FACULTY OF INFORMATION TECHNOLOGY AND ELECTRICAL ENGINEERING

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COLLABORATIVE FLOW IN ESPORTS, A SURVEY STUDY

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ABSTRACT

During the 21th century, e-sports has been rapidly rising in popularity with multiple e-sports events with multi-million dollar prize pools. This popularity also has piqued the interest of scientist from all fields, and the number of scientific publications has continued to rise year–to-year, and multiple fields have started to study esports from multiple angles. Esports has no generally accepted definition. Esports is most often seen as "professional gaming" but at closer inspection, this definition is too narrow and does not cover all that esports is and what it has become. Esports can be defined in many ways depending on the research angle and the study field, however the similarities between studies are that esports is computer-mediated competition where athletes compete in high-stress situations where they try to outplay their opponent. Whether it is with reflexes and teamwork in a First-Person Shooter (FPS) or Multiplayer Online Battle Arena Games (MOBA), or with strategy in a Real-Time Strategy (RTS) games, or in one of the multitudes of video game genres. Esports acts as an umbrella term for all computer-mediated human versus human competition; it does not matter if humans go against a computer if they compare scores against each other at the end. In this thesis work, I will also be conducting a quantitative survey directed at people who play video games. According to the results time spent playing, team size and whether the player mostly plays in a team or alone all affect the immersion of the gameplay moment.

Keywords: thesis, eSports, survey study, player experience, flow

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TIIVISTELMÄ

Kuluvan vuosituhannen aikana, E-urheilun suosio on kasvanut erittäin nopeaa tahtia ja turnausten palkintorahat ovat jo monen miljoonan kokoisia. Tämä kasvu suosiossa on herättänyt eri alojen tieteellisten yhteisöjen huomion ja tieteellisten julkaisujen määrä on myös kasvanut vuosi vuodelta. Monet eri alat ovat alkaneet tutkimaan elektronista urheilua eri näkökulmilta, kuten näyttää kirjallisuuskatselmuksessaan.
Elektroniselle urheilulle ei ole universaalisesti hyväksyttyä määritelmää. Elektroninen urheilu usein määritellään "Ammatti pelaamiseksi"mutta läheisemmällä tarkistelulla tämä määritelmä on liian kapea eikä kata kaikkia elektronisen urheilun osa-alueita. Elektronisen urheilun voi määritellä monella tavalla riippuen tutkimuksesta ja tutkimuskentästä, mutta yhteistä kaikilla määritelmillä on se, että elektronin urheilu on tietokoneen välityksellä toimivaa kilpailua, missä elektroniset urheilujat kilpailevat yrittäen voittaa vastustajansa. Kilpailu voi olla refleksejä ja tiimityöskentelyä vaativaa ensimmäisen persoonan ammuntapeli, taisteluareenamoninpeli, strategiapeli tai jokin muu peligenre. Elektroninen urheilu toimii kattoterminä kaikelle tietokoneen välityksellä toimivalle ihmisen väliselle kilpailulle. Kilpailijat voivat pelata myös tietokonetta vastaan, kunhan vertailevat tuloksia toisiin ihmisiin lopulta. Tässä kandidaatintyössä kerron elektronisesta urheilusta ja suoritan määrällisen tutkimuksen videopelien pelaajista käyttäen online-kyselyä, joka oli kohdennettu aktiivisille pelaajille. Kysely kartoitti flow-tilaan liittyviä pelaajakokemuksen aspekteja ja siihen osallistui 69 pelaajaa. Tulosten mukaan peliajalla, joukkueen koolla ja pelaako pelaaja pääosin joukkueessa vai yksin on vaikutuksia pelitilanteen immersioon

Avainsanat: Kandidaatin työ, eUrheilu, kyselytutkimus, pelaajakokemus, flow-tila, pelitutkimus

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FOREWORD

First and foremost I would like to thank my thesis supervisor for her continuous feedback and suggestions. Secondly I would like to thank my significant other for moral support and for sometimes reminding me that finishing the chapter I am trying to finish that evening is not worth the stress I was putting into it. Thirdly huge thanks go to my cats that took my mind off the thesis by trying to knock down things around my computer; it provided a well-needed sense of levity to keep the stress manageable. This thesis was made during the coronavirus pandemic. The pandemic made things somewhat tricky and limited options for the survey, however fortunately, we were able to navigate around the difficulties and finish the thesis even if it took longer than expected.

Oulu, June 4th, 2021

Jaakko Ohrankämmen

LIST OF ABBREVIATIONS AND SYMBOLS

MOBA	Multiplayer Online Battle Arena
RTS	Real Time Strategy
FPS	First Person Shooter
API	Application Programmable Interface
GUR	Games User Research
QA	Quality Assurance

1. INTRODUCTION

Electronic sports (esports) is a new field of professional sports and target for research, that has seen incredible growth over the last few years [1]. Electronic sports research has also seen a change in its philosophy during its 20-year lifespan. Rather than trying to explain electronic sports as a phenomena, researchers are beginning to study the complex mechanics of electronic sports [2].

The young age of electronic sports research has also made apparent a multitude of challenges and opportunities compared to traditional sports research, ranging from gathering data from athletes to the diverse nature of electronic sports where every game published is widely different from others. The way of gathering data must accommodate that. Two main ways of data gathering are the same as in other sciences, qualitative and quantitative. Qualitative data can be challenging to achieve without impeding on the athlete's performance [3]. Quantitative data can be easier to gather, since video games are executed on code, so it is possible to get exact information of the game-state down to the millisecond; or gather hundreds of thousands of data-points with game Application Programmable Interface (API) and try to notice patterns that way [4]. Some games also have first- or third- party tools to save gameplay for later analysis. These tools can be used, for example, to create heat maps that can be studied by researchers later. Some researches do not get much use out of these tools, since their study focuses on the player and not necessarily on the gameplay, and [5] explores different ways of gathering data.

Games user research is a research field dedicated to assist developers to make games that have the user experience as good as possible using every aspect of game development. Games user research is often overlooked because the results are not easily quantified, but nevertheless, it is an important aspect of game development.

The target of this study is flow. It is a deep state of concentration, where people lose track of time and feel a deep sense of enjoyment that happens when people are challenging themselves in something that they enjoy [6]. Immersion is a state going hand in hand with flow and has many of the same characteristics as flow. There are also some ways of gathering data about the player to notice when they are experiencing a state of deep concentration. Flow is also interesting when applied to teams. [5] noted that a state of team performance where teamwork was extremely fine tuned called "team cognition".

Teamwork is a integral part of the discussion when discussing esports since most popular esports titles are team-based. While individual skill is essential for any esports athlete, teamwork can be the deciding factor for a victory or a loss. Team forming can be difficult for an esports team, because it requires balancing between prioritising teamwork and individual skill. [5]. Some esports titles are about picking different characters to play, in a team this can manifest as giving every player the best character they can play to maximise the team performance, while sacrificing some individual performance, leading to a proficiency congruency dilemma.

1.1. Motivation, Method and Target for Research

The motivation for this thesis was to observe collaborative flow and other flow-related aspects of player experience in the gaming community. The method for this observation was a literary research to study what other researchers have found about this dynamic field. An online survey was also conducted, where I tried to get a sense of player immersion and flow when playing video games. The survey was created by combining different video game surveys that surveyed the aspects that we wanted to survey. surveys used were [7][8][9]

1.2. Structure of This Thesis

In the following chapters, I explain esports and aspects of esports with a literary study. After literacy study, I introduce the survey done and the participants. After that, I present the findings of the study and finally discuss the limitations and findings of the study.

2. ESPORTS

2.1. Esports Research

Compared to the size of the industry, the esports research scene is only in its infancy since it only has been studied for 20 years. During those 20 years, esports has seen a considerable popularity increase, both in viewership and academic interest [1].
Esports research has evolved from trying to explain the phenomena to audiences or the academic community to trying to explain the complex mechanics that make esports what it is. Every field studies their corner of esports and tries to explain esports from their point of view [2]. Esports research is starting to be a more and more complex and multi-layered research field and as the prize pools go up and up, so does it turn the eyes of the academic community.

2.2. Esports Research Methodology

Esports research has presented many unique new challenges, some do not differ from traditional sports, but some do. How do you monitor and gather data from players without too much impeding on their performance? The answer to this research problem depends on how esports is defined for that research and whether they try to study only the highest-ranking esports athletes or do they define esports more broadly and to study the player base, the game in question and the genre of the game. For example, MOBA and FPS games rely more on twitch reactions, and RTS games involve more strategy than twitch-reactions, so there are no one-size-fits-all research approach to get data from esports.
One approach to get data from esports athletes is using external sensors like hearth rate monitors, eye trackers, key-loggers, classic interviews, or in-game software to get data points from the players without impeding their performance [3]. This approach gives qualitative to researchers to get precise information from players and allows them to control the study environment.
Another approach is the quantitative approach to get a massive amount of data points. A popular research approach to study games is to use APIs to collect a multitude of data points and use mathematical formulas to deduce pattern in gameplay [10]. Some games also have first or third party tools to save gameplay for later analysis that are extremely useful for researchers, such as, the replay tools in games like Counter-Strike. These "replays" are files that are created in games and contain all events of the game. Replay files can be used to observe games from any players' angle with in-game tools, or they can be parsed using custom software to gather any data from a round of game. This data can be used to get precise data from games when trying to researching players and can be used to, for example, create heat maps of player positioning. Replays are handy tools when researching and gathering data from specific gameplay events.
Different fields, of course, research esports in different ways, and for some fields, the focus is not on the game or gameplay events but on the player playing the game. This is especially relevant for coaching professional players. Researching the players must be conducted using monitoring devices that are as non-intrusive as possible. Aaron Koshya and George Mathew Koshy [11] studied different viable methods for player

monitoring in esports. One of the most common and accessible methods is a smart-watch or fitness tracker. While not perfect, and more precise and reliable tools have been invented, smart-watch or a fitness tracker offer enough precision to be extremely useful in monitoring esports athletes [5].

2.3. Games User Research

Games User research (GUR) is the field of study intended help developers to make a data-informed decisions, that support the development progress of games while keeping the player and the user experience in the middle as the vocal point of the process. GUR as a field involves every area of game development, that influences the user experience in any way. GUR encompasses parts that you traditionally would not connect with user experience, such as audio engineering, management and even contract handling. [12]

As opposed to quality assurance (QA), which focuses on testing the game to expose all of the bugs and technological flaws to provide as technologically sound experience as possible, the actual user experience might not be the vocal point of the QA team. However, GUR focuses on researching players using methods from many research fields to figure out if the user experience is what the developers intend it to be. As human computer interactions research studies the interaction between human and the machine, GUR focuses on the player and how they interact with the game world. GUR allows the researchers and developers to iterate on the game mechanics on a deep level and understand what builds a good player experience.[12]

Although GUR has become more popular in academic research during the 21^{th} century, it is not often recognized in games industry, since the result of GUR is often only a subtle improvement in the final product that make the experience smoother and better for the user as opposed to assets, animations or game mechanics that drastically effect the end result of the game and are often given the credit for the success of games and industry-wide recognition for extremely polished mechanics or animations. Even though GUR may not be as flashy as assets or animations, it can provide vital information to the developers of the games' flaws that they may have not noticed or have overlooked. As the gaming industry grows larger and the diversity of gaming audience grows and people of different ages with physical or intellectual disabilities want to play; the need for data-driven design process and thus the need for GUR is higher than ever. GUR is a deep analysis of game elements that are detrimental to user experience, and works as a support for other aspects of game development by exposing weaknesses on the games' current design. GUR gives data-driven insight on how the design of the game can be improved. As the gaming sphere evolves the discipline of GUR must evolve to keep up with fast evolving field of gaming.[12].

2.4. Flow in Esports

Flow is one aspect of player experience and can be a target for GUR. It is defined in traditional psychological sciences can be described as a sense of exhilaration and a deep sense of enjoyment, where people feel deep enjoyment, satisfaction and are in a deep state of consciousness. Flow state can be achieved, when people are challenging themselves with something they enjoy. This activity must be hard enough that it is not too easy or boring, but the challenge must not be too hard, or people find themselves frustrated. [6]. Esports flow is the same phenomena but restricted to flow state while video gaming. While if flow state, people experience a heightened level of learning and skill [6], This heightened level of learning could be highly potent in esports and understanding flow could be crucial for maximising the potential for esports athletes.
Going hand in hand with flow is immersion, and logically speaking, immersion could be thought of as a precondition for flow, since immersion is a loss of sense of context and involving heightened involvement. [13] Nacke et all also noted that facial electromyography could be used to track the emotional state of the player and to search for correlations between the subjective state that the subject said they were into the objective facts that can be measured. Freeman and Wohn [5] and Lipovaya et al. [14] noted that the phenomena where the team's performance is so high that players start to accurately predict actions of their team, resulting in extremely fine-tuned teamwork called "team cognition" by [5], this could be just another name for collaborative flow or could be categorized as a subsection of collaborative flow. Collaborative flow being the flow state applied to the whole team where the team works almost as a single human, and everyone knows what others are doing with minimal vocal communication.

2.5. Teamwork

Most popular esports titles are team-based games, and as such, teamwork is an essential part of being a successful esports competitor. While solo skill is vital, teamwork and communication can make or break teams' success in a highly competitive environment where every team fights for every inch of ground against other teams in a highly stressful situation. Teamwork has been studied in the past from many different angles, such as personal attributes/skill or relationship dynamics, some have found that team performance prediction based on the individuals and their social skills is difficult.[5]
Esports teams forming is a difficult form of art where the team has to find the balance between individual skill and how well they can work with the existing team to create the highest possible performance from the team [5]. Studies have shown two essential traits of successful teams that can communicate effectively as the shared mental model (knowledge shared by the team) and situational awareness (awareness of events happening outside their vision). When a team has these traits, a team cognition is possible, a term when the team can process information and respond to that information effectively.
Some Esports titles, like the most popular MOBA game League of Legends, has a phase of the game where the teams are formed and each team member chooses their character or "champion" as they are called in the game. This phase of the game is called the "draft pick". During the draft pick, first teams ban champions from being

used by either team. After bans, teams start picking champions one-by-one switching between teams. League of legends also has self-governed (not enforced by any in-game mechanic) roles for each player during the gameplay [15]. This form of team picking reveals an interesting question while forming teams. How to organize and maximize the effectiveness of teams to give each player a role that they can perform the best? If 2 players feel like their best role is the same, it means that the other must give the role to the other one and play some other role. This brings an interesting dynamic to the game where both teams try to get the best team composition possible while keeping every player playing a role they are comfortable with [4]. This proficiency-congruency dilemma is a challenge for any team and happens on any level of gameplay and explains why the best performing player might not be the best choice for the team; it depends on how well they play together. Skill is still a significant factor, but not the be-all-end-all for teams. [4] noted that if a player plays with a character that they frequently play with, they have better performance and that teams that have formed the team coherently perform even better. Kim's et al. [4] findings noted that team proficiency and congruency becomes more common as players rise through the ranks.

2.6. Communication

Individual skill is essential for team to consider. However, personal skill is distinct from teamwork, and team cohesion might play a significant factor in the team's performance, this is especially noticeable in high skill-ceiling esports titles, where situations are so rapid that vocal teamwork may not be possible, so in league of legends, the players employ a mechanic called "ping" where players can leave a mark on the mini-map and give an auditory cue for their team. This communication is crucial for teams in high-intensity situations where every second counts [16].

3. SURVEY

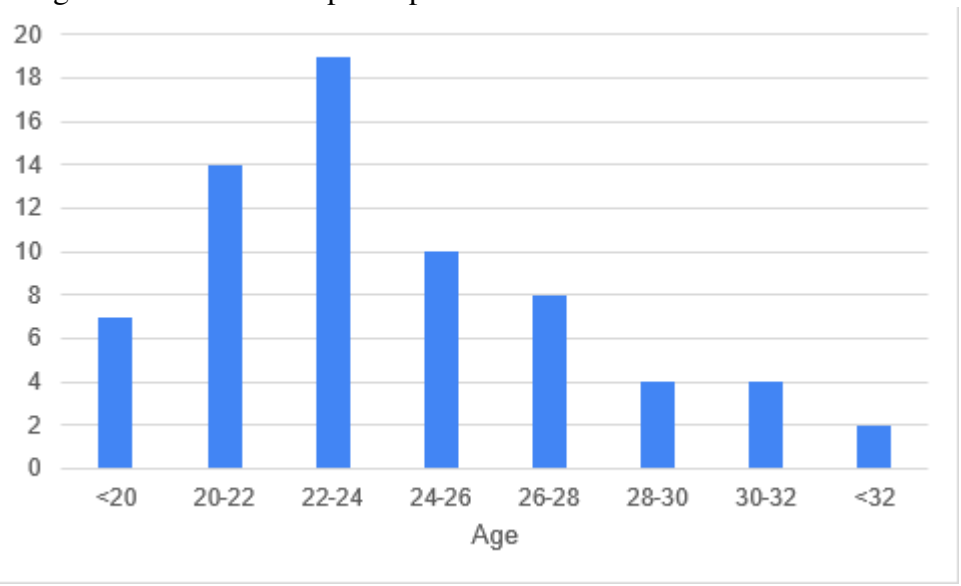
3.1. Survey

The survey was created using different existing psychometric questionnaires [17] [9] [18] to make it easier to form questions that test different attributes attributes to be observed.
The test consisted of 52 questions plus demography questions. The 52 questions were chosen to get insight on subjects' Flow, Co-presence, Sensory and imaginative immersion, Behavioral involvement, social presence and engagement. [17] [9] [18] When analyzing the data, the answers the answers were combined to test one category to get a better sample size and to get significant results with a limited sample size.

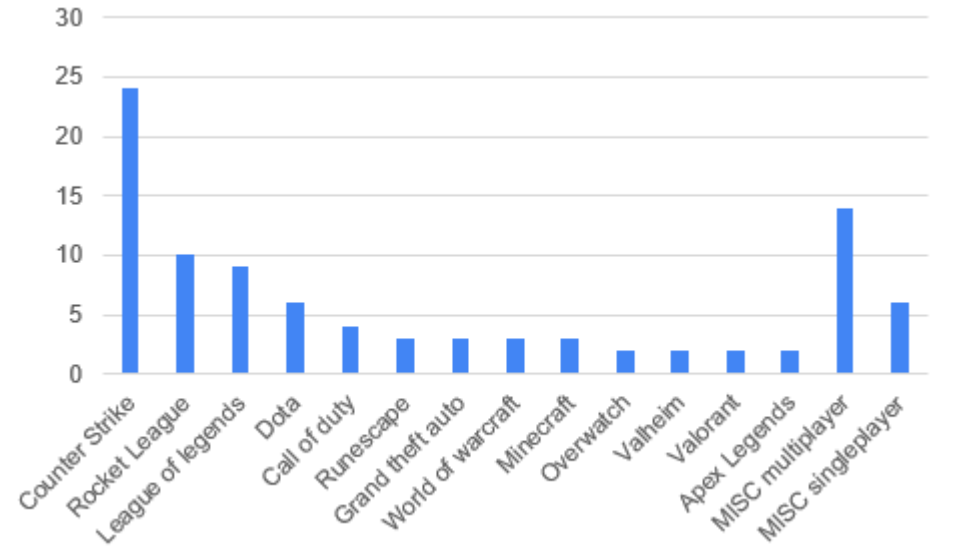
3.2. Participants

Participants were gathered by sending a link to google forms using instant messaging and digital distribution platform discord, where the link was published on several servers dedicated to gaming. The survey was also distributed using the University of Oulu mail-lists in April 2021.
The participants could answer the survey on their own time when they wanted. The game participants played before answering the survey was not controlled. The participants were directed to play a game before answering and reflect how they felt while playing when answering the survey.
The survey was answered by 69 participants, most of whom were male (61), some female (7) and one who did not want to specify their gender. The following page has 2 graphs, age distribution and the game the participants mainly play. The most played game was an open question and if the participants listed one or more game, both of the games were included in the graph.

Age distribution of the participants



Participants' most played game



Miscellaneous (MISC) multiplayer and MISC singleplayer are collections of answers that got only single reply

4. RESULTS

Table 1. Divided by weekly hours spent gaming using excel one-way-anova tool

Measured	Group	Count	Average	varianssi	p-value
Co-Presence	Over 30	60	4.75	3.48	p = 0.042
	15-30h	95	5.42	1.76	
	0-15h	108	5.05	3.13	
Sensory and imaginative Immersion	Over 30	90	4.18	4.18	p = 0.027
	15-30h	156	4.81	2.58	
	0-15h	168	4.52	2.90	
Social presence	Over 30	255	4.60	4.15	p = 0.035
	15-30h	442	4.94	2.98	
	0-15h	476	4.92	3.01	
Cognitive Engagement	Over 30	165	4.81	3.56	p = 0.015
	15-30h	286	5.07	2.26	
	0-15h	308	4.68	2.82	

Table 2. Divided by whether player usually plays alone or in a team using excel one-way-anova tool

Measured	Group	Count	Average	varianssi	p-value
Co-Presence	Team	203	5.03	1.93	$p < 0.01$
	Alone	60	4.38	4.95	
Behavioural Involvement	Team	306	5.64	1.79	$p < 0.01$
	Alone	108	5.01	3.34	
Social presence	Team	867	5.10	2.83	$p < 0.01$
	Alone	306	4.16	3.98	
Interaction	Team	255	5.17	2.55	$p < 0.01$
	Alone	90	4.48	4.18	

Table 3. Divided by team size using excel one-way-anova tool

Measured	Group	Count	Average	varianssi	p-value
Sensory and Imaginative Immersion	0-5	216	4.75	2.61	p = 0.01
	More than 5	192	4.32	3.60	
Behavioural Involvement	0-5	216	5.27	2.43	$p < 0.01$
	More than 5	192	5.69	2.04	
Behavioral engagement	0-5	288	5.26	3.05	p = 0.053
	More than 5	256	5.54	2.66	
Interaction	0-5	180	4.82	3.25	p = 0.04
	More than 5	160	5.21	2.78	

On some player experience aspects there were no statistically significant results after One-way-ANOVA. These results are reported for transparency in tables 4-6.

Table 4. non-significant results Hours spent gaming

Measured	p-value
flow	0.118
Behavioural Involvement	0.397
conscious attention	0.067
absorption	0.081
behavioural engagement	0.473
Social connection	0.153
interaction	0.538

Table 5. non-significant results team or alone

Measured	p-value
flow	0.253
sensory and imaginative immersion	0.127
cognitive engagement	0.227
conscious attention	0.097
absorption	0.934
social connection	0.100

Table 6. non-significant results team-size

Measured	p-value
co-presence	0.950
flow	0.995
social presence	0.237
cognitive engagement	0.418
conscious attention	0.783
absorption	0.353
social connection	0.631

5. DISCUSSION AND CONCLUSIONS

This thesis targeted aspects of flow in a survey study. The used survey was designed to study flow and flow-related phenomena. The survey was distributed using discord and university of Oulu mail-lists. The survey was open and available to anyone with the link.

The survey provided some exciting results. When divided by weekly hours spent gaming, study shows that people that play over 30 hours/week measured least in co-presence, sensory and imaginative immersion, social presence. 0-15h average was the second-highest, and 15-30h weekly game time averaged highest. Only in cognitive engagement the people with more playtime were, on average, more cognitively engaged. The fact that people that play more than 30h/week answered lowest on average on everything but cognitive engagement is surprising. This could be because playing game too much could make playing too familiar and the excitement of playing could lessen. More than 30h players averaging highest on cognitive engagement was not surprising, since it makes sense that people that play more are more engaged with the game outside of playing it.

When divided by whether people played in a team, the results are somewhat unsurprising. People in team, were on average higher in Co-presence, behavioural involvement, social presence and interaction. Logically thinking this makes sense since people that play in a team get more instantaneous feedback from their actions, because they hear other people talking about the game while playing, thus increasing immersion.

This study could be used by game developers to better understand their player-base, their immersion and the reaction to specific game mechanics by looking at the team patterns of players. This data could also be used to get an idea of how different people focus on different aspects of gameplay, and to get a better understanding of how the gameplay is perceived by players.

5.1. Future Work

This study compassed players that play all sorts of games, In the future, it would be interesting to focus the study and get a better understanding of tighter focus group. Another route that would be interesting to explore is to get a larger sample size and get a better understanding of players as a whole.

One of the significant improvements that could be done to the study is to do the study in a more controlled environment.A Controlled environment could have been utilised for gathering data and have multiple players play the same game in a group or alone. One of the downsides of doing the study in a controlled environment would be that realistically we could gather less data than a survey could. Maybe a possible way would be to make a survey and a controlled study. If given more time for the survey to gather participants and maybe a more varied focus group would be helpful. Future work could also be done to find out why people that play over 30 hours every week get less immersed in the gameplay moment compared to those that play less.

5.2. Limitations

Since people to answer the survey were sought from discord, which is a social platform, there is a chance that it might influence the questions that are about the consumption of video games besides playing them since people that use discord already seek information about the game outside of the game.
The study was done in an uncontrolled environment online. Significant limitation of the study is that we could not control the game people played, and while participants were instructed to play a game before answering the survey, there was no way of enforcing it. This means that some people might have been referencing old memory of playing while answering the survey instead of referencing a fresh memory before answering. This might affect the accuracy of the results, but it is unlikely that it had a detrimental result on the accuracy of the study.
One aspect that was also uncontrolled were the machines that the participants use to play games. This could affect some aspects of results, such as the sensory and imaginative immersion, because that category had questions regarding graphical fidelity. Players with more powerful machines could be enjoying the aesthetic aspects of games more simply because their machines can run the games with better graphical fidelity. In the related work, I explained the connection between immersion and flow [13]. Immersion can be seen as a result of using more attention-demanding, i.e. immersive technology [19], which may be what was observed. There is a low chance that the discrepancy in gaming hardware led to any significant changes is results.
The sample size for the study was not huge, a larger sample size could probably give more significant results from the categories that had a p-value of nearly 0.05. I think the sample size was adequate for this study, and I do not see a reason that a larger sample size would significantly change the results of the study.

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