6.7%), detached (0%), bored (6.7%) and confused (0%)

	very	quite	somewhat	neither	somewhat	quite	very	
alert	25.7%	40.0%	20.0%	6.7%	6.7%	0%	0%	**drowsy**
happy	20%	40.0%	20.0%	13.3%	0%	6.7%	0%	**sad**
cheerful	13.4%	6.7%	13.3%	20.0%	13.3%	13.3%	13.3%	**irritable**
strong	13.3%	46.7%	26.7%	13.3%	0%	0%	0%	**weak**
active	33.3%	33.3%	26.7%	0%	0%	0%	6.7%	**passive**
sociable	13.3%	13.3%	0%	46.7%	26.7%	0%	0%	**lonely**
proud	6.7%	13.3%	6.7%	53.3%	6.7%	13.3%	0%	**ashamed**
involved	0%	13.3%	26.7%	60.0%	0%	0%	0%	**detached**
excited	20.0%	33.3%	33.3%	6.7%	6.7%	0%	0%	**bored**
clear	20.0%	33.3%	20.0%	25.7%	0%	0%	0%	**confused**
relaxed	20.0%	6.7%	13.3%	0%	20.0%	33.3%	6.7%	**tense**
cooperative	20.0%	6.7%	6.7%	6.7%	26.7%	20.0%	13.3%	**competitive**

Table 1.22: Percentages of user's emotions and intensity

To evaluate the cognitive load the users may have during the gameplay better, they players were asked to define the level of difficulty of stated actions. They had to rate from 1(not at all) to 5 (very much). In the table 1.23 below, I present the mean, standard deviation and the percentage of given answers. In the majority of cases, the participants reported that they didn't have any specific difficulty on a high level. The only difficulty they seemed to have, was the level of concentration during the gameplay where 40% answered that it was very much difficult and 33.3% that it was of medium difficulty. This probably happens because they were playing the game in the laboratory settings and not in their natural environment (home or internet cafe). The other reason probably was because they were using other laptop that was not their own, complaining in some cases that the internet connection was slow and the game was freezing sometimes, leading to frustration. One type of difficulty, was to reply in the chat while the player was killing your enemy or hitting the tower. The findings reveal that there was a big enough variation in their answers (1.457) but from the mean (3.13) it seems like this was medium difficulty level for them additionally to that the participants had medium difficulty to be self-conscious (mean 3.47). All the remaining questions were rated with below 3 (mean). The easiest tasks for the players were to watch the life bar when they were killing the enemy (mean 1.80) and to choose the weapon/skill while fighting (mean 1.53). Also the difficulty was relatively low when recognizing the enemy when there were many players nearby (mean 1.87) and to use the skills during game play (mean 1.73).

Questions	**Mean**	**Std. Deviation**	**Not at all**	**Little bit**	**Medium**	**Pretty much**	**Very much**
How difficult it was for you to watch the life bar while you were killing your enemy or hitting the tower?	1.80	1.521	73.3%	6.7%	0%	6.7%	13.3%
How difficult it was for you to answer in the chat while you were killing your enemy or hitting the tower?	3.13	1.457	20.0%	13.3%	20.0%	25.7%	20.0%
How difficult it was to choose	1.53	0.834	60.0%	33.3%	0%	6.7%	0%

the weapon / skill while fighting your enemies?							
How well were you concentrating?	3.93	1.033	0%	6.7%	33.3%	20.0%	40.0%
How difficult it was for you to chat with one player?	2.20	1.146	40.0%	13.3%	33.3%	13.3%	0%
How difficult it was for you to chat with three players?	2.20	1.014	33.3%	20.0%	40.0%	6.7%	0%
How difficult it was for you to chat with more than three players?	2.73	1.335	26.7%	13.3%	26.7%	26.7%	6.7%
In battle with many players nearby how difficult it was for you to keep track/watch your summoner?	2.60	1.242	20.0%	33.3%	20.0%	20.0%	6.7%
In battle with many players nearby, how difficult it was for you to recognize who is your summoner?	2.13	1.060	33.3%	33.3%	20.0%	13.3%	0%
In battle with many players nearby, how difficult it was for you to recognize your enemy?	1.87	1.125	60.0%	0%	33.3%	6.7%	0%
How hard it was to use the skills during game play?	1.73	0.961	53.3%	26.7%	13.3%	6.7%	0%
Was it hard to concentrate?	2.07	1.033	40.0%	20.0%	33.3%	6.7%	0%
How self-conscious were you?	3.47	0.990	6.7%	0%	46.7%	33.3%	13.3%

Table 1.23: Mean values, std.deviation and percentages of user cognitive load variables

The players self rated the level of emotions that was evoked by certain events during the gameplay. They rated the emotions in scale from 1 (slight intensity) to 5 (very high

intensity). In the event they didn't feel any emotion, they rated it as 0. In the table below, the means of the ratings of all the participants are presented. From self-evaluation analysis it seems that the participants weren't experiencing most emotions on a high level, the two emotions that was rated in some cases below average was the irritation and joy/enthusiasm. The players felt more intensely the irritation when they were being killed (3.07/5), when the enemy destroyed their tower (2.86/5) and when the enemy defeated them in the battle (3.14/5). Joy/Enthusiasm was more intense when the player killed the enemy (4.00/5), when teammate kills the enemy (2.57/5), when the player destroys enemy's tower (4.07) and when a player's team wins the battle. The negative emotions such as stress, fear and sadness/frustration, had the average rating below. In the majority of cases, (irrespective of the event) the rating was below 0.50.

	Stress	Fear	Sadness / Frustration	Irritation	Joy / Enthusiasm
When someone kills you	1.29	0.50	1.93	3.07	0.21
When someone kills your teammate	0.57	0.29	1.29	2.43	0.71
When you kill your enemy	0.57	0.21	0.21	0.21	4.00
When your teammate kills your enemy	0.21	0.21	0.50	0.64	2.57
When your enemy destroys your tower	0.43	0.29	1.43	2.86	0.43
When you destroy enemies tower	0.57	0.21	0.21	0.43	4.07
When your team wins the battle	0.21	0.21	0.21	0.21	4.64
When your team is defeated in the battle	0.64	0.57	2.36	3.14	0.29
When it's hard to watch the chat and participate in the discussion	0.29	0.29	0.43	1.36	0.29

Table 1.24: Arousal level means during gameplay

Chapter 5

Conclusion and Discussion

In this thesis was presented the cognitive load and flow theory as well as the measuring tools used in previous researches which were applied in the current study.
The main goals of this study were the following: to investigate what kinds of cognitive overloads users of MOBA experience, what dimensions of flow do players of MOBA games show and what insights can be provided from Electrodermal activity of LOL players. Below is presented the summary of findings of current research.

Cognitive overloads

As was presented in previous research (Ang, Zaphiris and Mahmoud 2006) there are 5 different types of cognitive overloads that the user may experience in MMORPGs: the multiple game interaction overloads, the multiple social interaction overloads, the parallel game and social interaction overloads, the Interface overloads and the identity construction overloads. In the present study, we examined if these types of cognitive overloads can be applied in the Multiplayer Online Battle Arena games (such as League of Legends in this case). Based on analyzed data all the game interaction overloads of MMORPG can be applied on MOBA. First one is the *multiple game interaction overloads*, the user has to interact at the same time with multiple objects of the game such as enemies, turrets, minions e.t.c. The user must have strategy and manage his interactions with the game objects in order to have success in the game, for example he have to put some priorities, first he must shoot the turret because it destroys a lot of his health, second the enemies and last the minions. Another one is the *multiple social interaction overloads*, the user has to interact and chat with other players. The third type is the *parallel game and social interaction overloads, which* appears when the user interacts with other players and the game at the same time, i.e. chatting with other players while trying to kill the enemy. In case of current studies the majority of players was not using the chat at all or only for share important information with their teammates. In this way they eliminate the redundant information and were concentrating on

battle, but at the same time they were constantly watching the chat. Finally the *user Interface overloads* the user must keep track of all the information and the notifications appearing in the UI which distract his attention from the game. In case of League of Legends there wasn't a lot of redundant information presented in the UI so the players were successfully concentrated to the game. Finally the fifth type called *identity construction overloads*-this overload occurs when the user is not able to identify himself or another player among all the players participating in the game. This type applies also, in case the user is not able to construct his own identity. In case of League of Legends this type is very eliminated because the majority of players in every battle have different appearance also the life bar above them is different color in case of teammates and enemies. Generally the cognitive overload is eliminated in the current game so the player can concentrate on the game without any distraction.

Flow Factors

The flow factors of game League of Legends are the following. Players in general seem to enjoy trying out new skills, abilities and champions but they feel in lesser degree that LOL provides a good test for their skills and stretches the capabilities to their limits. The users tend to feel positive about trying new sets of skills and characters but they feel that the game does not support their capabilities fully. Studying flow factors in regards to action and awareness, here we can see that most users tend to feel ready for action and express being aware of what happens in the game; However, the users doesn't play automatically, probably they involve thinking about the strategy of the game and what weapons/skills to use in appropriate conditions. Regards to clear goals and feedback the participants revealed that they knew clearly their goals in the game and what they had to do but they reported that they received in lesser degree appropriate feedback of their actions. The participants reported that in general that playing LOL is an enjoyable experience. Generally there is tendency of users feeling completely focused on the game they played (while being monitored) but feel that they are always focused in the game to a lesser degree. Most users studied tend to feel in control over what was going on in the game and reported experiencing difficulties handling the control of the champion to a much lesser degree-which means in this case that controlling their champion is relatively easy and not a hard task. As for immersion inside the game

environment, the players reported that they were immersed but it fully as for losing their of consciousness, identity and immersion, in a considerable degree. According to time there were a clear tendency of users reporting that time passes quickly instead of freezing/stopping during gameplay. About the autotelic experience in the game, users in general tend to feel that they loved their performance and want to capture the feeling again. There is also a relatively high tendency to feel that the game is rewarding in itself although to a slightly lesser degree comparing to the other statements. In regards to social interactions as a flow factor, the mean value reveals that the interactivity functions are satisfying in general, although not fully. As for challenge as a flow factor, here we can see that users tend to find the game challenging and need to play often and feel bored to a much lesser degree. However, in regards to player difficulty, there is a relatively high tendency of the game being difficult in the most part. To sum up the League of Legends have been successful in majority of the flow factors, succeeding to keep the player's interest and engagement with the game, however it needs some improvements to get the ultimate flow experience in the game. Perhaps the game could be more demanding so the players can feel that it stretches their capabilities their limits. The feedback of game could be more appropriate relatively to players actions.

Limitation of current research and suggestions for further studies

The number of participants is not large, for that reason the generalization cannot be made for the whole population of LOL players. Also the user's true experience and emotions during gameplay were mixed, even though some tendencies were identified. This occurred probably because the user's were monitored in a foreign environment so probably there were some other factors that influenced the game experience and the arousal level. Therefore, future studies could study more subjects in their natural environment, using gaming computers instead of laptop in this way we can minimize any problems and interferences. Probably in other studies can be used some other tools for collection and measurement of related to arousal and anxiety biometrical data, such as heartbeat e.t.c.

Moreover, it would be interesting to study users in less popular and stimulating gaming environments (for example virtual reality games) to identify any similarities or differences concerning flow factors and user's experience in general.

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Appendix

CYPRUS UNIVERSITY OF TECHNOLOGY

Department of Multimedia and Graphic Arts

Master in Interactive Multimedia

CONSENT FORM

Consent to participate in an Experimental Study

Purpose of experiment: The purpose of this study is to examine the cognitive load and the cognitive absorption in Multiplayer Online Battle Arena (MOBA) games, in this case in League of Legends game. The study is part of Vera Gavrilova's Master Thesis in Interactive Multimedia, under the supervision of Professor Panayiotis Zaphiris.

Experiment description:

In order to participate in this study you will be asked to do the following:

1. Answer pre-questionnaire

2. Play one game 5 x 5 in League of Legends (approximately 30 minutes)

   The screen will be recorded also you will be video recorded on web camera.

3. Answer the post-questionnaire

The total time required for participation is approximately 1 hour.

Benefits/Risks for participant:

The main benefit is that after the analysis you will be able to know what type of gamer you belong to as well as to know specifically what makes you feel good while playing the game.

The only risk you may have is the feeling of discomfort while you know you are video-recording on camera.

Participants right:

Your participation in this study is entirely voluntary and you may stop participating in the study at any point during the experiment, or refuse to answer any questions with which you are uncomfortable. You may also ask the researcher any questions you may have at any time.

Confidentiality:

All the data that will be collected will be used only for the purpose of the certain research. The data will be accessible only to those working on the project, it will not be given or sold to any other third party. Your name will never be connected to your results or to your responses on the questionnaires. Information that would make it possible to identify you or any other participant will never be included in any sort of report.

Statement of Consent:
If you agree with the above stated-conditions and agree to participate in the experiment please sign below. By signing you agree that you have read the above information, you have asked any questions you had regarding the experimental procedure and they have been clearly answered.

Name of Participant (print)_____

Signature of Participant_____ Date_____

Name of Parent/Guardian_____

Signature of Parent/Guardian_____ Date _____

Name of Researcher Vera Gavrilova Signature of Researcher_____ Date_____

For any questions you can contact:

Researcher (Vera Gavrilova) Email: vera.g333@gmail.com

Supervisor: (Panayiotis Zaphiris) Email: **panayiotis.zaphiris@cut.ac.cy**

Thank you for the participation!

Pre-Questionnaire

A1. Age: _____ **A2. Gender:** □ Male □ Female

A3. How long have you been playing LOL?

□ less than 6 months

□ from 6 months to 1 year

□ from 1 to 3 years

□ from 3 to 4 years

□ more than 4 years

A4. How many days do you play per week ?

□ 1-2 days

□ 3-4 days

□ 5-6 days

□ everyday

A5. How many hours per day are you playing (approximately)?; _____

A6. In which category of players do you classify yourself?

□ Beginner- New player with little experience

□ Intermediate - player with medium experience

□ Expert- experienced player

A7. What is your current level in LOL _____

A8. What game settings you prefer (chose one answer from each column)?

	Game mode	**Game Map**	**Game Type**	**Difficulty**
PvP □	Classic □	Summoner's Rift □	Normal □ (Blind pick)	
	Dominion □	Twisted treeline □	Normal □ (Draft pick)	
Custom □	ARAM □	The crystal scar □	Ranked Teams (Draft pick) □	
		Howling Abyss □	Ranked Solo/Duo (Draft pick) □	
			Normal □ (All random)	
Co-op vs. AI □	Classic □	Summoner's Rift □		Beginner □
	Dominion □	Twisted treeline □		Intermediate □

A9.How many games per day do you play (mean) _____

A10. What was your maximum number of games played in one day? _____

A11. While playing LOL what else you do at the same time?

□ Nothing else, just playing

□ Surfing wedsites about LOL (i.e. forums, blogs)

□ Surfing wedsites with not relevant to LOL content (i.e. facebook, youtube)

□ Talking on phone/Skype

□ Watching TV/DVD

□ Eating/Drinking

□ Other (please specify) _____

A12. Rate in what extent do you agree with the following statements (please circle your answer)

		1= absolutely disagree	**2**	**3**	**4**	**5 = absolutely agree**
1	I always want to win the battles	1	2	3	4	5
2	I want to have the best ratings/score compared to my teammates	1	2	3	4	5
3	I want my teammates to consider me as the best player of my team	1	2	3	4	5
4	I want to experiment the new strategies	1	2	3	4	5
5	I want to try different champions to try out their skills and abilities	1	2	3	4	5
6	I want to try different combinations of mastery	1	2	3	4	5
7	I love playing just to spend my time	1	2	3	4	5
8	I like playing to earn new experiences	1	2	3	4	5
9	I don't care if I lose or win the battle	1	2	3	4	5
10	During game play I like to talk	1	2	3	4	5

	to other players in the chat					
11	After the end of the battle I like to talk to players in the chat	1	2	3	4	5
12	I like to walk around in the virtual world of the game	1	2	3	4	5
13	I like to kill the enemy / destroy the tower with the help of other players	1	2	3	4	5
14	I like to kill the enemy / destroy the tower alone	1	2	3	4	5
15	I am interested in experimenting with new abilities of champions	1	2	3	4	5
16	I enjoy trying out new skills	1	2	3	4	5
17	I often feel anxiety when I play LOL	1	2	3	4	5
18	Often I feel bored when I play LOL	1	2	3	4	5
19	The game is challenging, it leads me to need to play often	1	2	3	4	5
20	I have difficulties in handling the controls and my champion	1	2	3	4	5
21	The interactivity functions (chat, notifications e.t.c.) in game satisfy my communication requirements	1	2	3	4	5
22	I identify with my champion and I feel as it is an extension of myself	1	2	3	4	5
23	Playing LOL provides good	1	2	3	4	5

	test of my skills					
24	I am very skilled at playing LOL	1	2	3	4	5
25	The communication via chat with other players is very easy	1	2	3	4	5
26	The games I play are mostly difficult	1	2	3	4	5
27	I feel comfortable with the controls of game	1	2	3	4	5

Please write the **last three digits** of your cell phone number or your ID . * _____

* This is needed for identification of Pre-questionnaire and Post-questionnaire, which is important for accurate data analysis.

Post-Questionnaire

B1. Approximately, how long you have been playing the game?

_____

B2. Choose from the following list <u>THREE</u> emotions that you felt more intense during the game. (Circle the answer)

Stress	Happiness	Sadness	Irritation	Enthusiasm
Surprise	Fear	Disgust	Confusion	Relaxation
Disappointment	Boredom	Absorption		

B3. Describe your mood as you were playing LOL (one answer per row).

		very	quite	some	neither	some	quite	very	
1	**alert**								**drowsy**
2	**happy**								**sad**
3	**irritable**								**cheerful**
4	**strong**								**weak**
5	**active**								**passive**
6	**lonely**								**sociable**
7	**ashamed**								**proud**
8	**involved**								**detached**
9	**excited**								**bored**
10	**clear**								**confused**

11	**tense**								**relaxed**
12	**competitive**								**cooperative**

B4. Define the degree of difficulty in the following list

		Not at all	Little bit	Medium	Pretty much	Very much
1	How difficult it was for you to watch the life bar while you were killing your enemy or hitting the tower?					
2	How difficult it was for you to answer in the chat while you were killing your enemy or hitting the tower?					
3	How difficult it was to choose the weapon / skill while fighting your enemies?					
4	How well were you concentrating?					
5	How difficult it was for you to chat with **one** player?					
6	How difficult it was for you to chat with **three** players?					
7	How difficult it was for you to chat with **more than three** players?					
8	In battle with many players nearby how difficult it was for you to keep track/watch your summoner?					
9	In battle with many players nearby, how difficult it was for you to recognize who is your summoner?					
10	In battle with many players nearby, how difficult it was for you to recognize your					

	enemy?					
11	How hard it was to use the skills during game play?					
12	Was it hard to concentrate?					
13	How self-conscious were you?					

B5. Rate the intensity of emotions that you feel in following conditions:

	Rate from 1 to 5 (from 1 = slight intensity to 5 = very high intensity)					
		Stress	Fear	Sadness / Frustration	Irritation	Joy / Enthusiasm
	Example: When someone kills you	**4**			**5**	
1	When someone kills you					
2	When someone kills your teammate					
3	When you kill your enemy					
4	When your teammate kills your enemy					
5	When your enemy destroys your tower					
6	When your destroy enemies tower					

7	When your team wins the battle					
8	When your team is defeated in the battle					
9	When it's hard to watch the chat and participate in the discussion					

B6. Rate to what extent do you agree with the following statements (circle your answer)

		1= absolutely disagree	**2**	**3**	**4**	**5 = absolutely agree**
1	I had a good sense of time when I play the game	1	2	3	4	5
2	I have a sense of control, I know how to handle well my summoner	1	2	3	4	5
3	I'm always ready for action and I am aware of what happens in the game	1	2	3	4	5
4	I'm always very focused in the game	1	2	3	4	5
5	I know well what I have to do in game	1	2	3	4	5
6	When I play I don't feel the need for something else e.g. thirst, hunger	1	2	3	4	5
7	Playing LOL is a very enjoyable experience for me	1	2	3	4	5
8	When I play I don't understand what is going on in my surroundings (in real world)	1	2	3	4	5
9	I feel I am competitive enough to meet	1	2	3	4	5

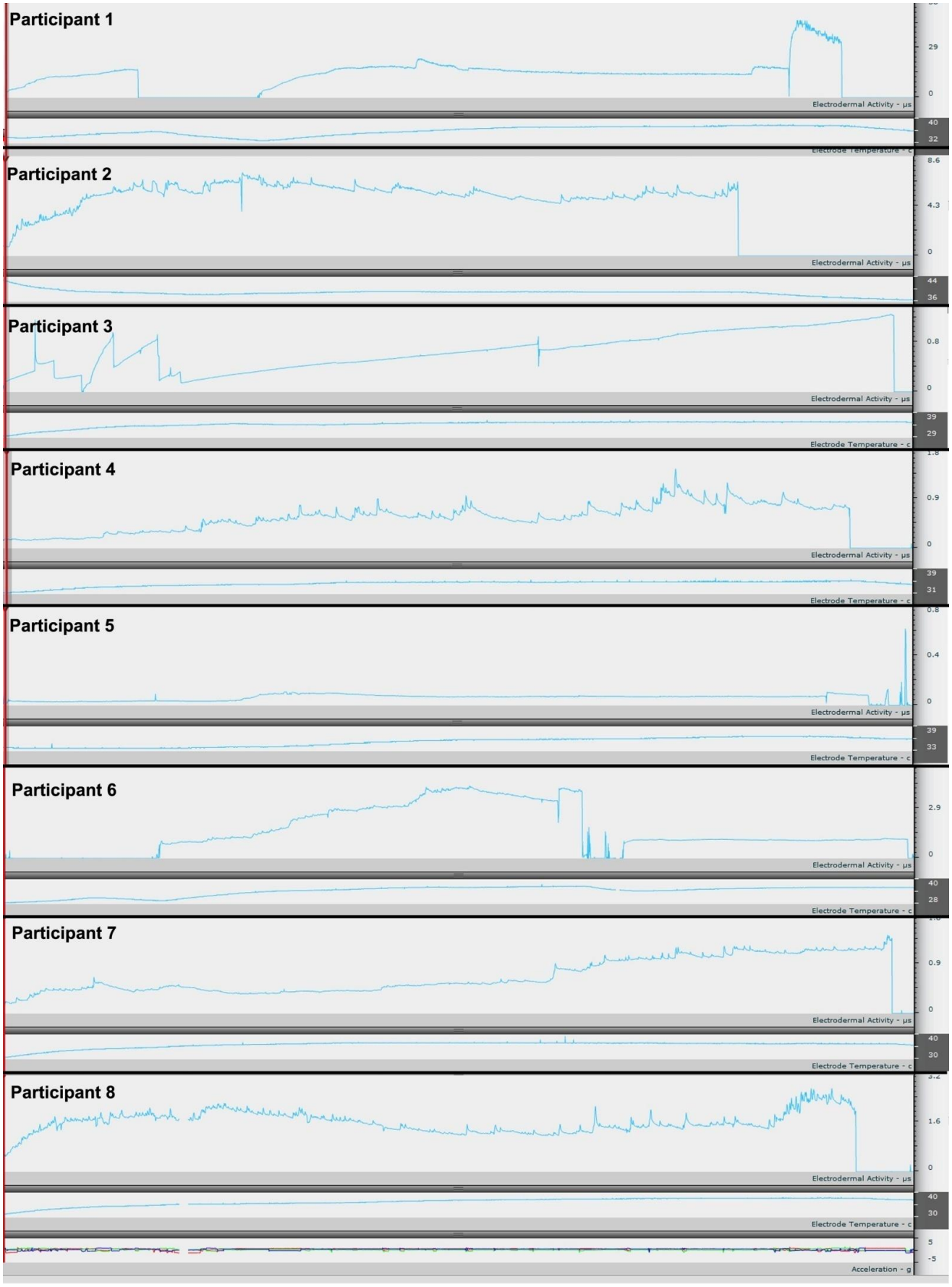
	the high demands of game					
10	When I played, time passed very quickly	1	2	3	4	5
11	During the game play I am immersed and I feel like I am located in the game environment.	1	2	3	4	5
12	I had complete control of the game	1	2	3	4	5
13	I know clearly my goals in game	1	2	3	4	5
14	I didn't feel engaged/ involved with the game	1	2	3	4	5
15	I had confidence when I played	1	2	3	4	5
16	I played spontaneously and automatically without having to think	1	2	3	4	5
17	Playing LOL is very interesting	1	2	3	4	5
18	When Playing LOL I feel like it is the extension of the real world	1	2	3	4	5
19	I get feedback for actions I do in the game	1	2	3	4	5
20	I felt that time freezed/stopped	1	2	3	4	5
21	Playing LOL challenges me	1	2	3	4	5
22	I was completely focused in the game	1	2	3	4	5
23	When I play I do not care about what happens around me	1	2	3	4	5
24	The way time passed seems to be different from normal	1	2	3	4	5
25	When I play LOL I feel that all my	1	2	3	4	5

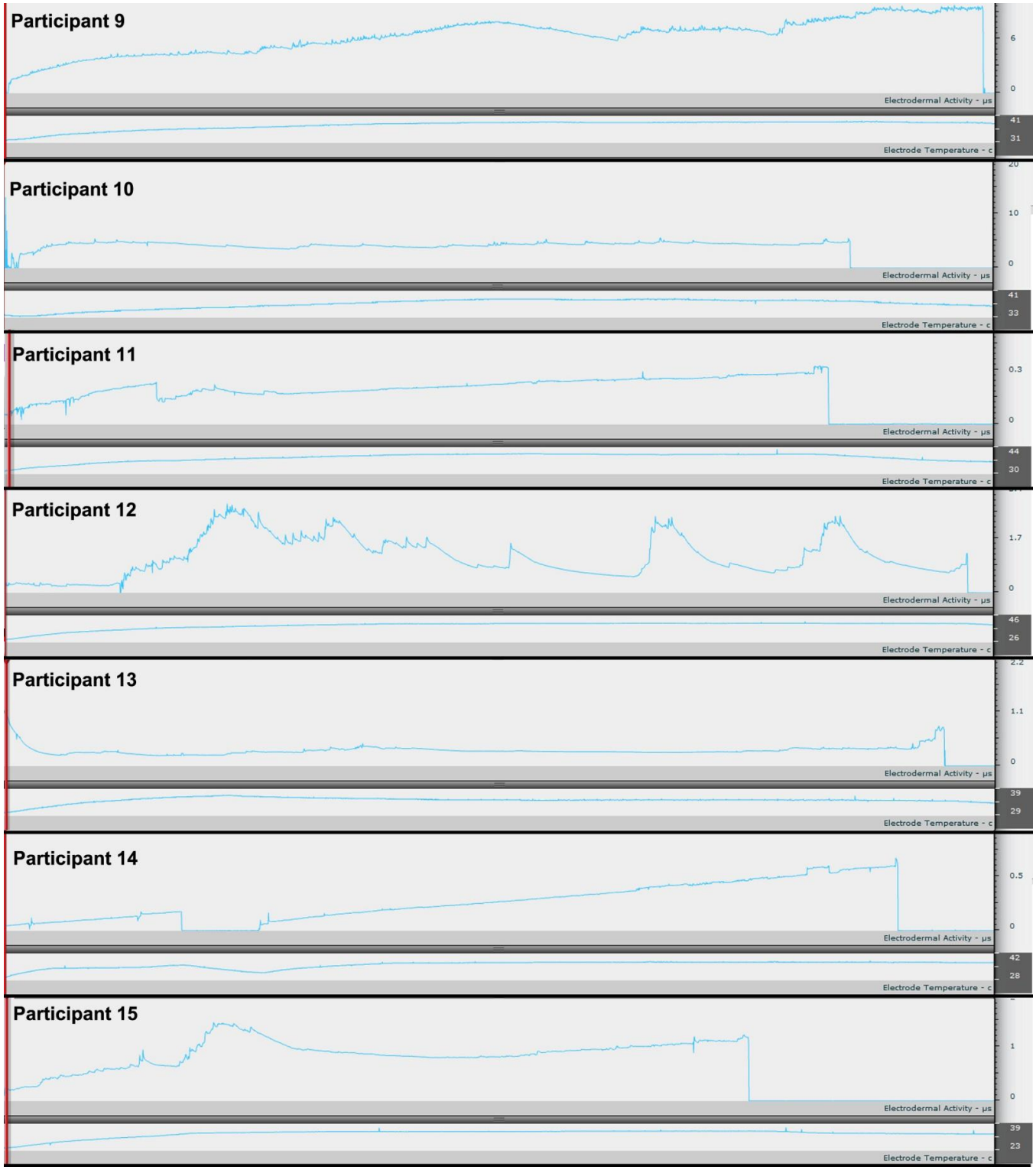
	feelings are in vigilance or alert					
26	I feel pleasure when playing the game	1	2	3	4	5
27	I felt like “nothing else matters”	1	2	3	4	5
28	I knew what I wanted to achieve in this game	1	2	3	4	5
29	I was aware of how well I was performing	1	2	3	4	5
30	I received immediate feedback on my actions	1	2	3	4	5
31	While playing the game, I had a good idea about how well I was doing	1	2	3	4	5
32	I lost consciousness of my identity and I felt like I was one with the game	1	2	3	4	5
33	I kind of forgot about myself when playing the game	1	2	3	4	5
34	While playing this game I sometimes felt like things were happening in slow motion	1	2	3	4	5
35	I find that playing this game stretches my capabilities to my limits	1	2	3	4	5
36	Playing this game is rewarding in itself	1	2	3	4	5
37	I loved the feeling of that performance and I want to capture it again	1	2	3	4	5
38	When playing this game, I felt in control over what I was going in the game.	1	2	3	4	5

Please write the **last three digits** of your cell phone number or your ID . * _____

* This is needed for identification of Pre-questionnaire and Post-questionnaire, which is important for accurate data analysis.

Figure 1.25: Electrodermal analysis of participants during gameplay




Participant 9
Electrodermal Activity - µs
6
0
Electrode Temperature - c
41
31
Participant 10
Electrodermal Activity - µs
20
10
0
Electrode Temperature - c
41
33
Participant 11
Electrodermal Activity - µs
0.3
0
Electrode Temperature - c
44
30
Participant 12
Electrodermal Activity - µs
1.7
0
Electrode Temperature - c
46
26
Participant 13
Electrodermal Activity - µs
2.2
1.1
0
Electrode Temperature - c
39
29
Participant 14
Electrodermal Activity - µs
0.5
0
Electrode Temperature - c
42
28
Participant 15
Electrodermal Activity - µs
1
0
Electrode Temperature - c
39
23