

Lipovaya, V.; Lima, Y.; Grillo, P.; Barbosa, C. E.; Souza, J. M.; Duarte, F. (2018): Coordination, Communication, and Competition in eSports: A Comparative Analysis of Teams in Two Action Games. In: Proceedings of the 16th European Conference on Computer-Supported Cooperative Work - Exploratory Papers, Reports of the European Society for Socially Embedded Technologies (ISSN 2510-2591), DOI: 10.18420/ecscw2018_11

Coordination, Communication, and Competition in eSports: A Comparative Analysis of Teams in Two Action Games

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Abstract: eSports are increasing in popularity and in importance worldwide and, given that they essentially involve the cooperation of teams competing among themselves, they are an interesting study object for the CSCW field. In this study, we contribute to the CSCW literature regarding eSports by performing a comparative analysis of two different action games, focusing on how cooperation, communication, and competition take place in each one of them. To do so, we perform a semi-qualitative study involving interviews with professional and amateur players. Then, we analyzed the results of the fieldwork, which consisted of a 31-question questionnaire with 65 valid respondents. Moreover, we discuss and highlight the relationship between our results and other CSCW-related works focusing on our research questions. Among our findings, we can highlight the specialization of work in different eSport teams, the importance of non-verbal communication during matches, and the interplay between competition and collaboration in the same team.

Introduction

Over the last decade, online games have become the industry standard. One segment of this industry — competitive games — is becoming increasingly popular. A competitive game is one in which players can compete against each other, either by themselves or in groups. The popularization of competitive games has enabled the creation of specialized events, usually broadcast via the internet, in which teams compete in championships. The prizes offered, both financial and non-financial, have led to the creation of professional teams, specialized in a given game. The concept of electronic sports (eSports) emerged from competitions involving professional players.

There is substantial financial potential in eSports given that the revenue in 2016 was US\$492.7 million, with a forecast of US\$1.5 billion for 2020 (Newzoo 2018), which indicates steady growth. Initiatives to take eSport content to traditional media, such as TV, are being developed (Beck 2017a, 2017b, Bullock 2017), and efforts are being made to make eSports comparable with traditional sports, in the hope of inclusion in the Olympics (Graham 2017, Good 2017). Several characteristics of eSports are challenging themes in the study of collaboration, given that players can be geographically dispersed and must execute a task — in the group — that demands constant decision making and the real-time sharing of situational knowledge.

Computer-Supported Cooperative Work (CSCW) is a collaboration-themed research field that seeks to understand how people work in a group to attain a common goal through the use of computational tools (Wilson 1991). We adopt the paradigm that an eSport game would be an interesting research subject for CSCW — as proposed by Freeman & Wohn (2017b).

In this study, we focus on analyzing the collaborative aspect that arises in eSport teams of high-performance players, highlighting the differences between amateur and professional players. In particular, we try and fill a gap in the CSCW literature regarding eSports as indicated by (Freeman and Wohn 2017b)): a comparative analysis of the collaboration that occurs with players of different games. Thus, in this study we answer three research questions:

- RQ1 — How is work coordinated in eSport teams?
- RQ2 — How do players communicate during matches?
- RQ3 — Are there conflicting interests during the matches that make players in the same team compete against each other?

In order to answer these questions, we did a qualitative study using structured and semi-structured interviews with 74 eSport players.

This study is divided as follows: in section 2, we analyze and discuss the current state of eSports; in section 3, we discuss how collaboration (specifically CSCW) is related to eSports; in section 4, we detail the methodology used in this work; in section 5, we present the results obtained; in section 6, we discuss the

results in light of the CSCW literature; in section 7, we present our conclusions; and in section 8, we discuss future works.

The Current State of eSports

eSports have been growing in number and in terms of the academic debate, which can be seen in the plurality of academic definitions regarding the concept (Freeman and Wohn 2017a). In this study, we adopted the definitions most relevant to the CSCW area. Wagner (2006) and Hamari & Sjöblom (2017) define eSports as computer-mediated sports and an area of sports activities in which people develop and train physical and mental abilities using Information and Communication Technologies. According to Freeman & Wohn (2017a), within the research areas of CSCW and HCI that concern the study of eSports, most authors (McClelland et al. 2011, Hamilton et al. 2012a, 2012b, Kaytoue et al. 2012, Kow and Young 2013, Leavitt et al. 2016) describe eSports as competitive computer/online games. The competitions can involve several levels and scopes, from a local match using Local Area Networks (LAN) to national and international championships.

As reported by (Newzoo 2018), the eSport industry is a significant market that won't stop growing. Having produced US\$492.7 million in revenue in 2016, and with an annual growth of 34%, this market is expected to reach US\$1.5 billion in 2020. Another financial element that shows how the eSport industry is already huge, is the value of the prizes of the highest paying championships. Currently, more than 40 competitions have a prize pool over US\$1 million, and The International 2017 (TI7) — a Dota 2 championship — is the biggest competition in terms of prize pool, with US\$24 million in prizes.¹

Several authors have discussed the relationship between traditional and electronic sports (Skubida 2016, Freeman and Wohn 2017a, Jenny et al. 2017, Funk et al. 2017, Hallmann and Giel 2017, Heere 2017). Like any professional athlete, professional eSport players have a training routine, an agenda full of events, and they must maintain a healthy relationship with supporters and sponsors. These similarities in traditional and electronic sports are currently very relevant, given the institutionalization possibilities worldwide. The International Olympic Committee announced that eSports would be medal events at the 2022 Asian Games in China, and it is also possible that they will be included in the 2024 Olympic Games (Graham 2017). Also in this trend of professionalization, in the US, professional players can request the P-1 visa for athletes (Academy 2017). In Brazil, the Senate is analyzing a bill for the regulation of eSports (Senado Federal 2018).

¹ <https://www.esportsearnings.com/tournaments>

eSports and CSCW

eSports involve collaborative virtual environments and a complex social organization between players (Brown and Bell 2004), which makes them relevant to the CSCW community. There is some research on eSports in the CSCW and HCI literature, which includes: measuring the attentional and cognitive abilities of eSports players, in order to differentiate them from non-videogame players; estimation of the necessary effort to become an elite player; using of game concepts in the design of collaborative systems (gamification); and understanding the social dynamics in gameplay (Kozachuk et al. 2016). According to Dafai (2016), eSports can be similar in design despite their genres. Dafai identified five design characteristics that League of Legends (LoL) and Counter-Strike: Global Offensive (CS:GO) have in common, and may be seen as *essential* for a successful eSport. The design characteristics that these two eSports explicitly share are *Match Based Structure*, *Player Evaluation System*, *Explicit UI*, *Player Performance Feedback* and *Game Client* (Dafai 2016).

Taylor (2012) deeply analyzes eSports – comparing it to regular sports – exploring how gamers become professionals, how eSports are structured and its culture, how the global and local contexts affect eSports, and discusses if eSports are a serious leisure or a true form of professional play.

Several eSport games are designed to support collaboration in competitions between teams of players, which makes them suitable with both the 3C collaboration model (Fuks et al. 2008a) and the concept of awareness (Teruel et al. 2016). In this section, we will analyze how cooperation, coordination, communication, and awareness apply to eSports, using the mapping of the 3C model for adaptive workflows, which are similar to the one in eSports (Fuks et al. 2008b).

Communication is used in the decision concerning the distribution of activities among team members, and to synchronize and renegotiate this division depending on the situational context (Fuks et al. 2008b). According to Leavitt et al. (2016), due to the frantic rhythm and the ad hoc nature of communications in eSports, the primary means of communication used are voice and text. The use of the “ping” — a non-verbal communication that marks, in the virtual environment, a situation to be acknowledged by the members of a team — is another option for improving situational awareness that has a reduced impact on the focus of the team members when compared to verbal communication (Leavitt et al. 2016). Not every eSport game has the ping as a communication method, but game dynamics, in general, tend to allow for such non-verbal communication, as shown by (Toups et al. 2014).

Coordination is responsible for the breakdown of the main goal into different activities (partial goals) and the distribution of these activities among the members of the workgroup (Fuks et al. 2008b). The execution of these activities in an integrated manner is responsible for the performance obtained and goals

achieved (Freeman and Wohn 2017b). In accordance with Freeman & Wohn (2017b), the mental models shared regarding the tasks to be performed as well as the interaction between the team members allow for anticipation and prediction of the behavior of the team's companion — an emergent phenomenon called *team cognition*.

Cooperation can be defined as the execution of distributed activities (Fuks et al. 2008b). Lameiras et al. (2014) argue that there are two types of cooperation for athletes of traditional sports: conditioned cooperation and unconditioned cooperation. Conditioned cooperation is related to the perception that the athlete can achieve his personal goals through cooperation with the team. In the unconditioned cooperation, cooperation happens regardless of the personal goals of each athlete. Lameiras et al. (2014) also indicate that situational factors can induce cooperation.

The awareness of the team, in turn, is generated and mediated by communication, coordination, and cooperation (Fuks et al. 2008b). Endsley (1995) argues that situational awareness (individual) involves the perception of the elements in the present moment, the understanding of their meaning, and the projection of the situation in a near future. Situational awareness is fundamental to the decision-making process of the actions that will be immediately taken in an eSport match to achieve a given goal.

Freeman & Wohn (2017b) emphasize that the study of eSports offers an opportunity for discussions in the area of CSCW, given that eSports feature hybrid collective work. eSport teams are a mix of two types of teams — high-performance teams and decision-making and knowledge-intensive teams. The teamwork involved in them occurs in highly competitive, stressful, and intense virtual environments that demand fast decision making and action taking associated with physical (both virtual and non-virtual) activities. Thus, these teams are oriented toward action, particularly in the action games that are the focus of this study.

Given this theoretical context, this present study was guided by the following characteristics of the definition of an eSport: (i) computer-supported cooperative work; (ii) involves the collective aspect of work; (iii) a physical and intellectual activity undertaken during training or a championship; (iv) has as a goal the defeating of opponents; and (v) represents a hybrid type of virtual team.

Methodology and Approach

We present below the summary of our research design, which follows (Maxwell 2009) model, with five components:

- (1) *Goals*: In a theoretical aspect, we want to contribute deepening recent discussion regarding eSports and coordination and communication, by focusing on action games. In practical terms, we want to contribute

exploring subjects that are rising in this emerging field, in order to help future research and policies that can be made.

- (2) *Conceptual framework*: As described in the previous chapter, we covered eSports and CSCW research, but we focused on using a recent study from Freeman and Wohn (2017b) to drive part of research concepts. Besides CSCW, another conceptual framework of our study came from our background in Ergonomics, which motivated our feedback loops to validate some research issues with professional players.
- (3) *Research questions*: We focused on three research questions: RQ1 – How is work coordinated in eSports teams? RQ2 – How do players communicate during matches? RQ3 – Are there conflicting interests during matches that make players in the same team compete against each other?
- (4) *Methods*: We used a 31 item online-based questionnaire (see Appendix), based on previous research (Freeman and Wohn 2017b), with a total of 65 final responses. Our approach in the process of elaboration, validation and data collection and analysis is described in Figure 1. The responses profile is shown in **Table 1**.

Table 1. Demographic profile of the respondents (N=65)

Sex	Female: 5 (8%) Male: 60 (92%)
Age	Mean: 19.8 years Oldest: 36 years Youngest: 12 years
Country	Brazil
Category	Professionals: 14 (22%) Amateurs: 51 (78%)
eSport games played	Counter-Strike: Global Offensive (CS:GO) — 25 (38.46%); Rainbow Six: Siege (R6) — 23 (35.38%); and Others — 17 (26.16%), which includes League of Legends (LoL) — 5, Overwatch — 5, Fifa — 4, Clash Royale — 2, and Dota 2 — 1

- (5) *Validity*: We used some feedback loops in order to increase questionnaire and responses coherence and validity, by confronting them with experienced players and professionals in eSports. It is important to remember that it was conducted only with Brazilian players and with a short period for data collection for this exploratory paper. For further investigations, it might be necessary a more complex and cross-sectional study.

The approach of the research followed three main phases, which are summarized in Figure 1, and briefly described in this section:

- I. *Exploration*: Some of the authors of this work have done interviews with eSports professionals in the past during the course of conducting other research (Lipovaya et al. 2017, Ikenami et al. 2018), this ongoing research connected with CSCW literature and a research group was formed with experiences regarding eSports and CSCW. Some interviews were made with four eSports experts in order to validate literature questions and explore problems, this helped us elaborating the data collection procedure, including the questionnaire.
- II. *Data collection*: The final questionnaire was validated and evaluated with other eSports professionals. In order to get more responses, we made an engagement strategy with eSports influencers to share the questionnaire using social media.
- III. *Data analysis*: Data analysis and compilation of the results involved a three-level structure – the highest level is the research question, followed by the type of the game, and, finally, player class (amateur or professional). We used a qualitative analysis methodology, first individually finding patterns in responses and then collectively constructing results, using the data analysis hierarchical structure.

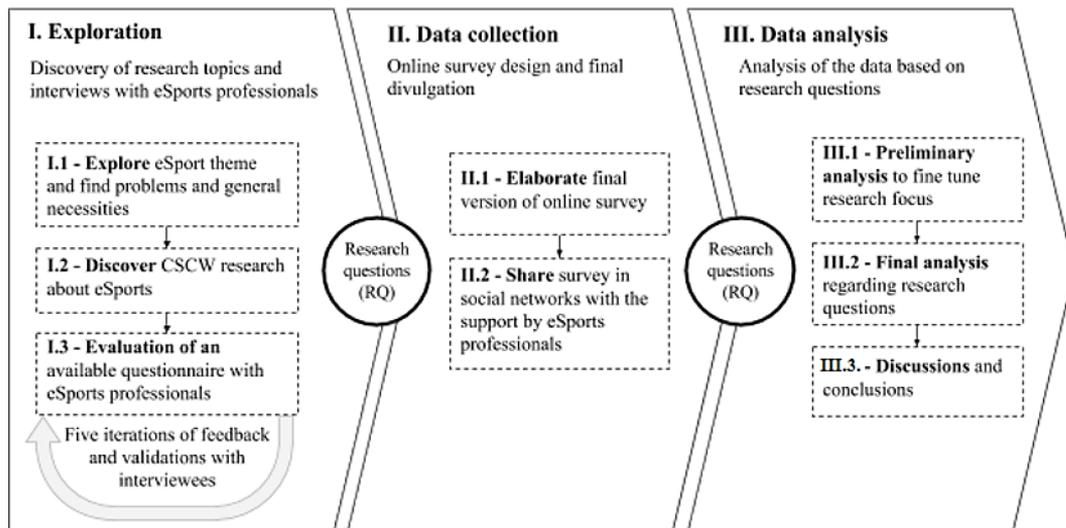


Figure 1: Summary of the phases and steps of the methodology.

Analysis of Results

Coordination

Given that understanding the division of work is essential for understanding how coordination is achieved (Mintzberg 1989), we sought to explore this question that remains underexplored in the literature on eSports. Thus, our field research was aimed at understanding how work is divided both vertically and horizontally; and understanding what is expected of each role in the team.

During the exploratory phase of our study, we found that, besides players, there are three important roles in eSport teams: captain, coach, and manager. In the questionnaires, we set out to understand if each of these roles exists in eSport teams, and if they are roles assumed by a single person (e.g., a player that is also a manager), and we also sought to understand what is expected of each of these team roles during the matches.

Captain

Overall, 62% of the interviewees said that the role of captain exists and that the captain plays with the team. Only 5% said that the captain exists and does not play with the team, while 29% said that there is no specific captain role, and of this percentage, 13% said that the role of the captain is divided between the team, as shown by Figure 2. For the CS:GO players, nobody said that the role of captain is taken by a non-player, and 67% affirmed that the captain is a player. Among the R6 players, this percentage increases to 78%. From these answers, we concluded that the role of captain exists and it is either a responsibility given to one of the team players or distributed among them — in other words, the non-player captain is uncommon.

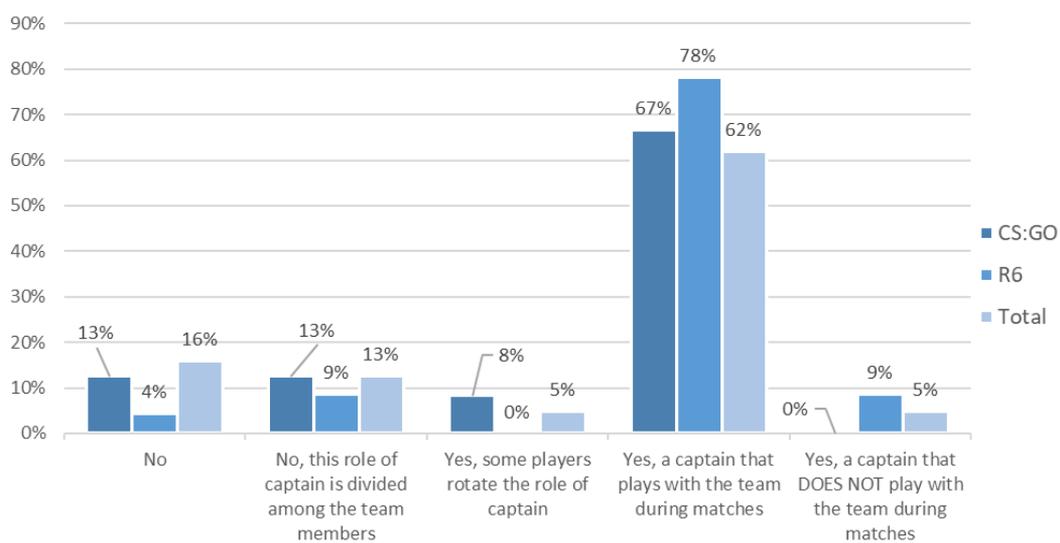


Figure 2. Answers to question 13 — “Is there a captain in your team (someone that leads the team during a match)?” — categorized by game.

Upon comparing professionals with amateurs, we realized that in the first group, nobody said that the role of the captain is divided among the players; whereas 16% of the amateurs said that this happens. Among the professionals, 17% said that there is a captain who does not play with the team, especially those who play R6, which may indicate a pattern in this group, considering that two out of the three respondents said that a captain is a person who is not part of the team. Among the amateurs, just one person gave this reply. Meanwhile, all the CS:GO professionals said that the captain is one of the players on the team. Therefore, we can conclude that there is a difference between the professional and amateur eSport teams with respect to the role of the captain, given that the professionals do not divide this role among the players in the team. Another conclusion is that professional R6 teams differ from the amateurs and CS:GO professionals because the role of captain tends to be given to a person who is not a player.

Concerning what is expected from the person who assumes the role of captain during a match, the analysis of the answers allows us to infer that the captains of the CS:GO and R6 teams must remain calm, define the tactics, and morally support and motivate the team.

Coach

When asked about the existence of a coach, the replies indicated no relevant differences when comparing the games. The only interesting facts are that in CS:GO teams there is more likely to be a coach and it is less likely that the coach plays with the team. On the other hand, there were some relevant differences when comparing professional and amateur players. As can be seen in Figure 3, 91% of professionals said that the role of coach exists, and 55% claimed that the coach is not one of the team's players. Among the amateurs, 60% said that the role of a coach either does not exist or is divided between the players — no professional gave the latter answer. The responses tell us that, in general, the professional teams have a coach — a trend that is not surprising, given the competitive nature of the industry and the financial interests vested in the victory of these teams. However, the role of the coach is uncommon among amateurs, who rarely have a coach who is not part of the team.

During a match, it is expected that a coach of a CS:GO team will provide tactical support with his knowledge, review the team’s mistakes, and help the team members with issues not related to the game itself. In R6 teams, the coach must study the adversary and the maps to formulate strategies for the team. In both games, the coach also has to perform some activities — such as motivating and leading the team — that are similar to the role of a captain.

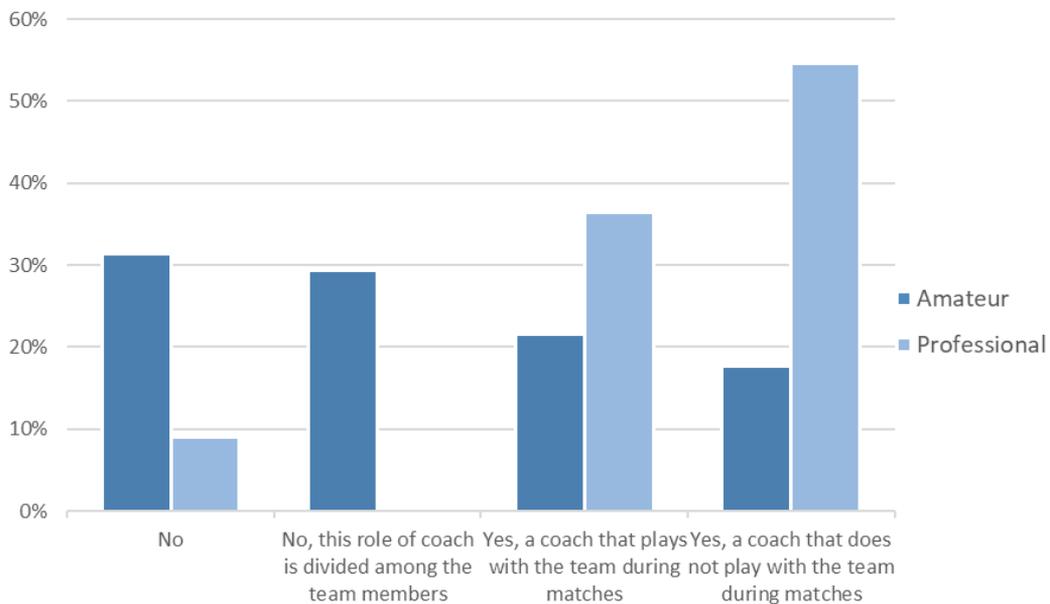


Figure 3. Answers to question 15 — “Does your team have a coach?” — categorized by player class

Manager

The results of the field research showed that the existence of a manager is much more common among professionals (69%) than among amateurs (37%). Comparing the games, we could see that 71% of the respondents who play CS:GO said that this role does not exist in their teams; while 56% of the R6 players said that someone has the role of manager, but the manager is usually (39% of the replies) not one of the players.

eSport players expect that during the matches, the manager will, if needed, give some support in matters unrelated to the game itself. The manager is more active outside the matches, mainly taking care of issues related to sponsors, registration in championships, and team marketing.

Player roles and role rotation

As seen in Figure 4, R6 and CS:GO teams usually have a different number of roles. The CS:GO teams have more roles than the R6 teams — five roles was the most common (52%) for CS:GO teams; while for the R6 teams, three roles (also 52%) was most common.

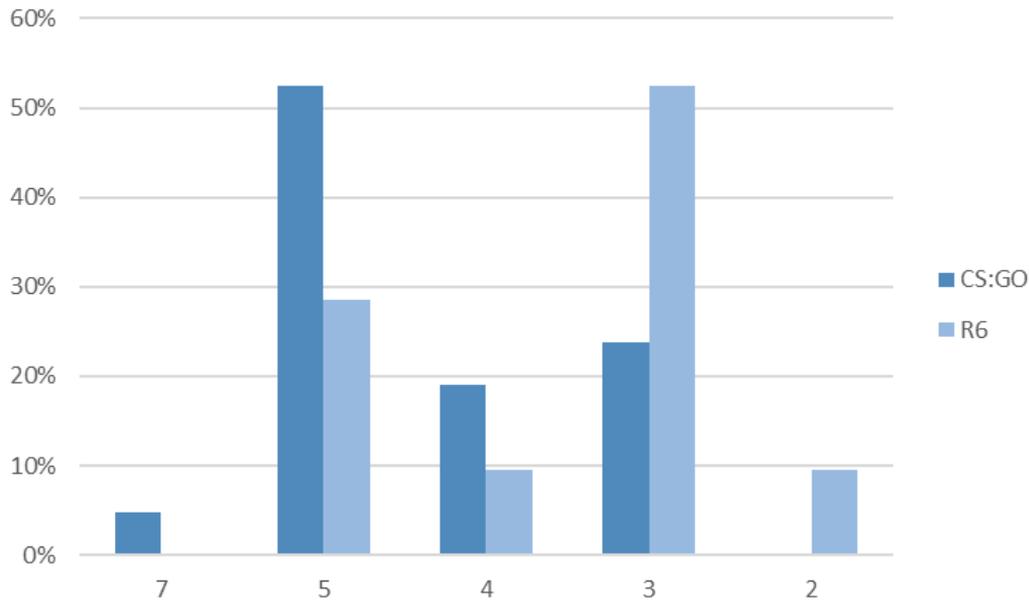


Figure 4. Number of roles in a team, categorized by game.

Among the CS:GO players, the most frequent role was Entry Fragger, which was cited by 100% of the respondents, followed by Support (95%), and AWPER (or Sniper) with 77%. Meanwhile, the roles that R6 players cited most were Support (100%), Entry Fragger (67%), and Intermediary (62%).

Role rotation is a common practice among the eSport players who answered our questionnaire — 82% said that they have changed roles at some time in the past. For the R6 players, in 50% of the cases, these changes happen between championships, with change during a championship (13%) or a match (23%) being less frequent. On the other hand, in the CS:GO group of respondents, role rotation is more common during a match (50%) than between championships (23%). Considering the professionals of these games, we can see that the trends are very different — for the R6 players, only one interviewee said that role rotation happens between matches, while the other two said that it does not happen at all; however, of the five CS:GO professionals, three said that role rotation happens during matches in progress.

Communication

In this section, we will analyze how eSport teams communicate. Among the means of communication, the use of voice chat is universal, followed by the use of in-game visuals, text, real-world visuals, and videos, as shown in Figure 5. When comparing professionals and amateurs, we can see that professionals do not use real-world visual communication in matches, and this is also uncommon among amateurs. Upon analyzing Figure 5, we can see that R6 players tend to use the most number of different types of communication within their teams.

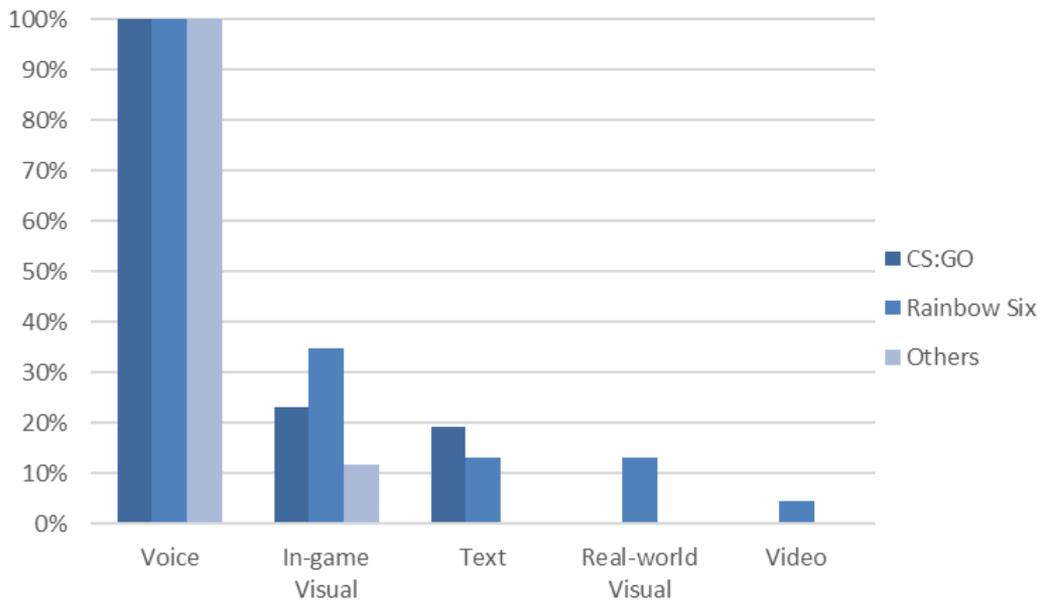


Figure 5. Type of communication used by interviewees, categorized by game.

We can see something relevant when analyzing the tools used to support voice chats: professionals use only one tool. On the other hand, 34% of amateurs use more than one chat tool. Another observation we can make is that — as shown in Figure 6 — the choice of communication tool appears to be segmented according to the game. CS:GO has a higher number of users of Teamspeak than the mean values for the other games. Nevertheless, Discord is especially popular among players grouped in the “Others” category, and Party is a tool commonly used by R6 players.

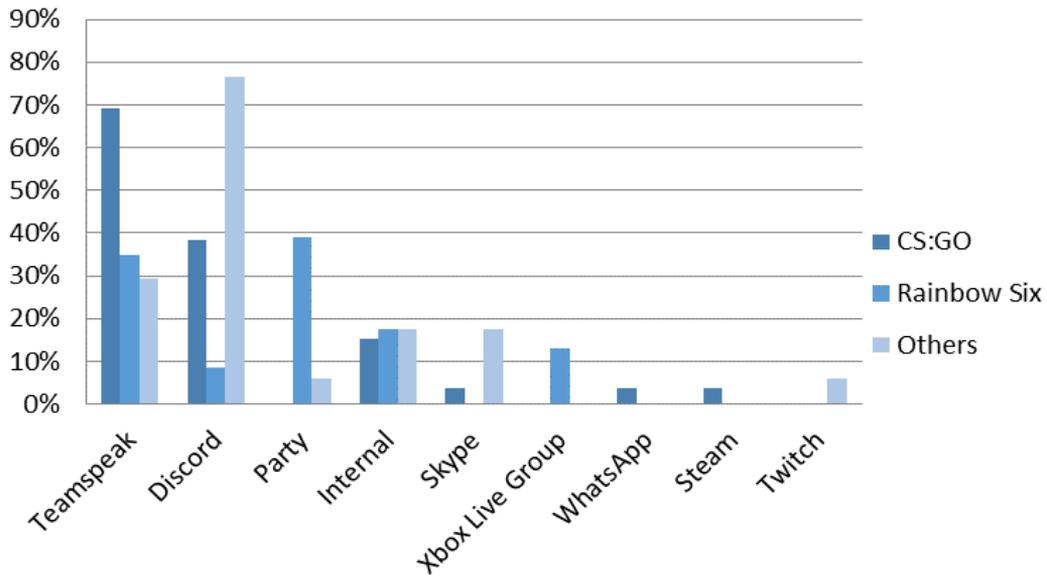


Figure 6. Tools used by interviewees to support voice communication, categorized by game.

Before and after-match activities

Here we analyze the activities that teams do before and after matches. For the activities done before matches, we have the following classification:

- Warm-up training: training with a focus on preparing the players for the upcoming match;
- Reviewing strategies/tactics: discussing the techniques that will be used and the responsibilities given to the players;
- Adversary focus: discussing how the opposing team plays and determining strategies to overcome its playing style;
- Generic chat: “small talk” among team members;
- Concentration: the team just seeks to focus its attention and energy on the forthcoming match;
- Watching matches: the team watches some matches of the opponent together.

Analyzing the data collected, which is shown in Figure 7, we can highlight that professional players tend to review strategies/tactics and focus on studying the adversary more than amateurs do. When comparing the games, it can be seen that warm-up training is more common among R6 players (more than 50%) than CS:GO (less than 30%).

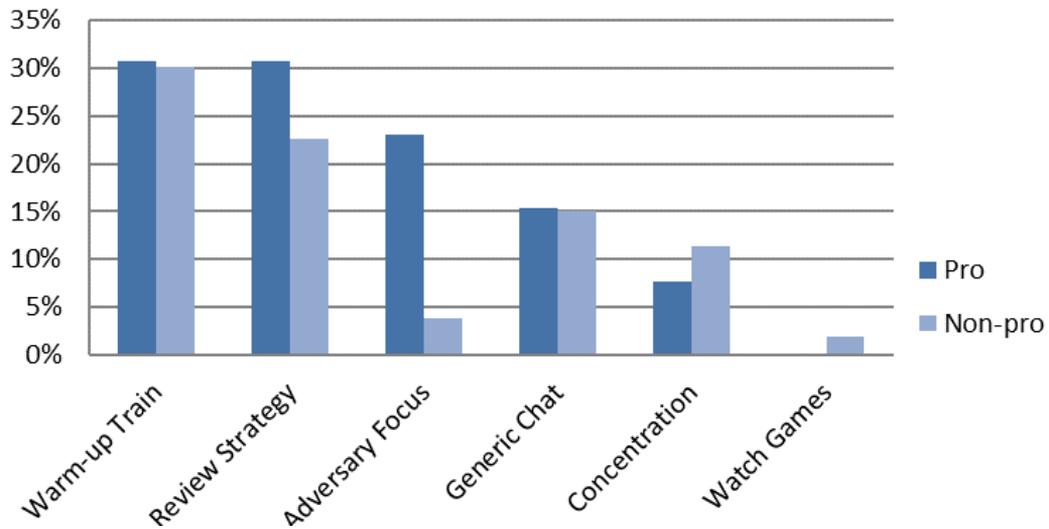


Figure 7. Activities performed before the game, categorized by player class.

Considering the activities performed after the match, the answers were categorized as follows:

- Post-match review/chat: critical analysis of the match played, with the aim of identifying and correcting errors;
- Relaxation: moment dedicated to relaxation;
- Training: playing other matches (ranked or not) in order to improve skills in a given game
- General chat: “small talk” among team members.

Upon examining the activities performed after the match (Figure 8), we can see that the most common activity among professionals and amateurs alike is the post-game review/chat. One relevant difference between these two groups is that relaxing after a match is more common for amateurs (37%) than professionals (15%). Upon comparing the different games, we can see that 30% of R6 players train after matches, something which is uncommon for the CS:GO players (less than 5%) and “Others” (10%).

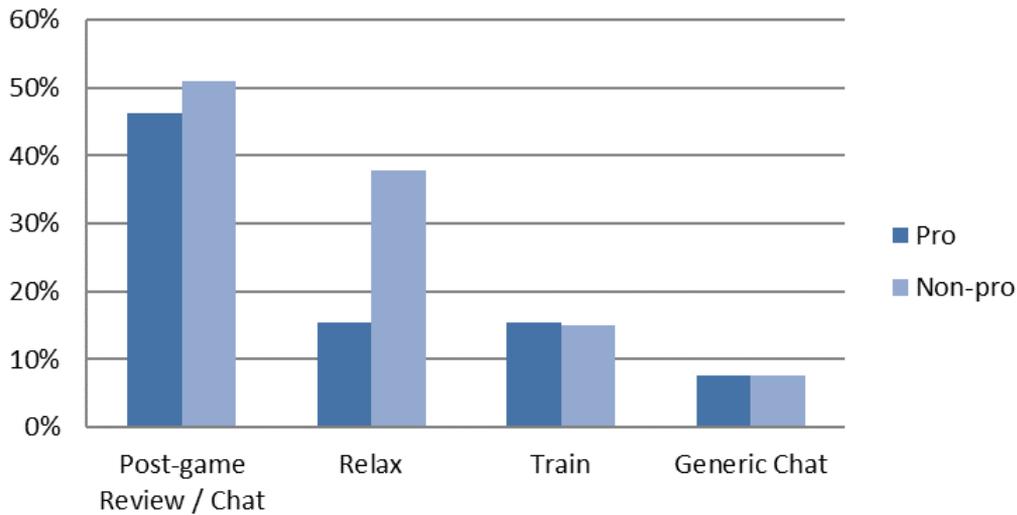


Figure 8. Activities performed after a match, categorized by player class.

Collaboration and competition

This section will present the analysis of the answers given by the players about how collaboration and competition occur in their teams. Firstly, we will present the results of the comparison of the answers regarding collaboration, followed by the analysis of the competition within the teams.

Collaboration

The analysis of the answers to question number 25 — about collaboration during matches — was based on the main keywords that players used to describe the collaboration situations. Most of the respondents (55%) described collaboration as being tasks that are part of their work helping teammates, and they discussed examples in which collaboration occurs in their teams, using game terminology such as “throwing bombs”, “killing enemies”, “giving help to jump”, and “covering someone”. One example is described by P20 (male, 15, professional): “[I collaborate] when I have to destroy an enemy gadget with a shock drone or incapacitate a colleague so that he can come back with more HP (Health Points)”.

Some players (19%) answered the question by speaking more broadly about collaboration as the importance of teamwork, the creation of strategies, and rehearsed plays, as commented by P34 (male, 29, professional): “I have to help my partners to take others out of position”.

When compared with amateurs, professionals emphasized the importance of training that helps in the development of individual and collective strategy — especially attempts to improve tactics in order to improve collaboration, as stated by P8 (male, 26, professional): “I help the captain at certain moments so that we can finish the match with the right strategy”. Additionally, when talking about

collaboration, professionals mention the importance of the gathering and transfer of information regarding what happens in the game, in order to always keep their teams up to date.

Competition

When asked if there is competition within their own team, 42% of all the respondents said that it exists — 62% of the professional players, but only 38% of the amateurs. Thus, there is a huge difference between the perception of professionals and amateurs when talking about competition.

In the explanations of the reasons for internal competition, 41% of players said that it is for recognition (e.g., being chosen as the most valuable player — MVP), 17% said it is just for the fun of competing, and 14% stated egotistical reasons — see Figure 9. One of the main differences observed between amateurs and professionals was that egotistical reasons are more common among professionals (25%) than amateurs (10%). Additionally, reasons for competing — such as discomfort with the team, motivation, and disputes between starters and substitutes — only appeared in the amateurs’ answers. The comparison between the different games did not show relevant differences.

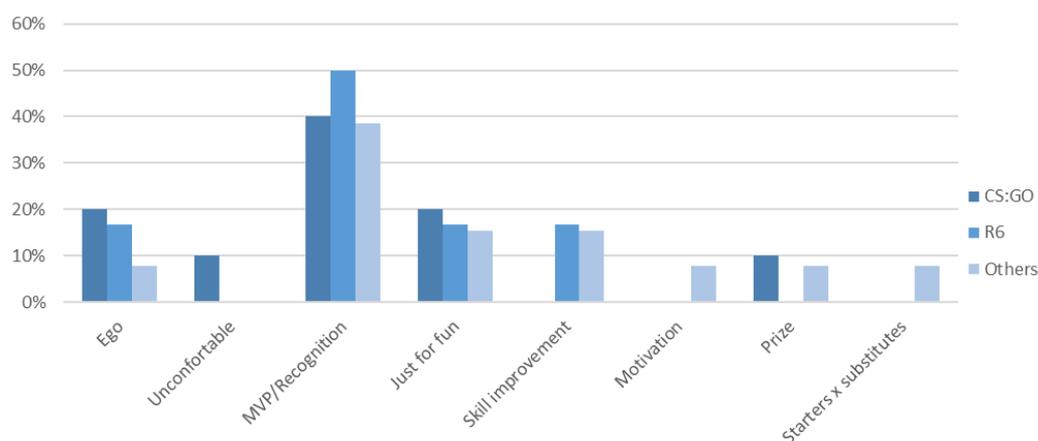


Figure 9. Players' reasons for competing, categorized by game.

Discussion

Having presented the analysis of the results of the field research, we will now conduct a preliminary discussion about the main topics that are relevant for the CSCW field, focusing on the research questions previously introduced. We concentrate our analysis on the two games with the most responses to our questionnaire (CS:GO and R6). Besides, we were able to reach professional players of these two games to give some of their insights about the results of our study, further improving our discussion.

Coordination

The fact that eSport teams — especially those that play action games — can be considered to be a mix of action and knowledge-intensive teams — as argued by (Freeman and Wohn 2017b), lets us compare eSports with other types of collaborative work — such as trading, transit control, and shipping navigation — previously explored by CSCW literature (Cheung et al. 2012).

As we explored action games in this study, it was clear to see how eSport teams can be considered to be action-oriented, as classified by (DeChurch and Mesmer-Magnus 2010). Both of the games are first-person shooters (FPSs), which means that players see the virtual world through the eyes of their avatars, making immersion in the action bigger than third-person shooter (TPS) games. Additionally, both games allow players to customize their avatars and weapons, further improving the usual identification of players with their virtual representations (Livingston et al. 2014). These factors give players such an immersion in the action as well as identification with their virtual selves that we can speak of eSport teams playing action games as virtual action teams.

When discussing the vertical specialization of work; that is, the separation of the execution of work from its administration (Mintzberg 1989), our results showed that the captain and the coach are the roles that the players expect the most from during matches; whereas managers' responsibilities involve helping the team before and after matches with matters such as registration, marketing, and public relations. Therefore, managers are not as important as the captain and coach during the actual competition. The role of captain exists in different ways — a player who performs this role was the most common in our findings, and it is expected that the person who has this role will define the tactics to be used by the team. This could be due to the fast-moving environment of eSports, which provides less opportunity for players to communicate and consider everyone's opinion (Kim et al. 2017).

The other type of work specialization — horizontal specialization or the division of parallel activities (Mintzberg 1989) — was also explored in our fieldwork. In order to discuss the results, it is necessary to understand what roles are available in the action games explored in our research. Despite being action games, CS:GO and R6 have several differences; therefore, we sought a professional player of each game (who had responded to our questionnaire) to help us understand these games, and we also consulted the fan-created wikis for each game.^{2,3} CS:GO is an FPS featuring an armed confrontation between teams of terrorists and counter-terrorists. R6 is a tactical FPS that involves armed close combat between two teams of counter-terrorist groups. Due to these differences in

² http://counterstrike.wikia.com/wiki/Counter-Strike:_Global_Offensive — Accessed on January 5th 2018

³ http://rainbowsix.wikia.com/wiki/Tom_Clancy%27s_Rainbow_Six_Siege — Accessed on January 4th 2018

the goal of the game, CS:GO and R6 teams have different roles. Even roles that have the same name in both games (e.g., *Support* and *Entry Fragger*) are essentially different. To give an overall understanding of the variety of roles that may exist in an action game, we will describe the roles in CS:GO that were most cited by interviewees. An *Entry Fragger* is the first combatant that seeks information behind enemy lines and tends to be the one with the most kills. The *Support*, as the name implies, is expected to give some support to *Entry Fraggers* by playing more defensively. An *AWPer* or *Sniper* is a player who has a powerful weapon (that can kill with only one shot) and can help both defensively and offensively.

Most players have changed roles at one time or another in the past, which could be a factor in improving the collective intelligence of a team (Kim et al. 2017) since this gives players a better understanding of everyone's responsibilities during a match. This rotation of roles or tasks is a normal business practice that provides several benefits to employees; for example, enhanced career development (Campion et al. 1994) and increased versatility (Eriksson and Ortega 2006).

Communication

As seen in the analysis of the results, players tend to use different methods to communicate with their teammates. One of these methods is non-verbal communication (cited by 25% of the players), which means that it is a relevant communication method. Thus, as previously shown by (Leavitt et al. 2016) in LoL (a strategy game), the importance of in-game visual communication was confirmed by our study of action games, and we inferred that this type of communication is important for eSports in general, and the way that it is employed by teams should be further evaluated. We believe that the use of non-verbal communication is even more common than reported by the interviewees because it is common knowledge in the CSCW literature that actions can be a substitute for verbal communications in shared visual space (Gergle et al. 2004). However, players have difficulties in externalizing the use of this communication method, because it is deeply rooted in their tacit knowledge and work practices.

As stated by (Cheung et al. 2012), non-verbal communication is even more important in fast-paced collaborative games like FPSs (i.e., the games we analyzed). The quick and ad-hoc decision making of action games demands that players find ways to communicate faster than verbal communication (either voice or text), just like or even more so than for strategy games.

As (Leavitt et al. 2016) showed, non-verbal communication methods improve the situational awareness of teams but can also interrupt a player's flow, disrupt their focus, or overload their attention. The fact that only 15% of professionals cited in-game visuals as a communication method might indicate that these more experienced and serious players understand the negative effects related to the use

of these methods and prefer to use verbal communication in order to avoid this issue during matches. Moreover, professionals tend to know better how they must act within a team, as (Mason and Clauzet 2013) argue, which makes them less dependent on communication in general.

Competition

The fact that players who are part of a given eSport team have to collaborate within a game, makes competition natural — gamification (even more so for games that depend on cooperative-competitive features) tends to cause competition even in environments in which it is undesirable (Morschheuser et al. 2017). Also, given that eSports are similar to traditional sports in several aspects, including their competitive nature (Jenny et al. 2017), it is expected — and our field research shows this — that there should be competition among players in the same team, because they want to be the MVP (same term as used in traditional sports). In a still growing market, particularly in Brazil, being the MVP allows players to be noticed by scouts and hired by bigger and better-paying teams.

As question number 35 of our questionnaire allowed respondents to leave their contact information if they so desired, in order to further improve our understanding of the competition within eSport teams, we decided to contact two of the respondents: one CS:GO player and one R6 player, but both professional players. The results of the questionnaire indicated the existence of a competitive climate inside the teams, whether amateur or professional. This can be explained by a desire to be the best and to improve oneself, which is one of the main goals of any athlete. When compared with amateurs, the professionals indicated competition as a need to guarantee their salary and acquire other sources of income (such as sponsorships), ultimately allowing them to dedicate themselves entirely to eSports as a job. As explained by the professional CS:GO player:

eSports is an intrinsically competitive modality — competition is part of success. The goal of a team is to win collectively. However, the goal of each athlete is to be the best individually, rising up the MVP list.

Thus, in eSports we can see a mix of conditioned cooperation and unconditioned cooperation (as defined by (Lameiras et al. 2014)) as, even if the desire to achieve high individual performance exists, eSport players need to understand the importance of collective work, which is impossible if the players do not help their teammates in the execution of their activities as well as fulfilling their own roles. As explained by the professional R6 player contacted:

For a team to win, players must be able to collaborate among themselves, balancing the aspects of cooperation and individual competition. It could be a tough day for the ‘star’ of the team... so what? The team cannot let its level drop,

and the game is too dynamic, everything happens quickly, so players must be quick on their feet. Not only speed of reaction, but an understanding of the game is also needed.

Final Remarks

In this exploratory work, we set out to answer three research questions, which are repeated here for convenience:

- RQ1 — How is work coordinated in eSport teams?
- RQ2 — How do players communicate during matches?
- RQ3 — Are there conflicting interests during the matches that make players in the same team compete against each other?

Regarding the first question, our results focused on the division of work in the eSport teams. We were able to understand what the main roles are, and what is expected of each one of them during matches, which lets us see how two different action games can be in terms of coordination. The second question involved the exploration of the main methods and tools used by the players on a given team to communicate during matches. Our research showed the importance of verbal communication followed by in-game mechanics. In relation to the third question, we were able to confirm the existence of competition between players within the same team, which is usually motivated by an interest to be recognized as the best player (MVP), and to improve oneself — something natural among athletes in general.

Our research also indicated some improvements for the design of games played in eSport competitions; for example: giving players more options to use non-verbal communication, while considering the distraction that this method may cause; and looking at how coordination is undertaken in real-world action teams in order to use this knowledge for game mechanics. As games — which were initially seen as essentially entertaining artifacts — are increasingly used for collaborative and competitive work, areas such as HCI and CSCW need to develop more research to support the design of eSport games, and we believe that our research is one of many small steps in this direction.

This study, which is part of ongoing research, certainly has some limitations. The time period for the data collection was short, yielding only about 80 fully answered questionnaires, thus reducing the robustness of our analysis. We interviewed some of the respondents personally to improve our discussion of the results, but due to time constraints, we were unable to fully process the results of this step, leaving it partly out of the text for this study.

Future work

This study is being expanded by personally interviewing people who perform the other roles mentioned in the course of the work: players, coaches, captains, and managers of professional eSport teams. Another method that we plan to use is the observation of teams' coordination, communication, and competition during the championships. We want to discover how the people with different roles within these teams perceive their own role, how they see other people's responsibilities, and how they develop strategies to coordinate the moments before, during, and after championship matches. Furthermore, we want to improve our comparison of the different games (CS:GO and R6) with the help of these methods.

The questionnaire developed for this article is still online, and we are receiving more answers that will allow us to update our analysis in the future.

Some of the questions raised by this article are also interesting for further exploration:

- (1) To what extent does competition within eSport teams affect team performance? What factors increase competition and how do players, captains, and managers control them?
- (2) How are eSport teams' coordination and communication capacities affected by the decisions taken during the formation of the teams?
- (3) What collaborative necessities of eSport teams' players are not considered in the design of eSports' games? How do players adapt to the lack of such features?

Acknowledgments

We would like to thank all the players who answered the questionnaire. In particular, the eSport professionals who helped in the understanding of eSports — Alexandre Marinho and Lucas "Marduk" Rapinelli — and those who helped in the evaluation and divulgation of the questionnaire — Samuel "Sagaz" Byron, Willian "LuL4" Elias, Daniel "Danzera" Azevedo, Guilherme Barbosa, Diego Hads, Luigi Mataratzis, Ariane Parra, and Nicolle "Cherrygumms" Merhy. We would also like to thank CAPES for its financial support of this work.

References

- Academy, U.S.S. 2017, May 11. Recognizing ESports as a Sport. Available from <http://thesportjournal.org/article/recognizing-esports-as-a-sport/> [accessed 16 January 2018].
- Beck, K. 2017a. Disney brings esports to TV in a major move. Available from <http://mashable.com/2017/07/14/disney-esports/#Mfrb1nYoJPqm> [accessed 5 January 2018].
- Beck, K. 2017b. NBC Sports is getting into esports, starting with "Rocket League." Available from <http://mashable.com/2017/06/21/rocket-league-nbc-television/#QeWWhoJT1qOqa> [accessed 5 January 2018].

- Brown, B., and Bell, M. 2004. CSCW at Play: “There” As a Collaborative Virtual Environment. *In Proceedings of the 2004 ACM Conference on Computer Supported Cooperative Work*. ACM, New York, NY, USA. pp. 350–359. doi:10.1145/1031607.1031666.
- Bullock, P. 2017, July 1. The Future of eSports on TV. Available from <https://medium.com/the-cube/the-future-of-esports-on-tv-b2d1e77c58cc> [accessed 5 January 2018].
- Campion, M.A., Cheraskin, L., and Stevens, M.J. 1994. CAREER-RELATED ANTECEDENTS AND OUTCOMES OF JOB ROTATION. *Academy of Management Journal* **37**(6): 1518–1542. doi:10.2307/256797.
- Cheung, V., Chang, Y.-L.B., and Scott, S.D. 2012. Communication channels and awareness cues in collocated collaborative time-critical gaming. *In Proceedings of the ACM 2012 conference on Computer Supported Cooperative Work*. ACM. pp. 569–578.
- Dafai, S.A. 2016. Conventions within eSports: Exploring Similarities in Design. : 16.
- DeChurch, L.A., and Mesmer-Magnus, J.R. 2010. Measuring shared team mental models: A meta-analysis. *Group Dynamics: Theory, Research, and Practice* **14**(1): 1–14. doi:10.1037/a0017455.
- Endsley, M.R. 1995. Toward a theory of situation awareness in dynamic systems. *Human factors* **37**(1): 32–64.
- Eriksson, T., and Ortega, J. 2006. The adoption of job rotation: Testing the theories. *ILR Review* **59**(4): 653–666.
- Freeman, G., and Wohn, D.Y. 2017a. eSports As An Emerging Research Context at CHI: Diverse Perspectives on Definitions. *In Proceedings of the 2017 CHI Conference Extended Abstracts on Human Factors in Computing Systems*. ACM, New York, NY, USA. pp. 1601–1608. doi:10.1145/3027063.3053158.
- Freeman, G., and Wohn, D.Y. 2017b. Understanding eSports Team Formation and Coordination. *Computer Supported Cooperative Work (CSCW)*. doi:10.1007/s10606-017-9299-4.
- Fuks, H., Raposo, A., and Gerosa, M.A. 2008a. The 3c collaboration model. *In Encyclopedia of E-collaboration*. IGI Global. pp. 637–644.
- Fuks, H., Raposo, A., Gerosa, M.A., Pimentel, M., Filippo, D., and Lucena, C. 2008b. Inter-and intra-relationships between communication coordination and cooperation in the scope of the 3C Collaboration Model. *In Computer Supported Cooperative Work in Design, 2008. CSCWD 2008. 12th International Conference on*. IEEE. pp. 148–153.
- Funk, D.C., Pizzo, A.D., and Baker, B.J. 2017. eSport management: Embracing eSport education and research opportunities. *Sport Management Review*. doi:10.1016/j.smr.2017.07.008.
- Gergle, D., Kraut, R.E., and Fussell, S.R. 2004. Action as language in a shared visual space. *In Proceedings of the 2004 ACM conference on Computer supported cooperative work*. ACM. pp. 487–496.
- Good, O.S. 2017, October 29. Olympic committee lays out expectations for esports’ inclusion. Available from <https://www.polygon.com/2017/10/29/16566528/olympics-ioc-statement-esports> [accessed 5 January 2018].
- Graham, B.A. 2017, August 9. eSports could be medal event at 2024 Olympics, Paris bid team says. *The Guardian*. Available from <http://www.theguardian.com/sport/2017/aug/09/esports-2024-olympics-medal-event-paris-bid-committee> [accessed 5 January 2018].
- Hallmann, K., and Giel, T. 2017. eSports – Competitive sports or recreational activity? *Sport Management Review*. doi:10.1016/j.smr.2017.07.011.
- Hamari, J., and Sjöblom, M. 2017. What is eSports and why do people watch it? *Internet Research* **27**(2): 211–232. doi:10.1108/IntR-04-2016-0085.
- Hamilton, W., Kerne, A., and Moeller, J. 2012a. Pen-in-hand Command: NUI for Real-time Strategy Esports. *In CHI ’12 Extended Abstracts on Human Factors in Computing Systems*. ACM, New York, NY, USA. pp. 1455–1456. doi:10.1145/2212776.2212483.
- Hamilton, W., Kerne, A., and Robbins, T. 2012b. High-performance Pen + Touch Modality Interactions: A Real-time Strategy Game eSports Context. *In Proceedings of the 25th*

- Annual ACM Symposium on User Interface Software and Technology. ACM, New York, NY, USA. pp. 309–318. doi:10.1145/2380116.2380156.
- Heere, B. 2017. Embracing the sportification of society: Defining e-sports through a polymorphic view on sport. *Sport Management Review*. doi:10.1016/j.smr.2017.07.002.
- Ikenami, R.K., Lipovaya, V., Sigette, E., Silva, E., and Duarte, F. 2018. The Ecosystem Approach as an Alternative to Navigate Across Innovation Environment. *In Strategizing New Growth Avenues in an Evolving Global Context*. São Paulo, Brazil.
- Jenny, S.E., Manning, R.D., Keiper, M.C., and Olrich, T.W. 2017. Virtual(ly) Athletes: Where eSports Fit within the Definition of “Sport.” *Quest* **69**(1): 1–18. doi:10.1080/00336297.2016.1144517.
- Kaytoue, M., Silva, A., Cerf, L., Meira, W., Jr., and Raïssi, C. 2012. Watch Me Playing, I Am a Professional: A First Study on Video Game Live Streaming. *In Proceedings of the 21st International Conference on World Wide Web*. ACM, New York, NY, USA. pp. 1181–1188. doi:10.1145/2187980.2188259.
- Kim, Y.J., Engel, D., Woolley, A.W., Lin, J.Y.-T., McArthur, N., and Malone, T.W. 2017. What Makes a Strong Team?: Using Collective Intelligence to Predict Team Performance in League of Legends. ACM Press. pp. 2316–2329. doi:10.1145/2998181.2998185.
- Kow, Y.M., and Young, T. 2013. Media Technologies and Learning in the Starcraft Esport Community. *In Proceedings of the 2013 Conference on Computer Supported Cooperative Work*. ACM, New York, NY, USA. pp. 387–398. doi:10.1145/2441776.2441821.
- Kozachuk, J., Foroughi, C.K., and Freeman, G. 2016. Exploring Electronic Sports: An Interdisciplinary Approach. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* **60**(1): 2118–2122. doi:10.1177/1541931213601479.
- Lameiras, J., Almeida, P.L., and Garcia-Mas, A. 2014. Relationships between Cooperation and Goal Orientation among Male Professional and Semi-Professional Team Athletes. *Perceptual and Motor Skills* **119**(3): 851–860. doi:10.2466/25.PMS.119c32z4.
- Leavitt, A., Keegan, B.C., and Clark, J. 2016. Ping to Win?: Non-Verbal Communication and Team Performance in Competitive Online Multiplayer Games. ACM Press. pp. 4337–4350. doi:10.1145/2858036.2858132.
- Lipovaya, V., Ikenami, R.K., Rodrigues, G.M.S.M., and Duarte, F. 2017. Ecosystemas Inovadores eSports: o caso da empresa SUPERNOVA. *In X Congresso de Administração, Sociedade e Inovação (CASI)*. Petrópolis, Brazil.
- Livingston, I.J., Gutwin, C., Mandryk, R.L., and Birk, M. 2014. How players value their characters in world of warcraft. ACM Press. pp. 1333–1343. doi:10.1145/2531602.2531661.
- Mason, W., and Clauset, A. 2013. Friends ftw! friendship and competition in halo: Reach. *In Proceedings of the 2013 conference on Computer supported cooperative work*. ACM. pp. 375–386.
- Maxwell, J. 2009. *The SAGE Handbook of Applied Social Research Methods*. In 2nd edition. SAGE Publications, Inc., Thousand Oaks. doi:10.4135/9781483348858.
- McClelland, P.J., Whitmell, S.J., and Scott, S.D. 2011. Investigating Communication and Social Practices in Real-time Strategy Games: Are In-game Tools Sufficient to Support the Overall Gaming Experience? *In Proceedings of Graphics Interface 2011*. Canadian Human-Computer Communications Society, School of Computer Science, University of Waterloo, Waterloo, Ontario, Canada. pp. 215–222. Available from <http://dl.acm.org/citation.cfm?id=1992917.1992953> [accessed 15 January 2018].
- Mintzberg, H. 1989. The structuring of organizations. *In Readings in Strategic Management*. Springer. pp. 322–352.
- Morschheuser, B., Maedche, A., and Walter, D. 2017. Designing Cooperative Gamification: Conceptualization and Prototypical Implementation. ACM Press. pp. 2410–2421. doi:10.1145/2998181.2998272.
- Newzoo. 2018. Key Resources | Games, Esports, Mobile | Market Size & Projections. Available from <https://newzoo.com/resources/> [accessed 16 January 2018].

- Senado Federal. 2018. Senado analisará regulamentação de esportes eletrônicos. Available from <https://www12.senado.leg.br/noticias/materias/2017/12/26/senado-analisara-regulamentacao-de-esportes-eletronicos> [accessed 16 January 2018].
- Skubida, D. 2016. Can Some Computer Games Be a Sport?: Issues with Legitimization of eSport as a Sporting Activity. *International Journal of Gaming and Computer-Mediated Simulations* 8(4): 38–52. doi:10.4018/IJGCMS.2016100103.
- Taylor, T.L. 2012. *Raising the stakes: e-sports and the professionalization of computer gaming*. MIT Press, Cambridge, Mass.
- Teruel, M.A., Navarro, E., González, P., López-Jaquero, V., and Montero, F. 2016. Applying thematic analysis to define an awareness interpretation for collaborative computer games. *Information and Software Technology* 74: 17–44.
- Toups, Z.O., Hammer, J., Hamilton, W.A., Jarrah, A., Graves, W., and Garretson, O. 2014. A framework for cooperative communication game mechanics from grounded theory. *ACM Press*. pp. 257–266. doi:10.1145/2658537.2658681.
- Wagner, M.G. 2006. On the Scientific Relevance of eSports. *In International Conference on Internet Computing*. pp. 437–442.
- Wilson, P. 1991. *Computer supported cooperative work:: An introduction*. Springer Science & Business Media.

Appendix

Questionnaire

- (1) What is your age?
- (2) What is your sex?
 - a. Male
 - b. Female
- (3) What is the main game that you play?
- (4) How many hours weekly, on average, you play this game?
- (5) Do you work or study besides playing?
 - a. Yes, both
 - b. Yes, I work
 - c. Yes, I Study
 - d. No, eSports is my job
 - e. Other (blank field to fill with answer)
- (6) Is eSports your main source of income?
 - a. Yes
 - b. No
- (7) Do your parents (or someone else) give you any financial support?
 - a. Yes
 - b. No
- (8) What city are you from:
- (9) Are you part of any team?
 - a. Yes
 - b. No

- (10) If you want to, tell us the name of your team (We will not reveal this information, it will only be used to know you better)
- (11) Have you ever participated in any eSports championship with prizes in money?
- Yes
 - No
- (12) Do you consider yourself a professional eSports player?
- Yes
 - No
- (13) Do a captain exist in your team (someone that leads the team during a match)?
- Yes, a captain that plays with the team during matches
 - Yes, a captain that DOES NOT play with the team during matches
 - Yes, some players rotate the role of captain
 - No, this role of coach is divided among the team members
 - No
 - Other (blank field to fill with answer)
- (14) If this role of captain exists, what do you expect of him moments before and during a match?
- (15) Does your team have a coach?
- Yes, a coach that plays with the team during matches
 - Yes, a coach that DOES NOT play with the team during matches
 - No, this role of coach is divided among the team members
 - No
 - Other (blank field to fill with answer)
- (16) If this role of coach exists, what do you expect of him moments before and during a match?
- (17) Does your team have a manager that makes strategic decisions as which championships to compete, which marketing strategies to adopt, etc.?
- Yes, we have a manager that plays with the team
 - Yes, we have a manager that DOES NOT play with the team
 - No
- (18) If your team has a manager, what do you expect of him moments before and during a match?
- (19) Into what roles is your team divided during matches (e.g., in LoL there are shooters, assassins, tanks, fighters and supports)?
- (20) And which of these roles is yours?
- (21) Is there any rotation of these roles among players?
- Yes, we have already changed of role in our team between championships
 - Yes, we have already changed of role in our team during a championship

- c. Yes, we have already changed of role in our team during a match
 - d. No, we never changed roles
- (22) What communication means does your team use during a match?
- a. Voice
 - b. Video
 - c. Text
 - d. In-game visuals (e.g., ping, crouching our jumping with the avatar/character, etc.)
 - e. Real-world visuals (e.g., signals, touches, etc.)
 - f. Other (blank field to fill with answer)
- (23) If you chose more than one, which is one does your team uses the most?
- (24) Which tool(s) do you use to communicate during a match (e.g., Teamspeak, Discord, in-game mechanics, etc.)? Please, cite all of them, even if you do not use too much
- (25) Tell us a bit about one or more situations in which you have to collaborate with someone of your team during a match (e.g., to destroy a structure, I usually tell the shooter of my team to help me attacking while I keep the distance with my mage)
- (26) Before starting a championship match, what does your team use to do? Do you make some kind of concentration? How does it happen?
- (27) What about after the match, what does your team do?
- (28) Is there competition among the players of your own team?
- a. Yes
 - b. No
- (29) If this competition does exist, why does it happen? What motivates a player to seek a personal goal instead of a team goal? Tell us about some cases in which this competition occurs
- (30) Do you think that is there any important question that we should have asked you about this topic? Which one would it be? How would you answer that question?
- (31) Thanks for answering the questionnaire, leave any of your contact (e-mail, phone number, Facebook, Reddit, etc.) so that we can invite you to new research and share with you the material that our group produces about eSports! We will not fill your inbox with spam; we also do not like that.