Analytical support in esports – Creating a new dimension using eye-tracking analysis

Master's thesis in Information Systems
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Abstract: The rise of esports in both viewership and the number of active players has sparked debate when comparing electronic sports to regular, in real-life sports. The debate between the two is mainly discussions regarding if esports can be regarded as a real sport or not. There are numerous studies and articles written about that subject, but this thesis will focus on blending esports and real-life sports together to find out if the same methods can be transferred from the real-life version to the electronic version of the sport. The biggest (in terms of viewers and active players) games in esports are, at the time of writing this thesis, of a certain genre that does not have a corresponding version in real-life.

For this thesis, a sport that can be found in the esports scene as well as in real-life has been chosen. The game NHL, which is the electronic version of ice-hockey made by the company EA, is used for multiple reasons. The first reason is the smaller size of the NHL community in esports compared to the bigger games. The second reason is that due to the small community size, there are not many researches conducted about the electronic version of the sport.

A foundation for the thesis is to research through literature what kind of analytical processes that can be found in both esports and in real-life hockey. Due to the small size of research done about the electronic version of the sport, analytical processes will be adopted from the real-life version of the sport.

For more detailed research regarding analytics in esports, the thesis will include a data-gathering section where an eye-tracker is used. This is done to have access to a more diverse set of data from multiple games and game genres. Is the use of an eye-tracker a compliment to the existing analytical processes and data collecting or are the results not bringing in enough value compared to the cost of the tracker and the work that is put into the use of it. The data that is gathered from the eye-tracker while playing the electronic version of the game will be analysed separately from the data that is gathered using the adopted analytical processes from the real-life version. After the analysis is done for both parts, they can then be compared and analysed further to answer the main research question.

Keywords: esports, analytics, eye-tracking, gaming	
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LIST OF ACRONYMS

K/D - Kills / Deaths ratio

PS2 - PlayStation 2

NHL - National Hockey League

CS:GO - Counter-Strike : Global Offensive, a first-person shooter

DOTA 2 - Defense of the Ancients, a multiplayer online battle arena

IEM - Intel Extreme Masters

GWC - Gaming World Championships

BR - Battle Royale

EA - Electronic Arts

AI - Artificial Intelligence

1 Introduction

The first chapter of the thesis will deliver diverse sections to pave the way for the rest of the thesis. In this chapter, the reader can find information about the problem this thesis tries to offer a new point of view for. Along with a statement of the problem, the author delivers reasoning to why this problem is relevant and needs addressing. At the end of the chapter, the research questions are introduced along with a hypothesis. Lastly, the procedure and methodology for answering the research questions are announced.

1.1 Background

Esports has seen a huge growth in individual players as well as in the size of the market share when it comes to viewership (Mangeloja, 2019). Esports provides information about games and players, and this information comes for the most part in numerical data, displaying perhaps how a pro player's K/D ratio in a first-person shooter has evolved. With an increase in popularity, some websites also gather data for someone who plays just for leisure, someone that is not considered a pro player in a pro-level team. Through the use of this data, it becomes possible to compare how a player has improved over time while playing a particular game or a specific game mode itself. As stated before, the data found on websites are often of a numerical type, only giving insights on how one's in-game statistics have developed.

When it comes to eye-tracking, which has been around for a long time, but not used to a large extent in the esports field, neither by professionals or players only playing for leisure. The lack of usage might be due to the hefty price tag of the eye-tracking hardware. With technology evolving and getting cheaper, we could see an increase in the use of high-tier eye-tracking hardware and software to improve one's game by doing an eye-tracking analysis.

1.2 Statement of the problem

It is a known fact that organisations in esports use software and data gathering tools to analyse their opponents, their team and their individuals. How could eye-tracking analysis complement this? What can we find out by running an experiment using an eye tracker and is it necessary to use eye-tracking at all or can we obtain the same results by comparing numerical data with and without the analytical data form the eye-tracking test? Another problem is evaluating a prospect player's abilities only by looking at their gameplay. I also want to find out how eye-tracking could be used in this case as analytical support when recruiting new players to organisations and teams.

1.3 Relevance to degree

This thesis and research are relevant to my degree through analytical work. Whether it is a big company or an esports organisation and it's individuals whose processes we want to make more effective, the process would look pretty similar. Using intelligent technology management and information systems makes it possible to obtain the most optimal and profitable solutions for the company or the organisation to thrive in their field of business.

1.4 Motivation

The motivation on an individual level comes from the author's love for gaming, which has been a part of their life since their first console, which was the PS2. Since then, the author has been gaming and following the development of consoles, watching the games look more realistic than ever. Following other gamers and content creators on twitch.tv and youtube came along a bit later, but the author feels like spectating esports via the internet has come to stay on a global level. This level of interest on behalf of the author led them to write about esports for their bachelor's thesis, which answered the controversial question; can esports be considered a real sport?

This time the author is taking a more analytical approach at researching esports by matching it up with eye-tracking, which is something the author does not know that much about down to the details. The main idea of bringing eye tracking into the study came from a university course. Testing an eye-tracker during that course sparked the whole idea for this thesis.

The third point of motivation is that when researching esports, especially the scene surrounding NHL esports, there is not that much research regarding the field, much less when it comes to eye-tracking studies related to gaming. Ultimately, that is why this is something relevant, needed and interesting for research and for the esports community.

1.5 Purpose of the study

The purpose of this study is to acquire a broader understanding of how analytics work in eSports from different points of view. What analytics do teams pay attention to and what software do they use? How does this research differ between a coach and an individual player? Also, how does the process look when a player does not have a coach or teammates?

The data gathering for this thesis focuses on the game NHL 20, an electronic version of the real-life game ice hockey. At the time of writing this thesis, the community and the esports scene around the game are much smaller than comparatively the community and scene around games like CS:GO or DOTA 2. A great example can be seen in the number of peak viewers, shown in Figure 1a and Figure 1b, during the grand final of the largest tournament for the respective games in 2019. Due to the small size of the esports scene of NHL 20 and the NHL series in general, most literature research regarding analytics in esports is going to be about the more prominent games mentioned earlier. As the NHL game franchise bases on a real sport, there is also available a dimension of comparing how analytics is used in real life and the electronic version, bringing up differences and similarities.

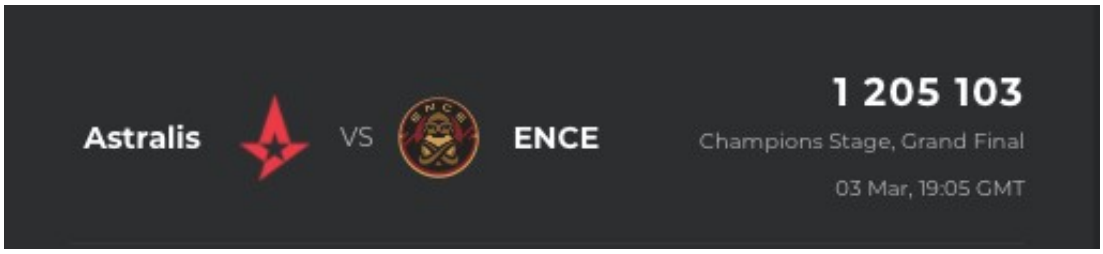

Figure 1a. Peak viewership during the grand final at IEM Katowice 2019 - CS:GO Major tournament. Source: https://escharts.com/tournaments/nhl/nhl-gaming-world-championship-2019.

Figure 1b. Peak viewership during the grand final at GWC 2019 – NHL 19 tournament. Source: https://escharts.com/tournaments/nhl/nhl-gaming-world-championship-2019.

1.6 Research questions

I. What analytical tools does esports use and what does the process include?

II. What is eye-tracking, and what does it offer to esports?

III. How is an eye-tracking test conducted?

IV. Can eye-tracking analysis be a complement to current analytics in esports?

The fourth and last research question is what the aim of this thesis will be about, the preliminary research questions aim to guide this thesis in discovering whether or not the previous question regarding eye tracking as a complement to present

analytics could be true or false. For the fourth question, a hypothesis is stated on the basis of beliefs regarding the matter before beginning the research on the subject.

1.7 Hypothesis

As stated before I will declare a hypothesis regarding the last research question. Taking into consideration my knowledge of the esports scene, the community and my gaming career, I would like to assume that eye tracking can be a beneficial complement to current analytics used in esports. In my opinion, eye-tracking data and analytics can help organisations in situations when recruiting new players. Acknowledging their abilities and predicting whether or not the player in question could be a prospect in the pro-scene according to the data gathered during eye-tracking tests.

Eye-tracking can also be used by teams to find out what could be going wrong or right for them in a competitive match. Finding out flaws or flawless executions in-game can help them move forward with polishing their tactics and in the future, execute plays flawlessly together as a well-trained unit.

1.8 Procedure and Methodology

To answer the research question, I need to research what the analytical part of esports looks like at the moment from an organisation and the community's point of view. For this, I will study what statistics different websites offer for the community as tools to give the viewers a more analytical approach to viewing the game. For the eye-tracking part, I will do comprehensive research on what it is and what history there is behind it. I will then analyse how different aspects from its current use could be beneficial in the esports scene. Attaining a detailed and justified answer on whether it is profitable to use eye-tracking in esports, I will conduct a small-scale data gathering using an eye-tracker which can then be analysed and compared with normal gameplay data.

To conclude the methodology part, the thesis will be a mixed-methodology with main focus on literature review and some experimental work in regard to creating new data.

1.9 Structure of the thesis

The structure of the thesis is built by dividing it into eight chapters. These chapters are designed to all contribute with different perspectives to help answer the research questions.

1. Chapter one is the introduction to the background, statement of the problem, motivation for the thesis and the research questions accompanied by a hypothesis.

2. Chapter two is a mix of literature review and theory around analytics, eye-tracking and the implementation of these in various situations. This is considered to be the most important part for answering the research questions, providing numerous perspectives on the pros and cons of eye-tracking.

3. Chapter three introduces the methodology of gaining insight through conducting an eye-tracking test. The chapter also includes data collection methods and procedures.

4. Chapter four is the analysis of the data collected from the test conducted. Interpretation of the analysis is also made.

5. Chapter five is dedicated to discussing the findings from this thesis. The discussion is done by answering the research questions individually.

6. Chapter six provides a short conclusion of the whole thesis.

7. Chapter seven is a Swedish summary of the thesis as required.

8. Chapter eight is the reference list.

2. Literature Review and Theory

The second chapter of the thesis will focus on earlier research done in different fields. These different sections include different perspectives on analytics, analytical processes, eye-tracking fundamentals and the physiological and psychological factors in esports.

2.1 Analytics

Analytics is a word often used without a proper definition, according to Adam Cooper (2012). In his paper, however, Cooper brings up clarity on analytics by describing it as a process of developing actionable insights. The problem must first be defined. After defining the problem, a set of statistical models can then be applicated to it and analysed by comparing it to earlier or simulated future data.

Cooper (2012), takes this definition apart to explain what it means. He explains that analytics do not have to include a data warehouse, big data or fancy computer software. According to Cooper, analytics is more about the evaluation, planning and executions of human activities instead of how a computer processes data.

The definition Cooper (2012) is talking about might be something that people are not aware of, as the word analytics is often used these days with the increasing amount of software available. Analysing can still be done without computers or software. Without humans, computers would be useless for analytics.

Data analytics are already widely used in sports like F1, football and cricket, according to Andrew Wooden (n.d.), a technology writer for Intel. Wooden states that esports is right on the heels of other sports with taking advantage of the big data available for analytical use.

2.2 Game analytics

When playing a game, one might want to find out what their statistics for that game are. How many wins does an individual player have or how long was it since the player last won a game? This type of data collecting and analysing is, according to

Medler (2011) better known as player dossiers. Medler explains that player dossiers are data-driven visual reports on individual players actions in a game.

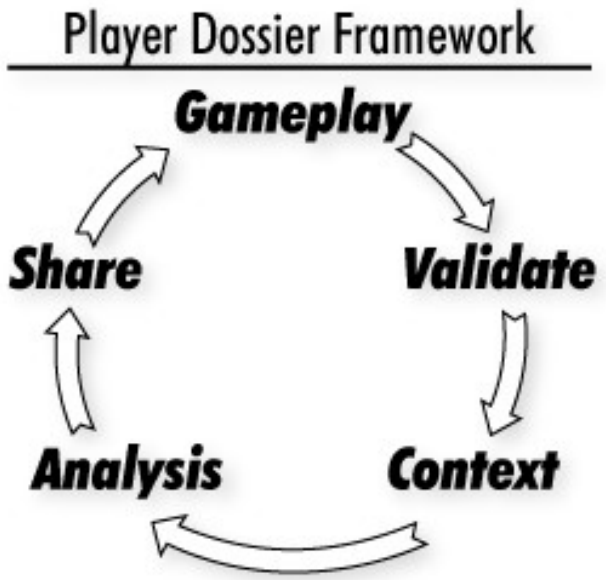

Figure 2. A visual representation of the player dossier creation cycle. Source: Medler (2011).

A player dossier framework, shown in Figure 2, consists of five different parts, starting with the gameplay and the actions the player takes in the game itself which are gathered by the game. The data then has to be validated and given meaning by contextualising it, so it is easier to understand. All of the approved and contextualised data is now analysable. As stated before, the data is individual and can be used to analyse that individual player's statistics only. Data can also be gathered from different players; for example, collect all data from team members to explain how the statistics look when playing as a team. The individual data can then be shared with the community to prove that the player is good at the game, or that the player has improved over time. (Medler 2011)

Whatever the statistics that are shared obtain, this information can be public and viewed by anyone, including the opponents, giving organisations a new way of preparing for games against their opponents by analysing how they are playing as individuals and as a team at a certain point.

2.2.1 Game analytics on an individual level

Gameplay statistics are also retrievable by websites not connected directly with a game company. An excellent example of this is the Tracker Network (tracker.gg), a website that provides the different type of statistics of popular games. Tracker Network gathers the data by having players sign up to their website and then connecting their game accounts to their site. For example, the popular BR game, Fortnite, is run by a company called Epic Games. In Fortnite it is possible to create an account called Epic account which can be connected to the Tracker Network website, allowing the site to gather a player's gameplay statistics.

When taking a glance at ex-pro-player, current streamer Ninja's stat page, the statistics offered for the game Fortnite are very varying. Firstly, it is possible to see how many wins Ninja has, what his win percentage is, how many kills he has, and what his K/D is. Statistics are also offered in a more detailed way by categorising the statistics according to what game mode Ninja has been playing. Fortnite provides the opportunity to play solo, duos or squads. By looking at statistics, it is possible to identify which game mode an individual has played the most and how that individual player has performed in it.

2.2.2 Game analytics on a team level

With the individual statistics covered an organisation or a team could move onto analysing how opposing teams look in the light of statistics. For the game, CS GO several websites provide statistics, including Tracker Network, mentioned earlier. Another page that offers statistics on an individual level is HLTV.org, a forum based around the game with discussion panels, news, details on upcoming matches and events, as well as statistics about the teams that participate in tournaments with a pro-team status. When inspecting pro-team ENCE, based in Finland, there are various parts of information available that could be very useful when matching up against them. The most exciting part is the statistics around the maps of the game. Usually, teams have a certain number of maps they know well and want to play, chosen out of a map pool. Knowing what maps potentially could be played when matching up against ENCE prepares a team well. Also knowing how well the opposition performs

on a map they might want to play is crucial, choosing a map they have excellent tactics on, but not perform that well because other teams might execute plays on that map in a better way. Analysing the statistics can inform a team very much about the opposition. When pairing up the information from the individual level, it can be a gamechanger for both the team and the opponent.

Game analytics can also be used in software created explicitly for the game a team is playing. Shadow is a company, founded in 2016, that has created a software for visualising all game demos and the metrics the game contains. According to Shadow's website, its software is used by top tier teams. Shadow offers 2D and 3D rendering to fully visualise different scenarios that happen in the game. These can then be analysed and viewed from different perspectives. Shadow points out that their software can help a team internally but also externally by analysing a team's opponents, finding trends in their game strategies. (Shadow, 2020)

2.2.3 Analytics in real-life on an individual and team level

When inspecting analytics in Ice Hockey, there are different kinds of ways on how to approach the game analytically. According to an article by Turun Sanomat (2013), the use of video analysis is broad throughout a hockey game. In the article, a video-coach interviewed opened up about how they use video analysis not only after the games but also during the games. During the games, the video-coach would act fast and find gameplay situations that needed to be solved which would then be explained by the head coach to the players to prevent the team's individuals from making the same mistakes again. Video analysis is used for preparing the team beforehand and after the game to learn what went wrong and how it can be corrected.

The game can also be analysed based off of different statistics. Chan, Cho and Novati (2012) have focused on fundamental statistics in their research paper about how different player types contribute to their team performance. For the forwards and defensemen, they concentrate on points consisting of goals and assists, plus and minus statistics, hits, blocks, how many penalty minutes the players got and their time on ice abbreviated to TOI. Goalies usually don't contribute with goals, assists or hits so for the goalies they used measurements like save percentage of shots on goal,

how many goals were allowed on average, wins, wins without allowing a goal and the number of games they were the starting goalie.

In the NHL, according to Vescovi, Murray, Fiala and VanHeest (2006), a player draft is concluded every off-season to determine which team chooses what player. During an extensive period, young prospects are monitored by looking at their stats and their style of play. From all available prospects, some are invited to the NHL combine where they are evaluated on their physical condition and interviewed by possible teams. After extensive monitoring of the players, prospects get ranked by their physical fitness as well as their on-ice skills. (Vescovi et al. 2006)

When analysing gameplay from video, analysts are mainly looking for how the team follows the agreed strategy. The positioning of different players and the fundamental objectives for various positions have been clarified and visualised by Schoolyardpuck (2010a) where the player positions and their areas discussed, to begin. It is important to remember that these zones are no restrictions for the individual positions, and the players are not limited to these zones, as shown in Figure 3a and Figure 3b. The defensemen (RD & LD) have their respective sides to cover in the lower part of the defensive zone. One of the most important objectives is to have at least one defenseman in front of the goal, guarding it, while the other defenseman is out of position. The wingers of the team split the defensive zone with the defenders taking up the upper part of the defensive zone. The wingers should not get caught up too deep in the defensive zone, but rather keep a reasonable distance between their fellow defender to cover as much area as possible. The position of the centre complements the gap between the players. The centre has the most significant area to cover and needs to be aware of where other players are to be able to balance the area of the ice the team is covering. (Schoolyardpuck, 2010a)

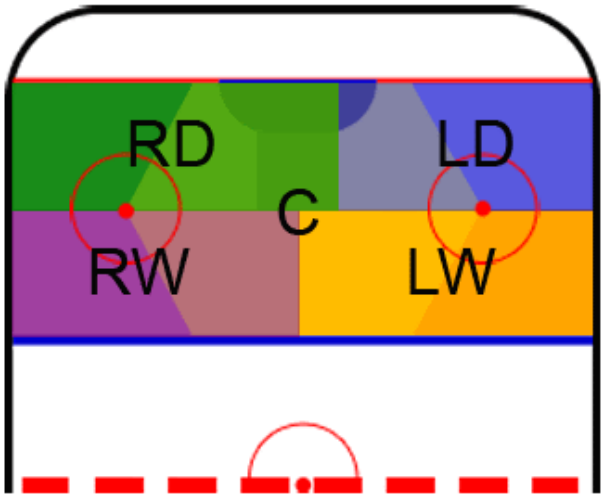

Figure 3a. Representation of the sectioning of the defensive zone per player position. Source: Schoolyardpuck, 2010a.

When comparing the defensive zone with the offensive zone, there are some differences for the player positioning. According to Schoolyardpuck (2010b), the defenders often stay at the blue line and act as support for moving the puck around and take shots from the point, but their main task is to keep the puck in the offensive zone. A significant difference is the positioning of the centre and wingers, who are all seen as forwards. The reason for them seen as forwards is because the forwards can move around more freely in the offensive zone compared to the defensive zone. The main objective for the forwards is to at all time have one forward in the slot while the other two are trying to get the puck to the slot. The movement of the players is dependent on the location of the puck. For example, in Figure 3b, the players try to move towards the strong side where the puck currently is located to prevent a breakout or a puck clearance. (Schoolyardpuck, 2010b)

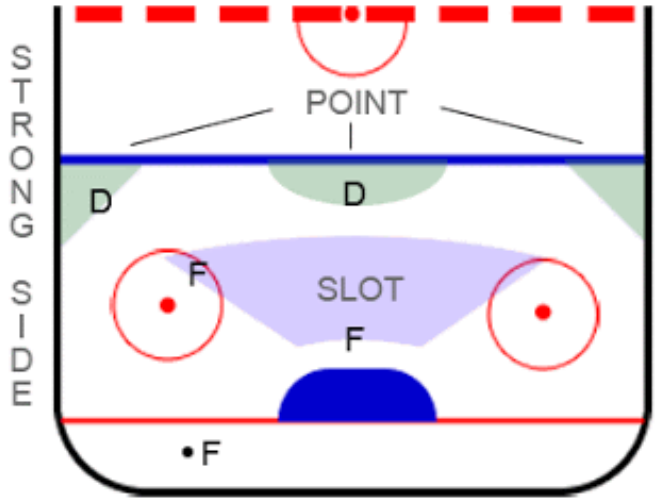

Figure 3b. Representation of the sectioning of the offensive zone per player position. Source: Schoolyardpuck, 2010b.

2.2.4 Big data, AI and machine learning for analytics

As Wooden (n.d.), writes, there are tons of possibilities nowadays to record, analyse and save this material to databases where they are easily accessible. Having the options to re-watch and access the past performances of a player and other teams is what makes big data analytics so crucial in the esports industry.

In his article on big data and how it is going to revolutionise the esports industry further, Wooden refers to a research article from the University of York, where they explain what the software *Echo* is. The Echo software is a data-driven tool used mainly to detect impressive and rare plays made by the players. Detection of unique and remarkable plays are brought up for the viewers to see, as some games are densely action-packed, meaning that the audience could miss these individual plays if it were not for the Echo.

The use of analytics is, therefore, not only applicable for teams or individual players but also for the business aspect by increasing the enjoyment for viewers at tournaments, in this case, the customers. Meanwhile, I will be focusing on the team, and individual players use of analytics I believe it is essential to bring up the fact that analytics is not only about the game and the gamers but also crucial for the business

and the community. By using software similar to the Echo, a tournament organiser can stand out from other privately-owned companies that organise esports events.

2.3 Ice hockey in real life and electronic form

The electronic version of ice hockey might be understood to be a picture-perfect copy of what is happening in real life, which might be accurate in the future. Still, at its current state, they have many differences even though the main idea is the same.

NHL hockey teams are explained by Chan, Cho and Novati (2012) to have forwards, defensemen and goalies, amounting up to 20 players for a game. The game lasts for 60 minutes, divided into three periods with extra time and shootout if the score is even after 60 minutes of regulation time. The teams have different lines out on the ice, consisting of three forwards, two defensemen and one goalie. What the primary purpose of the line is, is up to the team's strategy (offensive or defensive-minded style of play). During the game, there might be players sent to the penalty box if they commit a foul. Committing a foul leads to the team having to play short-handed with one or two fewer players than the opponent. The initial goal of the game is to score more goals than the opponent by the time the regulation time ends. (Chan, Cho & Novati, 2012)

2.3.1 Differences between the electronic and real-life version of hockey

According to a blog post by EA (2019), they introduced Real Player Motion technology (RPM tech) to the game franchise in NHL 2019 and overhauled the skating system. This year for NHL 20 they focused on improving the shooting by adding the same technology to the shooting mechanics to increase the lifelike feel of the game. EA (2019) states that there were some problems with the implementation of RPM Tech in last year's game where the player animation would stop during different actions like shooting, picking up passes or passing the puck.

As crucial parts of the game are animations, it tends to create a meta for the game. Meta being a gamer slang for "most effective tactics available". The animations in the game are going to be the same throughout the game unless a patch release for the

game comes out with significant changes, which means the game quickly becomes predictable to the point where the players know what different sequences do. For example, if the player moves in a certain way, the opponent's AI will do the same animation every time. When knowing the outcome of a sequence, it can be exploited and therefore doing that sequence becomes the most effective tactic available to beat the primary goal of the game.

When comparing the electronic version of ice hockey to the real-life version, there is not any animations or meta plays in the real-life version of ice hockey.

2.4 Visual Attention and Eye movements

According to Andrew T. Duchowski, author of *Eye Tracking Methodology* (2017), when approaching the use of eye-tracking, there has to be some motivation for why we want to find specific results that come from the visual attention of humans and why this is important. When looking at a picture, for example, we can find out what a person is looking at, how they got to an interesting point of the image and how they experienced the picture and its different points of interest by examining attentional behaviour and the neural mechanisms involved from two different perspectives. These perspectives are the psychological and physiological viewpoint.

Visual attention can behave in a cyclical process composed of a few different steps. The cycle starts by looking at a picture and seeing the whole image in a terrible resolution. Following the lousy resolution picture, certain features might start catching one's attention for further inspection. Moving on to the next step as the eyes will be repositioned to the area that is currently more specifically inspected, moving outside of the original foveal location. Once the eyes have repositioned, we enter the last step, which is to view that point of interest in a high resolution to make it more detailed. (Duchowski, 2017)

The brain and eye work together to produce eye movements. A picture goes in through the eye, which is processed by different parts of the brain, each part having its specific task when reacting to information coming in. This information is sent back to the eye for a possible repositioning on the picture or to enhance a point of interest (Duchowski, 2017).

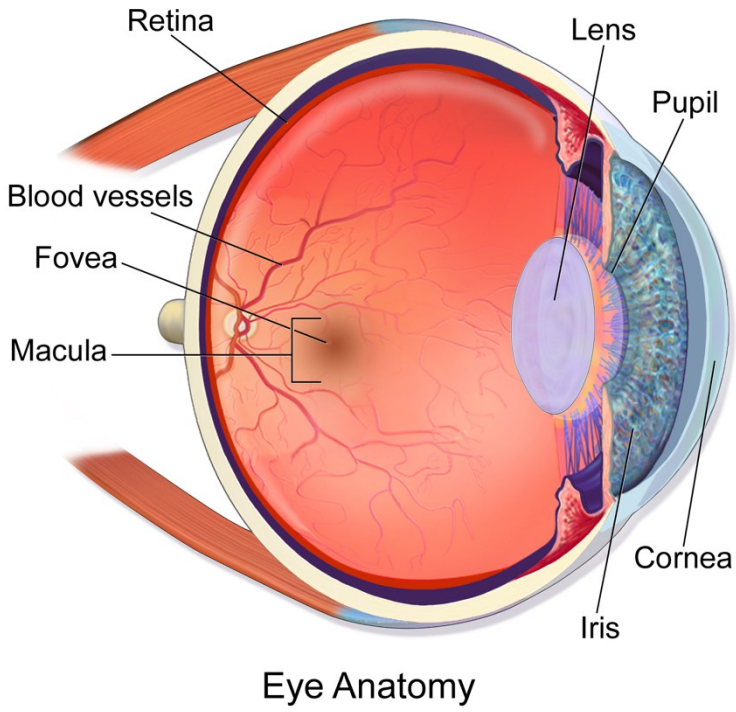

Figure 4 Eye Anatomy. Source: Blausen.com staff, (2014).

When examining a picture of the eye in Figure 4, we find that the fovea is a pit located in the retina. This pit is full of photoreceptors, but the problem is that the pit is tiny. The pit being small means that the foveal region of vision (central area of vision) is the only part viewed in high resolution. Duchowski brings up an interesting fact about astronomers that gaze into the sky looking at constellations. Humans can choose to move their attention outside the foveal region to find constellations as faint stars are easier to see out of the corner of the eye instead of in the foveal centre. Moving the attention outside the foveal region is a problem for eye-tracking studies, as a person could also be looking out of the corner of their eye without the eye tracker detecting this.

2.4.1 Models of eye movements

When taking a glance at a couple of models of eye movements that are crucial in eye tracking, the following models are brought up by Duchowski (2017) and will, later on, be explained further as to why they are so important and what we can find out by looking at them.

- *Saccades*

  According to Duchowski (2017), saccades are rapid eye movements. As explained earlier in the chapter, we tend to reposition the fovea to a new location on a picture, for example.

- *Smooth Pursuits*

  Smooth pursuits happen when we track a moving target and match the speed of that moving target.

- *Fixations*

  Saccades lead one to a new location which wants to focus on, a point of interest. Finding a new point of interest is when the saccade turns into a fixation where the foveal position stabilises to enable a high-resolution view (Duchowski, 2017). During a fixation, however, only around 8% of a picture viewed is seen in a detailed and high-resolution projection (Pieters Rik & Wedel Michel, 2017)

2.4.2 Eye movement analysis

The main goal of eye movement analysis is to find out as much as possible about the viewer's attentive behaviour. Observing raw eye-tracking data will not be enough information without further examination. Without more profound analysis, it will not be conceivable to discover, for example, how long a viewer fixated on different points, which can give much more information about the viewer's visual and attentive behaviour.

As stated earlier, the essential models in eye movement are saccades, smooth pursuits and fixations. The main task is to detect when one of these models is happening. For example, when a fixation ends, we move on to the saccade. When the saccade ends, we acquire a new fixation. Before we can examine saccades and

fixations, we need to do something called signal denoising, shown in Figure 5a and Figure 5b. The signal can be distracted because of the eye not being stable all the time or because the user needs to blink. These types of distractions can are possible to remove by ignoring the data that falls out of the effective operating range. (Duchowski, 2017)

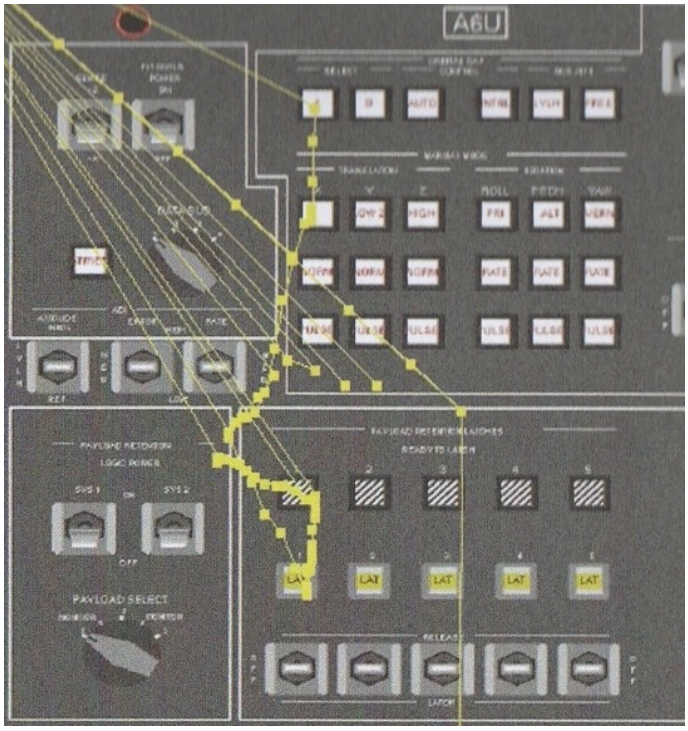

Figure 5a. Raw eye-tracking data before signal denoising. Source: Duchowski, 2017.

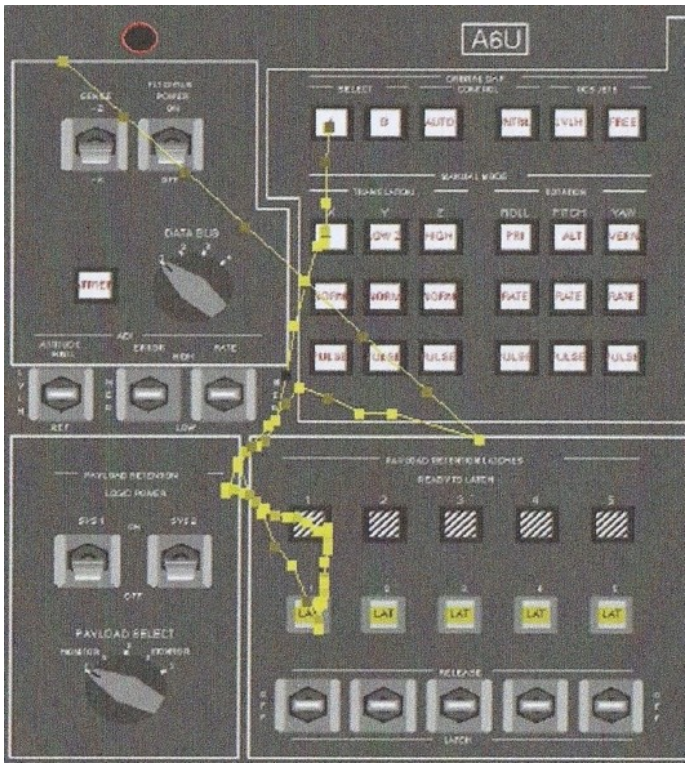

Figure 5b. Result of performing signal denoising on Figure 5a. Source: Duchowski, 2017).

To distinguish when one model ends and the next model starts, it should first be detected when the signal average changes drastically. Detecting the signal changes is called dwell-time fixation detection, which is measured by primarily identifying when we have a fixation, a stationary signal. When the stationary signal reaches a particular set of time, we can recognise it as a fixation. (Duchowski, 2017)

2.4.3 Eye-tracking techniques

The device used for measuring eye movements is known as an eye tracker (Duchowski, 2017). The method of tracking and gathering the eye movements is called oculography, divided into four different methods, according to Chennamma & Yuan (2013).

Electro-oculography (EOG) tracks eye movements by measuring the skin's electric potential differences. Tracking the differences is done by placing electrodes around the eyes. (Duchowski, 2017) These electrodes make it possible to record horizontal and vertical movements separately, and the EOG also provides the

possibility of recording eye movements even with the eyes closed. (Chennamma & Yuan, 2013)

Scleral Contact Lens or Search Coil is used to track eye movements by attaching a reference object, either mechanical or optical, to a contact lens worn on the eye. A scleral contact lens is one of the most precise ways to measure eye movement. (Duchowski, 2017) High accuracy is considered an advantage which comes with a disadvantage of having to place something on the eye. (Chennamma & Yuan, 2013)

Photo-OculoGraphy (POG) / Video-OculoGraphy (VOG) works by measuring the shape of the pupil, the position of the limbus and the corneal reflections caused by a light source, which is usually infra-red light. The biggest drawback of these methods is that the measurement may not be automated at all, which means there is a need for manual inspection afterwards. Manual control can take a long time and be very prone to errors. (Duchowski, 2017)

Video-Based Combined Pupil/Corneal Reflection differs from POG and VOG by providing a point of regard measurement. A point of regard measurement is made by either settling the head's position, so the relative position of the eyes to the head and point of regard is synchronised or by measuring multiple ocular features to separate eye movement from head movement. (Duchowski, 2017)

2.5 Use of eye-tracking in various fields

Eye-tracking is a useful tool for understanding and measuring human attentional behaviour. When trying to determine how a human performs in different situations and tasks, it is possible to inspect reaction time and accuracy. Adding eye-tracking to it tells us more about the cognitive, visual and attentional parts of the performance. Duchowski presents different scenarios where using eye-tracking has helped learn more about human behaviour. Aircraft and driving simulators combined with an eye tracker gives us information about how humans behave in different conditions and surroundings. With the help of simulations, it is possible to alter the time of day from night to midday without altering other dependent factors. In the studies Duchowski reviews, they found out that pilots of an aircraft tend to observe their instruments less when flying the plane at night.

The driving simulator provided results discovering that there is a considerable difference in driving without more significant distractions, compared to when asking the drivers to perform spatial imagery and verbal tasks. (Duchowski, 2017)

Eye-tracking is also very popular in the marketing industry to discover what consumers do and how they react when subjected to marketing. Research by Pieters & Wedel (2017) covering eye tracker usage in the marketing and advertising field revealed three main points on how using eye tracking is contributing to development. First of all, they concluded that eye tracking provides a good insight into the processing of communication and its effectiveness. Getting a good insight is said to be impossible to do at the same level of efficiency because of how fast the process is and how we consciously cannot access it. Secondly, eye tracking is seen as an excellent addition, as it provides more detail which can be beneficial for further and future development. Lastly, earlier research on visual attention in marketing has been transformed by eye-tracking methods, whereas current ideas and thoughts surrounding it might need updating as eye-tracking research is challenging knowledge believed to be correct at the time (Pieters & Wedel, 2017)

The company Tobii produce eye-tracking solutions for different fields, and they also include a section where they focus on sports performance and research. According to the company, the use of eye-tracking can explain a lot about an individual athlete. Tobii points out that an eye-tracker is also a powerful tool for trainers and coaches, not only players. The eye tracker can, according to Tobii, be used to create the material from experts for teaching those that are at a lower skill level. Those that are on a lower skill level can also use the eye tracker to create a better understanding of how they function as an individual, which then leads to a more efficient training program. Recording information also allows the individuals to follow up on their progress which also confirms whether or not their training scheme works. (Tobiipro, 2020)

2.6 Eye-tracking as an analytical tool in esports

One of the most extensive studies I found online that studied both eye-tracking and eSports tackled the improving of sensing systems for data collection and analysis

when regarding eSport players. In the research by Korotin, Khromov, Stepanov, Lange, Burnaev and Somov (2019), the different sensing systems were evaluated and analysed for future improvements. They also did an eye-tracking experiment with a professional Counter-Strike Global Offensive eSports team to gather data. From the eye-tracking data, they compared how the visual awareness differed relative to the individual player's skill level.

Another research paper, written by Velichkovsky, Khromov, Korotin, Burnaev and Somov (2019), stated that there is a direct impact between the skill level of a player and the player's visual fixations during a game. In conclusion, they noted that the eye-tracking data could be useful when looking for solutions for game interface design.

2.7 Benefits of Decision Support Systems

DSS is defined by Daniel J. Power (2001) as a broad category of information systems to inform and support decision-makers. DSS is used to improve and speed up the process of handling information but, as stated before, it is vast according to Power who presents a few types of decision support systems, of which I chose a couple applicable to an esports organisation.

Data-driven DSS, which is very self-explanatory, is the use of gathered data helping to make decisions based on what the analytics of the system proposes. Data-driven DSS is useful to examine different individual numerical data about a player on a particular map. Knowledge-driven DSS works by letting computers find hidden patterns and produce data content relationships. Observing the same example of an individual player on a specific map, we can identify if that one numerical data input was a one-time occurrence or if the player is continuously performing well or underperforming on a certain map.

These two decision support systems would work by having the raw data, the analysed data and a separate system finding the hidden patterns and relationships function together as a hybrid.

2.8 Benefits of Knowledge Management

Gathering data using an eye tracker and further analysing it produces valuable information and capitalising on the information available by exploiting it through knowledge management is highly beneficial. In their paper van Heijst, van der Spek, Edwards, Mallis, van der Meij, and Taylor (1999) introduce on an organisational level, the four operations found about knowledge. In their research, van Heijst et al., (1999) start by explaining knowledge development where there is a need for new creative ideas, analysing of failures and learning from them daily. In an esports organisation, this could mean creating new tactics in the game and learn what is and what is not working currently. Changes in organisations are inevitable due to retirement or other factors. Same factors apply to organisations in esports, where a player on the team could be retiring, causing a significant change internally team-wise as the team has to introduce a new player to the remaining roster. Using consolidation knowledge means minimising the potential loss of adjustment.

The use of the information inside the organisation, especially between the team, needs to be correctly distributed. To have some information not shared with the rest of the team could lead to chaos. For instance, one player could know that the opposition is going to execute a specific play in the game and repositions for that. Not informing the rest of the team about this could result in lousy positioning and potentially lose the game. Avoiding bad communication is also the case when combining the knowledge available. Sharing knowledge and connecting it to produce the optimal solution for countering something in the game is crucial. According to van Heijst et al. (1999), knowledge combining can be, for example, improved by job rotation. On a team, there are usually different roles. These roles could rotate entirely or just based on what map or opponent the team is playing, if for example, one player on the team is performing better in a particular role on that map than the player regularly playing that role.

2.9 Physiological and psychological aspects

According to the American Psychological Association (n.d.), sport psychology uses psychological knowledge and skills to address the overall well-being, developmental and social aspects of participation in sports. The three principal areas of sports psychology, according to APA, are training the cognitive and behavioural skills to enhance athletes performance, counselling and clinical interventions and lastly consultation and training. (American Psychological Association, n.d.).

Research in the health industry shows that eye-trackers can be used to find out different stages of mental fatigue, whether or not they were induced by cognitive or non-cognitive actions. Mental fatigue is said to affect cognitive and behavioural performance as well as serious health and social problems.

According to NeuroTracker, esports players achieve up to 400 movements and presses per minute on the keyboard and mouse. Due to these movements being asymmetrical, there is a lot of strain on various parts of the brain simultaneously. With heartbeats ranging between 160-180 beats per minute, inevitable fatigue will occur. There needs to be a well-thought-out plan taking into consideration how much stress-reducing activities are needed. Stress-reducing activities can differ from nutrition intake, physical activity and rest. (NeuroTracker, 2019)

Software similar to those following in-game performance is available to measure mental fatigue. For example, Performetric.gg offer real-time mental fatigue management for esports. Their product features fatigue detection, skills analysis, advanced analytics and team management. The features mentioned are supposed to be monitored using biometrics and cognitive tests with the possibility of integrating wearables to reach a new level of monitoring and management. (Performetric, 2020)

2.9.1 Investments in esports

The use of a sports psychologist in an esports team has already seen real-life examples. The Danish CS:GO team Astralis hired sports psychologist Lars Robl after being at a standstill in their development as a team. Robl succeeded in bringing out the top potential in the team and ranking them number one in the world. The use of a sports psychologist in esports is not only limited to Astralis. The likes of MIBR, Cloud9, Team Liquid and NiP have all hired a sports psychologist to their

organisation or at least accepted the fact that more workers in supportive roles need to be obtained when planning for the future. (HLTV, 2018)

Team Astralis is currently at the forefront in 2020 by using unconventional methods and strategies. The signing of a new player to increase the number of players in the team from five to six is causing some discussion on why this is done and will the new player replace someone from the current roster. However, the main reason for acquiring a new player is to be able to rotate the players and allow more time off the busy and stressing schedule according to team Astralis. Having one player on the team being ill or something similar, stopping them from training means the whole team is affected. The addition of an extra player gives the individuals time and space to recharge fully without having to face a burden of letting one's teammates down, causing stress and mental fatigue. Astralis have experienced these types of scenarios with several players missing out on games and tournaments due to health issues, leading to the team playing with stand-ins. (HLTV, 2020a)

It is understandable that teams would consider signing an extra player to reduce stress among the core five players in CS: GO. When inspecting statistics on Finnish team ENCE and the events, they attended in 2019; a conclusion can be drawn that they have been travelling most of that year. In 2019, ENCE attended 20 different events in Asia, Europe, North America and South America amounting up to ten different countries. (HLTV, n.d. a). In a tweet by ENCE player Aleksi "allu" Jalli, Jalli states that in a time span of 37 days the team was either travelling or at events for 29 of those days. (alluCSGO, 2019)

In an interview conducted by HLTV (2020b), NAVI psychologist Gleb Surabekiants points out how the industry has changed during the last few years in the eyes of the players. The competitive side of esports has impacted how younger players, from ages 13-16, have a very different mindset for esports than the earlier pro players. Competition impacts the younger players and the younger players impact competitiveness. (HLTV, 2020)

SAP has been working with Team Liquid since 2018 in analysing data from esports games, according to Andrew Birmingham (2019). The data analysis has reached a point where Team Liquid is not only focusing on the overall team performance but can dig deeper into the individuals. Team Liquid makes use of SAP's HANA technologies to create custom software which is just right for their needs. Both Team Liquid and SAP are fiddling with the possibility of creating an AI

which would mimic Team Liquids opponents, giving them a huge advantage when preparing for tournaments. (Birmingham, 2019).

A Spanish team by the name of Movistar Riders have taken the analytics to a much deeper level by trying out brain analysis on their players. Using a device called EMOTIV Insights, they can pick up variables such as stress, focus and engagement. The different variables can then be synced with the gameplay to find the right correlation between an in-game event, and the variable picked up by the device. (Macaulay, 2018)

3 Methodology

This chapter will introduce the methodology chosen for this thesis and why it was chosen. An introduction to what kind of data is expected to be collected is done together with an explanation of the processes for comparing the analysis as well as the eye-tracking plan.

3.1 Research methodology

According to Creswell and Plano Clark (2007), inductive research is done from the top-down, originating the ideas from theory to data, while deductive research works the other way around, creating theory from bottom-up. This thesis will aim to be a mixed-methodology with approaches of both inductive and deductive reasoning. Earlier research and theory are approached in an inductive way by building a foundation to answer the research questions. The inductive approach includes gathering theory and earlier research about esports and eye-tracking individually, but also earlier research where eye-tracking is used in esports.

A deductive approach is used for joining together the two main aspects of the thesis, esports and eye-tracking. The main reasoning for joining the two aspects is to discover new ways of utilising eye-tracking in the field of esports.

An experimental study is done to create an increased understanding of the two subjects. The experiment will have a deductive approach to create conclusions through gameplay analysis.

Discussing the insights and conclusions gathered by the inductive and deductive approaches is done later on in the thesis.

3.1.1 Gameplay data collecting

The gameplay is collected by recording the gameplay on the console (PlayStation 4).

3.1.2 Eye-tracking data collecting

For the different scenarios, the main idea is to discover what the player is looking at during that time frame. When using an eye-tracker, it is possible to track where the player is looking before and during the situation. The information collected from analysing the eye-tracking video material is then divided into the player either being aware of the situation or not aware of the situation. For each occurrence, there will be a comment made, explaining why the player was conscious or not.

3.2 Data collecting procedure

The eye-tracking data will be recorded simultaneously as the gameplay but analysed separately and then compared after that. In Figure 6, a representation of the conducting of the procedureis shown.

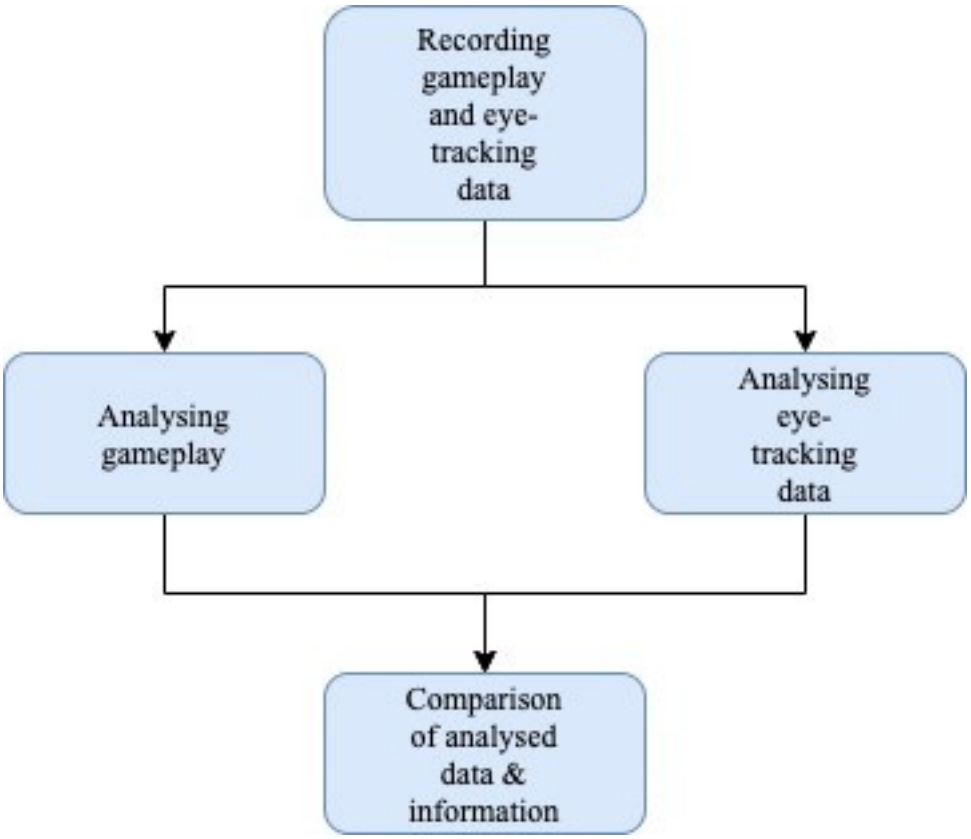

Figure 6. Representation of the data collecting procedure for the eye-tracking experiment.

3.2.1 Eye-tracking data collecting plan

This summary of the data collecting will consist of a plan for an eye-tracking experiment which in this thesis is done on a very small scale. The plan includes specifications regarding devices used (laptop and eye-tracker) as well as specifications about the software used.

1. The hypothesis:

   Eye-tracking can be a supplement to the current data and video analytics in esports.

2. The design is going to be an idiographic single-case experiment using an eye tracker as an independent variable (IV) used to change or enhance the numerical data which in this case is the dependent variable (DV).

3. Participants: Number of participants is one (1).

4. Apparatus:

- Devices used:

Laptop:

LENOVO / model: 20LA0025MX
Windows 10 , x64 ; RAM: 8 GB
Intel(R) Core(TM) i5-8250U CPU @ 1.60GHz - 4 cores
Intel(R) UHD Graphics 620 - Internal - 2 GB

Eye-tracker:

EyeLink Portable Duo
Eye-tracking mode: Remote, Head Free-to-Move Tracking
Eye-Tracking Principle: Pupil with Corneal Reflection (CR)

Eye-tracking software:

WebLink 1.1.1.0 64bit

5. Procedures: The participant plays the game while being recorded by the eye-tracker.

6. Tasks: The general idea is to have the participant play a game of the latest version of electronic ice-hockey. This test will focus on interceptions in the game and whether or not the player was aware of crucial information that is going on in different areas of the game.

3.3 Limitations of the study

There are a few limitations to the study, which will be presented next with suggestions for improving the reliability and accuracy of results in future studies.

3.3.1 Limitations of the experiment

The experiment sample size was small due to the outbreak of COVID-19, making it impossible to gather eventual data from multiple participants. This also led to the gameplay sample size being small. In the future, the experiment should be done with multiple participants from different skill groups.

3.3.2 Limitations of theory and earlier research

Esports is still evolving, and therefore it might not be possible to find enough academic writing about a certain part of the field. A lack of academic articles about esports also requires the author to deviate from academic guidelines for literature critique.

4 Analysis and interpretation

In this chapter, the thesis will be discussing the collected raw gameplay data and try to analyse it with an approach similar to the one that is used by analysts in real-life hockey-teams. A proposed plan on how the different information is comparable and analysed to find out how much value the eye-tracker creates.

4.1 Analysis of collected data

A small scale test was done to gain an insight into the use of an eye-tracker while playing the game NHL. The test mainly tries to answer the question on what we see with and without the eye-tracking data or visuals. Firstly, the gameplay will be analysed without the eye-tracking data to identify the player's performance in situations where the puck or the puck carrier was challenged, either by the player that is monitored or by the opponent.

A heatmap created during the eye-tracking session will also be analysed for further information.

The gameplay data consists of a 30-second video from a randomly selected point of the game. The gameplay was first analysed to find out the number of situations that can be compared. Three defensive zone and two offensive zone situations were identified to be further analysed.

4.1.1 Defensive scenarios

Gameplay D1: In the scenario, the player made an interception by positioning a defender well.

Eye-tracking D1: The player quickly identified who from the opposing team that would acquire a pass and acted accordingly.

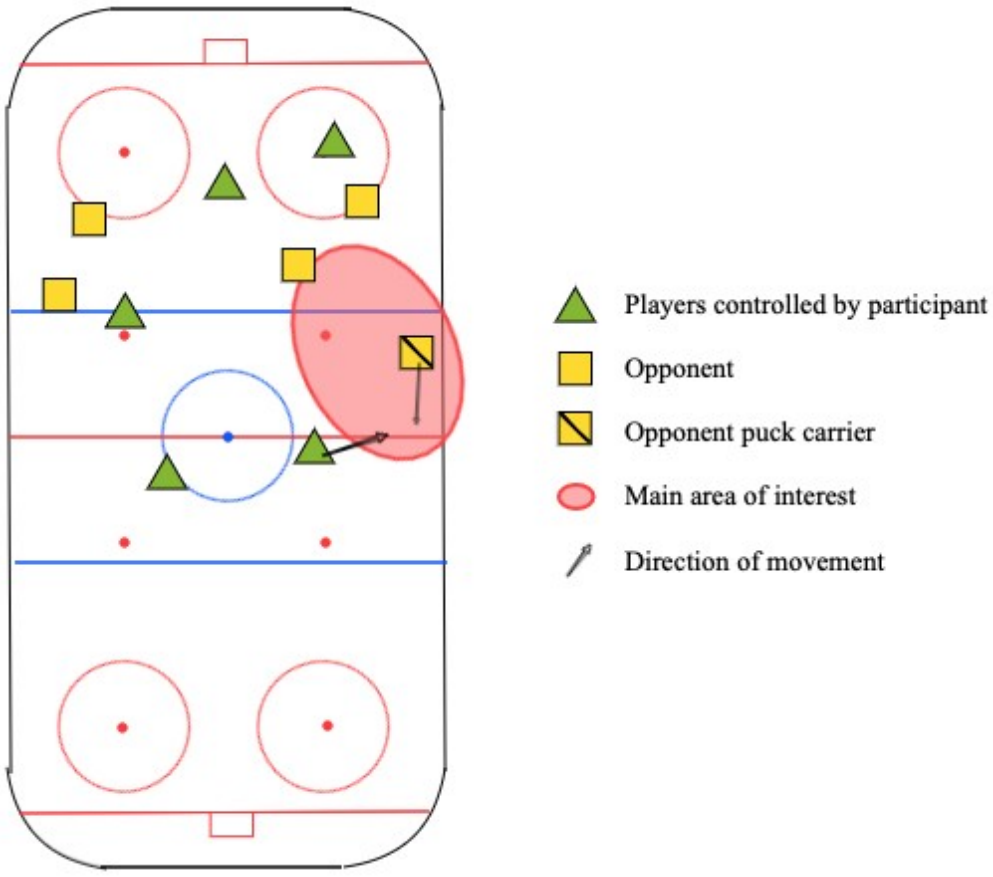

Figure 7. Visual representation of defensive scenario 1, including player movement and main area of interest.

Gameplay D2: Bad positioning using one defender, ending scenario with a poke check using another defender

Eye-tracking D2: The player had identified that there was only one attacker and tried to slow down the attacker using one defender which resulted in the other defender making a successful interception with their stick.

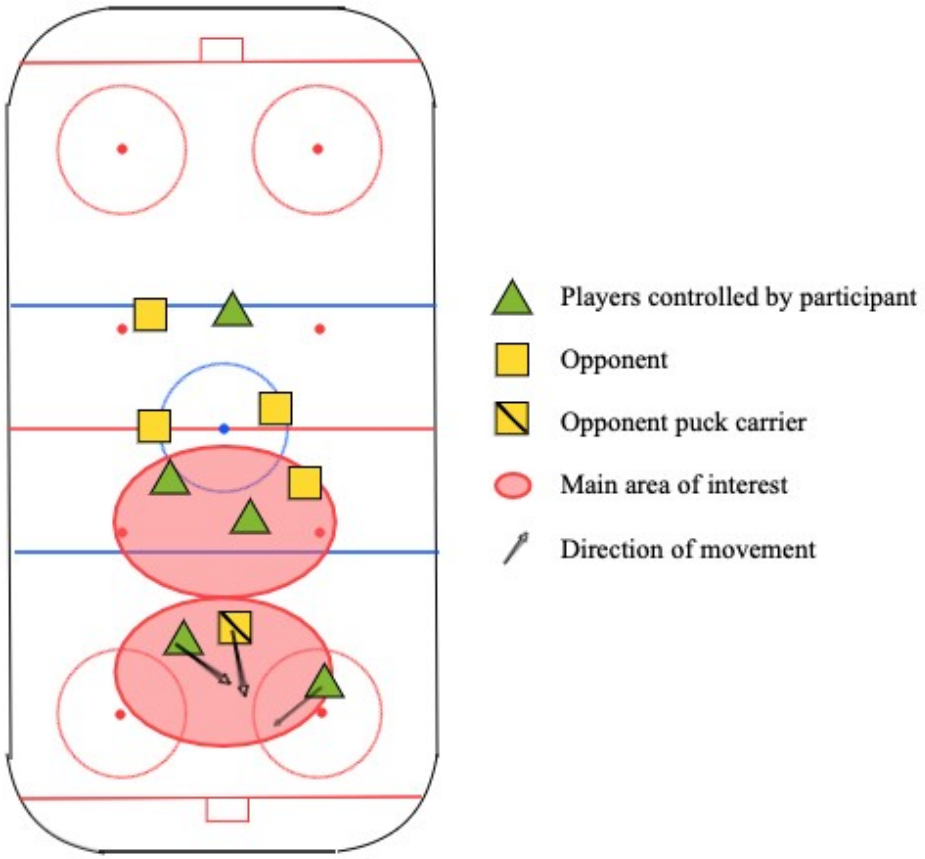

Figure 8. Visual representation of defensive scenario 2, including player movement and main area of interest.

Gameplay D3: Good positioning of a defender by the player to steal the puck

Eye-tracking D3: The player identified and showed awareness of surrounding players and committed to stealing the puck.

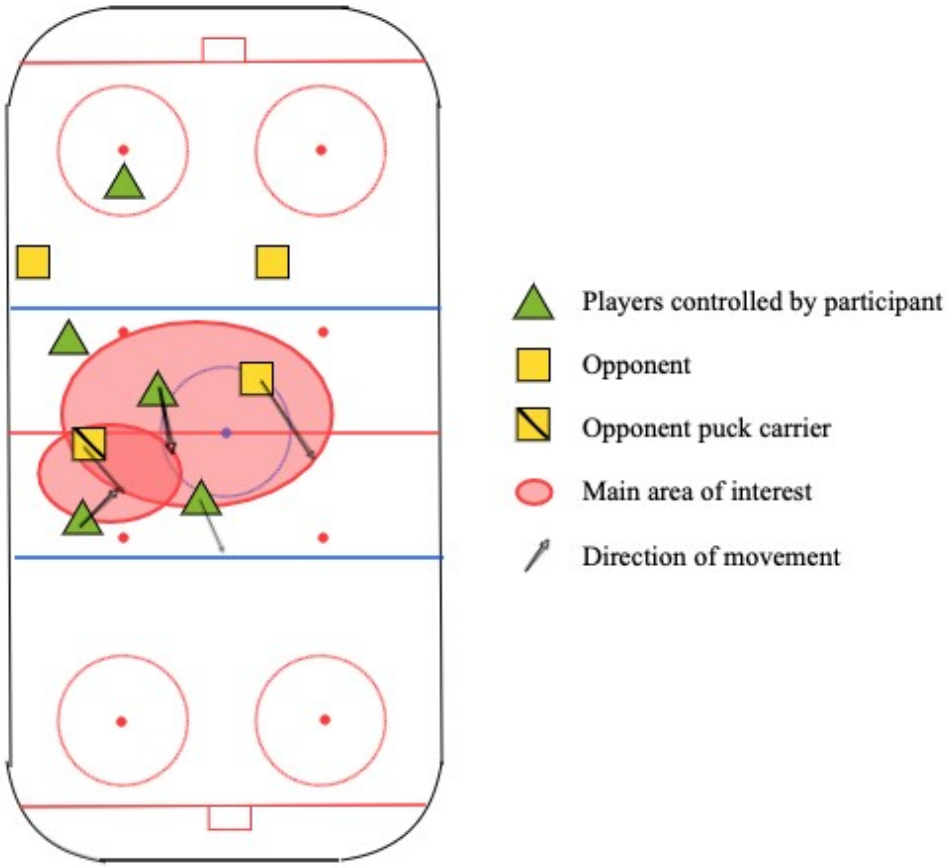

Figure 9. Visual representation of defensive scenario 3, including player movement and main area of interest.

4.1.2 Offensive scenarios

Gameplay O1: The player committed to stealing the puck with very high speed which ended up opening up a passing lane for the opposition and having the committed offensive player out of position.

Eye-tracking O1: The player only paid attention to cutting one passing lane and to pressuring a potential puck receiver. The eye-tracker provided added value by identifying what mistake was made by the player.

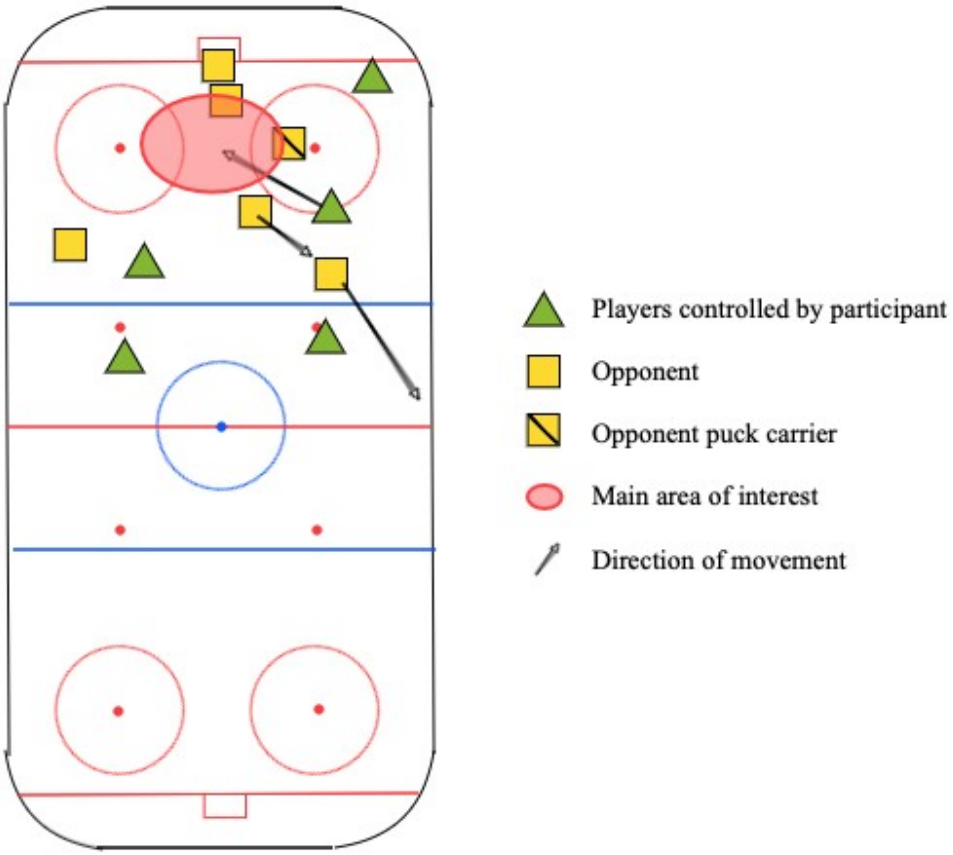

Figure 10. Visual representation of offensive scenario 1, including player movement and main area of interest.

Gameplay O2: The player chose to cut a passing lane, leaving another passing lane open which was used by the opposition.

Eye-tracking O2: The player had identified the position of its own defender in the neutral zone. The defender in the neutral zone would be able to cover the receiver of the other lane which was not cut by the player's attacker. The eye-tracker provided added value by identifying that the player chose deliberately to cut one passing lane, leaving the other one open, while having that covered by their own defender.

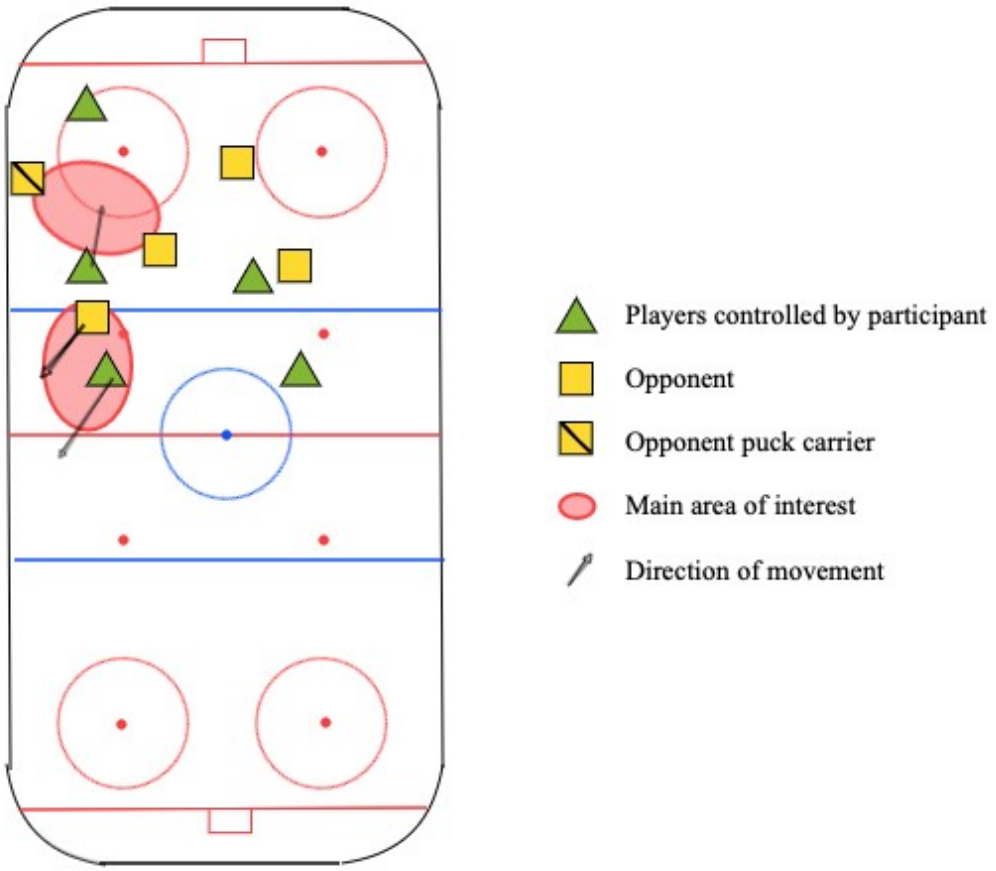

Figure 11. Visual representation of offensive scenario 2, including player movement and main area of interest.

4.1.3 Comparison of scenarios

The summary and comparison of the scenarios from both perspectives (gameplay and eye-tracking) include layered information. Firstly, the comparison of the two results per scenario is compared to determine if there is added value from the eye-tracking analysis.

Secondly, what was the grade of the added value from the eye-tracking data? For example, was any new information gained (high value), did the information confirm the same result as the gameplay analysis while not adding anything new (medium value), or did the eye-tracking data not provide anything new or confirm the result of the gameplay analysis.

Table 1. Table representing a summary on the added value of using eye-tracking analysis for gameplay

Scenario	***Added value?***	***Grade of added value***
Defensive 1	Yes	Medium
Defensive 2	Yes	Medium
Defensive 3	Yes	Medium
Offensive 1	Yes	High
Offensive 2	Yes	High

Defensive scenarios one, two and three, listed in Table 1, show that the eye-tracking data analysis confirms the gameplay analysis but that the added value only has a medium impact in comparison to what the initial gameplay offered.

Both of the offensive scenarios, listed in Table 1, show added value from the eye-tracking analysis where it is possible to learn more about the whole situation, which is not attainable while only inspecting the gameplay.

4.1.4 Heatmap analysis

A heatmap shows the areas where the player has spent the most time. To determine these areas and to what extent they have been inspected, a colour grading system is used. The time spent in a specific area is measured in milliseconds. The red areas seen in Figure 12 have received much more attention than the surrounding areas.

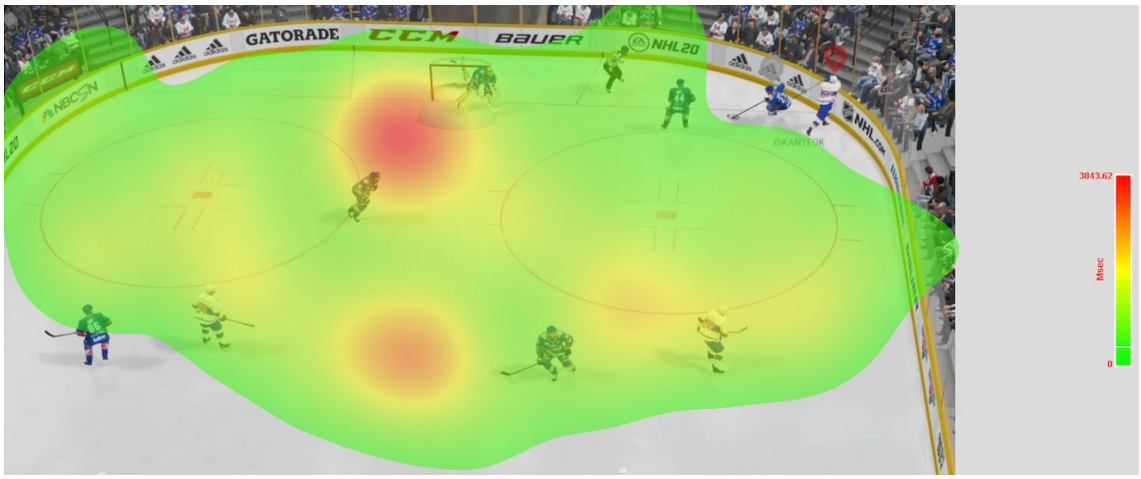

Figure 12. Heatmap representation of the visual attention during gameplay, measured in milliseconds.

In the electronic version of ice-hockey, the game allows the user to change the camera angle to one that suits them well. The game, however, aims to always have the puck visible to the player. This means that the camera has to move with the puck, making it impossible to view the whole rink in a horizontal or vertical way. Eventually, this means that the heatmap would be very similar for most of the players, as the game mainly tries to keep the attention in the centre of the screen.

From the test conducted, it is possible to determine that the player has paid attention to on-ice action, without bigger distractions (red areas) outside of the rink.

5 Discussion

This chapter takes into consideration every aspect of the thesis up to this point to answer the research questions, which were presented at the beginning of the thesis, through discussion.

5.1 What analytical tools does esports use and what does the process include?

The first research question discusses the use of analytical tools currently in use in esports. The discussion also includes a view on the process and its different stages.

Most of the tools used for analytical purposes in the esports scene are software programs that enable teams to load in demo sessions of their past games or practices. A software from Shadow.gg introduced earlier in this thesis presents their product on their website and explains how they are a huge asset to top tier teams in games like CS:GO. The software enables the teams to visually have a look at how the game went while having the freedom of choosing a certain timestamp in the game and use different angles to see the different in-game situations from different perspectives. This type of analytical use is mainly done to figure out what strategies work for your own team as well as for analysing how a team's opponent is playing and what possible trends there are in their game strategy.

Another approach to analysing how the team or an individual is playing is to use numerical data. This data can be used to find out similar trends as the software by shadow.gg.

Both of these processes require a certain amount of hours where the gameplay needs to be recorded to be able to gather the data. The process is similar to knowledge management in any other company where the data then needs to be interpreted and visualised. Visualising data makes it easier for everyone involved to easily understand and build upon the visualised data and maybe identify how this new information can be used in the next cycle. A cycle in knowledge management means using the information that has been created and testing it in a real-life

situation. After using the newly gathered information and possible solutions, the information can then be evaluated and compared to earlier findings. This can tell a team whether or not the new adaptions were a success or not and build a new ground for future solutions and decisions.

Besides taking the approach of rating a player's performance based on numerical data from the game, teams in esports are taking it to the next level with other methods. Analytical tools are also used to determine player performance by gathering data based on cognitive skills and mental fatigue.

5.2 What is eye-tracking, and what does it offer to esports?

The second research question discusses the basics of eye-tracking and how eye-tracking can be used on different levels in esports development.

When this thesis was planned for the first time, the main idea was to research how eye-tracking can be useful in addition to the numerical data that is gathered from players playing their games. However, during the writing process, there has been some enlightenment to what eye-tracking could be used for, contributing with a broader view of both eye-tracking and esports.

Earlier research has confirmed that eye-tracking does offer a variety of useful information. A player's gaze can be monitored to create heatmaps, revealing for example differences between professional esports athletes and those who only play for leisure. Checking areas of interest is a great example of finding out if the player is distracted by scoreboards or other static information presented on the screen. Acquiring knowledge about spending too much time distracted by different variables is a great first step in correcting that issue.

Another example of added value from an eye-tracker comes from the small-scale test conducted in this thesis. The test itself confirmed the results from earlier studies while adding some more context to the question regarding added value from eye-tracking data. Not only did the test verify that the eye-tracking analysis was useful but also that each scenario could not be divided into added value or no added value. Therefore, in the analysis summary, there was an additional grade assigned for

each scenario. This might affect the level of expertise when it comes to gaming, as everyone would not have the same value from an eye-tracker. A pro player might understand what they did wrong or right to a greater extent than someone of a lower skill level. This signifies that the grade of added value has a higher requirement. For example, the test conducted in this thesis might not be useful for a high-tier player as most of the grades were assigned a medium impact.

The other side of adding value with an eye-tracker, which was relatively new to the author of this thesis, was the overall investments in psychological aspects of the player's health situations. The possibility of using eye-tracking to gain a more detailed insight into individual players minds can take esports teams to the next level. Firstly, knowledge about individuals can be used to optimise their training schedule. Knowing what part of the day the individual is at their most alert and most prone to learn can increase the rate of development and performance. Secondly, combining the knowledge from all individuals from the same team allows a coach to schedule team meetings and training sessions at a time which is suitable for all individuals of the team.

There is, however, another dimension to the use of the eye-tracker. Learning more about an individual and for example, what their mental fatigue state is can benefit the player and the team on multiple levels. Optimising the training schedule also allows the players to take time off from the game to rest, eat and socialise with other people than their teammates. Confirmed by earlier research, mental fatigue affects both the psychological and physical side of a player’s body.

With the teams travelling a huge part of the year it would seem to be a high-priority task to enable the players to relax and recover, even if they are in another country. This could mean the eye-tracker would be useful for studying how the player’s various levels of stress vary when at home and when travelling. Knowledge of stress-diminishing factors would enable the team experts to take sufficient measures to ensure recovery for the whole team.

5.3 How is an eye-tracking test conducted?

The third research question discusses different procedures and possibilities when conducting an eye-tracking test. The main discussion is focused on how tests and experiments could be conducted by esports teams, at their office or while they are travelling.

There are a few procedures needed to be done to increase the accuracy of the results of the eye-tracking test. The eye-tracking test also differs whether or not the experiment is done in a laboratory with controlled elements, or if it is done in other facilities. When done in a laboratory, all elements are controllable and adjustable besides the participant. When deciding to conduct a test in non-laboratory facilities, factors such as lighting, temperature or similar may fluctuate and differ between participants.

It is also good to remember that the choice of facility and its requirements may vary depending on what information is desired.

Equipment used in laboratory facilities tends to also be of higher quality with a higher sampling rate, resulting in more accurate information. These, high-tier, equipment also come at a much higher cost which rules out a fairly huge clientele. For those who wish not to spend a fortune on an eye-tracker have the alternative to buy an eye-tracker from Tobii, which is designed for a much broader clientele with a more affordable price tag.

Conducting an experiment using an eye-tracker might be problematic at first and experienced as time-consuming or demanding when a new system needs to be understood. The main problem regarding whether or not an esports team should pursue the use of an eye-tracker to optimize their performance may not be if it is hard to conduct the experiment. It was stated earlier in this thesis that teams are very mobile during the year, attending events in different countries on multiple continents. Many of these events may be so close to each other that it is better for the teams to travel to the next event without returning home in between. Having a very tight schedule results in needing to come up with a way to create a space as similar as possible to the first space which was used to create a baseline for the players. The

need to have a space as similar as possible is to get as reliable results as possible when comparing data and information from two different locations.

5.4 Can eye-tracking be a complement to current analytics in esports?

The fourth research question works as a summary of the preceding research questions to join the different points of view regarding pros and cons of eye-tracking and its compatibility to procedures, strategies, time-schedules and overall need of esports individuals and teams.

In a competitive scene making it or breaking it comes down to the smallest details, most esports teams are most likely to use all means possible to gain an advantage over their opponents. The development in esports has seen extensive use of data for analytical processes, studying individuals, team cohesion and their opponents. When inspecting only the gameplay part of the teams, it is possible to state that eye-tracking can be a complement to the current analysis and analytics in esports. Discussed earlier, the added value is not consistent depending on the skill level of the individuals. A player with ten years of experience playing the game might not have as much use of eye-tracking analysis of their gameplay as someone with only a few months of experience.

However, the value is expected to increase when talking about individuals in teams. Attaining a better understanding of the team cohesion through studying individual behaviour might be beneficial as the individuals learn more about each other.

Analytics does not, however, limit only to understanding how individuals play the game, but how they are feeling mentally and physically during and after playing the game. Earlier research has confirmed that eye-tracking can be used to discover increasing levels of mental fatigue and recovery patterns of individuals. With the increasing worry of the health of these esports athletes, teams have started to hire psychologists to ensure that the players keep a healthy schedule of eating, sleeping, training and recovering. Therefore, it would be possible to use an eye-tracker to

create a baseline for each individual to allow check-ups in the future while monitoring the development of, for example, their mental fatigue.

However, with the advantages, come the disadvantages. The price of a high-tier tracker might not fit every team's budget, leading them to rely on low-tier equipment which does not offer the same accuracy. Another problem is that most teams tend to be very mobile during the year, travelling and attending events most time of the year. This means that teams would need to create a solution for re-creating viable conditions for the eye-tracking sessions.

6 Conclusion

This chapter concludes the thesis and the author shares the final statement of the thesis regarding the hypothesis and whether or not it was confirmed or rejected.

The explosive growth of the esports scene in multiple genres and games means it is also attracting attention from big companies. With bigger funding, it is also possible to attain high-tier equipment and arrange facilities fitting the requirements.

Therefore, the hypothesis is confirmed to be true, as eye-tracking can work as a complement to current analytical processes in esports. The hypothesis can also be considered confirmed on different levels.

The hypothesis stated that eye-tracking could be useful for recruiting new players to organisations. This was confirmed through earlier research and through the test conducted as new players might have more use and value-added to their analytical process of improving at a game than those with years of experience.

On top of confirming the hypothesis and its different sections, new value-adding ways were discovered regarding the health of the players. Having the chance to monitor the health of players is considered important and value-adding, even if a player has years of experience of being a pro player and assumes that their lifestyle is healthful.

7 Swedish summary - Kan ögonspårning användas som ett komplement till existerande analytiska processer inom esport?

7.1 Inledning

E-sport har sett en enorm tillväxt de senaste åren i form av deltagare samt marknadsandel, enligt Mangeloja (2019), och det finns ett konstant behov av konkurrensfördelar inom denna industri. Analyser av numeriska data tillhör de processer som för tillfället finns tillgängliga, men utvecklingen tillför mer avancerade mjukvaror. En möjlig lösning ligger i ögonspårning, då det möjliggör en mer djupgående inlärning om individer. Behovet av fördelar och en möjlig lösning är värt att forska kring.

7.2 Syfte och ämnesmotivering

Syftet med avhandlingen är att undersöka om ögonspårning kan komplettera de existerande analytiska processerna inom e-sport. Frågeställningarna försöker besvaras i avhandlingen genom fyra forskningsfrågor;

1. Vilka analytiska hjälpmedel används för tillfället i e-sport och hur ser den analytiska processen ut?
2. Vad går ögonspårning ut på och vad kan det bidra med till e-sport?
3. Hur genomförs ett experiment inom ögonspårning?
4. Kan ögonspårning fungera som ett komplement till nuvarande analytiska processer?

Valet av ämnet baserar sig på den fortfarande växande industrin samt ett personligt intresse för e-sport och ögonspårning. Ämnet lämpar sig även till studierna

inom informationssystem. Avhandlingen önskas även skapa intresse för framtida forskning inom samma ämne.

7.3 presentation av metod och material

Avhandlingen fokuserar på tidigare forskning samt teori inom ögonspårning. Detta kombineras med ett småskaligt experiment som inkluderar användning av en ögonspårare. Tidigare undersökningar och teori används för att besvara frågeställningarna genom induktiv metod. Experimentet genomförs med deduktiv metod för att skapa slutsatser som kan jämföras med tidigare undersökningar samt teori. Kunskapen som insamlats från tidigare undersökningar och teori jämförs med slutsatserna från experimentet i kapitlet resultat och diskussion.

7.4 Teori och tidigare undersökningar

7.4.1 Analytiska processer inom e-sport

De metoder som används för att genomföra spelanalyser baserar sig på mjukvara som ger analytikern möjligheten att inspektera situationer från olika perspektiv (Shadow, 2020). För att skapa en bättre helhetsbild av ett lag och dess individer, kan man även använda sig av numeriska data som t.ex. berättar mer om hur laget eller individen presterar i varierande situationer. Huvudsakligen vill man reda ut vad man inom laget gör rätt eller fel genom att analysera videosnuttar, numeriska data och annan statistik kring spelet. Analyserna kan även göras om motståndaren för att skapa en bättre bild av vad man kan förvänta sig av just den motståndaren, och sedan reagera och planera enligt den informationen. Analyser av video används också inom traditionell sport och i en artikel av Turun Sanomat (2013), betonades vikten av videoanalyser, inte bara före eller efter spelet, men även under spelets gång.

7.4.2 Visuell uppmärksamhet och ögonrörelser

Genom att följa ögonrörelser kan man skapa en uppfattning om en persons visuella uppmärksamhet då personen inspekterar t.ex. en målning. Den visuella uppmärksamheten kan fungera som en cyklisk process. Processen börjar med att personen ser en suddig bild där vissa områden börjar fånga personen uppmärksamhet. Hjärnan processerar den suddiga bilden och de områden som fångar personen uppmärksamhet och ger signaler för att omplacera blicken till ett av dessa områden. Efter att blicken har omplacerats till ett visst område som vill inspekteras blir bilden klarare och av en högre upplösning. Den cykliska processen fortsätter med att hjärnan styr blicken till nästa område för att igen fokusera hårdare och skapa en bild av högre upplösning. (Duchowski, 2017).

För att skapa en mer informativ bild av en person fokuserar man inom ögonspårning på olika modeller av ögonrörelser. Två av de viktigaste modellerna är sackader och fixeringar. Sackader är de snabba rörelserna från en intressant punkt till en annan och under sackader är bilden suddig. Då sackaden tar slut och blicken har nått ett nytt område som vill inspekteras börjar en fixering. Fixeringen tar slut då en sackad börjar och blicken igen flyttas vidare till ett nytt område. (Duchowski, 2017).

Ögonspårning har använts inom olika branscher för att skapa förståelse kring uppfattning av marknadsföring bland kunder samt hur piloternas handlingar skiljer sig från natt till dag (Duchowski, 2017). Tidigare studier har även genomförts inom e-sport där Velichkovsky et al. (2019) bevisade att det finns en klar skillnad mellan skicklighetsnivåer då det kommer till visuella fixeringar.

7.4.3 Psykologiska och fysiologiska aspekterna inom ögonspårning och e-sport

Lagen på toppnivå inom e-sport går igenom hektiska perioder av resande och spelande vilket har väckt en oro kring välbefinnandet av spelarna. Danska laget Astralis är ett av de lagen som redan sett konsekvenserna av de hektiska perioderna då flera av deras spelare gått miste om turneringar på grund av hälsoproblem. En av lösningarna Astralis kom fram med var att anställa en idrottspsykolog för att ta itu med spelarnas individuella problem. (HLTV, 2018). Nästa steg i att förebygga hälsoproblem var att anställa en till spelare till de tidigare fem spelarna inom laget. Då laget har en sjätte spelare till sitt förfogande, kan laget rotera spelare och därmed låta vissa spelare återhämta sig en längre tid vid behov. En annan aspekt som lyfts

fram är att laget inte kan träna utan att alla spelare deltar, genom att ha en extra spelare minskar man även stressen som orsakas av press från lagmedlemmar. (HLTV, 2020).

En av idrottspsykologins tre viktigaste principer är utvecklingen av de kognitiva- och beteendefärdigheterna för att förbättra idrottarnas prestationer enligt American Psychological Association (i.å.). Tidigare studier inom hälsobranschen har bevisat att man med användning av ögonspårare kan upptäcka mental trötthet, vilket man även kunnat konstatera ha direkt påverkan på de kognitiva prestationerna (Yamada och Kobayashi, 2018). NeuroTracker lyfter fram att spelare inom e-sport uppnår hundratals rörelser per minut. Då rörelserna är asymmetriska blir det en stor belastning på hjärnan, speciellt under längre spelsessioner. (NeuroTracker, 2019).

7.5 Redogörelse för undersökningen

7.5.1 Experimentets uppbyggnad

Huvudmålet med genomförandet av experimentet var att skapa en bättre förståelse för mervärdet av ögonspåraren. Experimentets uppbyggnad bestod av att deltagaren spelade en match av den elektroniska versionen av ishockey, NHL 20. Matchen bandades in för att analysera deltagarens handlingar under matchen. I samband med att deltagaren spelade en match, användes en ögonspårare för att analysera deltagarens placering av blicken.

I experimentet deltog endast en person, och för analyserna har det slumpmässigt valts ut ett utdrag från matchen som bandats in. Utdraget analyseras med betoning på situationer där spelaren som observeras vinner tillbaka pucken från motståndaren. Två skilda analyser görs; en analys av spelsituationerna utan ögonspårarens information, och en analys av spelsituationerna med ögonspårarens information tillgänglig. De två analyserna jämförs sedan för att se vilket mervärde analysen med ögonspåraren kan ha.

7.5.2 Analys och preliminära resultat

Analyserna baserar sig på fem scenarier; tre defensiva respektive två offensiva scenarier. Jämförelsen av de två analyserna bevisar ett mervärde i användningen av information från ögonspåraren. Alla situationer hade dock inte samma grad av mervärde, vilket ledde till en uppdelning på låg, medel och hög påverkan av ögonspåraren. Alla tre defensiva scenarier visade att ögonspåraren bekräftade den tidigare analysen, men bidrog inte med extra information, därmed klassades de som påverkande av medelgrad. De två offensiva scenarierna klassades som påverkande av hög grad, då man kunde bekräfta den tidigare analysen, samt bidra med tilläggsinformation om situationen.

En analys av en värmekarta indikerade att spelarens uppmärksamhet fanns konstant på rinken och inte utanför spelzonen.

7.6 Resultat och Diskussion

7.6.1 Vilka analytiska hjälpmedel används för tillfället i e-sport och hur ser den analytiska processen ut?

De flesta verktygen som för tillfället används inom e-sport är mjukvaror som gör det möjligt för lag att analysera sina matcher eller träningspass. Mjukvarorna gör det analytiska jobbet lättare, då man kan se olika matchsituationer från olika perspektiv (Performetric, i.å.). Vid sidan om de visuella hjälpmedlen, drar man även nytta av statistik från matcher på individuell och lagnivå.

Själva analytiska processen inom e-sport påminner om kunskapshantering (van Heijst et al, 1999) och data samlas då laget eller en individ spelar matcher. Insamlad data måste tolkas och förvandlas till information och kan sedan ytterligare förenklas genom att visualisera den, vilket gör det lättare för andra att förstå den. Visualiserad data kan sedan användas för att skapa nya strategier inom laget, vilket laget kan ha nytta av i nästa match. Under nästa match samlas data igen för att påbörja kretsloppet av kunskapshantering på nytt. I det nya kretsloppet kan man nu även inkludera en utvärdering av den föregående kunskapshanteringen och med hjälp av denna kan man upptäcka behov av förändringar i processen.

7.6.2 Vad går ögonspårning ut på och vad kan det bidra med till e-sport?

Ögonspårning handlar om att följa med hur individer upplever olika situationer och vad de lägger märke till. Tidigare studier inom ämnet e-sport har framfört resultat där ögonspårning kan bidra med en mängd nyttig information (Korotin et al., 2019). Spelarnas blick observerades för att skapa värmekartor, varefter man kunde dra slutsatsen att professionella idrottare inom e-sport skiljer sig märkbart från de som endast spelar för nöje (Velichkovsky et al., 2019).

Experimentet som genomfördes i denna avhandling har bestyrkt de resultat som visats i tidigare studier. Analyser gjorda med och utan data med hjälp av ögonspåraren bevisade att man i vissa situationer kunde skapa mervärde för spelarens utveckling genom användning av ögonspåraren.

Den senaste utvecklingen inom e-sport visar ett ökat intresse av den psykiska och fysiska aspekten av spelandet både bland lag och individer. Flera lag har redan anställt psykologer som är specialiserade inom sport och idrottare (HLTV, 2018). Detta betyder att ögonspåraren kunde hämta mervärde till laget genom att bidra med detaljerad information om t.ex. individuella spelares kognitiva förmågor och mentala trötttheten. Mental trötthet påverkar inte endast den psykiska hälsan, utan den kan på långt sikt även ha en negativ inverkan på den fysiska hälsan (American Psychological Association, i.å.).

Då man lärt sig mera om individernas återhämtningsfaser kan man bättre planera tidtabellen för vila och träning. Träningarna genomförs då spelarna är i den mest alerta fasen av sin dag för att optimera prestationen. Då spelarna närmar sig slutet av fasen, avrundar man träningspasset och inleder återhämtningsfasen för att säkerställa både psykiskt och fysiskt välbefinnande.

7.6.3 Hur genomförs ett experiment inom ögonspårning?

För att genomföra ett experiment inom ögonspårning krävs rätt utrustning och en anläggning där man kan kontrollera vissa variabler. Kontrollerbara variabler kan handla om temperatur, ljusstyrka eller ljudnivå. Planeringen av experimentet är viktigt för att få användbara resultat. (Duchowski, 2017). Det viktigaste för lagen inom e-sport är att skapa en anläggning som är möjlig att återskapa även om laget

befinner sig i ett annat land. Det är viktigt att kunna återskapa anläggningen, eftersom lagen inom e-sport reser största delen av året från evenemang till evenemang utan att återvända hem emellan.

Ögonspårare finns tillgängliga i olika prisklasser, där de billigare versionerna erbjuder bättre mobilitet, medan de dyrare har sina styrkor i resultatens precision. Valet av ögonspårare bestäms enligt de önskade resultaten. Vill man endast ha en vag översikt av en spelares förståelse av spelet, kan man använda sig av de billigare ögonspårarna. Vill en däremot ha mer detaljerad information om en spelare på långt sikt är det värt att satsa på en dyrare ögonspårare för att garantera mer enhetliga resultat.

7.6.4 Kan ögonspårning fungera som ett komplement till nuvarande analytiska processer?

Då e-sport blir mer konkurrenskraftigt handlar det till slut om detaljer, för att vinna på toppnivå krävs varje möjlig fördel. Utvecklingen inom e-sport har redan sett en ökad användning av data och mjukvara, för att gå mer in på detalj kunde man vända sig till ögonspårning.

För att dra mest nytta av den information man får av insamlade data och analyserna från matcher, kan ögonspårning absolut fungera som ett komplement. Situationen är inte enhetlig bland alla spelare, då de som har mer erfarenhet och förståelse av ett spel högst antagligen inte har lika stor nytta av ögonspårarens analys.

Under skrivandet av avhandlingen uppkom information om möjlighet till uppföljning av hälsan med hjälp av ögonspåraren. Eftersom flera lag inom e-sport har uttryckt intresse av att satsa på den psykiska och fysiska delen av elektronisk sport, blev det uppenbart att ögonspåraren kunde vara ett värdefullt redskap i sammanhanget. Ögonspårare som verktyg för att samla in information om individuella spelares psykiska hälsa gör den även användbar för de spelare som inte drar någon nytta av en mer traditionell spelanalys.

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