The Feasibility of Using Multimodal Analysis in the Playtesting of Video Games

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Contents Page

Attestation of Authorship

I hereby declared this thesis that I submitted is my own work and to the best of my understanding, knowledge, and capability. This thesis contains no material that has been published or written by other person, no written materials that have been accepted or submitted for any award, degree, diploma of other universities of other institutions of higher learning.

Zhaocong Chen

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List of the Figures

List of Table

List of Audio Transcription

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Abstract

This thesis has researched the feasibility of implementing the Multimodal Interaction Analysis method in the context of video game playtesting. Playtesting is a process that aims to test the design elements, content, and play experience delivered through the video game to the player to refine and improve the video game. Traditional playtesting often includes large scale experiments that combine quantitative and qualitative research for the player and require large numbers of participants and often relies on memory of events that occur during gameplay. The thesis proposes that Multimodal Interaction Analysis has the potential to enhance traditional approaches to playtesting that has not yet been explored.

This research uses multimodal analysis to examine the video game's designed mechanics, designed elements, and higher-level actions that the player conducted by analyzing specific video games' playing footage and clips. Two games have been selected as research objects, which are CS: GO and PUBG, and a total of seven playing clips of these two games, have also been selected for multimodal analysis. Based on the result of multimodal analysis, both games' mechanics and elements that consisted of the whole playing feature of the game, and factors that might lead to worse player experience have been successfully located.

This research has shown that multimodal analysis could be applied as a method during playtesting to locate the factors that impact the player experience for specific games, such as PUBG and CS: GO.

1 Introduction

This thesis is focused on exploring how gameplay in video games is related to game features and design in the context of current popular design frameworks, and specifically addresses the features and basic operating processes of mainstream playtesting methods and their utility, application, and limitations. Then the thesis considers the feasibility and value of applying Multimodal Interaction Analysis as a playtesting method, in order to address some of the limitations of mainstream playtesting methods, and as a result potentially refine and improve the whole framework system of game development and design.

1.1 Background and Motivation

Play is a fundamental human activity that has long been the subject of research interest. Ashcroft and Jones (2018) go as far as to argue that being human and the playing of games is inextricably linked. Games as a concept have survived, evolved, and adapted throughout history and borne witness as the whole world changes. In the modern era, the core of the idea of a game remains relatively unchanged, which is the purpose of recreation and often frivolous spontaneous actions, however the components, and patterns of manifestation of games has become increasingly diversified and digitalized. Currently, one of the most common form of games would be video games, a type of complex cultural product based on digital hardware that provides a player-centered experience and immersive environment for all participants. As a metaphor, the video game could be considered as a blank canvas or a “room of requirement”[1] that provides the stage for making designers’ ideas come true in a digitized form.

[1] Also known as the Come and Go Room, this was a secret room within Hogwarts Castle in the Harry Potter books, that only appears when a person needs it

Ben Hudson has noted that the video games as an artifact could provide a limited virtual immersion world for the player, but this limit is ruled by the designer and the player's ideas or imaginations (Hudson, 2014). The extent to which this limit impacts the player experience effectively determines the quality of the game. A game with outstanding quality could convey the designer's ideas clearly and provide a high-level immersive process of human-computer interaction, which is engaging in the virtual world by experiencing the game.

The modern video game has a special feature which is the adaptability of the medium. As a result, video games could implement requirements for nearly any player or genre. For example, sports fans could experience immersive football simulation games, novel lovers could experience unique text-adventure games, and plane lovers could enjoy the full flight simulator games. To meet what a player desires and make it come true is at the core of video game development, and the success of the medium has led to a huge variety of games that simulate almost all real-world activities (and more) and provide an immersive virtual world that reflect the designer's imagination. From the perspective of the video game industry, designers and developers are constantly developing new games to keep up with the evolving player's desires, which has caused a series of problems for the developers and designers.

Designers and developers don't truly discover whether the quality of the game and playability has fulfilled the player's requirement unless the game had been rolled out and is being sold in the market. To decrease the risk of financial loss that arises from negative reviews and poor sales, which normally occur if the quality of the game has failed to meet player's expectations, researchers, developers, designer, and practitioners that relevant to game developers have developed a method, which is

playtesting. Generally, playtesting is a method that provides a solution for minimizing the potential conflicts that occur during the process of a player community engaging with the game. These conflicts can be generated at any stage of the game development, the process of converting a designer's ideas and imagination into actual content. Specific designs could be misled into an alternative expression which cannot fulfill the player community's expectation. Playtesting is an iterative process that is intended to minimize those conflicts by detecting them before the game is released. The main purpose of conducting playtesting is therefore to improve the game by providing a better player experience and player community-friendly environment. Currently, most playtesting is based on heuristic evaluation methods such as *Rapidly Identify Common Issues In Game Design and Rapid Iterative Testing and Evaluation* which aims to collect data from the playability, mechanism, and narratives related to a given game (Quinn et al., 2013).

The framework of mainstream playtesting methods is normally based on a specific mixed methodology that combines questionnaires and interviews, with some methods also including the capture of in-game metrics and observations. The researcher and developer would build a questionnaire in order to collect data from the participants of playtesting who play a role as a member of the player community. And the scale of "player community" participants that are involved in playtesting is dependent on the designer's idea and the scope of the game being developed. The procedure of selecting "player community" participants to conduct the playtesting is challenging, the designer needs to guarantee they are all qualified to be the role they need to do during the playtesting because the designer needs to guarantee the validity of the data they collect from articipants. Although conducting these playtesting methods could provide a malleable blueprint that gives potential solutions for improving the game, the complexity of conducting these playtesting methods requires high budgets

and human resources. Especially in terms of ensuring the validity of the data, because most of playtesting are based on questionnaires which require all the participants to have a clear memory when they fill out the questionnaires and during interviews.

The process of developing a game is very long and requires numerous resources in each phase, to decrease the risk that mentions above during the development, lower the complexity or optimize the process of conducting playtesting is essential for each game developer. The player desires a better game, and the designer does as well.

1.2 Research Objectives

Most mainstream playtesting methods require a large-scale research framework, from recruiting experiment participants as members of the player community to verify the validity of data after the experiments. Although each step of the playtesting is essential for refining and developing the games, still, it requires extra time, financial requirements, and qualified human resources. And playtesting itself has also become an essential procedure for game development, no matter what genre of game is being developed. As an iterative test, playtesting could locate the part and detail that may lead to player community dissatisfaction, because playtesting is not a nonrecurring test, it requires multiple iterations where the participants are playing the roles of member of the player community.

Multimodal Interaction Analysis is a method for researching interactions and communication between humans across a range of different modalities, for example voice and gestures. Multimodal Interaction Analysis could be deployed to research of analysis player experience, which is the core intent of

playtesting. The research in this thesis aims to evaluate the feasibility of applying or embedding the Multimodal Interaction Analysis process as a means to refine, simplify and optimize the process of conducting mainstream playtesting methods.

1.3 Thesis Structure

This chapter has discussed the basic background of video games, the framework of video game development, the challenge that designers and players might encounter during the design, playtesting, and interacting as players. It also examines the essentiality of playtesting during the phase of design, the unique features and significance for a game, and introduces currently mainstream playtesting and briefly elaborate its application, limitation, and feasibility of using Multimodal Interaction Analysis methods as optimizing tools.

Chapter 2 goes on to discuss the basic idea of games and game design in general, as well as introduce research relevant to game design frameworks, player experience and how to measure it. Chapter 2 also discusses the literature related to the concept of playtesting and the necessity of conducting it, as well as a general overview of the literature related multimodal communication and interaction, and its actual application to current research and its potential of benefiting the playtesting.

Chapter 3 elaborates on the research objectives from this chapter and discusses the study's purpose in detail. It introduces the research methodology utilized in this study Chapter 4 presents the results of this study, including the process of selecting two specific video games, PUBG and CS: GO. The results of applying Multimodal Interaction Analysis are presented in order to explore the application of this

method on improving mainstream playtesting by analyzing the data from this method. Chapter 5 concludes the thesis with a discussion of the limitations of this study and possible directions for further research. In addition is summarizes the outcomes of this study and makes a final conclusion over the potential usefulness of Multimodal Interaction Analysis in playtesting of games.

2 Literature Review

This chapter introduces the basic concept of games and game design, and reviews the relevant research for measuring player experience, conducting playtesting, and multimodal interaction analysis which can potentially be used to improve the playtesting process in game development.

2.1 Games and Game Design

The most general definition of a game is an activity that provides a recreational function, normally entertainment or fun. Games have a very long history, with many ancient cultures having a history of board games and other activities that classify as games. Roberts Arth and Bush (1959) consider the basic features of games to consist of rules, player, organization, competitions, criteria of winning and losing. If an activity has these basics elements, the activity can be considered a game, irrespective of how the activity is enacted. Roberts, Arth and Bush also suggest that genres of the games could be reflections on different perspectives of the real world. For example, strategy games could be the reflection of real social systems, and physical games could be derived from different living environment conditions (Roberts et al., 1959). Contrary to the idea that games need to be competitive, Johan Huizinga noted that a game could be an activity of no definite intention, that's purpose is purely for providing entertainment (Huizinga, 1949). The competitive element is often used as distinguishing the difference between sports and games, though generally the distinction between sports, games and play is problematic in practice as one plays both games and sports (Suits, 1988).

As society has developed, games have developed as well. The core definition and components of games remain relatively constant, but games have been considered as many things, such as culture,

products, and primal meaningless activities that are only for player's recreational purpose. For example, physical games (or sports) like running marathons have emerged from different cultural and ecology environments. In the beginning, running was considered a basic human function, but this kind of basic human function had become a well-known physical game as cultures developed that glorified physical prowess. Most games require specific objects or actions to fulfill their recreation function, for example, board games, ball games, and video games. These genres of games cannot operate without support from specific tools and actions. Huizinga considers that the primal concept of the game, was a pure spontaneous action, the civilization of humans had never added any essential features to the game (Huizinga, 1949). He also suggested that all features of the game have been shown in animal play, no matter how games have developed and what tools that we need to engage with the game, the basic form of the game is unbreakable. But he also pointed out that games are a significant phenomenon of culture, games are a part of human society.

Games, as a symbolic meaning phenomenon of culture, have become highly prevalent in our world, the game of sport, the game of chance, video games, these forms of games have become a part of human life. Video games are in many ways the most complicated form of games. Video games have some unique features like iconography interactivity and diversity. Iconography represents the "video" of the terminology of video games. Interactivity is the basic element of the games. Diversity is the most unique feature of video games; it can conclude every form and genre of games and transfer them into digital and different forms of interaction. To classify the genres of games, Mark Wolf had set up a list that includes all main streams genres of games, which are Abstract, Adaptation, Adventure, Board game, et cetera. The key factor for classifying a game into a genre is the way that players participate in the game (Wolf, 2001). Not only the games could be digitalized, cultural products like music, movie,

and novel could also become video games. By the idea of terminology of interactivity, developers could develop a playable, interactive pathway between those non-game objects and the players. With the technology of digitalizing and interactivity design, developers can turn everything into video games.

The idea of technology has not only played a core role in the process of turning things into video games but also is the fundamental element of the video games. Tamborini and Bowman noted that the development of hardware has created a deeper and tighter relationship with three special dimensions, which is space, social and self. Modern video games can be realistic virtual environments that allow complex social interaction and virtual cognition (Tamborini & Bowman, 2010). But without the development of technology, early video games did not provide this degree of immersive virtual experience for the player. Even though the essence of modern video game is still the same as early games, being focused on recreation and no definite intention activities, the increased quality of the immersive experience can lead to a higher quality of player experience.

If the core idea of games is to promote recreation function and no definite intention activities, then design could be considered as the external shell of a game. Design is the interface and appearance of the game that allows players to play the game. According to Browne and Maire (2010), game design has two major parts, aesthetic and mechanisms. These authors also suggest that a game system is defined by the rules, play and outcomes (Browne & Maire, 2010). Game design could therefore be considered as the integration of rules and play that leads to an outcome. Rules are part of the mechanisms of a game, and play can be considered the symbolic meaning of integrating the aesthetic and dynamics. The mechanisms of a game determine how players interact with the game, and

aesthetics describe how the player experiences the engagement and interaction with the game. For example, the narrative of a game determines what a player would meet, see, and read when they engage throughout the whole game. Mechanisms, like challenges and rules, determines what actions and interaction that player is allowed to do during the game, and what they need to acheive to win or complete the game. If the level of the game is too difficult for the player, then it would lead to a less interesting experience for the player. If the narrative is too boring, it also leads to a less interesting player experience. Generally, the quality of game design, means the quality of the game, especially to the concept of terminology of player experience, and the concept of player experience would be discussed in section 2.2.

2.1.1 MDA Framework

The term framework is used to describe a mental model that people use to interpret the outside world as a basis for understanding, identifying, and defining their experiences. In a word, framework means a set of mature solutions for specific utility, for example, industries design and game design.

The Mechanics-Dynamics-Aesthetics (MDA) framework (Hunicke et al., 2004) is a common framework that is used by game designers to aid the design of games. According to the MDA framework, a game consists of three aspects, namely the mechanics, dynamics and aesthetics. These three elements are layered in the sense that the player interacts directly with the mechanics of the game, which creates a particular dynamic in the game which determines the aesthetics. Hunicke consider game design as an activity that is diverse and transdisciplinary as it draws upon many different fields, and also argues that the MDA framework, as a comprehensive framework, could be the pathway to

understanding the idea of games and providing a pathway that links design, development, player experience and technology research (Hunicke et al., 2004). The MDA framework is a model that provides methods for understanding games (Kim, 2015). Hunicke et al (2004) argue that a game is a product developed by the developer and consumed by the player. Similar to other products a game is purchased, used, and then discarded. However, unlike many entertainment products, the consumption cycle of games is unpredictable because the events that occur during gameplay and the outcome of those events are unknown at the time the product is finished.

The designer and the player of the game have different perspectives, the player evaluates a game based on how "fun" it is to play, and this determines how long before the player discards the game. The designer starts designing a game based on assembling components in a system that will eventually produce an experience that is fun or may not be. The MDA framework is essentially proposed as a formal bridge between the designer and player perspectives to guide the designer to producing a "fun" experience for the player.

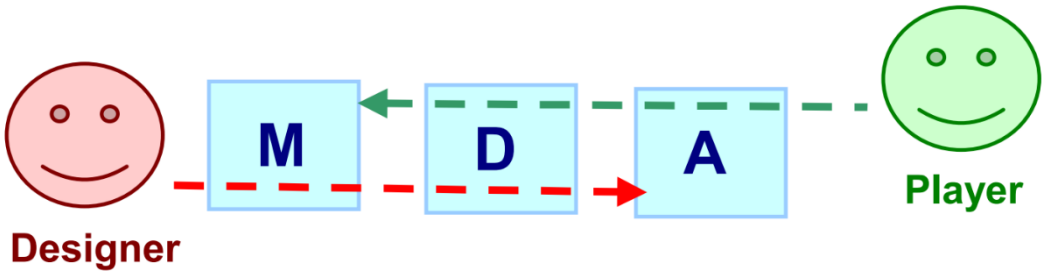

Figure 2-1 Bridging Designer and Player Perspectives (Hunicke, LeBlanc and Zubek, 2004)

Hunicke et al (2004) argue that games are more like artefacts than entertainment media and that the core concept of the game is its behavior rather than the media that is presented to the player.

In the MDA framework, the mechanics, dynamics, and aesthetics are described as:

- Mechanics describes the components of the game, at the level of data representation and algorithms.
- Dynamics describes the run-time behavior of the mechanics acting on player inputs and each other's outputs over time.
- Aesthetics describes the desirable emotional responses evoked in the player when she interacts with the game system.

In practice, game mechanics includes the rules and essential elements like algorithms, data structures and so on. The rules are designed by the game designer, but the functions of the rules are fulfilled by the data and algorithms. A player interacts with the game by following the actual rules, but player cannot engage with the rules, data and algorithms directly, just with the actions, behaviors and control mechanisms afforded to the player in the game that are how the rules are fulfilled. Dynamics is the reason that Hunicke, LeBlanc and Zubek (2004) consider games to be unpredictable and are considered as a process that emerges from the player engaging with the rules and other function provided by the mechanics. When a player is engaging and interacting with the game, even though there are rules grounded in the game, each player, as a unique individual, makes decisions that are different. In a word, dynamics can not only be considered as a process, but it also can be considered as an adjective. Like dynamics, which could be observed from two angles, aesthetic, the last element of MDA framework, also represents two meanings. The first explanation of aesthetics of the games, is the emotions that are generated from the process of a player interacting with the game. The simple version of MDA framework considers fun as a part of the game, but aesthetics includes more than just

fun. Nervous, happy, or angry are emotions that are caused by losing the game, and all emotions are included in the first explanation of aesthetics. The other explanation of aesthetic is things that are provided by the game, for example, narrative of the game, art elements of the game, music of the game, in this level, aesthetic has fulfilled the interface function of the game, and with the combination of game rules from the mechanic parts, these two elements build an actual game.

2.1.2 DDE Framework

The Design-Dynamics-Experience (DDE) framework is a framework that is derived from the MDA framework to address some of its potential shortcomings (Walk 2017), for example that the MDA framework does not include game content explicitly in the mechanics.

The MDA framework has played a significant role in game design since it was introduced, but in recently years, the weakness of MDA framework has been identified and discussed. In addition to Walk (2017), various authors have identified shortcomings of the MDA framework (Polansky, 2015; Duarte, 2015; Lantz, 2015). These shortcomings include:

a) Only focus on game mechanics

b) Limitation on application, MDA framework cannot be applied to all genre of the games.

c) Limitation on narrative framework. MDA framework does not offer a clear framework for the developers to design the narrative.

Taking these shortcomings into account, Walk (2017) has proposed the DDE framework. Walk (2017) considers the actual description of Mechanics from the MDA framework is limited due to its

conceptualizing only specific parts like algorithms, rules, and data of the game. Walk has suggested that game content, such as sounds graphics and controllable parts of the game could be seen as part of the overall interface between the player and the game. To optimize the structure of conceptualizing and upgrading the MDA framework, Walk uses the terminology of Design to replaces the Mechanics and Aesthetic. Walk also summarizes the Design into three sublet ideas, which is Blueprint, Mechanics and Interface as shown in Figure 2-2. Blueprint consists of all conceptual parts of the game design, including art, narrative, sound, rules, et cetera. Elements inside of the Blueprint are in concept form, they do not have a form in reality. The Dynamics part of the MDA framework was highly completed but still is refined in the DDE framework.

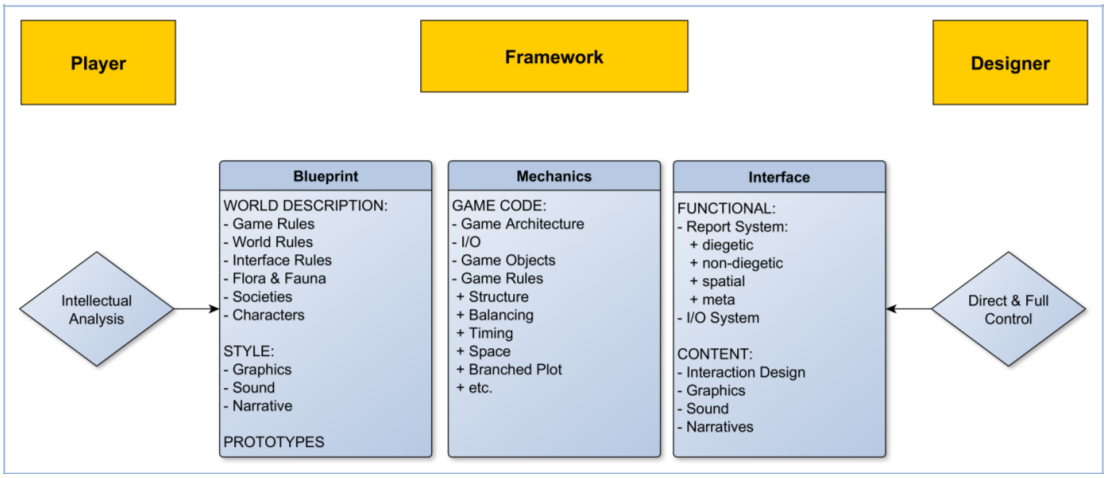

Figure 2-2 Blueprint, Mechanics, and Interface in the DDE Framework (Walk, 2017)

Walk also suggests that the MDA's Dynamics should be formalized and organized. To achieve this, Walk introduced a new framework for the MDA's Dynamics part, as shown in Figure 2-3. In this framework Walk probes into the relationship between Player and Designer. Players interacte indirectly with the designer by engaging with the player subject, and designer are making indirect full control by making rules,

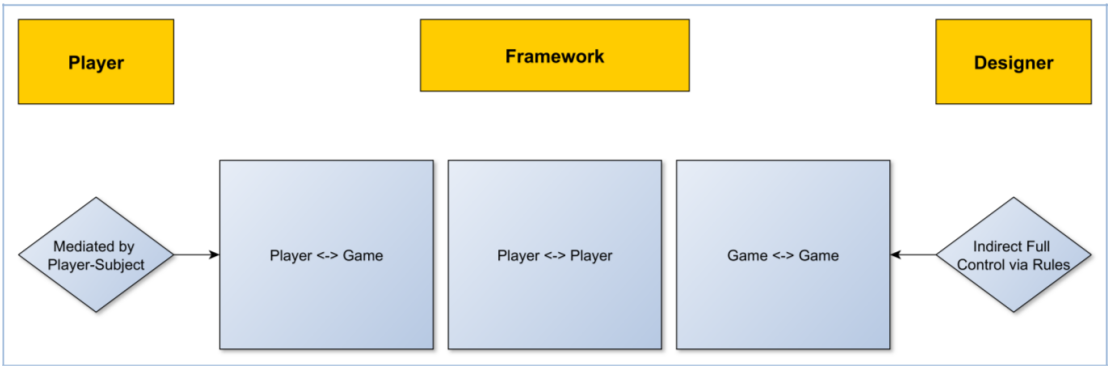

Figure 2-3 The Framework of Player and Designer (Walk, 2017)

The most unique features of Dynamics, the unpredictability, remains in both the MDA and DDE frameworks. Theoretically, the designer could make indirect full controls to the player by making rules, but in reality, the designer cannot predict the style or form of the process of player interaction with the games. The designer could have full control over every element in the Design part, but only indirect control in the Dynamics part.

To measure or describe the process of a player engaging or interacting with games, the terminology of Experience could represent this specific process. Walk (2017) notion is that this interaction is based on the theory of Player-Subject, which means when player is interacting with the game, the identity of the player is not just the people who play the game, as any interaction with the game has a reflective subjectivity with a player's own ideals, values, and culture. In Walk's concept of Experience, the Player-Subject experiences an organoleptic journey, emotional journey, and intellectual journey during the process of interacting with the game. After experiencing these journeys, the Player-Subject would become the recipient that perceives challenge, beauty, fun, story, et cetera. Overall, the process of the actual experience of how Player-Subject experiences the journeys and turn that into their own perceptions is considered Experience in the DDE framework.

Walk suggests that the DDE model is a process of non-linearity, that is both parallel, and iterative. It allows designers to evaluate, alter, and refine the game within this framework. Each part of the DDE framework is linked but not vague to identify what function they represent, it has a clear and organized structure, which could improve the whole process of development of the game.

2.2 Player Experience

The evolution of modern video games has occurred in parallel with the development of increasingly more powerful hardware. Video games have emerged to play an important role in many people's lives and can be used as an educational tool to deliver academic knowledge or provide high-quality recreational times for the player. The concept of player experience has become an increasingly important topic. At first, player experience was only an idea that player elaborating their comments or ideas on the video game community. As the development of HCI (Human-Computer Interaction) grows, the concept of user experience, an idea that mostly are applied to the research developing ordinary software, hardware and operating system, has redefined the old concept of player experience. The modern concept of player experience is more focused on addressing the root of the game, it can be considered as an essential consideration during video game development. When developers revise a video game, by using the concept of player experience, they could reach the core of the game, but not just touching the surface like old times.

Player experience also plays a significant role in the process of delivering in-game content to the player. This in-game content is mostly the playful elements of the games, which is the core of reviewing the quality of a specific video game. In a rhetoric sense, playful content is the treasure in a locked box and

player experience is the process of unlocking the box, and the key would be player itself. Design, Game (playful content) and Player are argued to be the three elements needed for a complete video game (Ferrara, 2011). Ferrara also argues that player experience is divided into 5 parts: Motivation, Meaningful Choices, Balance, Usability and Aesthetics. This model was refined from a UX (User Experience) theory on UX elements (Garrett, 2011). In these five elements, motivation plays a role of providing interest that is normally delivered to the player by creating challenges. Motivation is also at the core of in-game reward systems, by using different levels of rewards to the player to sustains the player's interest in the game itself. Ferrara (2011) also considers meaningful choices as a significant factor that determines the quality of the interest, because it leads the player to make a series of choices while the game is being played. These series of player-leading meaningful choices could be seen as controllable variables in the video game. The balance of these variables determines the experience of the game, it cannot be an extreme range like extremely hard or extremely easy, as the challenges in the game need to be matched to the players skill level to produce a positive player experiences (Petralito et al., 2017). And when it comes to the concept of usability, the elements of defining the perception from player to the game's reward systems and choice-making system. Usability is a way of describing how easy it is for the player to realize the challenge mechanism while player playing the game.

These four elements mentioned above are all, to some extent at least, interlinked with each other. Unlike these four elements, aesthetic, the last element from Ferrara's player experience model, is a special element that does not have an impact on the basic mechanism of the game but includes a lot of elements that directly communicate to the player, most of these elements are related to art, design, or narrative design.

Player, design, and game consist of the whole interaction process of playing a game. However, a player cannot interact with the design, mechanism, and aesthetic part of the game directly. The general flows of how player perceive the design of the game is by engaging in playing the game from which the player experience emerges. And games are only truly playable when an appropriate interaction environment for the player is present (Nacke et al., 2009). In a different perspective, player experience is a complex concept that based on this special term, playability. As mentioned before, playability bridges the player to the game and its design. Sánchez, Zea and Gutiérrez (2009) notes that playability could also become the measurement method to identify the player experience inside the game. Ultimately, a positive player experience is required for a game to be truly successful.

2.2.1 Measuring Player Experience

According to the DDE framework, the concept of Experience is a linear sequence, the player receives some game content and interprets it, essentially screening the in-game experience, and after this the player would transform what they received from the experiences into their perception of aspects such as the gameplay, story, et cetera (Walk et al., 2017.) Although, this process is a linear sequence, it is still based on the different individual circumstances of a specific player due to the unpredictable features of Dynamics and the bias of the player, which increases the complexity of understanding the overall player experience of a game. Using standard measurement tools has the potential to minimize the subjective factors and vague, uncontrollable elements that may result with individual players.

Measuring is a significant method of analyzing objects or events, normally the process of conducting

measuring subjective experiences consists of using both quantitative research and qualitative approaches. Quantitative measurement is a method that focuses on statistics, data, and metrics. Qualitative measurement is more focused on observing objects or events without criteria, metrics, statistics, and data. Using measuring methods could highlight the critical parts and indicate potential refinement options for the researchers. In research on methodologies of measuring Player Experience, the framework of measuring is considered across three levels, which is research methods, instruments, and measurements (Chu, Wong & Khong, 2011). Like the traditional way of research methodology, qualitative and quantitative are the core of methodologies, Chu, Wong & Khong consider the features of numerical or non-numerical is the distinguishing aspect of these two research methods. Qualitative research is focused on collecting subject feeling, experience, the outcome of that is non-numerical. Different methods could cover the difference that exist in different individuals. In the level of instruments, Chu, Wong and Khonguse verbal and von-verbal as the approaches to measuring the emotion part during the process of measuring the Player Experience. The last level in this measurement framework, which is measurements of probing the metric of products that offering pleasurable, would be empirical and non-empirical.

By conducting measurements on Player Experience, the outcome of that is significant for the participants who are engaging the game, whether its the designer or developer because the outcome could provide a better comprehension of the player experience and improve it (Nordin, Denisova & Cairns, 2014). Indeed, some studies have shown that games that are successful tend to satisfy players needs more directly (Scott & Richard, 2007). With the growth of the game industries, conducting measurements of Player Experience has become a trend, as it can lead to the development of more successful games. A large number of studies have investigated methods for measuring Player

Experience which has led to a a very diverse set of metrics and criteria that can be used. Given the differences between individual players, appropriate methods for capturing these differences are important (Chu, Wong and Khong, 2011). To accommodate these individual differences, many approaches utilise questionnaires as their major method to collect data. For example, to measure the enjoyment while engaging the video gamesIjsselsteijn et al. (2008) havedesigned a questionnaire, named GEQ (Game Experience Questionnaire), which is based on evaluating player experience. This questionnaire is divided in to seven levels, which are Sensory, Flow, Competence, Imaginative Immersion, Tension, Negative Affect and Challenge (Ijsselsteijn et al., 2008). These authrs suggest that the questionnaire has been applied to a number of studies successfully provides solid data on measuring the enjoyment of experiencing digital games. Similar type of questionnaires, like the IEQ (Immersion Experience Questionnaire) (Jennett et al., 2008) have also provided a means of measuring the immersion level of player experience. The IEQ consists of 16 pairs of questions for participants which aims to quantify the immersion level experienced during game play as an indication of the overall player experience. Jennet et al. suggest that immersion could be measured by the IEQ, though the data that he collected from IEQ is subjective, and more objective data could be collected by research on eyeball movements and time of completing the task (Jennett et al., 2008). Such approaches have the advantage of collecting data during the actual game play, not after the game has been finished.

Questionnaires have played a significant role in measuring player experience because they exhibit designable and controllable features and can combine qualitative and quantitative data. Researchers like Jennet (Jennett et al., 2008), Ijsselsteijn (Ijsselsteijn et al., 2008) and Nordin, Denisova and Cairns (2014) , have all developed of questionnaires for measuring player experience in different perspectives due to their research requirements. However, questionnaires have their weaknesses. Questionnaires

are designed for specific groups of participants, where the designer has set up numbers of questions to guarantee the questionnaires could collects accurate and objective outcomes. But based on the difference from different individual of participants, questionnaires are inflexible because they are not designed for specific individual participants. On the other hand, questionnaire have a feature of low validity because all data that is collected from participants is based on the intentions from participants, and often is based on their memories of their experience rather than captured throughout the playing of the game. The process of measuring player experience should be designed thorough and flexible.

2.3 Playtesting

Game development is a long process, after the completion of the design and testing of the player's experience, it also requires a thorough examination or test of the overall game to see if the game could live up to the developer's design philosophy and provide a good game for the player. Testing the game normally is based on the action of the play by using specific action of the play to conduct a test to analyze the game and improve it. Playtesting could provide solutions to solve the problems generated by novice game designers and affect the iterative game design process (Choi et al., 2016). Playtesting is an evaluation method based on a community of Games User Research. And Games User Research is a community that integrates games research and develops relative researchers and developers to understanding, measuring, and improving player experiences (Mirza-Babaei et al., 2016). Ultimately, playtesting is conducted throughout the entire game development process and iteratively evaluates the player experience to inform how the game is developed. The purpose of playtesting is to produce a game that is successful because of the quality of the player experience.

Choi's team conducted research on the usage, design method, and applicability of how to use playtesting with requirements as a solution to solves specific problems that occurred in the process of game design. In Choi's research, workshops that included researchers in different fields, were set up, and students become the participants of the workshop and the playtesting research projects. To find out how the process of playtesting made an impact on the game design, or the game itself, the workshop considered the basic concept and direction would be “explore, refine, and prove”, correspond to Choi's idea on the process of developing a game, which is “concept, pre-production, production and quality assurance.” In the research, the workshops incorporated a series of methods and experiments for the participants by following the “explore, refine and prove” idea, and collecting the data from the overcome of these experiments. When the data has been applied to design iterative games, participants had not necessarily considered playtesting as a significant factor and procedure during the process of game design, which caused the vague and blurred intention of the game. The outcome has also indicated that the designer should understand why playtesting is significant and its function rather than considered playtesting as a mandatory designing procedure. To refines the workshop, Choi's team had redesigned the workshop to relocate the meaning of conducting playtesting in design phases. Even with the limitation of the inadequate numbers of samples, and participants might have a higher level of understanding, but the outcome of Choi's team indicated that more creative and interesting games could be designed by applying purposeful playtesting and integrated iterative design.

To improve the versatility and accuracy of collecting data from playtesting, Mirza-Babaei’s introduced their method of playtesting, which is using the concept of visualization (Mirza-Babaei et al., 2016). By combining visualization data and other supportive quantitative approaches, the complex data

collected during the game would be easier to comprehend. Supportive quantitative approaches also play a significant role in collecting quantitative data because visualization data can't provide any qualitative data. Generally, data of movement, verbal comments, text data, physiological data that collecting by capturing during interviews, would be collect and analyzed (Mirza-Babaei et al., 2016). This playtesting method, which combined with visualization data and qualitative data, has indicated that would improve and giving potential solutions for game designing, especially for designing decision making of the game.

Playtesting, as a type of experiment or research that would engage with games and peoples, would need a basic framework to optimize the whole process. To provide a practical playtesting model for designers, Mirza-Babaei and his team had also introduced a playtesting framework for those indie game designers, which can't afford expensive equipment and organize large-scale experiments. The framework of Mirza-Babaei is based on two evaluation method, which is First Time User Experience (FTUE) and Rapid Iterative Testing and Evaluation (RITE.) RITE is a hybrid method that consisted of observation, think-aloud technique, programmers that could adjust the testing environment as the changes, and some traditional methods. And FTUE is a traditional method based on providing questionnaires and interviews. The whole process of conducting playtesting would be list as followed:

1. Identifies the variations and the design of playtesting
2. Determines what to focus on and which methods of evaluation need to be conducted during the playtesting.
3. Setting up the labs, equipment, places that using to collecting specific data.
4. Build up a comprehensive database that could fit the requirements of the diversity of different participants.

5. Playtesting training for developers. Well-training on conducting playtesting could minimize the biases and improve the credibility of outcomes.

This framework provides a clear solution on how to conduct playtesting for games. The application of using playtesting has also shown that playtesting could improve the games in the design phase and offers a more innovative and creative player experience for the players. However, as play testing is often reliant on using player experience questionnaires to measure the player experience, the limitations of such approaches become embedded in the playtesting approach. If playtesting incorporated more real-time data captured during gameplay, there is potential to further improve the game design process.

2.4 Multimodal Interaction Analysis

Multimodal Interaction Analysis focuses on exploring the communication and interaction that occurs simultaneously in different modes. In fact, all communication that happen in our daily life is multimodal because when people are engaging with communication, the form of communication is not singular (Norris, 2014). For example, gestures, postures, text via phone, email, video calls, interactions, or actions like these are considered as a different type of communication. One basic model of communication considers it as an action that consists of the receiver and the sender (Narula, 2006). In this action, the sender delivers their ideas or opinions to the receiver, and the receiver receives these opinions or ideas from the sender which will be comprehended by the receiver's own cognition and perception.

The process of communication is simple, but the pathway that builds up the whole process of communicating is normally based on two major elements, visual and audio, of course, more elements have played a significant role in building up the communication pathway, like feeling smell and touch. As technology has developed, the communication pathways between individuals have also changed significantly and facilitated the development of new modes of communication. For example, Chang, O'Modhrain, Jacob, Gunther, & Ishii, (2002) have explored technology facilitated vibrotactile communication modes.

As mentioned before, multimodal communication happens in our daily life and it already becomes our major pattern of communication, though some researchers do argue that voice plays an important part of this (De Ruiter, 2004). The process of engaging multimodal communication is preferred puts its emphasis on the agent element of the communication pathway, which is multimedia. Modern multimedia is also based on the same theory that visuals and audios are the major components that build up the communication pathway, so does the multimedia. Chen considered that multimedia is the integration of audio, text, image, and video (Chen & Rao, 1998). The multimedia could expand the pathway of conducting multimodal communication because multimedia had provided a new model of delivers the sender's opinions and ideas to the receivers.

There are many examples of multimodal communication and multimodal interaction analysis in the literature. Those selected here are not intended to be a comprehensive review of this literature, just sufficient to consider the breadth of this area. For example,

Bourlai and Herring's researched analyzing the emotional expression by multimodal communication on specific social network services websites (Bourlai & Herring, 2014).

The social network services are the technology product that provides multimodal communication and allows multimedia message delivery between multimodal communication. Bourlai and Herring had to keep extracting data, which all are the actual multimodal communication conducted by the user on this social network service website to analyze. The outcome indicated the action of different forms of multimodal communication has included different levels of emotional expression. The multimodal communication that has including images has stronger emotional expression, more intense emotion, and more positive values expression (Bourlai & Herring, 2014).

Herring's notion that digital multimodality communications lead into two major phenomena, interactive multimodal platform, and robot mediated communication. The interactive multimodal platform is those Web2.0 platforms that provide users delivering multimedia messages to users. Robot mediated communication is those forms of communications that required the robot's assistance to complete delivering audio, video messages (Herring, 2015). Normally the multimodal communication in the interactive multimodal platforms such as social network services website is a long durable process, a user could retrieve those communications whenever they want. In the contrary, robot mediated communication is not a retrievable communication, it must happen in real-time and is synchronous in nature , such as video call. Although these two new forms of multimodal communication are not directly relevant to this study, researching more into

these neo multimodal communications could provide deeper understanding of communication and giving rise to a potential solution for designing a better pro-social multimodal communication method.

The major feature of multimodal communication is its flexibility and multifunctional that could be applied to any circumstances. The core of this feature is multimodal interfaces, which means the interfaces that the user interactives with during engaging the multimodal communication (Oviatt, Coulston and Lunsford, 2004). But the limitation of multimodal interfaces is they require higher cognition and certain learning ability to engage because each type of multimodal interface is totally different, some of them are relatively complex in comparison with the basic forms of communication like verbal and gestures. Oviatt, Coulston and Lunsford have introduced a new theory of cognition load, which aims to get a deeper understanding of multimodal communication. The outcome of this research into cognition load indicated that the cognition load is relative to the complexity of communication. When conducting communication interaction, participants would prefer switching to multimodal communication as the complexity of communication increases. Multimodal interfaces providing a higher-performance solution for conducting complex communication. But the error rates may increase as the complexity of multimodal interfaces increases because the cognition load of each different individual is different. In general, this research pointed out that moultimodal research is critical and it needs to persist because it could upgrade the current multimodal communication and providing a blueprint for designing future multimodal communication.

Multimodal interaction analysis extends the ideas of multimodal communication and looks beyond the simple sender-receiver model. It instead looks at how one or more people interact with other people or things, and in doing so allows a much wider analysis to be undertaking. For example, Wilmes and Siry (2021) utilise multimodal interaction analysis to determine to what extent students engage in science practices. In contrast, Andrade, Maddox, Edwards, Chopade and Khan (2019) use the approach to evaluate problem solving skills. Other examples include the analysis of shopping behaviour (Krummheuer, 2019), group dynamics (Tung, Gomex, Kawahara and Matsuyama, 2012), educational leadership (Tomlin, 2015) and smart homes (Manchón, del Solar, Amores & Pérez, 2007) to name but a few.

Of particular interest to this research are examples of applying multimodal interaction analysis and consideration of multimodal communication in relation to video games. Whilst several studies examine multimodal communication through more general games (Clark, et al, 2021), there are few studies that touch on analysis computer games at all. Abdullah (2016) has considered how games influence players, particularly in terms of how they lose attention during game “cut scenes”. Shoukry (2020) has also considered multimodality in the context of collecting data to evaluate serious games. The recency of Shoukry’s work, and the general lack of focus on analysing multimodal game play, would suggest that analysing games in a multimodal way is an emerging area of interest. When analyzing multimodal communication and interaction, various techniques can be deployed that capture and record communication as it happens. These techniques have the potential to be used in the playtesting of games, and by doing so provide a platform

to analyze both in-game communication and player behavior in relation to specific aspects of a game design. If successful, such an approach could be used to revolutionize the game design process by directly capturing the player experience during playtesting to help designers understand how their choices in design elements produce different dynamics in a game, and how these dynamics influence the player experience.

2.5 Summary of Literature Review

This chapter has explored the background of games and games design, introduced the idea of mainstream game development framework, Mechanic, Dynamic, Aesthetic (MDA), and the refinement game development framework which based on the MDA framework, Design, Dynamic, Experience. also It has also addressed the importance of the game designing framework because it is the core of the game and discussed and introduced the concept and explanation of the importance of player experience. This has been extended to consider the process of measuring player experiences and discussed the advantages and disadvantages of it. To finding the potential solutions for improving the player experiences while the designing phase, current research has been analyzed related to the conduct of playtesting to refine the game, and consideration of relevant studies that probe into their limitations. After the analysis of current orthodox ideas on conducting playtesting to improving player experiences and the game itself, an overview of multimodal interaction analysis has been given. And providing some relatives cases studies which also using multimodal interaction analysis as a methodology to providing refinements for other fields.

3 Research Objectives, Methodology, and Design

This chapter outlines the research objectives, the methodology utilized and the detailed research design.

3.1 Research Objectives

The main purpose of designing a video game is to provide recreation and entertainment for the player community. Usually, a complete video game would consist of a suitable narrative, playable content, interaction mechanisms, and visual and audio components appropriate for design purposes. In general, the game designer would focus on ensuring that the interaction mechanisms, playable content, and overall aesthetic of the game combine into the final product that will appeal to potential players. Although each video game genre is different, and each game has a different intended purpose, nearly all games need to be developed through design, production, playtesting, refinement, and rollout. This process is iterative and game designers' and developers' intention is to fulfill and surpass user, or players expectations, by providing an extraordinary player experience.

The challenge of fulfilling players' expectations and even surpassing their requirements is to make sure the process of design stays on track, and in doing so to decrease the existence of game elements that might result in player dissatisfaction either intentionally or accidentally. In fact, most of these elements could be considered as usability errors during the player-game interaction, even though sometimes these errors maybe have been designed intentionally as challenges for the players to provide more playable content. In general, such challenges are significant in video games, as they encourage players to learn and develop new methods and abilities to overcome them (Pinelle & Wong, 2008). But sometimes these features could be not designed or implemented correctly, which shifts

them into a liability for the game because they disrupt the overall balance of the game play. The intended purpose of these features could be misplaced and distorted in either the core of the game or in the interface, with both of these aspects being key factors that determine the actual player experience of the game. In this context, and with reference to the MDA and DDE frameworks, the core means the mechanics that are embedded into the game, and the interface means that the combination of the dynamic processes that emerge from the designed elements that are based on the designed mechanics.

Much of the time, game designers and developers may not be aware of or can't locate any imbalance in the designed challenges in the game during the process of actualizing their designed purpose into the game, as the usability errors only become apparent during actual game play. It is essential to use a specific iterative testing approach to evaluate the prototype game, and this iterative testing approach is called playtesting. The purpose of conducting playtesting is refining the game by quantifying the player experience. Such a process aims to explore every potential factor and detail that might be affecting the player experience and using these factors and details as criteria to evaluate the prototype game. Basically, playtesting is an iterative test that is based on a framework of heuristics that evaluate the player experience. Often, playtesting is only applied in the later phase of designing a game, for example conducting the debug test after the program has been completed. Conducting playtesting means that the game designer and developers need to put in extra effort and resources after they have already spent considerable time completing the design. Conducting the playtesting is a very important but also very complex task, that needs to be well managed in order to acquire useful data that provides insight to the player experience for a given game. The designer of the playtesting must quantify the prototype of the game and design a complex experiment that combines quantitative tests and qualitative tests based on the potential player experience of the game prototype. The designer then

needs to recruit qualified participants who have a clear idea of conducting playtesting and are familiar with playing the games and with strong cognitive ability so that they could provide valid and effective data after playtesting is completed.

At the macroscopic level, playtesting is largely based on the data collected from participants, and this data is also often largely based on participants' memory and their subjective consciousness of the actual experience of playing the game. Even though game designers have developed tests such as Rapid Iterative Testing And Evaluation (Medlock et al., 2002) to decrease the unstable variabilities of playtesting, most approaches reply to some extent at least on the participants' memory and subjective consciousness during the test.

To assist in alleviating the unstable variabilities of playtesting and lower the resources needed for conducting traditional playtesting, Multimodal Interaction Analysis (Norris, 2019) offers the potential to reform and optimize the process of traditional playtesting. Multimodal Interaction Analysis has a wide range of potential application and can capture a wealth of information in real time during interactions. Multimodal Interaction Analysis is a process that focuses on communication and interaction between two or more actors that is spread across different modes of interaction. For example, two human actors will communicate and interact with each not just using their voices, but also their body language and gestures. Playing games, even conducting the playtesting, can also be considered as communication and interaction, with events occurring between players in the game, and with the game itself. Multimodal Interaction Analysis could provide valid and reliable data during playtesting because the process of Multimodal Interaction Analysis is often used to transcribe, define, and analyze multimodal data (Norris, 2019). Potentially, the features of Multimodal Interaction

Analysis could provide improvements to traditional playtesting to free from the limitation of relying on massive resources and participants' subjective cognitions and consciousness during conducting traditional playtesting.

The overall objective of this research is therefore to determine to what extent Multimodal Interaction Analysis could be deployed in the playtesting of video games and whether it assists in identifying game features that are influencing the overall player experience of a game.

3.2 Research Methodology

The method of this research is based on Norris's Systematically Working with Multimodal Data approach (Norris, 2019). Whilst the research originally intended to observe game play in real time with real players, potential restrictions due to the COVID-19 pandemic necessitated a switch to using videos of game play. The source of the research data is therefore all derived from the public video service website YouTube.

According to Norris (2019), video has become one of the most common methods of recording human action and interaction with objects. Multimodal Interaction Analysis provides a practical method of transcribing video content that effectively turns the video into data (Norris, 2019). This method has multiple phases, three of which are relevant to this thesis, and are based on specific data collecting procedures. These phases are shown in Figure 3-1.

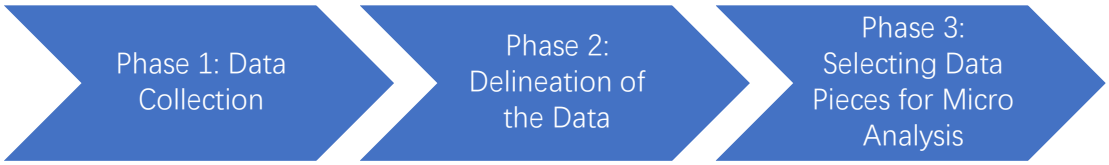

Figure 3-1 Phases of Systematically Working with Multimodal Data

The first phase is collecting the data, the method of conducting it requires the researcher to determine what themes that need to be collected for the research and realize what exactly the data is. According to Norris (2019) actual raw video clips that recorded human action and interaction are not data, because they have not been processed by researchers. The raw data needs to be named and classified to identify specific parts of data that need to be analyzed.

After this classification is completed, the raw video clips have become data that requires delineating and the raw video clips are transformed into a large data set. Delineation as method facilitates a deeper comprehension of the large data set and consists of a five steps process (Norris, 2019):

1. Identify the data set by using a data set figure.
2. Understanding the research objectives and the engagement of researchers and Data Set.
3. Identifying a data piece by generating a screenshot that has certain of significance for you research.
4. Have comprehension of the research objectives and the concrete mediated actions analyzed from the data set.
5. Re-phrasing a Research Question that is based on the data set.

Once the videos have been collected and the data delineated, the next phase of the process is to analyze

and transcribe the data. The analysis phase involves selecting specific data pieces and conducting microanalysis for these data pieces (Norris, 2019). In general, even relatively small raw video clips may become a large data set after the first two phases, which may result in inadequate evidence and a lack of researchable details. Analysing such a data set effectively can be undertaken by introducing the level of mediated actions.

Norris (2019) suggests that the continuum of action consists of higher-level mediated actions and lower-level mediated actions. If reading is considered as an example, reading itself would be a higher-level mediated action, whereas the status of sitting, lying, reading from monitor or paper book, thinking and so on are lower-level mediated actions. Higher-level mediated actions are based on, and built by, the lower-level mediated actions. Based on this theory of action and mediated action, conducting micro analysis of data pieces is based on the following steps (Norris, 2019):

1. Re-phrasing the research question into a mediated action way, which is what elements inside the game that selected and transform into form of data, could affect the player experience.
2. Identifying the higher-level mediated actions for the data pieces based on the new research questions: in the context of research, it would be to identify the elements that are relative to the research question developed from step1. (Table 3)
3. Analyzing the data pieces in higher level mediated actions and producing an overview that elaborates the higher-level mediated actions from the data set. (Table 4)
4. Narrowing and highlighting the data pieces for micro analysis that are relevant for player experience

As a result of this process, the original video clips have now been segmented into data pieces that can be presented in a retrievable and organized way, and as such are ready for micro analysis. The technique used for micro analysis in this research involves applying Multimodal Transcription Conventions on the data pieces.

Multimodal Transcription Conventions are applied to transcribe the verbal movements and non-verbal movements across all levels of mediated actions and the outcome of transcriptions are all retrievable and copyable (Norris, 2019). Multimodal Transcription provides a thorough and detailed analysis of the data pieces, as well as providing the possibility of conducting embedded aspects of analysis and providing a clear and accurate way of illustrating the outcome of the analysis. The application of Multimodal Transcription involves several steps:

1. Identify the mode in the data set (Norris 2019). Mode is considered as a system of mediated actions (Norris, 2013), every type of mode is viewed as a system of mediated actions (Norris, 2019.) In the context of this research, it would be the elements that might affect the player experience.
2. Transcribing the actual stage or layout of the data piece.
3. Transcribing the actions, such as gestures, postures, movements. In the context of this research, it would be like, movements of attacking, the changes of the point of views which are controlled by the player, switching weapons, et cetera.
4. Transcribing language that occurs in the data piece.

3.3 Research Design

The previous section has outlined the systematic approach for analysing multimodal interaction in this research. As has already been stated, the focus of this research is to consider the potential for these techniques to be deployed during the playtesting of video games. Due to potential constraints of the COVID-19 pandemic, this potential is being explored using existing game play videos rather than live playtesting. To demonstrate general applicability, video clips from two different games have been used.

3.3.1 Game Selection

The two games selected are Counter-Strike: Global Offensive (CSGO) and Player Unknown Battleground (PUBG). Both are multiplayer games that involve different competitive, collaborative, and communication requirements for successful game play. The mainstream game media website Metacritic has classified CSGO in multiple genres, namely action, shooter, FPS (First-Person Shooting), modern and tactical games. Similarly, Metacritic also classified PUBG in the same genres (Metacritic, 2021). According to the game database Steam DB, CSGO has almost 800 thousand active players in the peak time of one day, and PUBG has almost 400 thousand active players in the peak time of one day as well (Steamdb,2021.) Both games have also played a significant role in the game industry and player community. But with updates for fixing bugs and new content that added to these two games, controversy and dissatisfaction have occured because of some specific elements that have affected the player experience. This research has considered these two games as research objectives and conducting Multimodal Interaction Analysis as part of the refinement for the iterative playtesting in order to optimize the imbalanced factor and unsatisfied design elements that failed player's expectation and player experience.

3.3.2 Counter Strike: Global Offensive (CS: GO)

CSGO is a game that develops by Valve software, aiming to provide an intense team competitive tactical experience across different maps, weapons, and items. As a modern video game, CSGO has provided competitive mode, default mode, and other interesting modes that have been developed by the player community, but the most significant and popular mode is the competitive mode. This research is focused on the competitive mode for which the basic rules are:

1. Five players as a team, begin as the counter-terrorist team or terrorist side randomly, each game needs two teams to compete.
2. Each game needs maximums of 30 rounds, but any side of the team that has won 16 rounds could be considered as wining the whole game and the game would end immediately after any team has taken the 16 rounds of winning in total and declares the wining of the winner.
3. The weapons and items could be purchased from the store in the first 20 seconds when the round start, the funds for purchasing could receive by eliminating enemies and wining the round, losing the round could also receive fewer funds but after losing several rounds there will be extra bonus for the losing side. The team who has planted the bomb could also receive extra bonus, but if the bomb has exploded and the bonus would be higher.
4. Each team begin with 800 of money and a pistol.

These rules could be considered as the main features of CSGO and why the research focused on the competitive mode essentially represents the whole game. The mechanism behind these rules is symmetry, each side of the team is playing by the same strict rules. The financial system and purchasing system, which is the bonus of each action could provide the chance for those teams to keep

losing their rounds to fight back, but in general, the rules and mechanism of CSGO could be considered as well-balanced and symmetrical. But still, CSGO is not considered a completely balanced game because the maps provide the opportunity for unbalanced play. Normally, elements that could affect the balance of the map are angles, distances, chokepoints, and structures (The Competitive Maps of Counter-Strike, 2019.) The angles mean that certain places can provide more effective cover and ambush spots can allow one side to engage with enemies with lower damages and costs. The distance relates to distances requirement of each team to arrive at crucial chokepoints, bomb planting zones, and defensive zones when travelling from the spawn spot. Because the maps are not symmetrical, the distances could be very different for each team. Sometimes these differences could be the key factor for one team losing their round. Chokepoints are specific spots that have tactical value for each team. Engagement between teams often happens in chokepoints because once the chokepoints have been taken by one side, the possibility of winning by this side would be increased.

When considering structure, this relates to the overall layout of the whole map, including routes, architectures, the position of covers spot, stairs, et cetera. The maps of CSGO are highly complex, each route and door could be the main factor of providing a chokepoint environment for each side of the team. An imbalanced map could lead to the failure of meeting the player community's expectations and result in a horrible player experience for the players.

3.3.3 Player Unknown Battleground (PUBG)

PUBG had also categorized as a tactical, shooter, and FPS genre by Metacritic (Metacritic, 2021) But in fact, PUBG is a totally different game from CSGO although they are sharing some similar genres

and features. In the description of PUBG on game media, IGN mentioned that PBUG is a tactical-based game, and it also provides a competitive survival battle that fights until the last enemies have eliminated (IGN, 2021.) and as such would be considered a “battle royale” game. This survival battle has considered the most notable and significant feature of this game, even though PUBG also provides other modes for the player. The major difference between PUBG from CSGO is that the player experience of PUBG is not relying on the strict, strong mechanism design for the player. In CSGO, the player needs to rely on the strong and strict designed mechanism to make sure the game is relatively balanced, because the maps are not balanced as the rules as mentioned before. The mechanism and features of PUBG is much complex if comparing with CSGO. The basic rules of PUBG are:

1. 100 players in total during the whole game, player could build a team as four, three, two or play as solo.
2. The winning would be the last team that survived .
3. The maps are very large scale, the building and facilities provides the function of chokepoints, shelter, and offering essentials equipment such as supplies and weapons. The location of this essential equipment is randomly distributed in each building and facilities on the maps.
4. As the game progress, the game would have a randomly generated ring that includes part of the map as safe zone and the outside of the ring would be causing damages for each player. As the safe zone gets smaller throughout a round, the nature of the gameplay changes significantly.
5. Player has two statuses, the first one would be knocked down, which means the other teammates could healing the player that has been knocked down by the enemies. When a player is in knocked down status, dropping the equipment is the only action that allows doing. Once player lost its health point during the knocked down period, it means eliminated from

the game immediately.

6. Eliminated players would leave their collections of supplies and weapons as shown as a box-like object on the spot where players got eliminated. All players could have accessed this box to acquire supplies.
7. Plenty of vehicles and transport tools has distributed randomly on the map.
8. Air supply would be also delivered to random spots within the safe zone.

In general, PUBG has offered much more variable elements for the player to create a large simulation experience. To decrease the imbalance that could occur because of these variable elements, the designer had used randomization to ensure some sense of balance. Items such as weapons and ammunition are randomly distributed across the map in each round, so each player could have the same chances to acquires the equipment, transport, and other supplies. But even though the random mechanism has minimized some of the imbalance of this game, PUBG still has several imbalance elements or elements that could lead to generated unsatisfied player experience. For example, the mechanism of randomly supplies distribution could lead to some certain area has massive of supplies and weapons but the rest of the area on the map has barely useful supplies (Raj, 2019). Furthermore, each supply, weapon, and equipment have different intensity, power, and functions, especially PUBG has a clear chain of upgrading in-game items. For example, bandages could heal 15% of health points, the First Aid Kits could heal 70% of health points, and Med Kit could heal all the health points. Specific items and weapons have an extraordinary attraction to the player because of their unusual intensity and power. Sometimes the map design has also been considered as the negative player experience factor as well, such as some specific unreasonable landform design could provide imbalance chokepoints during the engagement. These kinds of designs could easily turn the normal

player experience into specific equipment and weapons searching, which leading a negative player experience for other players. As mentioned before, playtesting as an iterative testing approach that could provide a clear pathway for the designer to identify their design became the trigger of ruined the player experience or not. As stated before, Multimodal Interaction Analysis could provide rapid, accurate, reliable microanalysis on specific data, by conducting it, the imbalance that hid from massive of variable elements could be identified easily. For example, conducting microanalysis on data collected from specific landforms (Hill or House) in the game could be the pathway to find out the limitation or imbalanced factor after the analysis. The main factor of providing a chokepoint environment for each side of the team. An imbalanced map could lead to the failure of meeting the player community's expectations and result in a horrible player experience for the players. It should be considered essential to utilize iterative playtesting during the design of any new maps, but a highly complex map has many variable elements that could be the key factor that leads to imbalance, so it such a process would involve considerable iterative playtesting to decrease the imbalanced factors. Multimodal Interaction Analysis could provide a solution for collecting data from the map and analyzing them. The imbalanced design of the map could be detected and identified after the microanalysis of higher-level mediated actions occurred in the data. For example, imbalanced cover spot design in specific chokepoints could be identified by conducting microanalysis for the data collected from player's recording footages. Besides, Multimodal Interaction Analysis could transform the map into retrievable data, which means the scales of iterative playtesting could be smaller and lower budget.

3.4 Video Selection and Data Collection

Once the games had been decided to adopt in the research, the research had shifted to raw data collection, which is collecting the video footage as raw data for the data collection. The process of this phase would be mainly focused on those video clips which have representative features of mechanics, system, designed elements, and player experience. YouTube, as a public video website, the user could upload their video on this website, and based on that, massive amounts of video clips of players playing these two video games have been uploaded on this website by the player themselves. That simplifies the procedure of selecting video clips as raw data because the video website already provides a number of videos that might include the features that might fit the research purpose.

And based on this website, seven video clips have been collected and each video has shown the certain extent of designed elements, mechanics that might involve in the player experience, and each video has its features that differ from the other six videos. In these seven video clips, three of them are collected from the video game of PUBG, four of them are from the video game of CS: GO.

Data Collected	Date	Place	Participants
Data Session 1	13/March collected	https://youtu.be/hGixnMPdQDQ	Four player(PUBG)
Data Session 2	16/March collected	https://youtu.be/d0MxZbVRnxo	Two players(PUBG)
Data Session 3	16/March collected	https://youtu.be/LQf6bdfqGYg	Four Players(PUBG)
Data Session 4	20/March collected	https://youtu.be/QtjU4YNg624	Ten Players (CSGO)
Data Session 5	20/March collected	https://youtu.be/HRxxa84mw9s	Ten Players (CSGO)
Data Session 6	20/March collected	https://youtu.be/t_t-iXmHnY8	Ten Players (CSGO)
Data Session 7	20/March collected	https://youtu.be/y_WLmpCdtgc	Ten Players (CSGO)

Table 1 Data Collection Table

The results section then goes through the process discussed earlier, showing the results for each phase for each game.

This data collection table lists and names all the raw video clips as Data Session and with a serial number in the first column. The date of when these clips were collected is included in the second column. To prevent any file crashed and lost data situation in the future, these clips were re-uploaded to YouTube again and set it as public video so that could fulfill a function of retrievability for these raw video clips, and the URL link provided on the third column of the table. The fourth column includes the exact numbers of participants that are engaging in the raw video clips, in the context of this research, it means the numbers of players that interact with the game from the main perspectives.

Then the raw video clips need to be edited to fit the research requirements because some clips could contain too many irrelevant elements. After cropping into research purpose-suitable length and size, to prevent the incoherence and chaos situation during transcribing, it is essential for the raw video clips that need collating and add a time stamp for each raw video clip. And using screenshot function that could provide serial action for specific research purpose.

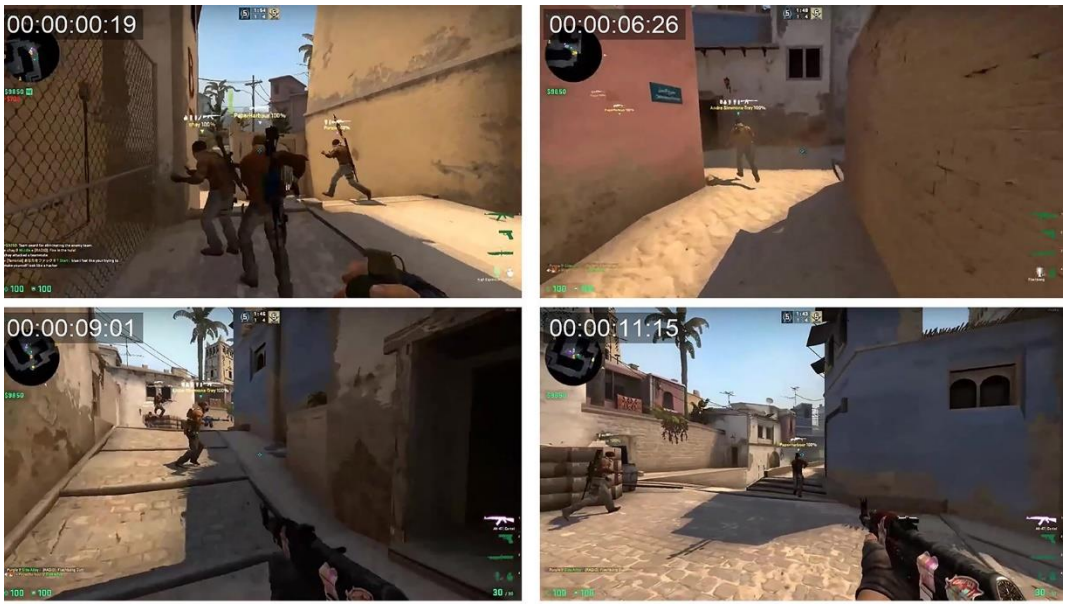

Figure 3-2 Time Stamped Screenshots

Name of Data Piece	Length of Recording	Participants + 1-3 important mediational means/cultural tools	Notes(Relationships, ect)	1-3 Observational Notes and/or special points in interviews (Brief generally relevant notes)
Clip1	2 minutes	10 Players per round PC and PC game CS:GO	Third round of the game 31 rounds in total	Actual communication happened Actual interaction happened (Poor communication but shown great teamwork interaction)
Clip2	1 minutes 55 secs	10 Players per round PC and PC game CS:GO	Leading 4 round in the 6th round Tactics and Comms failured	Actual communication happened Actual interaction happened (Poor comms and interactions)
Clip3	1 minutes 12 secs	10 Players per round PC and PC game CS:GO	Leading 6 rounds in 8th round Tactics and comms works great	Actual communication happened Actual interaction happened (Real time communication during engaging)
Clip4	1 minutes 22 secs	10 Players per round PC and PC game CS:GO	Leading 2 rounds in 6th round Showed process of negotiating tactics in the beginning	Actual communication happened Actual interaction happened (Negotiating)
Clip5	4 minutes	4 Players in a team, one round, total participants 100 per round PC game PUBG	Took the chokepoint and conducting defense and offense	Actual communication happened Actual interaction happened (Providing information)
Clip6	2 minutes 53 secs	2 Players as a team, one round, total participants 100 per round PC game PUBG	Finale round of the game, 4 enemies remain	Actual communication happened Actual interaction happened (Providing information and tac)
Clip7	2 minutes 22 secs	2 Players in a team, one round, total participants 100 per round PC game PUBG	Finale round of the game, 10 enemies remain	Actual communication happened Actual interaction happened (Has casulty and fierce engaged)

Table 2 Data Set Table

The data set table provides basic information about the data set and its features. In the first column, the same name that also has implemented in data collection, to prevent causing incoherence of the

research. The second column is the length of each clip, the third column is the actual participants, basic mediational means, and actual cultural tools of each clip, in the context of this research, would be the name of the games, the platform that executing the game, and the exact number of participants in the clips and basic concept of the exact number of participants that engage with the game. Then the fourth column represents the basic details, relationships of each clip, in this research context, it would be the basic information of the exact situation of these games in brief. The fifth column has listed 1 or 3 observational notes and special points in interviews, in this research context it would be brief details of notes from the perspectives of this research.

Time stamp in video at the beginning of a higher-level mediated action	Brief description of a higher-level mediated action
0:00:01	Searching enemies
0:00:18	Teammates engaging
0:00:24	Player1 moving to advantage chokepoint
0:00:40	Pursuing enemies
0:00:46	Player1 position exposured
0:00:48	Player1 taking cover
0:00:49	Player1 found the enemies
0:00:52	Player1 attack enemies
0:00:53	Player1 eliminate an enemies
0:00:53	Enemies fought back cause damages on Player1
0:00:55	Player1 taking meds
0:01:03	Player1 aiming
0:01:09	Player1 hit one enemy
0:01:10	Player1 fire, but miss
0:01:15	Player1 hit one enemy
0:01:21	Player1 reloading
0:01:33	Player1 fire, but miss
0:01:45	Player1 fire, hit one enemy
0:01:55	Player1 moving to another advantages chokepoint
0:02:05	Player1 Stop moving, begin aiming.
0:02:07	Player2 eliminate one enemy
0:02:15	Player1 fire, hit one enemy
0:02:20	Player1 fire, but miss
0:02:22	Player1 moving
0:02:45	Player1 changing weapons
0:02:59	Player2 eliminate one enemy
0:03:13	Player1 moving to the eliminated enemies
0:03:21	Player1 Searching enemies
0:03:41	Enemies found.
0:03:44	Whole team engaging with enemies
0:04:01	Player got hit and take cover
0:04:21	Player3 eliminated one enemy
0:04:35	Player1 eliminated last enemy

Table 3 Higher-level mediated action table

The higher-level mediated action table has included all the higher-level mediated actions that exist in the pieces of data. Table 3 is part of the table generated from micro analysis from Clip1. The left

column lists all the exact times when higher-level mediated action happens during Clip1 from the beginning by using the timestamp, which has already added to the video clip in Phase1 as mentioned above. The right side of the column briefly describes the higher-level mediated action by locating the time listed on the left side of the column. In the context of the research, the first action is to summarize and simplify the higher-level mediated actions. For example, the actions of using weapons to attack would be the higher-level mediated actions of attack, changing weapon because of the lack of bullets or urgent needed as higher-level mediated action of changing weapon. And receiving damages by enemies' weapons would the higher-level mediated action of got hit, killed any enemies with weapons as higher-level mediated action of eliminating. By conducting micro analysis to the pieces of data set, this table has provided a clear vision of higher-level mediated actions and present it in a retrievable and organized way. But this table still could not provide a categorized and summarized way to present the actual higher-level mediated actions. The higher-level mediated actions need to be bundled and extracted from the data set in a higher-level way.

To develop a more thorough overview of higher-level mediated actions based on the current extracted data set from the higher-level mediated action table (Table 3) involves the development of a bundled higher-level mediated action table. By binding the higher-level mediated actions into a categorized way and actual position of these actions occurred from the data set, it could provide a method of conducting deeper micro analysis to the data directly rather than re-evaluating and analyzing the data set thoroughly again.

Substance of higher-level mediated action	Time in video
Attack attempt	C1: 0:00:30, C1: 0:00:52, C1: 0:01:25, C2: 0:00:09, C2: 0:00:43, C2: 0:00:48, C3: 0:00:14, C3: 0:00:25, C3: 0:00:41, C3: 0:00:46 C4: 0:00:10, C4: 0:00:36, C4: 0:00:49
Failed voice comms attempt	C1: 0:00:36, C3: 0:00:04, C4: 0:01:07
Tactics voice comms	C1: 0:00:57, C1: 0:01:15, C1: 0:02:08, C1: 0:01:56, C2: 0:00:39, C2: 0:01:17, C3: 0:00:10, C3: 0:00:19, C4: 0:00:05, C4: 0:00:11
Engage	C1: 0:00:38, C1: 0:01:13, C1: 0:01:18, C1: 0:02:12, C2: 0:00:45 C2: 0:00:54, C2: 0:01:11, C3: 0:00:33, C3: 0:00:46, C3: 0:01:05 C4: 0:00:47, C4: 0:01:16
Tactics items deploy	C1: 0:01:44, C2: 0:00:13, C2: 0:00:21, C2: 0:00:51, C3: 0:01:44
Tactics purpose movements	C2: 0:00:31, C3: 0:00:27, C3: 0:00:37, C3: 0:01:00, C4: 0:00:23 C4: 0:01:04
Irrelevant voice comms	C2: 0:00:47, C3: 0:00:39, C4: 0:00:55
Information voice comms	C3: 0:00:41, C3: 0:00:51, C4: 0:01:09
Failed tactics attempt	C4: 0:00:40
Bomb planted	C1: 0:01:48, C3: 00:00:45, C4: 0:00:51

Table 4 Bundled Higher-level Mediated Action Table

This table summarizes all types of substances of higher-level mediated action that occurred in Clip1 to Clip4. Unlike the types of higher-level mediated action mentioned in higher-level mediated action table, these actions need to be extracted in a briefer way because the data generated from micro analysis needs to be put in a larger data set for the research. To avoid causing chaos for further research, the form of higher-level mediated actions has been determined for the game's features after conducting micro analysis for the larger data set. For example, the scenario of each team's about to attack as attack attempt, uncleared and irrelevant communication would be failed voice communication attempt, using a grenade, smoking grenade or any tactical items inside the game would be tactics items deploy, et cetera. And that is what is listed on the left side of the column of the table. The right side of the column lists the exact time the of when this specific higher-level mediated action occurred, and because the higher-level mediated actions had been identified and defined from a larger group, so the position of time could also apply to the larger data set, so the scale of the column includes the whole larger data set. This bundled higher-level mediated action table provides a much easier way to determine what elements and what higher-level mediated actions need further research and focus, highlighting which

mediated actions occur often and which ones are rare, and helping to retrieve the data accurately clearly and easily (Norris, 2019.)

Figure 3-3 Transcription of actions, layout

Figure 3-3 is an example of transcription of the continuum actions of the data pieces from Clip1. In this example there is still not a final transcript yet, it still illustrates the transcription of a complete process of how players are engaging with the specific game mechanisms, and the layout of the data pieces which is the interface of the game. To produce a final transcript, the verbal communication that occurred in the data excerpt needs to be transcribed and included.

Figure 3-4 Final version of Multimodal Transcription

Verbal communication is an essential element of evaluating the player experience of multiplayer games, so the transcription should be also analyse the spoken language which occurred. Figure 3-4 is an example of the final transcript. In the final transcript, the wave means the pitch tone and the size of the letters indicate loudness of each player while engaging the game, different colors represent the different players that are speaking. And this is the final transcript of data pieces collected from the data set.

And this is the whole process of conducting Multimodal Interaction Analysis as a methodology. Owing to the tables and the transcriptions, data could be used to conduct micro analysis to probe into the research objectives, questions, and purpose in an easily and clearly way.

4 Result and Findings

This chapter presents the results and findings by conducting case studies with multimodal interaction analysis as a method, on the different cases from two different games.

4.1 PUBG

In this section, three different cases had been selected as research objectives and conducting multimodal analysis on these cases. The main observational squad in the first case would be squad#1, and squad#2 would be the main observational squad of the second case. The squad#3 is the main observational squad in the third case. Each case was in a different round of the game of PUBG, different scenarios, different phases, and conducted by different players.

4.1.1 PUBG Case Study#1

In this case, the main observational participant's squad has shown a series of lower-level actions of defending and attacking the enemies they meet throughout the round. By using multimodal transcription, these lower-level actions have been transcribed to analyze the higher-level mediated actions to find out its relation of game mechanics, design, and feature of the player experience of this game.

The first PUBG case is an engagement that happens on a hill, the main observational participant's squad was attacking other squads from a very long range. The map, in this case, is called Erangel, a far-east island map covered by trees, hills, cities, villages, military facilities, and fields. The size of the

map is 8 kilometers × 8 kilometers, which is the biggest map in PUBG. The actual engagement spot could be inferred by observing the tiny map in the user interface that showed in the upper right spot, which is around a hill in the north part of the map as shown in Figure 4-1.

Figure 4-1 Location of Engagement, (PUBG Interactive Map n.d.)

The main observational squad were engaging the enemies that came from bottom of the hills, and the elevation of the landscape has provided a wide, flexible environment for the main observational squad to locate the movement of the enemies. This elevation is shown in Figure 4-2 and as seen from the perspective of the player in Figure 4-3.

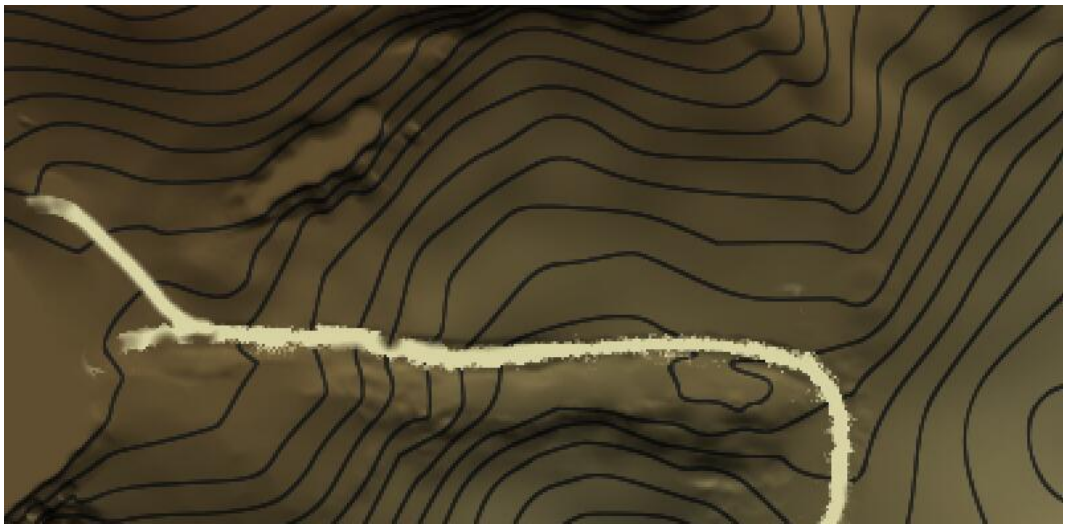

Figure 4-2 Elevation of Engagement Spot, (PUBG Interactive Map n.d.)

Figure 4-3 User Interface of PUBG

In PUBG, the trees and the cliffs can be used to provide cover to avoid attack by the enemies. In this case, the squad was guarding a highland zone that is covered with trees and small cliffs which not only allows the squad to take cover from long-range attacks, but also can negatively impact line of sight as they provide cover for enemy squads. Such a location may be of interest during playtesting of games to check whether the correct balance of cover and line of sight has been achieved. However, in general, the increased elevation would be expected to provide the observational squad with the upper hand as

they would be more difficult to locate because of the landscape of highland, cliffs, and trees, but the observational squad could locate the enemies and attack them more easily. This advantage of elevation can be illustrated by considering Figure 4-4.

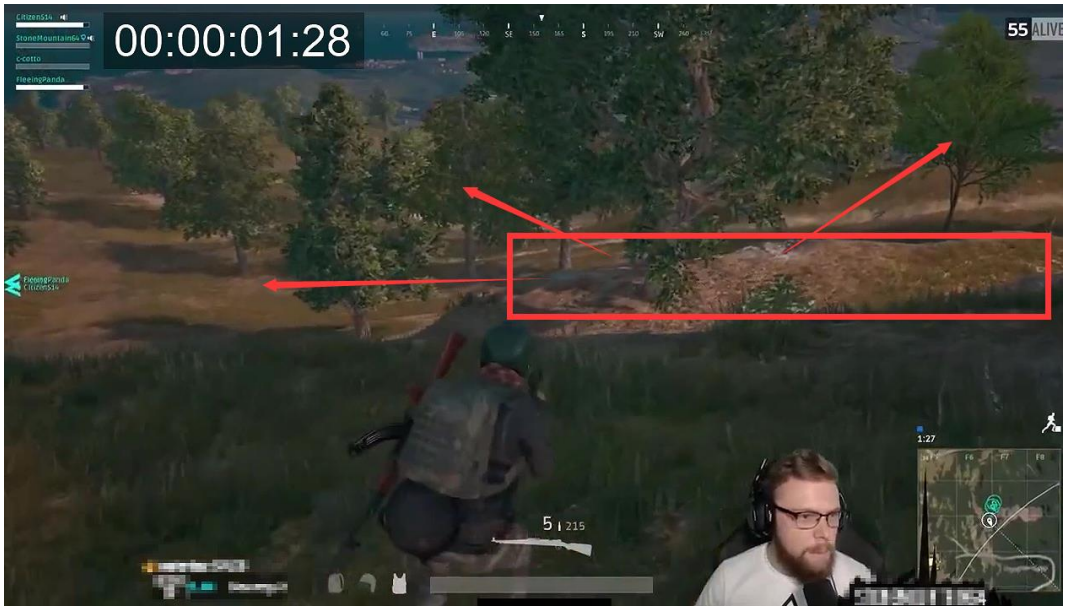

Figure 4-4 Potential Cover Spot

The highlighted zone is a cliff and it is also an example of a potential cover spot for the player. PUBG has a posture system that allows players to stand, crouch, and lie. By using the posture system, a player can take advantage of cover such as trees and rocks. Besides taking cover, the player could also move their position to get a better angle to attack the enemies, especially when player in a position of the highland-like location where the cliff top provides some degree of occlusion from enemy players further down the slope.

Figure 4-5 shown such actions from the perspective of the main observational player as they move, take cover, eliminate an enemy, and then change equipment after a short period of engagement. This sequence of events has been identified as worthy of analysis as a result. because it has included

multiple forms of higher-level actions and based on the analysis of these higher-level actions, PUBG's features on communications, actual gameplay could be identified. For example, the actions that the player has conducted, such as reloading, firing, taking cover, the action of moving, communicating, these actions have been considered as higher-level actions because these actions are the basic action that built the whole gameplay and the player experience.

Figure 4-5 Transcription of An Attack Without Audio

To emphasize the description in the further discussion, the specific observational participant within the transcription would be named Player#2, which also according to the player number displayed on the interface of the PUBG. In the first image of Figure 4-5, Player#2 has been informed about the proximity of a squad of enemies after being notified by his teammate, Player#1. According to the voice system of PUBG's user interface, the teammate who is using the voice communication system would be highlighted automatically. After Player#2 has been notified of the position of enemies, he decides to move his position and runs to another location to get different angles because he does not have a good angle of vision for observing the enemies if he remains in his current position. As a result, Player#2 has acquired a better angle to initiate an attack from behind when he arrived the other aspect of the hillside. After confirmed the position with the squad, Player#2 has located the enemies immediately and initiates an attack successfully, which eliminates one enemy.

The importance of voice communication in this engagement can be considered by furthering the multimodal transcription and adding the voice communication that is key to the success of the team in this engagement. This is shown in Figure 4-6, where #Player1 is shown in red and #Player2 in white.

Figure 4-6 Multimodal Transcription of Initiate an Attack

During this sequence of continuum action, Player#2 has switched his visual angle rapidly while he communicated with his teammate. In image1, Player#2 had begun to run to find a new position, and Player#1 has provided the information of the location of enemies and the updates for Player#2 so that Player#2 could have a clear concept of what direction he needs to look in order to initiate an attack or decide to return. In image2, Player#2 has apparently lost this sense of the direction of the location of enemies, so he raised an immediate query and he received the answer just right after he asked the question. In image3 to image5, Player#1 is guiding Player#2 to pass the tree line with verbal

communication. In image6, Player#2 has found the enemies and initiated an attack with his long-range weapon, and successfully knocked down one of the enemies.

As the position of Player#2 is hidden well, the enemies have not immediately noticed the direction of the attack initiated by Player#2, but after two or three times of firing the enemies have found the position of Player#2 and retaliated. And that is the reason why Player#2 got hit and took damage both to their health as well as their bulletproof vest[2]. In image8, Player#2 has reported his status and the fact that the enemies had lost one teammate to his teammates immediately to ensure they maintain complete situational awareness. The transcribing of this engagement continues in Figure 4-7.

[2] In PUBG, there is equipment call bulletproof vest that design for the player to reduce the damage from enemy's attack, the level of reducing damage is depending on the level of the bulletproof vest, level 1 has 30% of damage reducing, level2 has 40% and level3 has 55%. And the health point of each player is 100.

Figure 4-7 Multimodal Transcription of Locates Enemy and Providing Information

Because Player#2 has knocked down one enemy, this causes problems for the enemy squad, and thanks to the different angle of observation, Player#2 can take the responsibility for the role of sharing and updating information with his squad. In image9, Player#2 has a clear line of sight that enables him to locate the remaining enemies and share this information with his teammates. However, because Player#2 is in a different position he cannot confirm the identities of the enemies, as it could be another squad joining the engagement. Player#1 has responded quickly and given an affirmative answer back to Player#2 as shown in image10. In image11, Player#3 has given more information based on what

has been heard during the process of finding the enemies. Many gamers wear high quality headphones that allow them to pinpoint the direction of sound. This engagement would be useful in terms of playtesting games as it not only highlights the importance of voice communication, but also establishes how other game mechanics (such as directional sound) influences the gameplay.

As the game continues, Player#2 continues to engage with the enemies because they have not moved their position due to the loss of teammates. As the enemy has been knocked out rather than killed, the enemies can still save their teammate and keep the squad complete so as to not be disadvantaged on the basis of squad numbers. This is another example of how particular game mechanics can be explored in playtesting and analysed using multimodal transcription. If the ability to revive teammates was not an option, a different gameplay would likely emerge.

In image12, Player#2 has to shout out that he is reloading his weapon, which provides information for his teammates that he is not available for engaging for a short period. In image13 and 14, Player#2 considered his angle was good, but his teammate had provided further information that the enemies are running off from the fight in the voice communication system. In image15 and 16, Player#2 has moved out of his old position and is looking for a new position that provides a better vantage point for targeting the enemies. In image16, Player#2 have found out the location of the running enemies and he share this information with his squad immediately. The transcription of the engagement continues in Figure 4-8 in which Player#2's squad keeps attacking the enemy's squad.

Figure 4-8 Multimodal Transcription of Communication and Negotiation Tactics

In image17, Player#1 has knocked down one of the enemies, but he has also found out there is one more that is hiding behind cover. PUBG has a revive system, which means the knocked-down player could be revived and continue playing. Reviving a player needs one of their teammates to conduct a continuum action which is standing behind the knocked down player for 10 seconds, during which time they may not move or fire a weapon. In the situation where a player is being revived, Player#1 has caused a problem for the enemy's squad because the number of people available for combat are reduced.

In image 20 and 22, the enemy's squad seems to have given up on fighting and decide to escape, but Player#1 has noticed this and chooses to engage with the last enemy and eliminates him directly because it is the last enemy of their squad. In images 23 and 24, Player#2 has raised a tactical opinion of defending because the circle of the safe zone has been reduced, and as a result the possibility of engaging with extra enemies is increasing. In image24, Player#2 has designated the area of defense for his teammates, and he got a positive answer back from his teammates. The transcription of the video segment is continued in Figure 4-9 below.

Figure 4-9 Multimodal Transcription of Facing Another Enemy's Squad.

As has previously been described, Player#2 has decided to defend the edge of the circle because it is likely that more enemies will arrive as the circle decreases in size. The reduction of the play zone area

is a key game mechanic for PUBG, and the ability to analyze player behavior as the circle creates more density of players would clearly be useful whilst playtesting the usefulness of this particular mechanic.

In image25, Player#3 has discovered new enemies running towards the squad's position and uses a direct method to locate them, which is calling out the number of degrees of the direction[3]. Again, in terms of playtesting realizing that players utilize the compass mechanic in communication provides useful insight to game designers. After Player#3 alerts their squad, they stop and prepared to engage with the new enemy. In image26, Player#2 has given a piece of incorrect information on the exact number of the enemy's squad due to the limited vision of his position. But Player#3 has given correct information on the exact number of enemies. Player#2 has also added the information of the location of the enemy as well. In images27 and 28, Player#1 had a problem locating the enemies but with the accurate details provided by his teammates, Player#1 has successfully located the enemy. In image29, as the image described, Player#2 has in a lower position to engage which he needs to switch to a higher position to gain more vision and avoid critical damage from enemies. And this image has also indicated why Player#3 could provide the correct information because according to the cursor on the user interface shown, Player#2's teammates were in a higher position during the engagement, which gave them a better angle to locate the enemies. In the last image, which is image30, Player#2's teammate has eliminated the final enemy and they finished their fight. This continuum action of engaging last 4 minutes and 35 seconds, from the first fight in the high land to the second fight of defending the circle and eliminated all the extra enemies.

[3] In PUBG's user interface, every player has using the same system to identify the direction of coordinates. The numbers 0-360 represent the exact coordinate of east, south, west, and north. For example, if a player said 180 and that would be the south direction. Just like the function of the compass but in a simpler way.

Time stamp in video at the beginning of a higher-level mediated action	Brief description of a higher-level mediated action
0:00:01	Locating direction of the enemies
0:00:12	Teammates engaging
0:00:15	Player#2 moving position
0:00:19	Locating direction of the enemies
0:00:21	Player#2 aiming
0:00:23	Player#2 moving position
0:00:47	Player#2 exposed the position
0:00:48	Player#2 taking cover
0:00:53	Player#2 eliminate an enemies
0:00:53	Enemies fought back cause damages on Player#2
0:00:55	Player#2 taking meds
0:01:03	Player#2 aiming
0:01:09	Player#2 hit one enemy
0:01:10	Player#2 fire, but miss
0:01:15	Player#2 hit one enemy
0:01:21	Player#2 reloading
0:01:33	Player#2 fire, but miss
0:01:45	Player#2 fire, hit one enemy
0:01:55	Player#2 moving to another advantages chokepoint
0:02:05	Player#2 Stop moving, begin aiming.
0:02:07	Player#1 eliminate one enemy
0:02:15	Player#2 fire, hit one enemy
0:02:20	Player#2 fire, but miss
0:02:22	Player#2 moving
0:02:45	Player#2 changing weapons
0:02:59	Player#1 eliminate one enemy
0:03:13	Player#2 moving to the eliminated enemies
0:03:21	Player#2 Searching enemies
0:03:41	Enemies found.
0:03:44	Whole team engaging with enemies
0:04:01	Player got hit and take cover
0:04:18	Player#3 eliminated one enemy
0:04:35	Player#2 eliminated last enemy

Table 5 Higher-level Mediated Action Table of PUBG Squad Battle

In the micro analysis of the transcription and the case itself, the higher-level actions were classified as moving, firing, eliminating, locating, taking specific items of the game, reloading, aiming, and engaging. The outcomes of this micro analysis are shown in Table 5. In the higher-level mediated action table, moving means that Player#2 has to move his position from a location that he stays for a period or break the status of standing still. The engaging means the continuum action of firing that happens between Player#2's squad (Including Player#2 himself) and the enemy squad. Firing means the singular action of Player#2 and his teammates pulling their triggers and firing at the enemies. Aiming means the specific action of conducting the aiming mechanic that is designed from the game. Hitting means successfully hitting the enemies, and missing means a failure to hit the enemies. Eliminate means disable the enemies from conducting further actions, or make enemies lose their qualifications to participate in the rest of the game. Reloading and changing weapons means the action that interacts with the weapon, for example, refill the bullets for the weapon or change two secondary weapons. Locating, searching means a serial continuum action of seeking enemies. Based on the

higher-level action that was extracted and collected from the data, the process of conducting a normal engagement could be considered as:

1. Searching or locating the enemies
2. Prepare to fight immediately or moving to a position that provides a better angle from which to initiate attack.
3. Use the weapon to fire and making the action of hitting the enemy and causing damages to their health point. Or disable the enemies to making further action by causing massive damage higher than their health point.
4. Vice versa, the enemies could also cause damage to the player. To prevent the enemy from disqualifying/eliminating the player, it requires players to take cover, if they have already received damage, taking/using specific items to recover the health points.
5. Once the last enemies that participate in the engagement have been disqualifying/eliminating, the process of engagement is complete.

Substance of higher-level mediated action	Time in video (PUBG CASE#1)
Moving	0:00:01 0:00:12 0:00:18 0:00:23 0:01:54 0:02:02 0:02:13 0:02:20 0:02:41 0:02:46 0:02:58 0:03:55 0:04:07 0:04:19
Take covers	0:00:48 0:04:01 0:04:28
Aiming	0:00:20 0:00:49 0:01:02 0:01:35 0:02:01 0:02:06 0:02:17 0:02:26 0:02:43 0:02:56 0:02:03 0:03:45 0:03:48 0:03:53 0:03:59 0:04:12 0:04:33
Firing	0:00:52 0:01:06 0:01:09 0:01:15 0:01:19 0:01:27 0:01:34 0:01:41 0:01:45 0:02:11 0:02:19 0:02:28 0:02:40 0:02:44 0:03:48 0:03:55 0:04:00 0:04:05 0:04:14 0:04:17 0:04:34
Receive Damages	0:00:52 0:04:00
Reloading	0:01:21 0:02:15 0:02:49
Eliminating/Knocked Down/Causing Damages	0:01:38 0:01:45 0:03:45 0:03:52 0:03:55 0:04:14 0:04:34
Using items/loots	0:00:54 0:02:42 0:04:08
Irrelevant voice communication	0:00:26 0:01:42 0:03:07 0:04:16
Relevant voice communication	0:00:01 0:00:06 0:00:12 0:00:16 0:00:19 0:00:21 0:00:24 0:00:28 0:00:32 0:00:36 0:00:45 0:00:49 0:00:53 0:00:55 0:00:57 0:01:02 0:01:02 0:01:07 0:01:11 0:01:15 0:01:21 0:01:24 0:01:28 0:01:31 0:01:33 0:01:45 0:02:07 0:02:13 0:02:22 0:02:28 0:02:33 0:02:35 0:02:46 0:02:49 0:02:52 0:02:58 0:03:16 0:03:35 0:03:41 0:03:42 0:03:45 0:03:49 0:03:52 0:03:55 0:04:02 0:04:05 0:04:10 0:04:14 0:04:18 0:04:31
Failed voice comms	0:02:26 0:03:40 0:03:59

Table 6 Bundled Higher-level Mediated Action Table of PUBG Squad Battle

Based on the bundled higher-level action table, the features of case#1 are easily identified in an organized way. Table 6, which is the table, indicated that case#1 has included significant events consisting of firing, aiming, and voice communication that is relevant to the game. And the frequency of the higher-level action of taking cover, and the frequency of receiving damage has indicated that the whole battle was in the favour of the squad. The frequency of failed voice communications and irrelevant voice communications has barely happened, which means the effective communication was conducted well during the engagement. This table has provided certain general descriptions for the sequence. To find out more about the detail and features to better understand this sequence, the audio

transcription in the text will be used as an analyzed object and will be analyzed as well in the next paragraph.

00:01:15 Player1: Ok you really see visual 152 meter by the tree
00:01:08 Player2: Yes, I am
00:05:08 Player1: Left side of the tree
00:07:25 Player2: Squad are there, taking shot
00:11:20 Player1: 150 of you
00:13:24 Player2: I think this tree is blocking my vision, it's left to you guys.
00:16:28 Player1: They are moving
00:19:10 Player2: Left or right?
00:21:10 Player1: Left of the tree
00:23:45 Player4: Left
00:25:11 Player2: Alright I don't have position on them yet
00:30:01 Player4: If we move position we could got the position on them
00:35:00 Player2: Well I just go west of you guys, so low here.
00:36:14 Player1: Stick to us, it's pass the tree line, where are he it's just little lower(position)?
00:43:16 Player1: Yes over to your west now.
00:46:19 Player2: You could see it right, as soon you get pass to the tree line.
00:49:02 Player2: Take a shot, oh I see it.
00:50:25 Player3: 150 by the tree! 150 by the tree!

Audio Transcription 1 PUBG (1)

In the audio transcription, the verbal communication could be also identified which scenario that Player#2's squad is engaging in. Audio Transcription 1 is a text transcription of audio, which has described a scenario that Player#1 has found the enemies. But Player#2 has failed to locate the enemies because he did not have a visual of enemies. As the audio transcription indicated, Player#1 has been providing accurate information of the location of enemies to Player#2. Due to the reason of Player#2 moving to a different position, the information provided by Player#1 was probably outdated because, in the process of moving, Player#2 might have lost their sense of direction. The frequency of mentioning or asking about direction and location is increasing.

01:07:15 Player2: Nicely done. Nicely done. Hit one. Hold on, hold on, I got him.
01:16:23 Player4: Heard shots from southwest.
01:20:23 Player2: Reloading! I have a super good angel on them, guys stay cover or get some good shots on them. Ah so close!
01:30:04 Player3: Running off from south farm
01:36:04 Player2: Ah this guy just, oh, little too much for me. What? What is that?
01:45:18 Player1: Knocked them out!
01:46:14 Player2: There you go.
01:47:16 Player1: Behind the rocks, at 165!
01:51:19 Player2: Nice work, they still wanna the from tree, he's become left side right now. I don't have visual. I am moving to the south. I mean the tree is two closer tree, he's running back! He made it to the tree. It's closer the rock, it's just little north of the rock.
02:07:21 Player1: Knocked down! Ok there is one more of their squad.

Audio Transcription 2 PUBG (2)

According to the Audio Transcription 2, in the process of fighting or engaging, the communication content would be also included high-frequency location information content. The red and yellow highlighted text is the actual audio communication transcription. Most of the audio is related to information that enemies have been knocked down, or enemies spotted. As the process of engaging continues, the information of the enemy's location has been mentioned often. Based on the transcription, the actual communication content would be mostly like self's status reporting, for example, reporting the action of reloading a weapon, reporting the status of the enemy, and reporting the action of damage caused to the enemy. Besides the status reporting, the location, or information reporting is another major content during the communication, such as reporting the direction and location.

In this case, by comparing the multimodal transcription and the audio transcription, the higher-level action that conducted during the engaging phase and searching phase, is mostly leading by the communication contents. Players sharing their information in the real-time voice in-game communication system to different teammates of the squad, and making movements, actions based on

the information that given by teammates. For example, Player#2 has found the enemy by following the information and guidance from Player#1, because the location has been confirmed by Player#1 and Player#4 (Figure 4-6), the movements and actions have been narrowed down into moving to the new position to allows Player#2 initiates the attack by following the information. Basically, the higher-level action of engagement in PUBG is:

1. Communicating (Sharing information)
2. Conducting actions that follow from the communication.

In general, the features of case#1 could be considered as two battles that happen on different aspects of a location offering a team advantage, and includes great quality of communications. The advantages the location offered the squad was incredible vision and angles for squad#1 to attack the enemies from different angles. Great quality of communication on strategies discussion and information providing by each teammate of the squad, has lower the whole squad's risk of making decisions on deploying tactics such as initiate an attack or evacuate from the engaging area. Each of these general conclusions can be related to specific game design features or mechanics relevant to the gameplay.

4.1.2 PUBG Case Study#2

The second case study of PUBG is a case from the final period of a game in DUO mode, where a team consists of two rather than four players. The map is same as the case study#1, which is large Erangel map. In the case study, the safe zone has already been significantly reduced with only two further reductions remaining, which means each survivor has approximately 5-6 minutes left to fight with the other remaining survivor and the game would end automatically because the safe zone would shrink

into a spot so that player could not survive and will be eliminated by the game mechanism automatically. In this case study, there are only six players are remaining in the game, and the area of the final fight has been highlighted in the in-game small map located to the right bottom of the player user interface of PUBG. The final battle area is located in the plain covered by grass, some small ravines that could be used as cover if the player were crouching down, and some trees. Based on the small map of the game, the exact location could be identified as the lower plain to the south of the farm as shown in Figure 4-10.

Figure 4-10 Location of Final Battle (PUBG Interactive Map, n.d.)

According to the interactive map of PUBG, the location of the final battle has few buildings that provide large cover for the players. The blue circle indicates the current safe zone and the small white

circle is the upcoming safe zone, which means all the players need to enter this zone quickly to avoid receiving critical damage as a result of the playzone game mechanic. Figure 4-11 is the elevation map of the location that will be the stage of the final battle of the game.

Figure 4-11 Elevation Map of the location of Final Battle (PUBG Interactive Map, n.d.)

According to this map, the landscape of this area is relatively flat due in accordance with plain-like landscape. This means each player is sharing the same elevation and altitude to fight, unlike case#1. In case#1, the player's squad was engaging with the enemies in hills which provides advantages in terms of both locating and fighting with the enemies. In Case#2, this hill advantage has disappeared. The main factor that would influence winning the game would be position of cover, and the route of movement in the playzone. Figure 4-12 is the multimodal transcription, including audio

communication, of Player#1 and Player#2 first time conducting continuum action in the period of the final battle.

Figure 4-12 Multimodal Transcription of Final Battle. (1)

In image1 and image2, Player#1 and Player#2 have led down on the ground to prevent any movements that lead to exposing their position. In image1, Player#1 has noticed that the remaining number of

players in the game is down to the final six. This action of reminding could prevent Player#2 from missing the information because whilst this information would be displayed on the right top side of the PUBG user interface, it is very easy to ignore while the player was conducting a continuum action such as observing. And in image2 Player#1 has swung his perspective to observing any possible place that might be the hidden position for the remaining enemy players. In the meanwhile, Player#2 has also provided a piece of information on the remaining time of the shrinking of the safe zone to remind the squad that it needs to enter the safe zone. In image3, Player#1 has noticed that the small ravines could be considered as potential cover to protect them from any danger while they enter the safe zone. From image1 to image3, they have spent 14 seconds observing the place that might be hiding an enemy squad, but the result is they have not located the locations of enemies successfully. In image4, Player#1 has noticed that one enemy was crawling on the edge of the circle. But Player#2 was in a different position so in the voice communication system he proposed an inquiry of the location of the enemy.

In image5, Player#1 has used a weapon that is equipped with a long-distance scope to locate the enemy he just found. However, as the enemy was moving in the meantime, Player#1 has lost the visual sign of the enemy. But Player#1 still provides a potential direction to Player#2. In image6, Player#1 has moved to a location that is potentially behind the position of the enemy with a running movement action that results in a faster speed but with more noise that can easily exposes the players location. In image7 and image8, Player#1 has moved to a position that could easily initiate an attack on the enemy from behind with a medium-range distance and Player#1 has also conducted the attack by using his weapon and eliminated the enemy immediately. In image8, Player#1 successfully eliminated the enemy directly because the enemy was the last member of their squad. As mentioned before, if the player has become the last member of their squad, once this player has been knocked down then the

player would be removed from the game directly by the game mechanic. In image9 Player#1 was asking Player#2 to come to his position with the voice communication system. In image10, Player#1 was examining the enemy's loot to find supplies, as the possessions of all eliminated players are left in the game and can be picked up by surviving players. As has been previously noted, the multimodal analysis approach allows actions relevant to specific game mechanics to be easily identified and analyzed. The continuation of the transcription of this engagement is given in Figure 4-13.

Figure 4-13 Multimodal Transcription of Final Battle. (2)

In fact, image10 and image11 were a continuum action of acquiring loot from the eliminated enemy. But to identify different phases of action that happen during the sequence, using the action of before and after acquiring items from loot would be a clear mark to separate the different phases. In image11, Player#2 has successfully acquired the Ghillie suit[4]. The Ghillie suit has made it easier for Player#2 to hide when crawling on the ground and passing the grass area. As the multimodal transcription of Figure 4-12 described in the beginning, the circle is closing in already, which means the safe zone has been shrinking when they moving to different positions to eliminate the enemy. The actual communication contents are totally different in image11, Player#1 is still worrying about the trees that might be the cover position for extra hidden enemies after the engagement happened seconds ago, and Player#2 was worrying about the shrinking safe zone and trying to remind Player#1 to move. In image12, because the safe zone has been shrunk and Player#1's squad is still outside the safe zone, Player#1 has received considerable damage from the safe zone mechanic. In the meanwhile, Player#2 still takes the responsibility of observing the tree's position to prevent possible ambushes.

Player#1 and Player#2 have managed to enter the safe zone by crawling and try to recover their health point to a safe limit in image 13 and 14. From image11 to image 16, which means from 52 seconds to 1 minute and 53 seconds, Player#1 and Player#2 have failed to locate the position of hidden enemies in the safe zone. In image 14, Player#2 has provided information of the numbers of remaining players, and Player#2 also giving a potential location that might be hiding the enemies. In image15, Player#2 is using a grenade as a decoying method to lure out the enemies and initiate a surprise attack by throwing it into the tree area, however this attempt is unsuccessful. It takes until 2 minutes and 5

[4] A special costume that providing a specific disguise function for a player hiding in a specific area, in PUBG it can be acquired from the air supply.

seconds of the clip, which is the image17, until Player#2 has successfully located one enemy and also reported this toto Player#1. In image18, Player#1 is moving himself to the position of the grass field that Player#2 has identified as being the location of the enemy.

Figure 4-13 could be considered as a reconning phase because the game play that is the subject of the multimodal transcription does not include any content related to an engagement, instead it consists of observing and communicating the possible location of enemies. The exception to this is when Player#2 using a surprising tactic to attempt to lure out the enemy which has failed. Once the enemies showed up and the reconning phase would be shifted to the engaging phase because the purpose of recon is to locate the enemies. Figure 4-14 is the multimodal transcription of engagement after the enemies have been located.

Figure 4-14 Multimodal Transcription of Final Battle. (3)

In image19, Player#2 has heard the gunshot from another place and makes an inquiry to find out the location of the gunfire. Because the gunfire is from a different enemy, this was not observed because of his current location. The location of the gunshot was close to Player#1 and Player#1 also reported the information to Player#2 directly. In image 20, to avoid the attack from enemies, Player#1 has moved his position to behind the tree which could be used as solid cover. In image21, Player#1 has noticed that one enemy was attacking other enemies from a different place and Player#1 has the best chance to initiate an attack from behind, which Player#1 also behind a solid cover as well in the meanwhile. In image23 and image 24, Player#1 has successfully knocked down this enemy, and Player#1 has also caused massive damage that will essentially result in the enemy being eliminated from the game after the knocked down phase. In the meantime, Player#2 has been knocked down as

well due to an engagement with a separate enemy. In the voice communication system, Player#2 has asked Player#1 to ignore him because there are two enemies left and Player#1 could not arrive at the place where Player#2 got knocked down. The remaining gameplay is transcribed in Figure 4-15.

Figure 4-15 Multimodal Transcription of Final Battle (4)

In image 25, Player#1 has observed the grass field in an attempt to identify enemies. In Image26, Player#2 has noticed the position of hidden enemies and report to Player#1. In the meantime, after observing that behind the tree as cover, Player#1 has also located to the enemy, and the remaining enemies have dropped to one left due to the reason of possible knocked down enemies has been eliminated by overtime eliminated. In image27, Player#1 has to aim at the last enemy and prepares to shoot. In the image28, because Player#1 has the disguise function provided by the Ghillie suit that was

picked from the loot earlier, the enemy hasn't reacted yet and has been directly eliminated by Player#1. In the image29, it is the winning declaration page of the PUBG, which means the win belongs to Player#1 and Player#2 as a squad.

Because of the different scenarios and different modes, the higher-level action has shown different features in comparison to the first case. This is shown in Table 7.

Time stamp in video at the beginning of a higher-level mediated action	Brief description of a higher-level mediated action
0:00:02	Moving as crawling
0:00:07	Moving as crawling
0:00:17	Moving as running
0:00:19	Located the enemy
0:00:21	Player#1 aiming
0:00:23	Player#1 moving
0:00:32	Player#1 aiming
0:00:33	Player#1 firing
0:00:35	Player#1 eliminate an enemies
0:00:36	Player#1 moving
0:00:39	Player#1 moving as crouching
0:00:45	Player#1 searching for loots
0:00:51	Player#1 use the loots
0:00:53	Moving as crouching
0:01:11	Moving as crawling
0:01:13	Squad receive damages (Out side of Safe zone)
0:01:15	Moving as crawling
0:01:18	Moving as running
0:01:19	Moving as crouching
0:01:27	Player#1 use items
0:01:28	Moving as crouching
0:01:50	Player#2 using items
0:02:05	Player#2 found enemies
0:02:07	Player#2 firing
0:02:09	Player#2 receive damages (from enemy)
0:02:23	Player#1 moving as running
0:02:24	Player#1 aiming and firing
0:02:28	Player#1 eliminate an enemy
0:02:28	Player#2 has been knocked down
0:02:29	Player#1 reloading
0:02:32	Player1 taking cover
0:02:35	Player#1 aiming and firing
0:02:37	Player#1 eliminated last enemy

Table 7 Higher-level Mediated Action Table of PUBG Duo Mode

The higher-level action that occurs with greatest frequency during this case would be different types of moving, such as running, crawling, crouching. This differs from case#1, where the majority of movement was running. The mode of action varies between the two cases as a direct result of the different style of gameplay, which emerges from specific design features and mechanics of the game. Furthermore, the overall diversity of high-level actions has changed as well. In case#1, the player's squad engaged with the enemies a lot under a wide and open environment and the position they were

holding is a high-ground chokepoint. The feature of the advantageous location in case#1 has reduced the risk of Player#1's squad while they are engaging with the enemies. Besides, Player#1's squad was inside the safe zone and also near the edge of it, ambushing the enemies that have not entered the safe zone would also be an easy task for them because those enemies outside the safe zone were normally already receiving certain damage by the game mechanic. That also reduced the risk of engaging for Player#1's squad. To separate the different squads in different cases and prevent chaos on the further discussion, the squad in case#2 would be Squad#2 instead of Player#1 squad.

In case#2, the squad is facing a totally different scenario. The phase of the game has come to a closing end, everyone was trying to hide behind cover and wait for other teams to expose their position and be eliminated by others. That is the main reason why the pattern of higher-level actions in case#2 is totally different from case#1.

Substance of higher-level mediated action	Time in video (PUBG CASE#2)
Moving	0:00:01 0:00:19 0:00:23 0:00:25 0:00:37 0:00:39 0:00:54 0:01:09 0:01:17 0:01:19 0:01:34 0:02:22 0:02:31
Aiming	0:00:21 0:00:32 0:02:24 0:02:35
Firing	0:00:33 0:02:07 0:02:15 0:02:25 0:02:36
Reloading	0:00:41 0:02:28
Eliminating/Knocked Down	0:00:34 0:02:28 0:02:37
Using items/loots	0:00:46 0:01:22 0:01:45
Irrelevant voice communication	0:00:55 0:01:15 0:01:21 0:01:25
Relevant voice communication	0:00:01 0:00:07 0:00:08 0:00:11 0:00:18 0:00:20 0:00:22 0:00:27 0:00:36 0:00:41 0:00:43 0:00:59 0:01:02 0:01:10 0:01:30 0:01:32 0:01:38 0:01:43 0:01:53 0:02:05 0:02:11 0:02:28 0:02:33
Failed voice comms	0:02:30

Table 8 Bundled higher-level mediated action table of PUBG Duo Mode

According to Table 8, the pattern of higher-level actions of case#2 is mainly consisted of voice communication and moving. In case#2, Player#1 has eliminated three enemies by aiming 4 times, firing 5 times, and reloading 2 times. And based on the multimodal transcription, each time of aiming, firing that also leading to one time of elimination successfully. Additionally, Player#1 has not conducted any extra high-level action of engaging but instead conducting multiple movements in different patterns and lots of time communicating. And based on the communication from multimodal transcriptions, most of the actual communication content is the provision of information, primarily the location of the enemies, with some discussion of the number of remaining enemies Player#1 and Player#2 are barely negotiating the tactics, and the action and movements are not led by the communication, which is totally different from case#1.

Another feature of cases is the length of the engagements and the times of locating enemies. According to Table 7, the squad only located enemies twice, one is at 19 seconds of the sequence, the other one is at around 2 minutes and 5 seconds. In both instances, locating enemies successfully has led to an engagement. The time of the first engagement was from 33 seconds to 35 seconds, which takes a total of 3 seconds from aiming to eliminate. The time of the second engagement began when Player#2 located the enemies at 2 minutes and 5 seconds of the sequence and ending when Player#1 had eliminated the last enemies and won the whole game at 2 minutes 37 seconds. The difference between the first time of engaging and the second time of engaging is the number of enemies. The first time of engaging, there is only one enemy, in the second time of engaging, squad#2 has to face more than two enemies and some of them are still in a position that squad#2 not aware of.

There is one more feature that needs to be discussed, which is the cover and location. As mentioned before, the landscape of the final battle was located on a plain covered by grass, one small building, and some trees. The cover in this specific area provide few advantages during the engagement because it is an open wide area. But still, Player#1 has used the special feature of disguising items and crawling through the grass on a very small hill to avoid enemies successfully. In the second battle, Player#1 has eliminated the enemies that could initiate the attack on the people who are behind it and use this safety cover to eliminate the last enemies. Generally, the process of conducting the final battle in PUBG would be:

1. Entering the safe zone without noticed by other players.
2. Locating the remaining players.
3. Moving under the cover even it can not provide huge protection.
4. Once locating the enemies and eliminated those enemies who could create a danger to the people behind the cover.
5. Once make sure the cover is safe, attack the rest of the enemies.

As for the communication that happened during the sequence, the features of it were mainly based on the information providing and brief conduct tactics discussions between Player#1 and Player#2. As the multimodal transcriptions shown, most of the enemies remained in an unknown status for squad#2, which is Player#1 and Player#2's squad. And the reason of that could leads to the mode of the game, which is the Duo mode. Before Player#2 located the enemies in the fields, there were three enemies left and all of them were in unknown locations. This kind of uncertainty has become the key factors of why most of the communication contents were mainly the discussions of enemies' locations, instead of talking about strategies.

00:02:24 Player#1: Six left
00:07:00 Player#2: We have 40 seconds, let's trying go to··· I don't know···
00:13:04 Player#1: We gotta take this hills here as cover I think, I think that's our best move.
00:19:04 Player#1: I see one!
00:20:20 Player#2: Where?
00:22:01 Player#1: Straight in front of me
00:27:20 Player#2: I don't see anything
00:36:28 Player#1: Got him
00:41:00 Player#1: Come over to me
00:43:20 Player#2: Yeah
00:56:01 Player#2: Where are they(enemy)?
00:59:16 Player#2: Circle closing in, they might be in these trees.
01:01:16 Player#1: they might be in these trees.
01:09:06 Player#2: I am watching the tree on the right, immediately.
01:30:10 Player#2: Three left, I don't think they behind the tree.
01:39:20 Player#2: Maybe the big one to the west, 285? I have grenade, I could check them.
01:45:10 Player#1: Okay.
01:54:08 Player#1: I bet they are in the house, the shed.
01:58:16 Player#2: Three of them?
01:59:27 Player#1: Maybe two.
02:04:15 Player#2: I think I see one.
02:12:03 Player#2: Where is that from? I see I see one closer.
02:13:07 Player#1: Right in front of me.
02:29:00 Player#2: Go without me, I am fine.
02:35:15 Player#2: I think there still one, two on the west, behind the rocks.

Audio Transcription 3 PUBG (3)

In Audio Transcription 3, the highlighted parts in green color are related to information sharing, the red parts are the communication related to strategy and tactics. According to the contents of the whole process of squad#2 won the game that delivered by multimodal transcriptions, the uncertainty caused by the player limits in Duo mode has created less playable content for the player. The style of the players would prefer to hiding and prevent any actions that could expose their information such as locations and the remaining number of the squad. Under this style, the player experiences would fill a process that fill with massive high-level actions such as crawling and observing enemies.

4.1.3 PUBG case study#3

The third case of PUBG is also a continuum sequence of the closing end for the game, which also could be considered similar to the final battle that was the subject of case#2, but in a different form. And the form of case#3 has also consisted of different elements. Case#3's main observational object is a player who is in a four-player squad, which for clarity has been named as squad#3. According to the small map of the PUBG's user interface provided, the location where the sequence was conducted has been identified and is shown in Figure 4-16.

Figure 4-16 Location of Battle, (PUBG Interactive Map, n.d.)

The sequence was located on a small courtyard which includes two house-like buildings, one small shed, and some debris of a car inside the courtyard. The whole courtyard was surrounded by walls, and the height of the walls was the same as the player's character of the game. And the safe zone has also shrunk to this courtyard, according to the white circle is shown on the small map.

The elevation map shown in Figure 4-17 also indicates that the courtyard, which is the stage of the final battle, is located on a plain. The landscape around the courtyard was also almost flat, except for the small hills located behind the courtyard.

*Figure 4-17 (*PUBG Interactive Map*, n.d.)*

Comparing Figure 4-16 and Figure 4-17, the upcoming safe zone has excluded the hills area outside the safe zone. Besides the courtyard, the elements of cover that could provide advantage to a squad are limited, there only being one tree on the left side of the wall that surrounded the courtyard. This structure of this place, which also could be considered as the stage of the final battle of the game, has

indicated that the whole battle would be only conducted around this courtyard. Because the courtyard has provided spots of cover that could let each player have great protection from another player's attack. For example. The house-like building could provide solid cover from whole squads to initiating attacks or defending. However, an entire squad in a building is vulnerable to grenade attack. Like the house, the walls could provide good cover for the squads that are outside the courtyard but more flexibility in terms of where the squad can move without giving away their location. Figure 4-18 shows the buildings located in the courtyard.

Figure 4-18 Building of the Courtyard (Xaiin, n.d.)

As mentioned before, the courtyard includes two house-like buildings, which is the left image, and one shed, which is the right image. The house-like building has three separate spaces, kitchen, toilet, and main bedroom. The main bedroom and kitchen provide large windows that could be used for observing and to initiate attacks. The window in the toilet is small and does not allow players in the toilet to conduct attacks, but it could also be used for observational purposes. The left figure is the image of the shed, which also located in the courtyard. The shed has one door and four windows, none of which are available for conducting attacks by using weapons, except using throwing weapons.

Both buildings could be used as a great cover for defense from the majority of attacks, however throwing weapons could penetrate the building and cause massive damage to the players inside because the space of the building has increased the difficulty of evacuating during an attack using a grenade or other throwing weapons. Especially for the player inside the shed, although the shed could give a solid cover for the player to get away from enemies' attacks, (most of them are bullets), once the player got inside and it is hard to leave the shed because there is the only exit of the shed, unlike the house-like building, the house-like building has two exits. These plans of the buildings are shown in Figure 4-19.

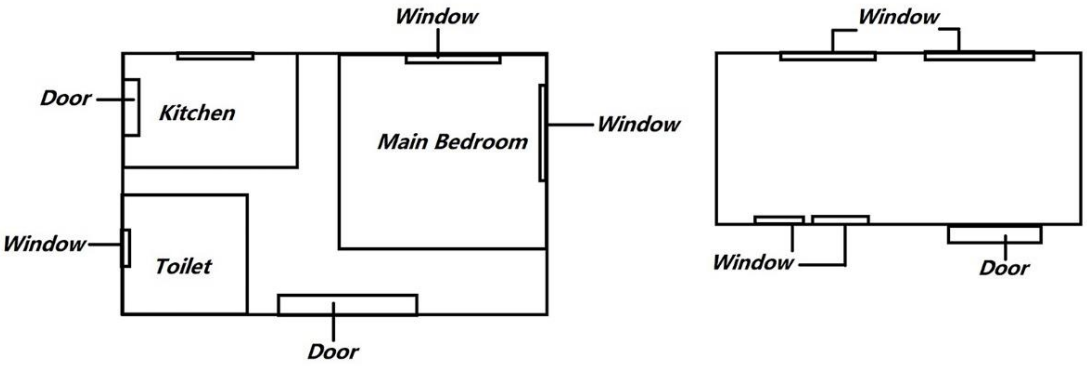

Figure 4-19 Layout of The House-Like Building, and Shed

Unlike case#1 and case#2, case#3 did not happen on a wide-open area that not provide much cover, instead the environment included buildings, walls and associated cover. Figure 4-20 shows the initial transcription at the beginning of the sequence of case#3.

Figure 4-20 Multimodal Transcription of Sequence of Case#3（1）

Squad#3 has entered the safe zone near the courtyard, and Player#1 has aimed at the rock because he was notified by the teammates of the location of the enemy. In image2 3, Player#1 has eliminated this enemy directly. In the meanwhile, before Player#2 fires the weapon, Player#2 has also given extra details of the enemy by describing the actual status of the enemy, which is running away, and provide this detail to the squad. In image3, after Player#1 has knocked down this enemy, Player#3 has also given a response of the elimination by reporting the "enemy is dead" to the squad. In image4, the remaining players have come to the number of 7, which means there are three more enemies left.

While squad#3 has observed the courtyard and try to locate the enemies, Player#1, and Player#4 have successfully located one enemy's location. In Player#1's view, the enemy was near the abandoned car in the middle of the courtyard. In Player#4's view, he has noticed the enemy running towards the house. The outcomes of the communication of reporting the location of the enemy from Player#1 and Player#4 are also different. Player#1 keeps repeating "car", which means the location might be around the abandoned car based on his position. Player#4 has proposed a tactic strategy which is to let the enemy move to the house. Player#3 has not acquired the vision of the enemies in the image4, but 2 seconds later he successfully located the running enemy as well and reported to the squad immediately in image5, so does Player#2, Player#2 also reported that she has successfully located the running enemy.

As the first player of the squad that located the enemy, Player#1 choose to initiate an attack by throwing a grenade to the abandoned car, which is also close to the location of the running enemy in the image5. After the grenade has been thrown, Player#1 has also moved his position to the wall that might be the cover of the enemies in image6. In the meanwhile, Player#3 has reminded the number of remaining enemies to the squad. In image7, Player#1 has arrived in the position that might be the hiding place or cover of the enemies, and the rest of the squad members have successfully knocked down one enemy when Player#1 was moving position. Player#4 has also trying to highlight the location of the car. But due to the reason of Player#1 was not in the same engagement area as his squad, and the multimodal transcription is locked to Player#1's perspective, the actual meaning of Player#4's communication is not identified. In image8, Player#3 has reported that the knocked down enemy has been eliminated and two enemies left after the elimination of the enemy. And Player#2 has successfully located the location of the enemy and reported it to the squad. Figure 4-21 continues the sequence transcription.

Figure 4-21 Multimodal Transcription of Sequence of Case#3（2）

In image9, Player#2 has withdrawn the report that she saw an enemy in front of her because Player#2 considered the "enemy" that she identified in image8 might be the shadow instead of an actual enemy. And she also reported her thoughts to the squad as well. Player#3 and Player#4 have discussed the potential hidden place of the last two enemies, and Player#3 has confirmed the enemies are in the shed. In the meantime, because as discussed in the last paragraph, Player#1 was in a totally different position from his squad, the location of other teammates is unknown. In image10, although Player#1 was not

in the same position and direction as his teammates under the information provided by Player#3, which is the enemies are in the shed, Player#1 has chosen to initiate an attack by throwing a grenade to the shed that located in the courtyard.

In image11, when Player#1 has moved his position closer to his teammates, Player#3 has reported that he has successfully found an enemy in the west, and this information has also confirmed by Player#2 right after Player#3 reported and Player#2 has also pointed out that the tree is the exact location of the enemy. In image12, Player#1 has also successfully found the enemy under the tree based on Player#2 and Player#3's information. But before Player#1 has arrived at the position closer to the squad, Player#3 has been knocked down by the enemy already. Player#4 has reported that he does not have a visual on enemies. In image13, Player#1 has stayed behind the abandoned car as cover and asked Player#3 if he could crawl back to the place that behind the cover. As Player#4 has failed to locate the enemy in image12, Player#2 and Player#3 have kept repeating the location of the enemy for Player#4. In image14, Player#1 is trying to revive Player#3 but Player#3 forgot to remain in a still position so that Player#1 asked Player#3 to stop moving. In image15, Player#1 was reviving Player#3 and Player#3 has giving his advice on the strategy of taking cover. But in the process of reviving, Player#3 has noticed that enemy was moving their position as well and it is very close to the position of Player#1 and Player#3. After Player#3 has reporting this information to Player#1 and Player#1 gave an affirmative response. In image16, Player#1 has revived the Player#3 and returned to the cover behind the abandoned car. The transcription is continued in Figure 4-22.

Figure 4-22 Multimodal Transcription of Sequence of Case#3（3）

In image17 and image18, Player#1 has tried using a gun as a weapon to attack the enemy but because the enemy is not visible, Player#1 has chosen to swap to a grenade as weapon. In the meantime,

Player#2 and Player#3 have been knocked down by the enemy, and they also knocked down one enemy meaning that there is only a single enemy remaining. In image18 and 19, Player#3 has given information related to the potential position of the last enemy. In image19 and 20, Player#1 is moving to this potential position based on the information that has been given by Player#3. In image21, Player#4 has asked the remaining teammates to hold on. In image22, Player#3 and Player#4 have found the last enemy was in the shed instead of the house that Player#3 indicated in image18 and 19, with the relative positions shown in Figure 4-23.

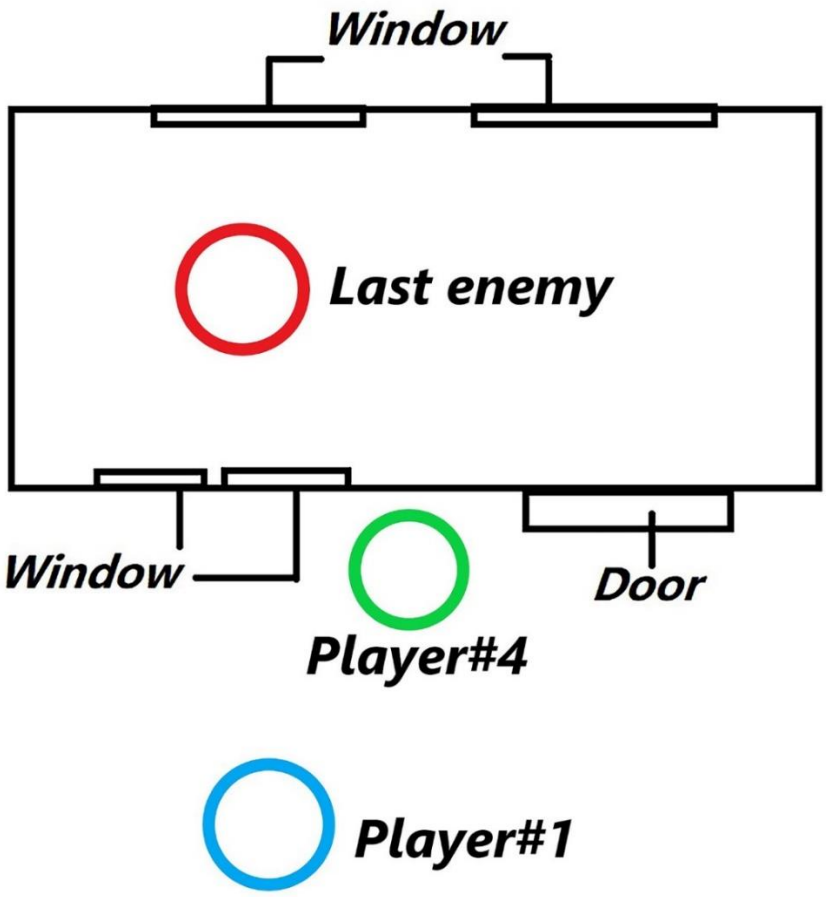

Figure 4-23 Position of Squads and Enemy

In images 23, 24, and 25, Player#1 has eliminated the last enemy. As the shed has only one exit and small windows that could only be used as an observational function, a player outside the shed could

easily attack the player inside the shed through the windows. After the last enemy has been eliminated, squad#3 has won the game. The high-level actions of this sequence are shown in Table 9.

Time stamp in video at the beginning of a higher-level mediated action	Brief description of a higher-level mediated action
0:00:02	Player#1 Aiming
0:00:03	Player#1 Crouching
0:00:04	Player#1 Changing Weapon
0:00:05	Player#1 Changing Weapon
0:00:06	Player#1 Aiming
0:00:07	Player#1 firing
0:00:08	Player#1 elinminated an enemy
0:00:12	Player#1 reloading
0:00:13	Player#1 moving
0:00:15	Player#1 Changing Weapon
0:00:17	Player#1 Throwing grenade
0:00:20	Player#1 Changing Weapon
0:00:21	Player#1 moving as crouching
0:00:23	Player#1 moving as running
0:00:26	Player#1 Changing Weapon
0:00:35	Player#1 moving as croching
0:00:39	Player#1 Observing
0:01:02	Player#1 Changing Weapon
0:01:05	Player#1 Throwing grenade
0:01:11	Player#1 Changing Weapon
0:01:13	Player#1 Moving as crouching
0:01:19	Player#2 has been knocked down
0:01:20	Player#1 Taking cover
0:01:21	Player#1 found enemies
0:01:23	Player#1 aiming
0:01:27	Player#1 moving to other cover
0:01:29	Player#1 moving to other cover
0:01:31	Player#2 Evacuating
0:01:38	Player#1 moving to the Player#2
0:01:45	Player#1 reviving Player#2
0:01:56	Player1 Moving back to the cover
0:02:00	Player#1 Firing
0:02:01	Player#1 Throwing Smoke Grenade
0:02:01	Player#2 and Player#3 has been knocked down
0:02:06	Player#1 moving as running
0:02:10	Player#1 receives damages
0:02:11	Player#1 Taking cover
0:02:16	Player#1 Moving as crouching
0:02:18	Enemy firing
0:02:20	Player#1 firing
0:02:21	Player#1 Elinminated last enemy

Table 9 Higher-level Mediated Action Table of Battle in Courtyard.

The main feature of the higher-level actions shown in the sequence of case#3 relates to changing weapon, aiming, moving, and firing. The patterns of moving, while Player#1 moving in the game, are different. And the action of changing weapons, using throwing weapons also happens commonly in this sequence. Generally, due to different landscapes, modes, types of enemies, types of covers, and locations of case#3, the higher-level actions have also changed. For example, the frequency of moving is mainly increased, because the courtyard has blocked every player's vision when the player is using the courtyard as cover. The frequency of changing weapons is also increased due to the different ranges

of attack and different types of cover in the play area. Player#3 used throwing weapons a lot because the location of enemies was not able to be attacked using guns. In the first 2 seconds of the sequence, Player#1 was using the long-range weapon as an attack method, in 2 minutes and 21 seconds, Player#1 switched to short-range weapons as an attack method. Based on image1 and image 25 from Figure 4-20 and Figure 4-22, it can be seen that the two different firings were initiated as a result of different cover, distances, and different locations. Each of the two times of firing using different attack methods led to a successful elimination of the enemy.

Unlike case#1 and case#2, the frequency of higher-level action of taking cover has decreased in case#3. The reason of that is the feature of the location of the whole case#3 took place, which is a courtyard. As previously mentioned, the courtyard included buildings, walls, and some abandoned cars. And the higher-level action of moving was often taken place near the walls, abandoned cars, and buildings. That means most of the higher-level action of moving has been conducted by the player, they also conducted the higher-level action of taking cover at the same time.

Substance of higher-level mediated action	Time in video (PUBG CASE#3)
Moving	0:00:03 0:00:13 0:00:20 0:00:31 0:00:36 0:01:01 0:01:09 0:01:20 0:01:26 0:01:56 0:02:06 0:02:13
Aiming	0:00:01 0:00:06 0:01:23
Firing/Using Throwing Weapons	0:00:07 0:00:17 0:01:05 0:01:59 0:02:03 0:02:19
Reloading/Changing Weapons	0:00:04 0:00:05 0:00:12 0:00:15 0:01:02
Eliminating/Knocked Down	0:00:08 0:01:18 0:02:04 0:02:21
Irrelevant voice communication	0:01:00 0:01:20 0:01:58 0:02:09 0:02:11
Take Covers	0:00:03 0:00:29 0:00:35 0:01:20 0:01:27 0:01:46 0:01:57 0:02:01 0:02:10 0:02:16
Relevant voice communication	0:00:01 0:00:06 0:00:08 0:00:10 0:00:13 0:00:17 0:00:19 0:00:20 0:00:20 0:00:27 0:00:30 0:00:36 0:00:38 0:00:40 0:00:51 0:01:02 0:01:04 0:01:08 0:01:13 0:01:16 0:01:22 0:01:24 0:01:25 0:01:30 0:01:46 0:01:53 0:01:56 0:02:03 0:02:05 0:02:14
Failed voice comms	0:02:30 0:00:33 0:00:47 0:01:12 0:01:48 0:01:50 0:01:50 0:02:17
Revive Teammates	0:01:39

Table 10 Bundled higher-level mediated action table of PUBG Battle in Courtyard.

The bundled higher-level action table has indicated the communication was the highest-frequency higher-level action in this sequence according to Table 10. But the frequency of failed voice communication has also increased as well.

0:00:02 Player#3: The car, behind this.
0:00:03 Player#2: I see one.
0:00:04 Player#3: Knocked, two out.
0:00:05 Player#1: Nice, nice, nice
0:00:06 Player#1: Rock, rock, rock
0:00:08 Player#2: There is guy running out there, a guy running out.
0:00:09 Player#1: Down, down, down, down, down.
0:00:10 Player#3: Dead, dead, dead, dead, dead.
0:00:13 Player#1: Car, car, car, car, car. Compound.
0:00:15 Player#3: Who is running?
0:00:16 Player#4: Let them run, let them run! Is the house.
0:00:18 Player#3: I see the guy running. I see the guy running.
0:00:19 Player#2: I see the guy running. I see the guy running.
0:00:20 Player#1: Tossing a grenade!
0:00:23 Player#2: Two left, two left, two left.
0:00:24 Player#1: Alright, grenade.
0:00:28 Player#3: He's down, he's down, he's down.
0:00:30 Player#1: House.
0:00:30 Player#3: Watch out the car.
0:00:33 Player#1: This side···
0:00:35 Player#3: He's down. Dead.
0:00:35 Player#2: Nice
0:00:36 Player#3: He's dead.

Audio Transcription 4 PUBG (4)

As Audio Transcription 4 shown, most of the content of the communication relates to the game movements. And the multimodal transcriptions also show that this communication includes information, strategies of the game, and urgent status reports such as Player#4 asking Player#1 to stay in position in a sudden occasion in image 21 of Figure 4.3.7. This communication has contributed to the elimination of enemies and even the wining of the game. However, the communication content is repetitive as indicated in Audio Transcription 5.

0:00:06 Player#1: Rock, rock, rock
0:00:08 Player#2: There is guy running out there, a guy running out.
0:00:09 Player#1: Down, down, down, down, down.
0:00:10 Player#3: Dead, dead, dead, dead, dead.
0:00:13 Player#1: Car, car, car, car, car. Compound.

Audio Transcription 5 PUBG (5)

As can be seen in the audio transcription of the process of squad#3's first elimination of an enemy at the beginning of the sequence, the key information in the communication was repeat by different players multiple times. And when the player repeating the information or reporting status to the squad, another player was also repeating and reporting as well. For example, in the nine-second, Player#1 has eliminated one enemy and he keep repeating the word "Down" more than 5 times. In the meanwhile, Player#3 also repeats this information that the same enemy has been eliminated by repeating the word "Dead" more than three times. Although the information is the same and coherent to the actual scenario, the overlap has caused the process of poor quality of communication. In other squad teammates' voice communication system, which is the side of receiving the message in the process of communication, is two people repeating a word synchronically with different tones.

Audio Transcription 6 is also the audio transcription during the process of image11 to 12 from multimodal transcription of the sequence.

0:01:20 Player#1: Oh no! No, no, no, no. I see him, I see him, I see him!
0:01:22 Player#3: West…
0:01:23 Player#4: I don't see him.
0:01:25 Player#3: He's west, he's behind the house. Behind the house.

Audio Transcription 6 PUBG (6)

Player #1 has reported that he has the visual of the enemy by using interjection words such as “Oh, no!” and also repeating the fact that he has the visual on the enemy by using the term “I see him”. Within 2 seconds, Player#3 has given a direction in a very short word “West” to the squad while Player#1 was repeating. But the information has inadequate details for other squad members because Player#4 has reported that he didn’t see the enemy. To help Player#4, Player#3 has described the direction and given more details to the squad again and this time.

Again, the phenomenon of repeating in the process of communication happened. And the communication has also causing details to be missing when Player#3 was providing information by using a simple word “West”.

4.2 CS: GO Case Study

Counter Strike: Global Offensive (CS: GO) is a competitive shooting game between two teams, the terrorist team and the counter-terrorist team, that plays out over several rounds. As mentioned before, CS: GO has several modes of gameplay, but the competitive mode is the most significant one and this is why the competitive mode is used in this research.

Unlike PUBG, CS: GO is a game that has strict rules on the gameplay. There is a maximum of 30 rounds in competitive mode, three results of the game: draw, lose and win. An overall win is achieved when a team wins 16 of the rounds out of the 30 maximum, resulting in the other team losing. A draw occurs when two teams each have won 15 out of the 30 rounds. Each team switches their side in the 16th round. For example, the counter-terrorist team would switch to the identity of terrorist side after

the 15th round and vice-versa. The terms of winning one round are also based on the identity of the team. For example, to win any round the terrorist team must plant a bomb and ensure it goes off within the time limit of one round, just 1 minute and 55 seconds. Noting that the bomb has a 40 second timer, it is clear that the game play in any given round is faced-paced. If the bomb is prevented from being planted or defused by the counter-terrorist team, then the counter-terrorist team has won the round.

The sequences used the case study have happened in a map called Mirage. This map was designed in a Middle East style and includes lots of locations, chokepoints and complex routes. The spawn points are located on the opposite sides of the map, and there are two designated bomb planting sites (A and B) located between the spawn points. The Mirage map and callouts are shown in Figure 4-24.

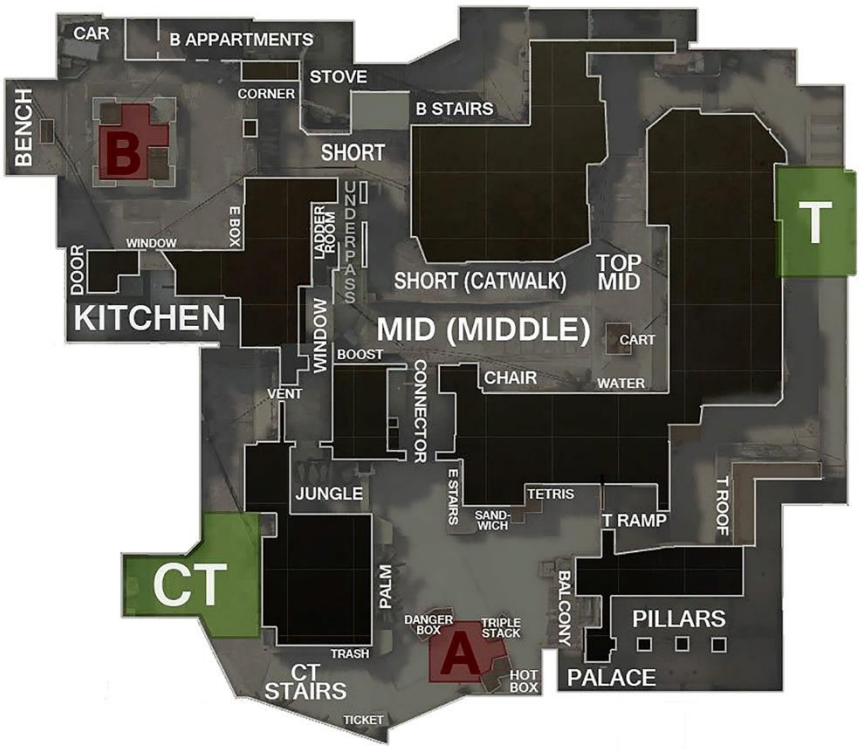

Figure 4-24 Map and Callouts of the Mirage (CS, 2014)

In this map, the main locations have been named by the player community based on the features of the location, as this simplifies communication during the game. By using these names, or “callouts”, it could be easy to provide information during the combat and prevent distraction from the process of considering how to describe the locations.

Figure 4-25 shows the user interface of CS: GO. The whole user interface consists of the main camera view, which is the first person perspective of the player, the real-time location module, mini map, health condition module, remaining bullets module, time module, and team status module.

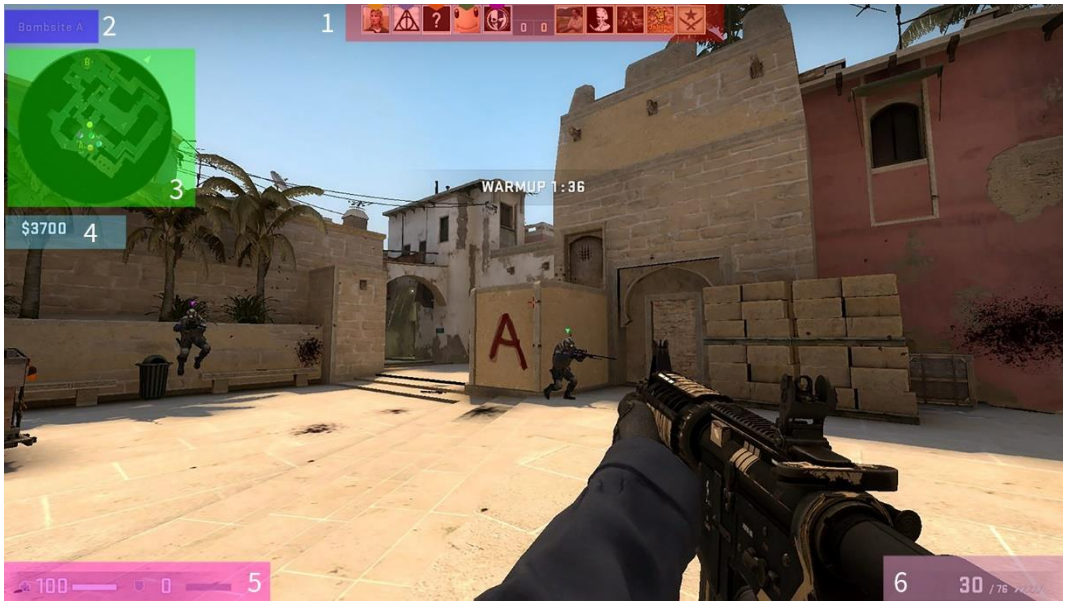

Figure 4-25 User Interface of CS: GO

Each module has been highlighted in the figure. The first module (1 - red) is the team status and time module. This module provides the basic information of the remaining players in each team, the remaining time of this round, and the remaining rounds of the game. The second module (2 - blue) is the real-time location reminder module, which displays the location of the player as text. As the player moves to a new position, this module changes the location displayed based on the player's movements. The third module (3 - green) is the mini map, which displays the real-time location of both the player and all teammates as an overlay of the 2D level map. The fourth module (4 - teal) is the remaining currency. Players receive currency amounts by conducting bonus actions such as eliminating an enemy or defusing the bomb successfully. The currency can be used to purchase items and weapons at the beginning of the rounds. In the first rounds, each player has an initial amount of $800 and a free knife and pistol. The fifth module (5 – pink) is the health condition module. This module provides the current health status of the player. The maximum number of health points is 100 points, and the armor also has a maximum of 100 points. Once these points have decreased by receiving damage, they cannot increase within the round. Each round, the health points refresh to 100, however the armor can only

be increased by buying a new bulletproof vest. The sixth module (6 – purple) is the remaining bullets module. This informs the player of the exact number of remaining bullets in their weapons in a numerical way. The rest of the user interface consists of the player view in the first-person perspective.

In this case study, three rounds from the same game have been processed into multimodal data and will be discussed and analyzed.

4.2.1 Case Study#1

This sequence was in the early phases of a game where each team has won a single round. As mentioned before, each team has the same amount of currency at the first round of the game, and winning, elimination, and other bonus action would increase the currency. The sequence under analysis is the third round, and a win for each team means that the two teams had about the same amount of currency, and the weapons and items are relatively equal. Figure 4-26 is a multimodal transcription of the first engagement and elimination during sequence#1 from the beginning.

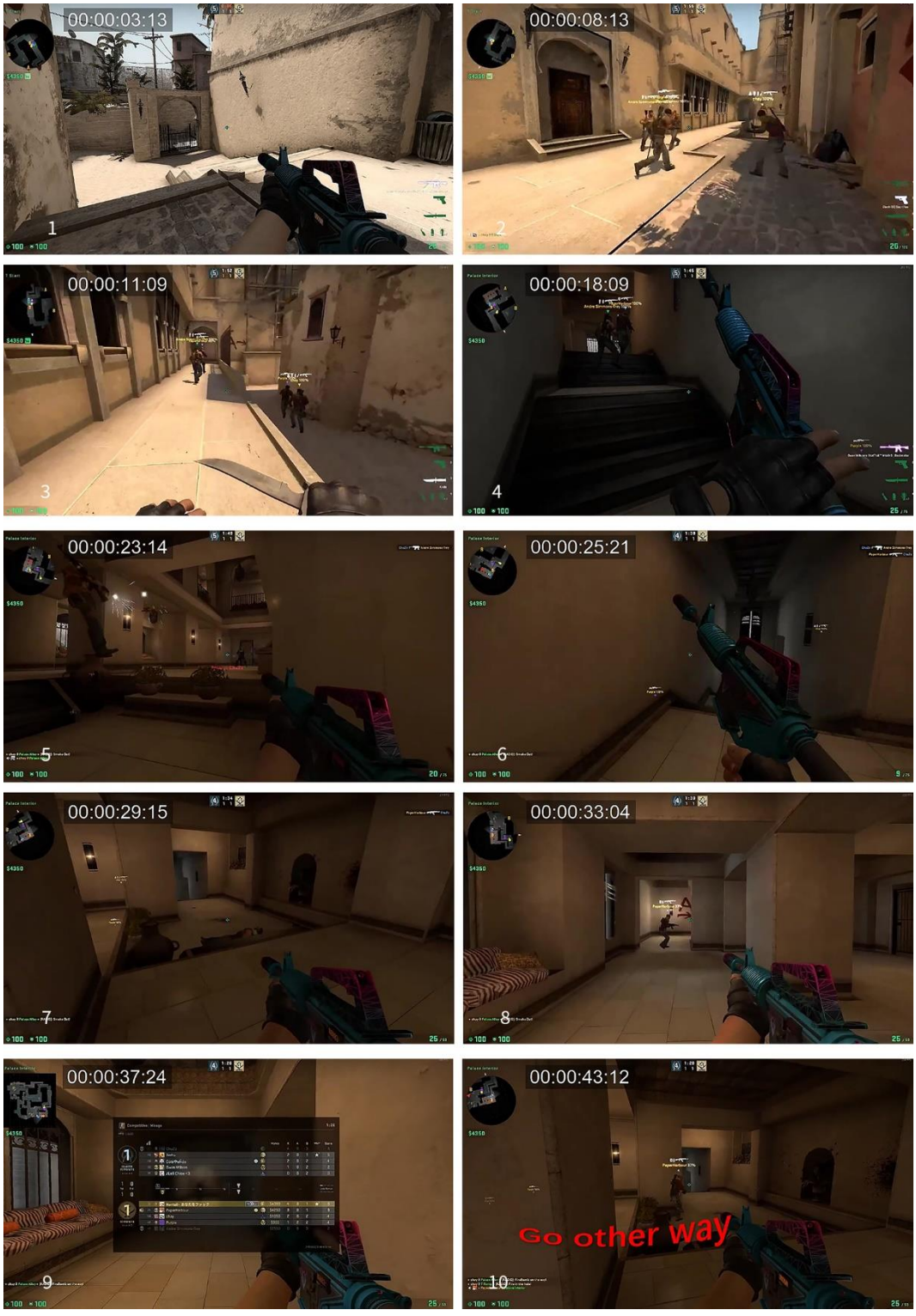

Figure 4-26 Multimodal Transcription of CS: GO (1)

In image1, Player#1 (the main player in terms of observation) has been designated as playing in the terrorist team, which means for the next 15 rounds, Player#1 has to play as the terrorist team and respawn from the terrorist side at the beginning of each round before the 16th round. The terrorist

spawn site is shown in Figure 4-27, both in terms of location on the map, but also as seen in the game.

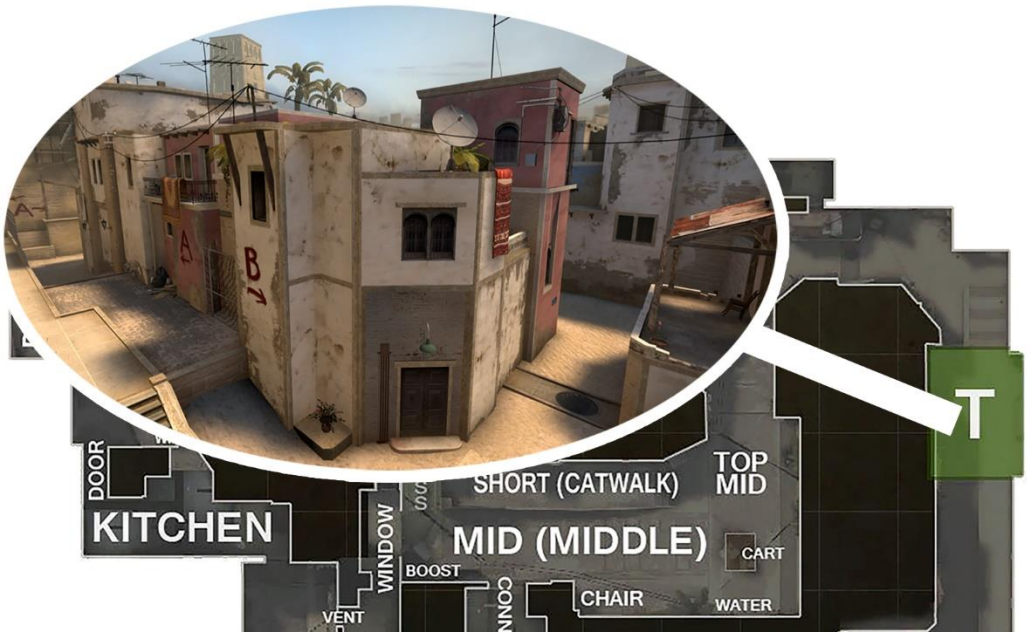

Figure 4-27 Terrorist Team Spawn Site

The terrorist spawn site has been designed as a part of the street that has two exits that connect to the A and B bombsites. The direction of each bomb site has been marked on the wall with an arrow mark. In image2, the position of the other four terrorist team teammate's spawn was relatively close to the bombsite A. In image3, the whole terrorist team was moving to the A bombsite. This image has also indicated a small feature of the CS: GO, Player#1 has switched his weapon into the knife. In CS: GO, each weapon has a weight system, the heavier weapons would cause a decrease in moving speed. And as the knife is the lightest weapon, by switching to the knife, the player could reach the fastest speed whilst moving. As was highlighted in the analysis of the PUBG cases, multimodal analysis of the gameplay provides very fine-grained analysis of how game mechanics influence the actual gameplay. Bombsite A is closer to the terrorist spawn point than bombsite B, making it an attractive destination. However, it is very much closer to the counter-terrorist spawn point, which make is easy to defend.

The palace is roughly equidistant to both spawn points and as such is highly likely that the counter-terrorist team may try to reach this location to defend the bombsite due to the way it restricts the movements of the terrorist team players. This location is shown in Figure 4-28.

Figure 4-28 Chokepoint Palace

The location of the palace is an indoor chokepoint that also includes three pillars inside. As Figure 4-28 illustrated, the blue zone was the visible area for the terrorist team, and the pink zone is the blind spot once the terrorist team has entered the chokepoint of the palace. And the red zone is another entrance that closes to the counter-terrorist team spawn site. In image4, Player#1 had switched to the main weapon when he entered the palace, no doubt anticipated the chance of an engagement occurring.

In image5, when the terrorist team has entered the palace, an enemy from the counter-terrorist team has attacked the terrorists from the blind spot area, which is the pink zone marked in Figure 4-28. This enemy has eliminated one of terrorist team players and has been eliminated by Player#1. In image6, Player#1 is reloading their weapon before proceeding to guard the entrance to the palace as seen in image7. In image8, Player#1 has switched his sight of vision to the teammate (Player#2) who is

guarding the other entrance to the palace. In image9, Player#1 is using the scoreboard function of the game to check the remaining players. In image10, Player#1 followed Player#2 to leave the chokepoint of the palace by using the entrance of the terrorist spawn site's side. Further transcription of the sequence is shown in Figure 4-29.

Figure 4-29 Figure Multimodal Transcription of CS: GO (2)

In image11, Player#1 and Player#2 have returned to the terrorist team spawn site. In image12 and 13,

Player#1 was also using the method of switching to the lightest weapon to increase the speed of movement. In the meanwhile, the enemy has turned up and Player#2 has fought back with his weapon. In image14, Player#1 has turned his focus to the wall side and has switched to the main weapon. In image15, Player#2 has been eliminated by the enemy on the right side of Player#1, and the enemy has tried to eliminate Player#1 as well. Also, Player#2 is the bomb carrier of the team, in the moment that Player#2 got eliminated, the bomb dropped to the ground immediately as well.

In image16, Player#1 has tried to retaliate and successfully caused damage to the enemy. After the enemy got hit by Player#1, the enemy was trying to leave this engagement spot. In image17, Player#1 has moved to the stairs. In image18, Player#1 eliminated the enemy in the location between stairs and the terrorist spawn site. The spatial location of these engagement sites is show in Figure 4-30.

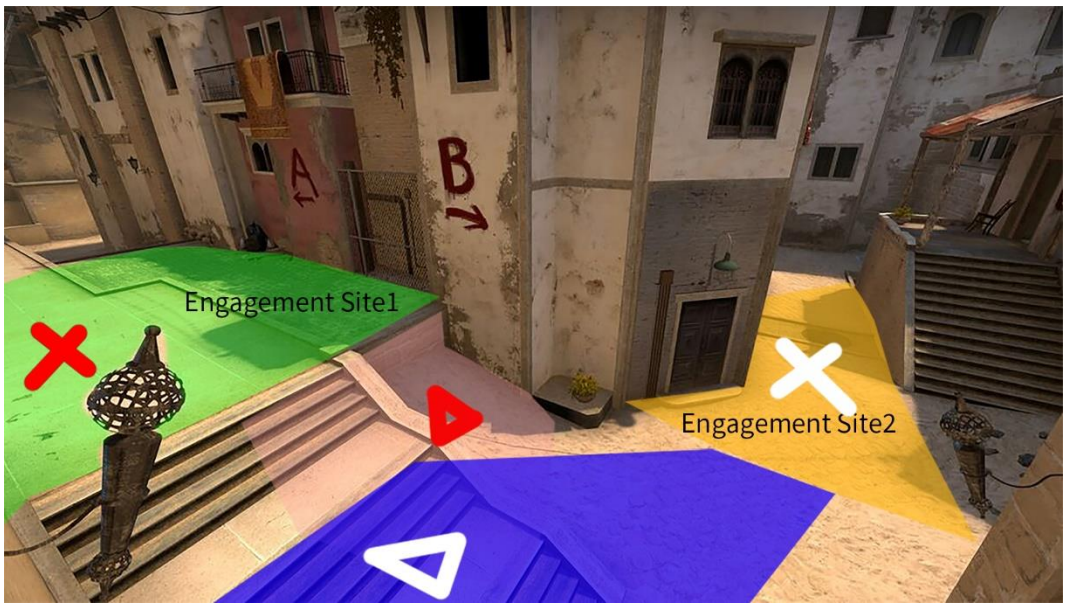

Figure 4-30 Location of Engagement Spots

The first engagement is marked as the green area and the pink area. The enemy was in the pink area, which has a stair and a small amount cover to protect himself from the attack by Player#1 and Player#2.

The green area was the location that Player#1 and Player#2 got ambushed, as the figure indicated, there is no cover in the green area. The red mark of the triangle is the attacked position, and the red cross is the position where Player#2 was eliminated. After the first engagement happened, the enemy moved to the yellow area and Player#1 moved to the blue area as well. The white mark of the triangle is the position where Player#1 attacked, and the white mark of the cross is the elimination location of the enemy. The blue area has a large angle from which to attack the yellow area, the wall of the corner cannot provide any protection to the enemy when the attack was initiated from the blue area.

The view shown in Figure 4-30 shows that even relatively small areas can produce interesting gameplay when the map is designed around balancing factors such as cover, line of site and elevation. Figure 4-31 continues the transcription of this sequence.

Figure 4-31 Multimodal Transcription of CS: GO (3)

In image19 and 20, Player#1 has carried the bomb to bombsite B, the route that he selected was bypassing the B stair, stove, and apartment. In the process of moving, Player#1 has focused on the locations that might be the place enemies are hiding and ready to attack. This action that was conducted

in advance called Prefiring. Player#1 used the action of “Prefiring” when he passed by the B Stairs, and the windows in the apartment. In image21 and 22, Player#1 has arrived at bombsite B and also using “Prefiring” when he passed the locations of Van, Bench, and Door of the Kitchen. In image23, Player#1 was planting the bomb at bombsite B. In the meanwhile, Player#3 has thrown a smoke grenade (a throwing item that could block vision in CS: GO) to the bombsite B to cover Player#1 while he was planting the bomb. In image24, and 25, Player#3 has eliminated an enemy while he was in the apartment, and Player#1 was using the action of “Prefiring” to guard the location knows as “Short” whilst also using the walls as cover. In image26, Player#1 has noticed the last enemy was in the Kitchen. In image27, Player#1 has left the cover and returned to bombsite B and eliminated the last enemy. Figure 4-32 shows the movements of Player#1 in this round.

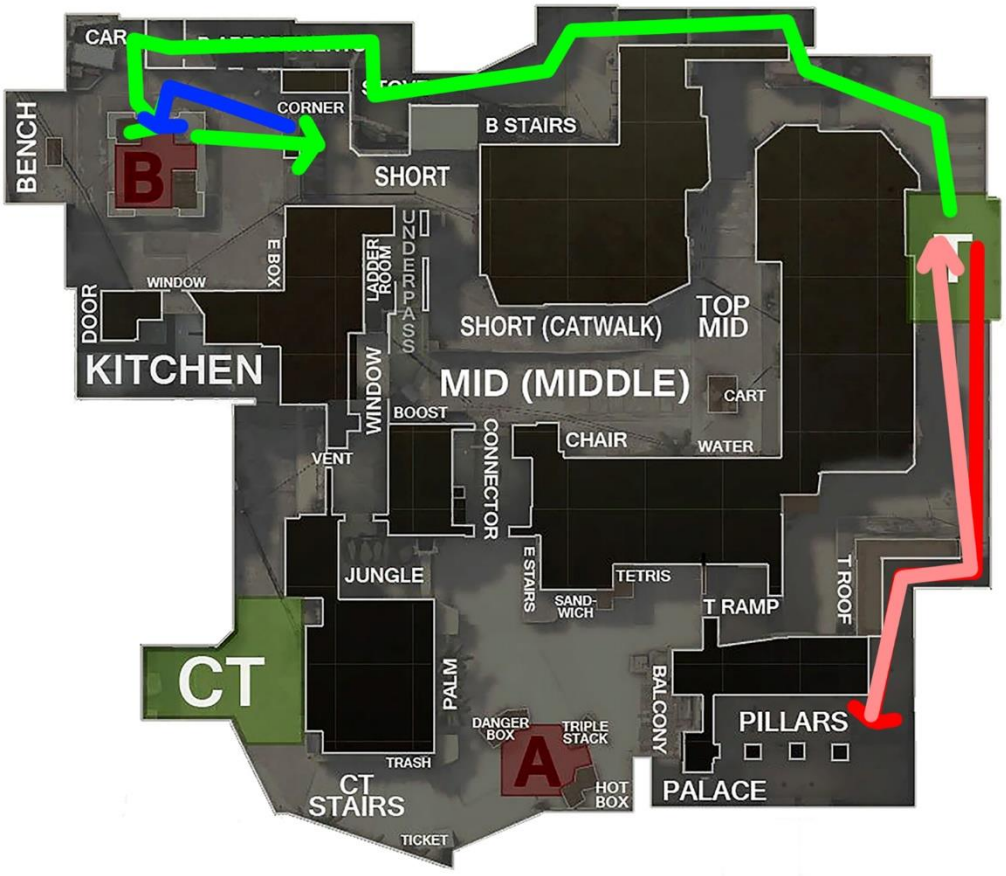

Figure 4-32 Moving Route of Player#1in Case#1

The first phase of movement is from the terrorist spawn site to the location of the Palace and Pillars, and from there Player#1 returns to terrorist spawn site in the second phase. The third movement is from terrorist spawn site to the bombsite B, specifically the location known as “Corner”. In their final movement, the player enters bombsite B. In these four phases of moving, Player#1 has passed through a number of chokepoints which are designed to create restrictions that promote encounters between the two teams and it is clear that the multimodal analysis of the engagement has identified these encounters and this supports the potential usefulness of the approach in the playtesting of games.

The main patterns of higher-level action conducted by Player#1 in this round were moving, firing, “Pre-firing”, change weapons and these are shown in Table 11.

Time stamp in video at the beginning of a higher-level mediated action	Brief description of a higher-level mediated action
0:00:08	Moving
0:00:09	Change Weapon
0:00:17	Change Weapon
0:00:18	Moving (Silent walk)
0:00:22	Firing
0:00:22	Enemy firing
0:00:23	Teammate Eliminated
0:00:24	Enemy Eliminated
0:00:25	Reloading
0:00:28	Moving
0:00:33	Waiting
0:00:35	Teammate Firing
0:00:40	Moving
0:00:53	Change Weapon
0:00:56	Teammate Firing
0:00:56	Change Weapon
0:00:57	Teammate Eliminated
0:00:58	Firing
0:00:59	Moving
0:01:01	Picked Up Bomb
0:01:02	Moving
0:01:03	Firing
0:01:04	Enemy Eliminated
0:01:04	Moving(Silent walk)
0:01:10	Moving
0:01:13	Pre-firing
0:01:13	Moving
0:01:17	Pre-firing
0:01:18	Moving
0:01:21	Pre-firing
0:01:21	Moving
0:01:23	Pre-firing
0:01:23	Moving
0:01:25	Pre-firing
0:01:25	Moving
0:01:27	Pre-firing
0:01:27	Moving
0:01:28	Teammate Deploy Item
0:01:31	Planting Bomb
0:01:35	Moving
0:01:42	Teammate Firing
0:01:44	Taking cover
0:01:49	Enemy Eliminated by Teammate
0:01:50	Taking cover
0:01:50	Enemy Deploy Item
0:01:52	Pre-firing
0:01:53	Firing
0:01:54	Moving
0:01:56	Enemy Eliminated

Table 11 Higher-level Mediated Action Table of CS: GO (1)

The chokepoints that Player#1 has encountered are mainly located in the route that connects B stairs and bombsite B. According to the higher-level action table, Player#1 has conducted the actions of moving and “Prefiring” after he is moving along the route that connects B Stairs to bombsite B. In this process, the patterns of Player#1 were “Prefiring” to the chokepoint, then once it is considered safe to keep walking along the route and conducting the same pattern of higher-level actions again at the next chokepoints.

When Player#1 has entered this route, the time limit of this round has 40 seconds, and the position of the enemies remained unknown. Generally, the distribution of the locations Apartments, B stairs, Van,

Bench, and Car, have caused a slight imbalance for the player who wants to initiate an attack or plant the bomb in bombsite B by using this route. From 1 minutes 4 seconds to 1 minutes 31 seconds, Player#1 conducted 13 “Prefiring” and moving actions.

As can be seen in Figure 4-33, this route was a route that has multiple entrances and exits, by using the underpass to defend the B stairs, Stove, and Apartment. However, as can be seen in Figure 4-33, the counter-terrorist team has two main access routes to arrive at the route taken by Player#1 to bombsite B

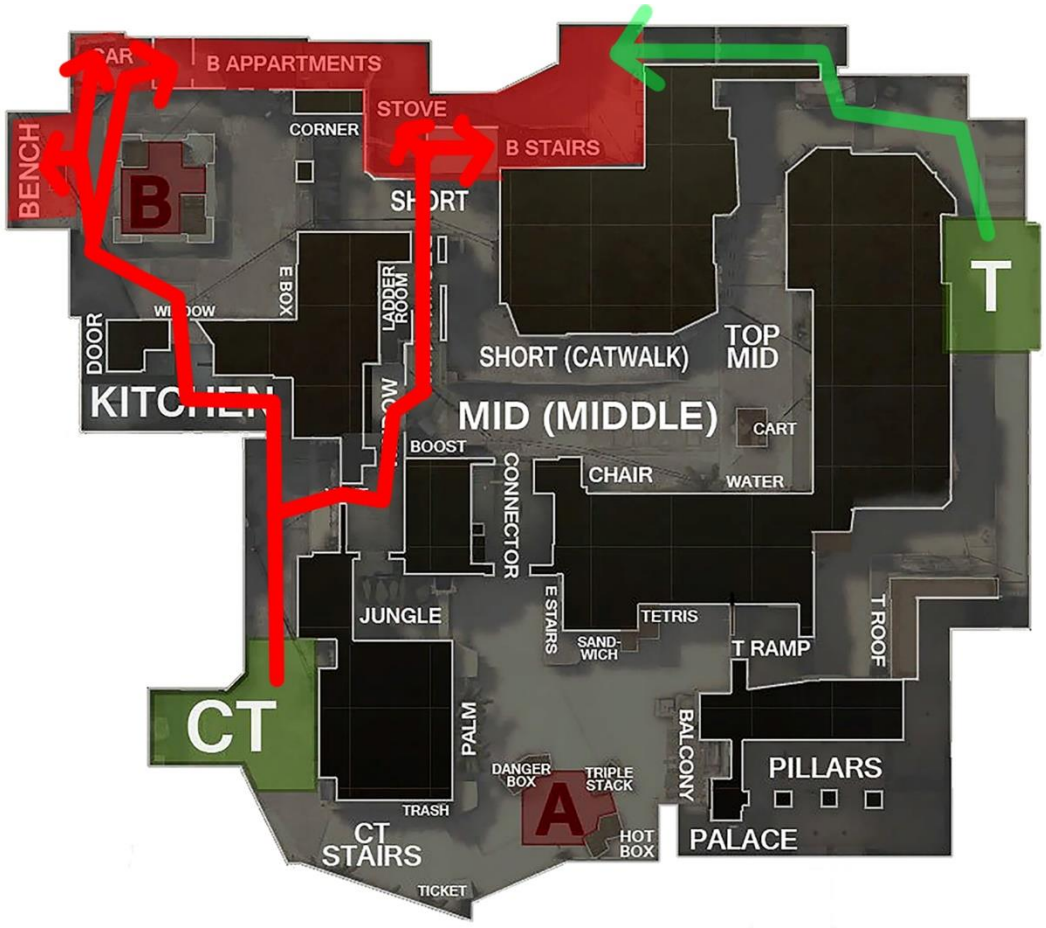

Figure 4-33 Potential Ambushed Spot and Defense Route of Counter-Terrorist Team

Figure 4-34 Chokepoint of Underpass and Short

Once committed to this route, there is only one exit for the terrorist team to change their mind, which is the B stairs. But the B stairs are also one of the access routes for the counter-terrorist team to move to the red zone that include several chokepoints. This means the counter-terrorist team could attack the terrorist from different directions if the terrorist team were moving along this route. And no safe evacuation for the terrorist team if the counter-terrorist team was attacking them from chokepoint Underpass and Short, which has been highlighted in red area in Figure 4-34.

4.2.2 Case Study #2

The sequence of case study#2 is also a part of the beginning phase of the game. The terrorist team is 3 rounds ahead of the counter-terrorist team, with the current score being 4-1, and the counter-terrorist team have only won one of the five completed rounds. According to the bonus system, the losing rounds have results in the addition of $1400 for each teammate on the losing side. If the losing rounds have come to two rounds in a row or three times in a row, the losing bonus would come to $1900 or $2400. That means in this sequence, which is also the 5th round of the game, each team has relatively

similar weapons because the losing side has already received the losing bonus from those losing rounds and those higher-power weapons are affordable for the losing side. The multimodal transcription of the sequence starts in Figure 4-35.

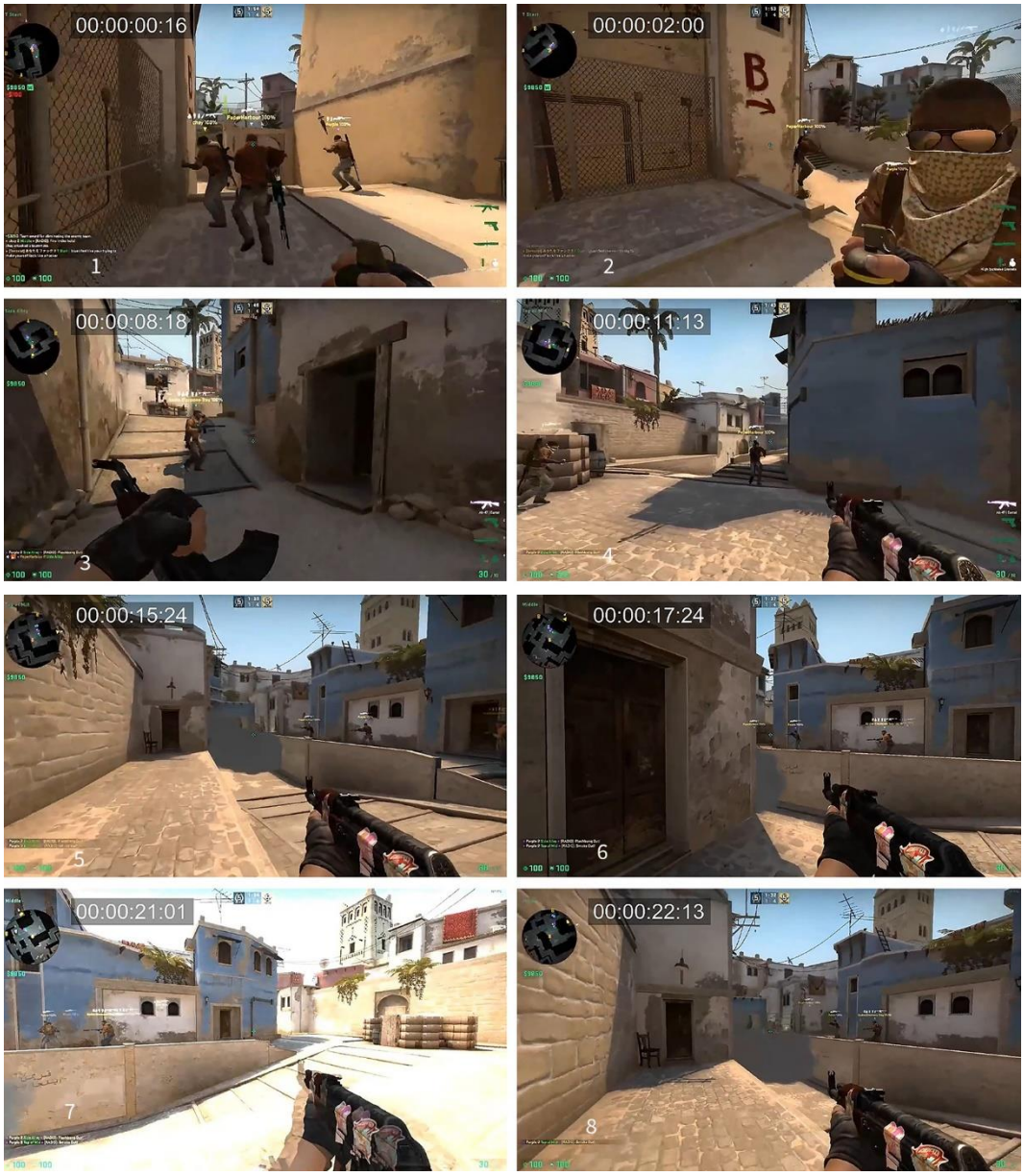

Figure 4-35 Multimodal Transcription of CS: GO (4)

In image 1, the terrorist team has spawned in the same spot as the first round. The spawn sites of the terrorist team and the counter-terrorist team are fixed and unchangeable. In image2, Player#1 has a

small collision problem with his teammate. They blocked each other's way when Player#1 wanted to move with the main squad and this teammate was trying to move to the position that allowed him to throw a grenade across the street. In CS: GO, each character that is controlled by the player has a solid model, which means each character cannot occupy the same space in the game. In image3, Player#1 is about to enter the Middle area and he has switched to his main weapon. In image4, Player#1 has entered the Middle location while also using "Prefiring" to prepare to engage the potential enemies behind the Window.

The Middle area is a large open area in the center of the map. It is location that sees frequent battles as it connects the two bomb sites. Indeed, snipers from both sides often wait for their victims here as it is designed to be an area where engagements happen. This location is visualized in Figure 4-36.

Figure 4-36 Mirage Map Middle Area

The pink area is the area that the terrorist team entering and initiates engagement with the counter-terrorist team. And the yellow area is the Catwalk callout, it is a pathway that allows the terrorist team

to enter the bombsite B without entering the apartment route mentioned in the last case. The green area is known as the Window, which his located in a position near the counter-terrorist spawn site. The blue area and the red area in this figure are the Chair and Connector callouts.

As would be expected given the likelihood of engagements in this area, the space has been designed to promote engaging gameplay, and provides a well-balanced trade off between cover, elevation, and line of sight. As a specific example, consider the Window which is shown in Figure 4-37.

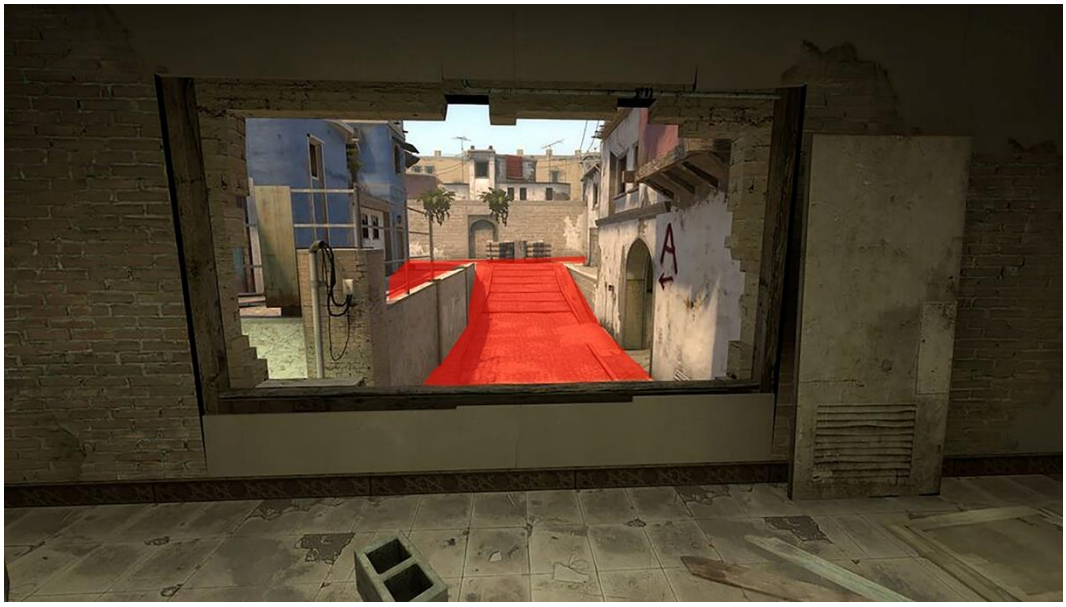

Figure 4-37 Window Callout

Figure 4-37 shows the view from the Window into the Middle. The counter-terrorist team can enter this location to defend against the terrorist team. The red zone is the area that the counter-terrorist team could have good vision and angle to conduct engagement, particularly of players entering from the Top Mid location. However, these would be at a similar elevation and are also afford a number of cover options, by hiding behind the Cart or moving to the Chair. Referring to Figure 4-36, in order to prevent the potential defense from the counter-terrorist team, the terrorist team used a smoke grenade, which is a throwing item that could releases smoke to block the vision of a certain area, the view from

the Window. In image5 and image6, Player#1 has moved to the position of the Chair, which is a small location that allows people to defend a potential attack from the Catwalk. And the terrorist team has also deployed the smoke grenade to block the Connector location. In image7, Player#1 has lost his visual for a few seconds due to the enemy throwing a flash grenade from the Connector, which is also a throwing item that creates a stunning and visual-dysfunction effect on every player. Player#1 has used the action of turning around to avoid the stunning effect caused by the flash grenade. In image8, Player#1 has moved a little back and is preparing to initiate an attack on the enemies. The multimodal transcription continues in Figure 4-38.

Figure 4-38 Multimodal Transcription of CS: GO (5)

In image9, Player#1 has left the Middle area and he has also switched to the knife to gain the fastest walking speed. In image10 Player#1 has taken position near the entrance of the Apartment, switched to the main weapon, and is preparing to engage with potential enemies. In image11, Player#1 is using the "Prefiring" action to guarantee the position of the front is safe. In image12, Player#1 is under attack from the terrorist team spawn site. In image13, Player#1 has been eliminated by the enemy. At the same time, the terrorist team has been reduced to only one teammate remaining. In image14, as Player#1 is no longer in the game the view has switched to the observational mode and he is watching

other teammate's perspectives. This is a design feature of CS: GO, the player can observe other teammates and communicate with the remaining alive players to provide information and advice. Using multimodal transcription has identified that this design feature is being used and would allow how it impacts gameplay to be evaluated during the playtesting process.

In images 14, 15, 16, this last teammate of the terrorist team has moved to the Apartment and eliminated the enemy who eliminated Player#1. In image16, this teammate has only one health point left and is reloading his weapon. Further transcription of this sequence is shown in Figure 4-39.

Figure 4-39 Multimodal Transcription of CS: GO (6)

In image17 and image18, the teammate being observed was trying to leave the Apartment and go to bombsite B. In image19 and 20, this player has encountered an enemy who is initiating an attack from the Van. In image20, the teammate has defeated this enemy and is again reloading his weapon in image21. In image22, the teammate has tried to enter bombsite B by going through the Apartment. Player#1 has been giving advice to their teammate and has asked the player to save the weapons and try to avoid any battle because the weapons and items could be saved to the next round so which could

save the currency of the game. In image 24, the teammate has moved to the B Stairs location and also used the action of “Prefiring” to prepare to fight with the enemy. The next phase of multimodal transcription is shown in Figure 4-40.

Figure 4-40 Multimodal Transcription of CS: GO (7)

In image25, the teammate under observation has taken the advice of Player#1 and has chosen to save the weapons and life for the next round. This teammate has also thrown an incendiary grenade, which is a throwing item that creates a lasting burning area and causing damage to everyone inside the burning area, to block the entrance of the Apartment. In image27, 28, and 29, this teammate keeps hiding in the upper level of the B Stairs and uses “Prefiring” to guard the Apartment and B stairs. In image29, this round has ended, the terrorist team has lost this round by failing to plant the bomb within

the limit of time, however as a result of the survival strategy they will carry forward some advantages into the next round. The movement of Player#1 in this round is shown in Figure 4-41.

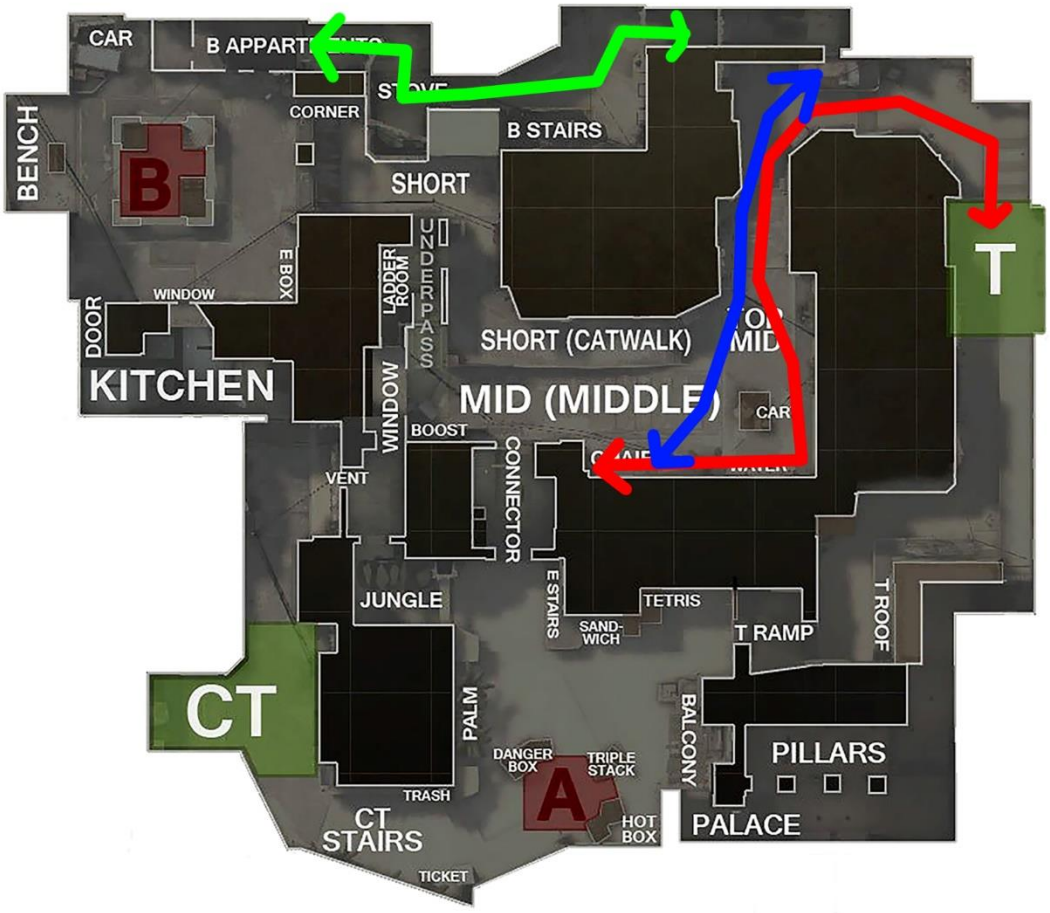

Figure 4-41 Moving route of Player#1 And Observed Teammate in Case#2

The red route is the first phase of Player#1's movement, which began at the terrorist spawn site and ended in the Middle area. The blue route is the route of the second phase where Player#1 evacuated from Middle area to move back to the entrance of the Apartment, where they were eliminated from the game. The final route with the green color is the route of the last teammate whilst being observed by Player#1, which is a periodic movement to defend the entrances to their location and prolong their survival to the end of the round. The higher-level actions in the entire sequence are shown in Table 12.

Time stamp in video at the beginning of a higher-level mediated action	Brief description of a higher-level mediated action
0:00:01	Moving
0:00:03	Change Weapon
0:00:08	Change Weapon
0:00:12	Pre-firing
0:00:12	Moving
0:00:13	Teammate Deploy Item
0:00:18	Taking cover
0:00:18	Pre-firing
0:00:19	Enemy Deploy Item
0:00:21	Stunning by Enemy
0:00:21	Moving
0:00:25	Change Weapon
0:00:27	Change Weapon
0:00:29	Pre-firing
0:00:37	Teammate Eliminated
0:00:39	Moving
0:00:44	Enemy Firing
0:00:45	Firing
0:00:45	Teammate Eliminated
0:00:46	Elimianted by Enemy
0:00:48	Teammate moving
0:00:52	Teammate Eliminated
0:00:54	Enemy Firing
0:00:55	Enemy Eliminated by Teammate
0:00:55	Teammate Reloading
0:01:00	Teammate Moving(Silent Walk)
0:01:04	Teammate Prefiring
0:01:09	Teammate Prefiring
0:01:10	Enemy Firing
0:01:10	Teammate Prefiring
0:01:10	Teammate Taking Cover
0:01:11	Teammate Firing
0:01:12	Teammate Reloading
0:01:17	Teammate Moving (Silent walk)
0:01:24	Teammate Prefiring
0:01:29	Teammate Moving (Silent walk)
0:01:31	Teammate Prefiring
0:01:33	Teammate Prefiring
0:01:40	Teammate Moving (Silent walk)
0:01:42	Teammate Change Weapon
0:01:44	Teammate Deploy Item
0:01:46	Teammate Prefiring
0:01:54	Teammate Prefiring

Table 12 Higher-level Mediated Action Table of CS: GO (2)

The pattern of higher-level action that occurred in this round was similar to the first case, mainly changing of weapons to gain more moving speed, “Prefiring” to prepare for the unspontaneous battle with the enemy, moving or moving as silent walk to reduce the noise of moving to avoid the noise that leading to location exposed, and firing with the enemy. But in this round, Player#1 has been eliminated as they failure to inflict sufficient damages to the enemy during an engagement, and the enemy has successfully caused enough damage on Player#1 to eliminate him.

The feature of this round is that Player#1 has been eliminated and switched to the observing mode provided by the game. After 46 seconds of this round, Player#1 was removed from this round and the only action that Player#1 could do was observe the other player and use the communication system. According to Figure 4-39, Player#1 was using the voice communication system to ask the teammate

that he has watching after Player#1 has been eliminated, to conduct a tactic of “Save”. This tactic is trying to avoid any battle and hide until this round ended, and the purpose of it has been mentioned before, is to save the weapons and items so that the player does not need to purchase them again in the next round because once the player has eliminated and all the weapons and items would disappear and unretrievable.

Prior to this, Player#1 had used the communication system to provide tactical advice and other information to the teammate, this teammate was trying to move to bombsite B. After the communication has been conducted, and this teammate has adopted Player#1’s advice which is to maintain the hiding position and conduct the “Save” tactic and avoid any battle with the enemy. And this teammate, as the last teammate of the terrorist team, has successfully implemented this “Save” tactic in this round and saves the weapons for the next round.

In general, the in-game communications system and the observation system for the eliminated player are the core of the reason of tactic that has been adopted and conducted successfully. Before the communication that was initiated by Player#1, the teammate was trying to move to a location with zero information on the location of the enemy team in that location. However, the information provided allowed the player to remain in a safe location because this teammate had already eliminated the enemies around them. The communication has stopped the moving plan of this teammate and it also delivered a new tactic to this teammate to conduct. The observation system for the eliminated player and the in-game communication system has played the role of real-time adviser for the remaining player of the game. The alive player could leave the tactics problems to those players who have been eliminated and let them gather extra details and information of the game and provide feedback to the

alive player. But this feature has led to an information imbalance for both sides of the team. If different tactics and advice are suggested by different players, that could be leading to a failed communication for those alive players, who need to take care of the enemy's footsteps and considering the adoption of the suggested tactics. And that would cause extra pressure and seriously affect player's decisions and actions in the game.

4.2.3 Case Study#3

This sequence was the 7th round of this game, the terrorist team is leading by 4 rounds, and the counter-terrorist team has only won 2 rounds. Because this sequence happened case#2, the counter-terrorist team has won a round, which means that the terrorist team might have less currency to purchase weapons and the counter-terrorist team could have enough currency to purchase weapons, due to the outcome of the previous round. The multimodal transcription of the sequence starts in Figure 4-42.

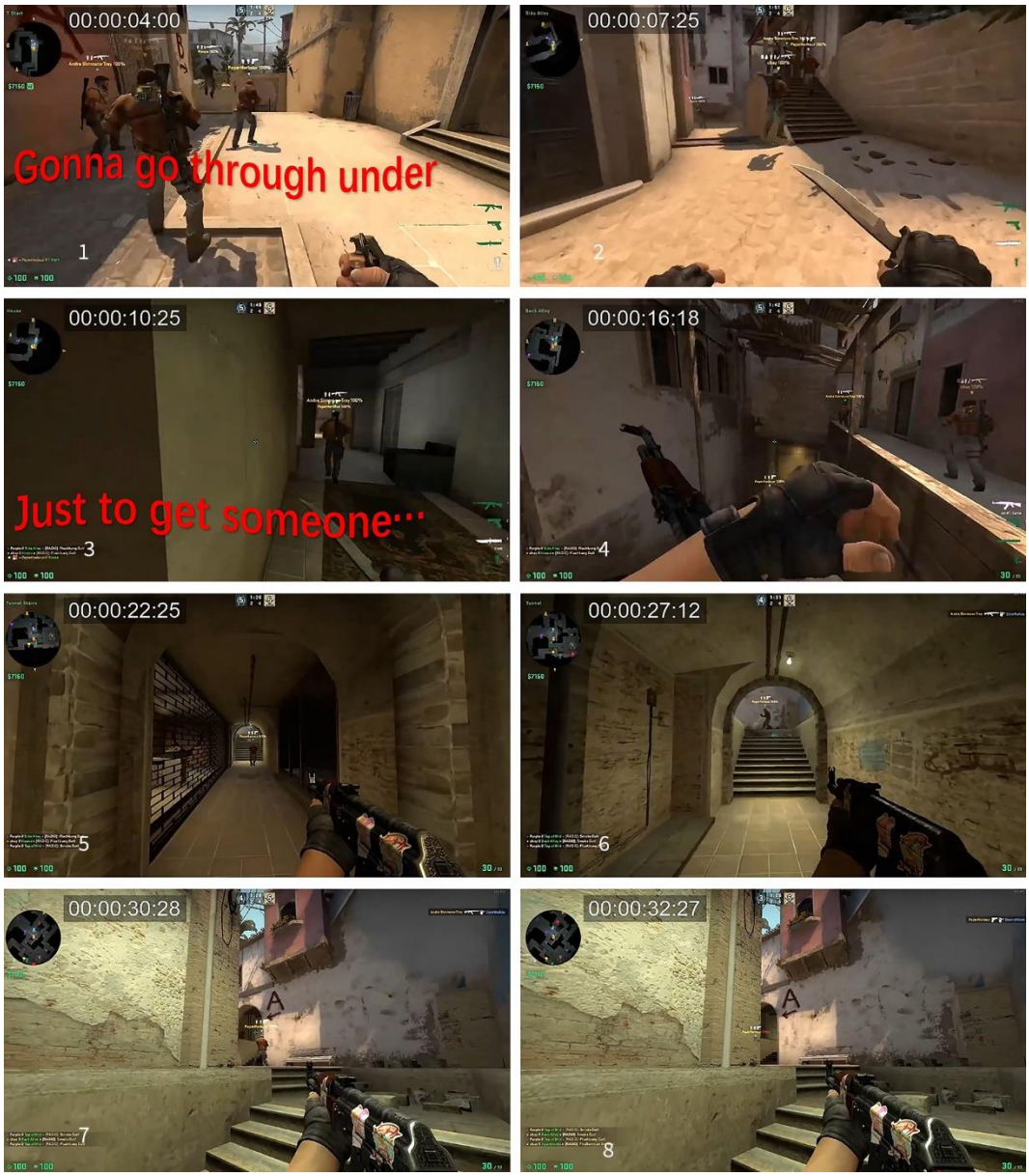

Figure 4-42 Multimodal Transcription of CS: GO (8)

In image1, Player#1 has talked about the tactic that he would implement in this round using the voice communication system. In image2, the terrorist team has separated into different directions, as the image described, a teammate was moving to the Middle area and the rest of the teammates including Player#1 are entering the Apartment. Player#1 has also switched to the knife to gain the maximum moving speed so that could save the time on entering locations in advance. In image3, Player#1 has used the voice communication system to share his thoughts on this round. In image4, 5, and 6, Player#1

and one teammate have moved separately and left the squad that had entered the Apartment together via the Underpass. In the meanwhile, Player#1 has switched to the main weapon and is using the silent walk action to avoid being noticed by the enemies. The Window has already been impacted by a smoke grenade thrown by a player from the terrorist team. That means the movements of Player#1 and the accompanying teammate are safe because the counter-terrorist team could not attack them from the Window as a result of the impaired visibility. The Underpass location is shown in Figure 4-43.

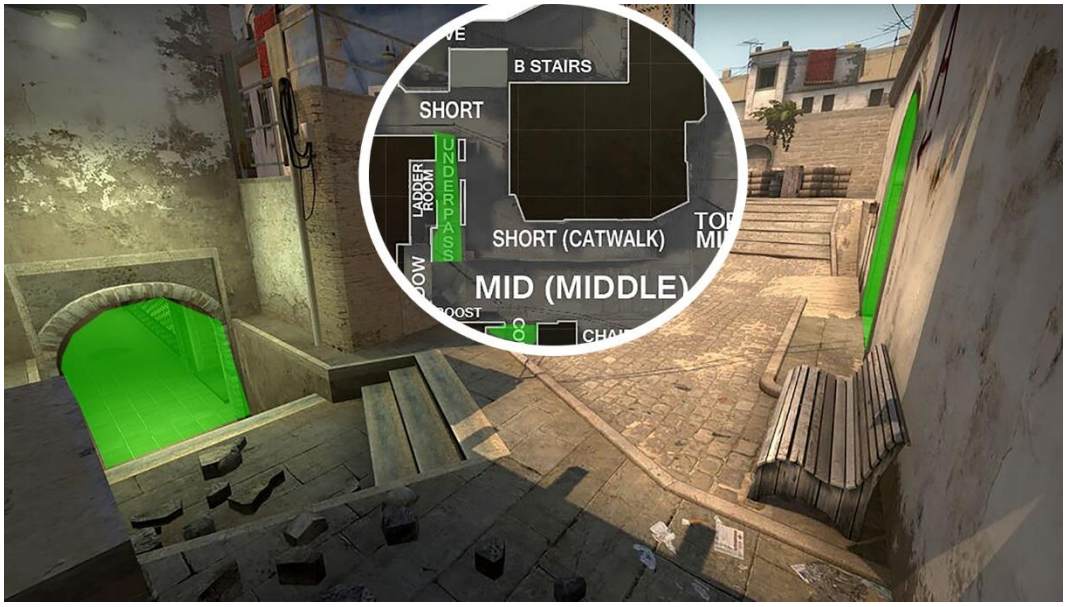

Figure 4-43 Underpass and the Connector

The Underpass is a tunnel that connects the Apartment area, which includes the Stove and B Stairs, to the Middle area and on to the Connector, which is the entrance of bombsite A. The green areas of Figure 4-43 are the Connector and the Underpass. In image7, and 8, Player#1 has used the action of "Prefiring" to prepare to fight with the enemies that are potentially hiding in the Connector. But the teammate that moved in front of Player#1 has entered the Connector and successfully eliminated one enemy by using a secondary weapon that was retained due to the terrorist team losing the last round. The next stage of transcription is shown in Figure 4-44

Figure 4-44 Multimodal Transcription of CS: GO (9)

In image9, Player#1 has switched to the knife to gain the max speed. In image10, 11, 12, 13, 14, and 15, Player#1 has conducted a jumping action to move into the special entrance of the Window. This action will be discussed in light of Figure 4-45, which shows the proximity of a bench to the Window location.

Figure 4-45 Boost and Bench

In image10, Player#1 has jumped onto the bench located near the Window, which has been highlighted as a blue area in Figure 4-45. In image11, Player#1 has run over the bench and jumped to the ledge of "Boost" right under the chokepoint of the Window, and the "Boost" ledge has also been highlighted as a red area in Figure 4-45. In image12, Player#1 has failed to jump on to the ledge, so he decided to return to the bench. In image13, Player#2 has stood on the bench and conducts a combination action of running and jumping. In image14, Player#1 has successfully jumped on to the ledge under the Window would allow the player to enter this location directly rather than via an access corridor. However, as seen in image15, Player#1 has fallen from the ledge, and then decides to enter the Connector. Further multimodal transcription is presented in Figure 4-46.

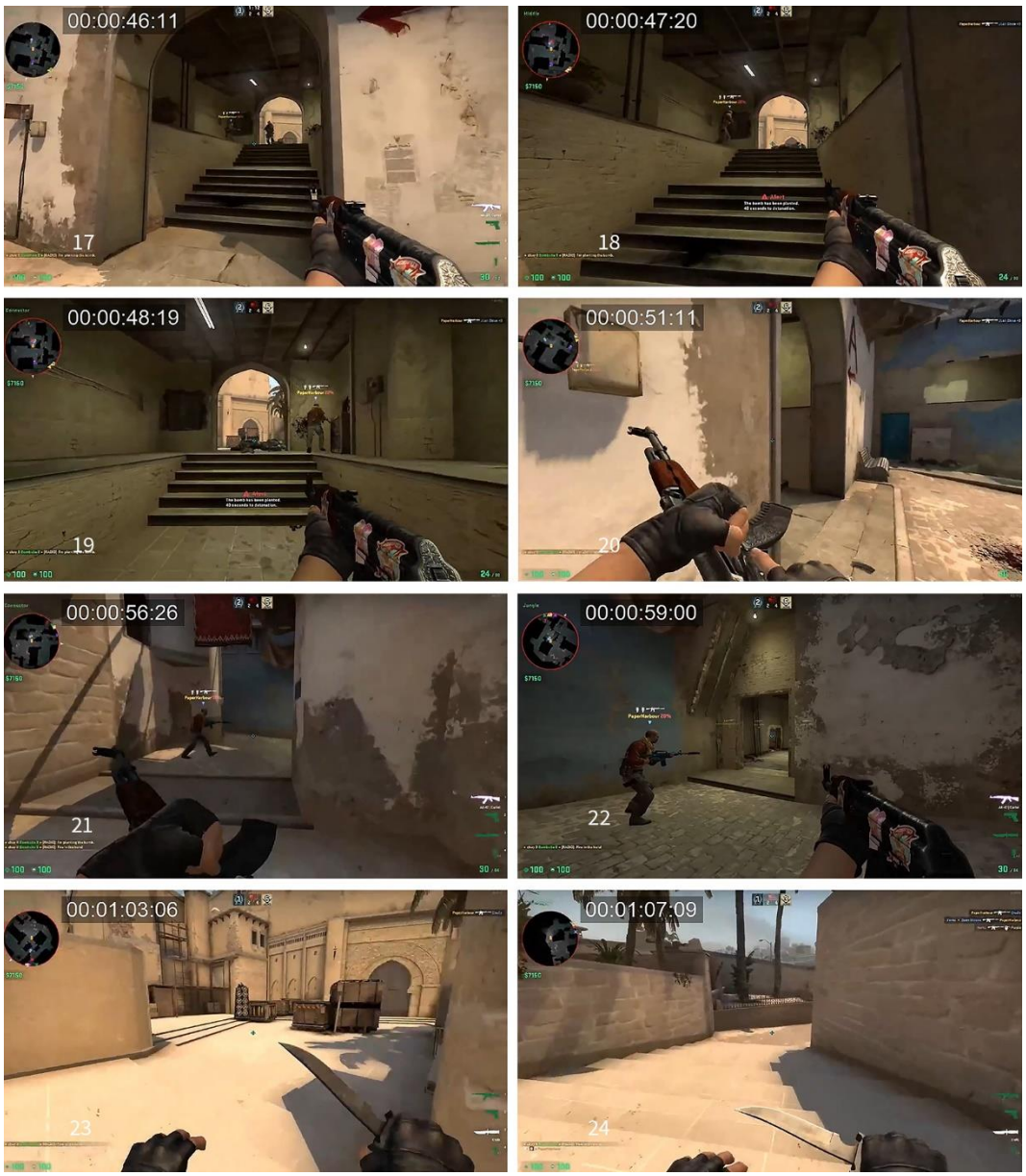

Figure 4-46 Multimodal Transcription of CS: GO (10)

In image17, Player#1 has moved to the Connector and encountered the enemy who is standing at one of the exits to this location. In image18, the teammate who is moving in front of Player#1 has eliminated this enemy because he was standing behind the corner and out of line of sight from the enemy. In image19, the bomb has been planted on bombsite B by another team member. In image20, Player#1 has left their location to return to be near the Window and is reloading the gun to prevent potential risk from the unknown enemies. In image21 and 22, Player#1 has traversed the Connecter

and using the action of “Prefire” to prepare to fight with the enemies that might be hiding. The location of these actions is shown in Figure 4-47. In image23 and 24, Player#1 has moved to the counter-terrorist team’s spawn site by passing through bombsite A.

Figure 4-47 Connector Area and the Jungle

As can be seen in this image, the green zone is the Jungle (left) and the Connector (right), and the red zone is the cover that could be the hiding place of an enemy. The action of “Prefiring” conducted by Player#1 during image21 and 22 is in order to guarantee that no enemy is hiding behind in this area to ambush Player#1. The transcription continues in Figure 4-48.

Figure 4-48 Multimodal Transcription of CS: GO (11)

Player#1 was previously holding the knife to increase their movement speed. In image25, Player#1 has switched to the main weapon once he entered the counter-terrorist spawn site. Meanwhile, two teammates of the terrorist team have been eliminated by the enemy. And one teammate has also provided the information that the last enemy has already received 81 health point damages from the terrorist team. In images 26 and 27, Player#1 has used the action of “Prefiring” to minimize the potential locations that might be hiding the enemy. In image28, the enemy was spotted at the entrance of the Kitchen. In image29, Player#1 has successfully eliminated this enemy and wins this round. The movements of Player#1 are shown in Figure 4-49.

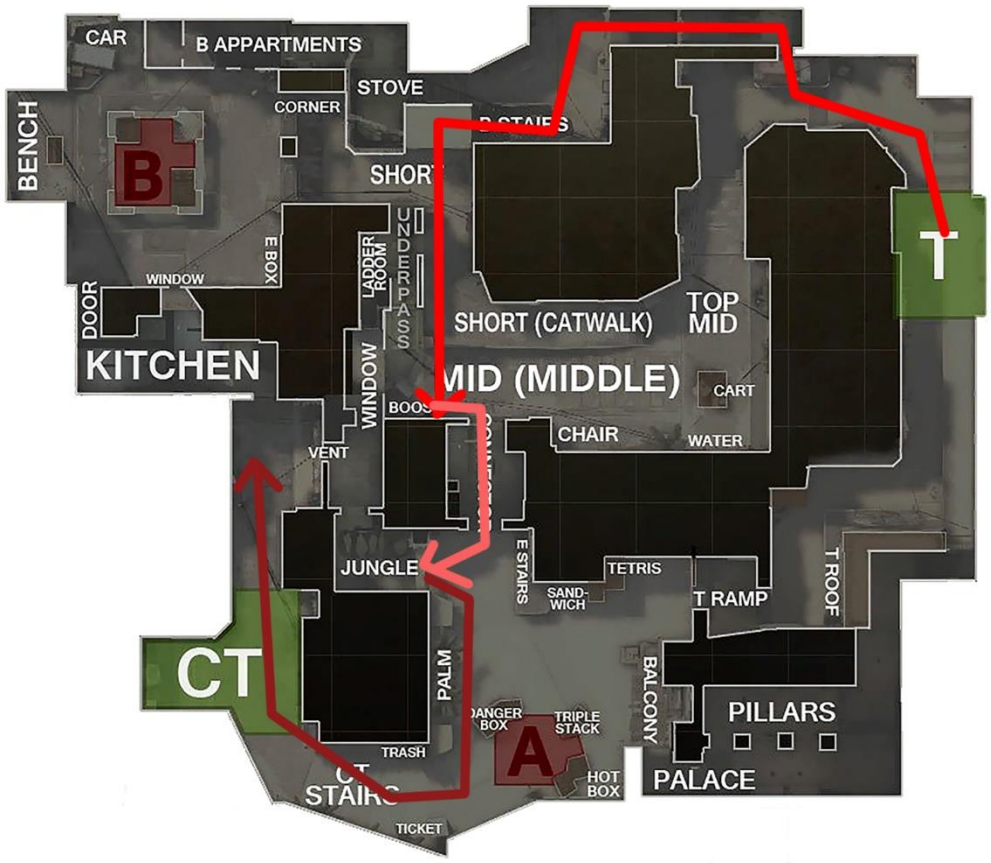

Figure 4-49 Moving Route of Case#3

According to the multimodal transcription, the moving route of Player#1 could be identified into three phases. The first phase was Player#1 moving from the terrorist spawn site to the Middle area by passing through the Underpass. Before the second phase of movement, Player#1 attempted to enter the Window by through a combination action of running and jumping on the “Boost” and “Bench”. Player#1 failed twice in this maneuver and begun the second phase of movement, which is from the Connector to the Jungle. In this phase of movement, Player#1 was following his teammate and Player#1 also excluded the potential enemy’s locations using a “Prefiring” action. The third phase of moving is from the Jungle to the counter-terrorist team spawn site. This movement route was based on the communication of information provided by Player#1’s teammate. The higher-level actions for this sequence are shown in Table 13.

Time stamp in video at the beginning of a higher-level mediated action	Brief description of a higher-level mediated action
0:00:01	Moving
0:00:01	Change Weapon
0:00:08	Change Weapon
0:00:12	Moving
0:00:16	Change Weapon
0:00:17	Moving (Silent walk)
0:00:22	Teammate Deploy Item
0:00:23	Moving (Silent walk)
0:00:30	Pre-firing
0:00:32	Teammate Firing
0:00:33	Teammate Eliminate Enemy
0:00:34	Moving
0:00:35	Change Weapon
0:00:36	Jump
0:00:37	Moving
0:00:38	Jump
0:00:38	Moving
0:00:39	Jump
0:00:40	Moving
0:00:40	Jump
0:00:41	Change Weapon
0:00:42	Pre-firing
0:00:43	Jump
0:00:44	Moving
0:00:46	Teammate Firing
0:00:46	Firing
0:00:47	Teammate Eliminate Enemy
0:00:48	Pre-firing
0:00:49	Reloading
0:00:51	Taking Cover
0:00:52	Moving
0:00:55	Change Weapon
0:00:57	Change Weapon
0:00:58	Moving
0:00:59	Pre-firing
0:01:02	Moving
0:01:03	Change Weapon
0:01:08	Change Weapon
0:01:13	Pre-firing
0:01:15	Firing
0:01:15	Elimiante Enemy

Table 13 Higher-level Mediated Action Table of CS: GO (3)

The higher-level actions of this round were mostly shown as moving, “Prefiring”, firing, changing weapons, and elimination of an enemy. But in this sequence, Player#1 has conducted a new high-level action, which is jumping. As mentioned before, Player#1 tried to use the combined action of running and jumping to take a shortcut to enter the Window. According to Figure 4-44, Player#1 spent 6 seconds attempting to using this shortcut by conducting higher-level action of jumping and moving multiple times. As Figure 4-44 illustrated, Player#1 needed to jump on the Bench and using the lightest weapon which is the knife to gain the max moving speed and use the higher-level actions of moving and jumping once Player#1’s character was close to the edge of the Bench to jump on the “Boost” ledge under the Window. In Figure 4-45, the Bench and the “Boost” are located separately and have a certain distance. Each player who wants to jump on the “Boost” by using the Bench needs a certain

technique because as mentioned before, Player#1 has spent 6 seconds trying to use this way as a shortcut to enter the chokepoint. The failed attempt to take this shortcut was stalling the movement of the squad. As shown in image 17, when Player#1 stopped their attempt to use this shortcut and move to the Connector, a teammate who passed through the Apartment and the Underpass was waiting for Player#1. This shortcut, which required a certain technique in the game, and it also designed by the game designer, has become an imbalance challenge for the player because once the player has failed to enter the shortcut, the consequences are stalling the whole team's speed.

The features of this shortcut mechanic have been filled with instability elements for the game. And the advantages of using this shortcut successfully could be the key to increase the possibility of winning, and its instability feature could also become the potential trigger of losing the game because it requires certain techniques and has the possibility of failure, unlike players conducting other normal higher-level action such as "Prefiring", moving, and reloading weapons, where there is barely any possibility offailing. The multimodal analysis approach has successfully identified the failed attempt to utilize a particular design feature in the game map and would therefore be potentially very useful for game designers whilst playtesting ideas and concepts during the development of maps and new games.

4.2.4 Case Study#4

This case happened in the 9th round of the game, by which time the terrorist team was leading by six rounds with the counter-terrorist team having only won two rounds. The initial transcription of the sequence is shown in Figure 4-50.

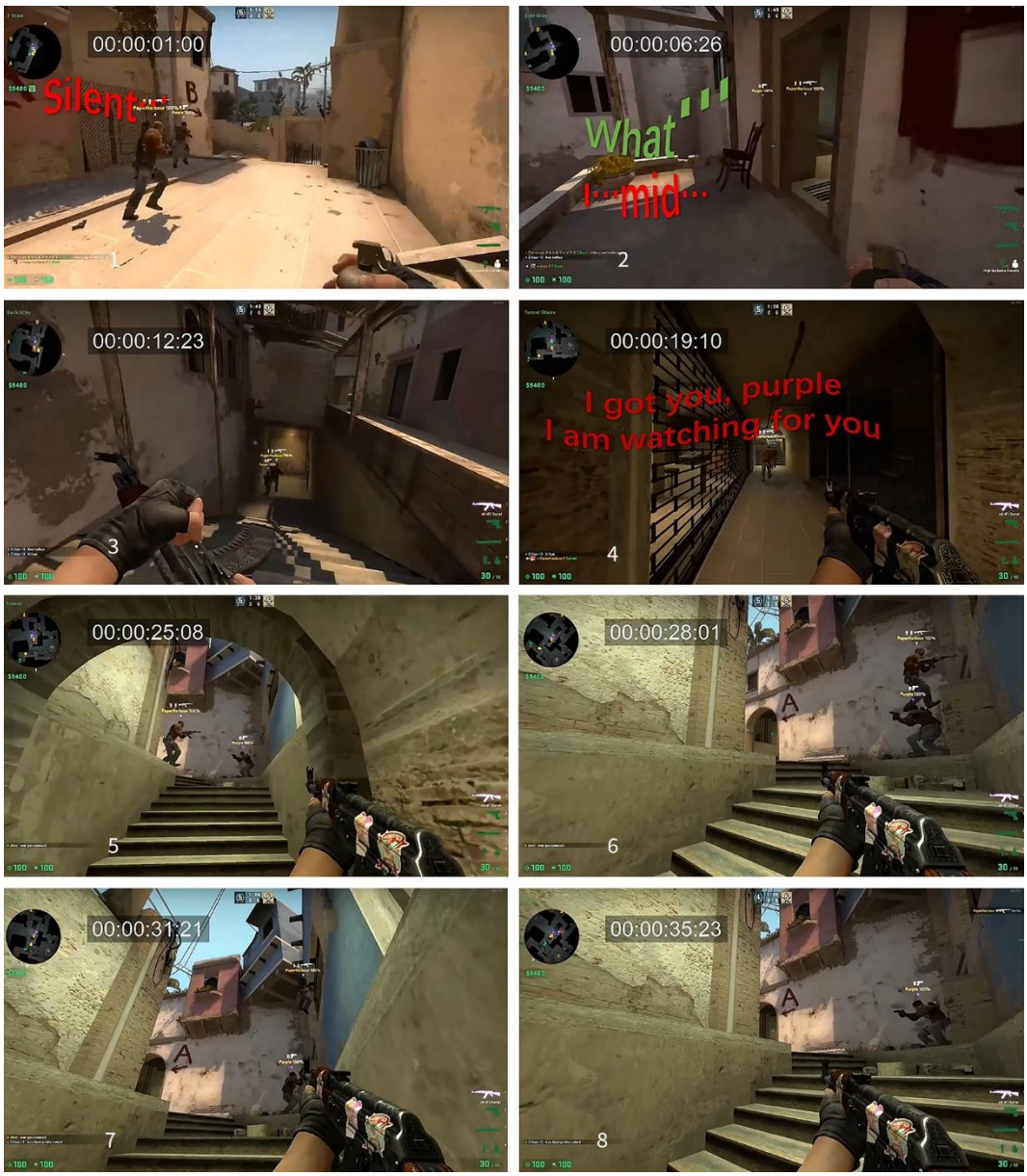

Figure 4-50 Multimodal Transcription of CS: GO (12)

In image1, 2, and 3, Player#1 was spawned in the terrorist team spawn site and moved to the B Stairs location and is preparing to enter the Underpass with two other teammates. According to the communication content, Player#1 has mentioned his route tactic in this round to his teammate in image2. In image4, Player#1 and three teammates were passing through the Underpass. Meanwhile, Player#1 has also reminded the teammate that was moving ahead that Player#1 would protect him because he had noticed that this teammate was not equipped with any main weapons. In image5 and 6, those three teammates who were moving ahead of Player#1 were conducting a special tactic of

using a crouching player as a stair to provide a shortcut to enter a certain location by jumping on this crouching player and conducting further actions such as moving or jumping. As image5 and 6 show, one teammate jumped on the crouching teammate and was about to jump to the ledge that was located under the Window. In image7, this teammate has already used this crouching teammate, and the ledge, to enter the Window area. In image8, the player who just entered the Window has eliminated one enemy in this location. And the crouching teammate has remained in their crouching position. Figure 4-51 again shows the area around the window, however in this case different regions are highlighted as the bench is not being used to access the shortcut.

Figure 4-51 Multimodal Transcription of CS: GO (12)

The red area was the location of the crouching teammate' and the blue area was the ledge under the Window. According to the game mechanics of CS: GO, a player can jump on to another player when they are crouching, as two characters cannot occupy the same space. The feature of this mechanic provides alternative tactics for the player because by using this tactic, the player can enter areas with an alternative route, however in this case without the challenge of jumping from the bench. The

crouching teammate has provided the function of a small platform for the other player so they could easily jump on to the ledge, which is already highlighted in blue color. This ledge was designed to be higher than the height of the player conducting high-level action of jumping, which means a player cannot simply jump on to the ledge. The next steps of the sequence are transcribed in Figure 4-52.

Figure 4-52 Multimodal Transcription of CS: GO (13)

In image9, one more teammate has used the crouching player as an aid to enter the Window. But in

this process, the jumping teammate has caused teammate damage to the crouching teammate by accidentally attacking with a knife. Whilst some games have mechanics that do not take into account damage from friendly fire, this is not the case in CS: GO and this subtle interaction has been identified by using the multimodal transcription process. The teammate who just caused damage has apologized to the crouching teammate.

While these three players were conducting this special tactic, Player#1 was using the action of "Prefiring" to defend the Connector as described by the transcription in image6 to image8 as well. In image10, Player#1 has moved to the Connector and is using the communication system to provide information of available weapons for the crouching player. In image 11 and 12, Player#1 has moved to Top Middle and he has also used the action of "Prefiring" while he was in the status of moving. In image13, Player#1 has turned to face the Window and two of his teammates were there. In image14, two teammates from the terrorist team had been eliminated and one teammate has used the voice communication system to inform the terrorist team that the Jungle has an enemy and has received damage from him. And Player#1 also switches to the throwing weapon of grenade and initiates an attack by throwing a grenade. In image15, Player#1 has moved to the entrance of the Catwalk whilst also using the action of "Prefiring" to prepare to fight with the potential enemy behind the corner of the B Apartment's entrance. In image16, Player#1 has moved to take a position at the entrance of the Catwalk, an area that is shown in Figure 4-53.

Figure 4-53 Chokepoint of Catwalk, Window and Connector

The red zone is the Catwalk itself, the blue area is the Connector, and the green area is the Window. As can be seen in image16, Player#1 has noticed that one enemy was in the Window and appears to intend to use the elevation of the Catwalk to gain an advantage rather than taking cover behind the Cart. The unfolding of this engagement is transcribed in Figure 4-54.

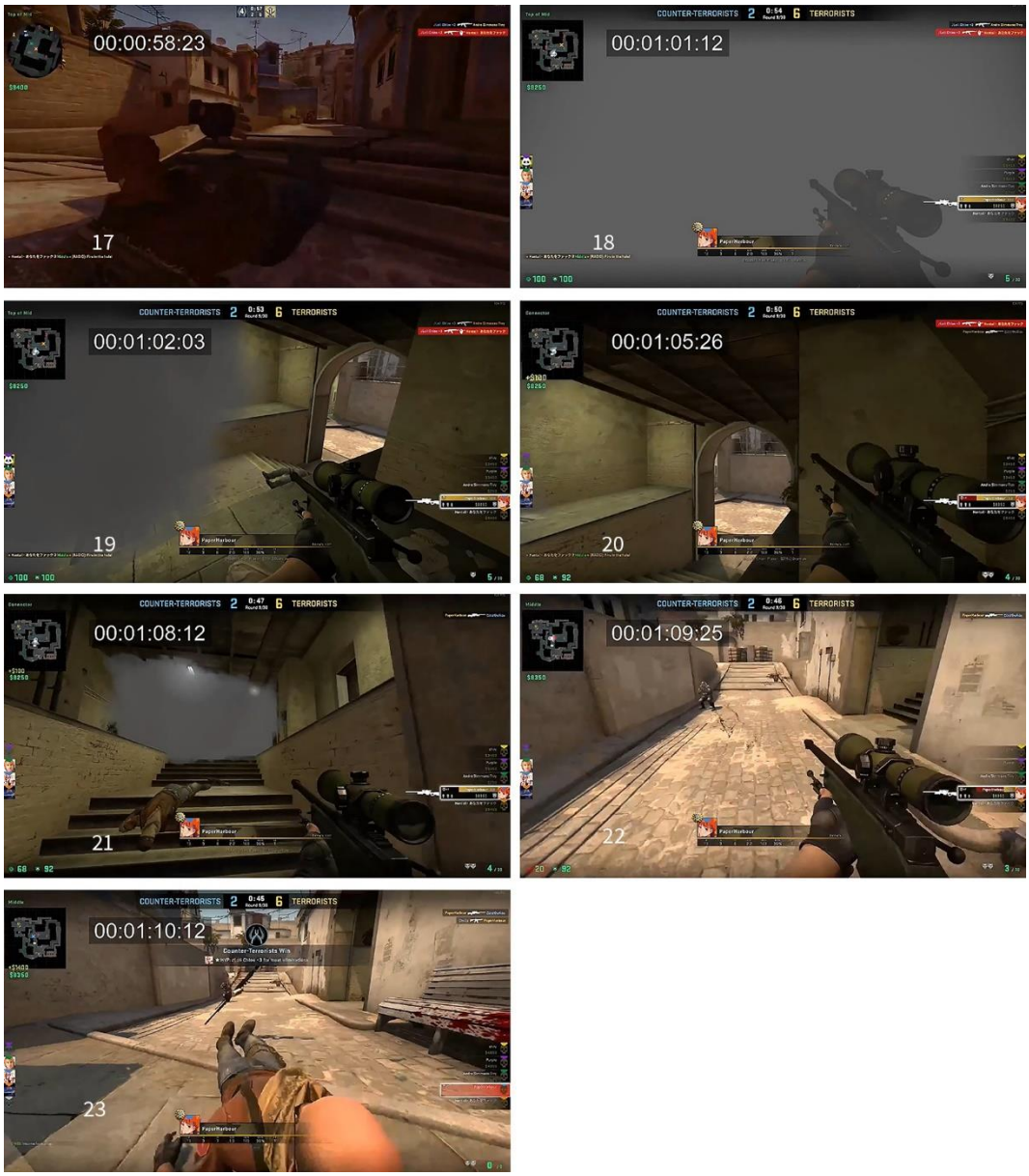

Figure 4-54 Multimodal Transcription of CS: GO (14)

In image17, Player#1 has been eliminated by the enemy in the Window whilst moving on to the Catwalk. In image18, the player perspective has switched to the last team member who is behind the smoke and hiding in the Connector. In image19, this teammate has using a pillar in this area as cover. In image20, this teammate has eliminated one enemy that has moved on to the Catwalk. In image21, this teammate was moving out from the Connector, which is still covered by smoke and moved into the Middle area. In image 22 and 23, this teammate has completed this movement and is eliminated

by an enemy. After the last member of the terrorist team has been eliminated, the counter-terrorist team has won this round. The movements associated with this round are shown in Figure 4-55.

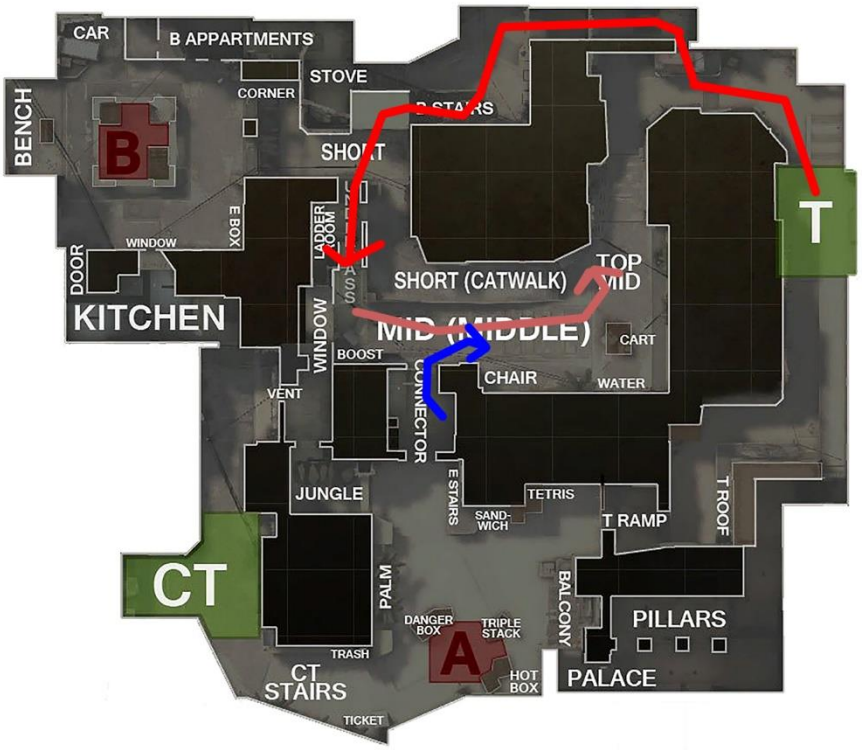

Figure 4-55 Moving Route of Players in Case#4

The routes utilized in this round are similar to the last rounds, both rounds were passing through the Underpass and attempting to access the Window. The red route is the first phase of movement of Player#1, which begins on the terrorist team spawn site and ends at the Underpass. Player#1 used the action of “Prefiring” to protect those three players who were trying to access the Window. The pink route begins at the Underpass and ends at the entrance to the Catwalk where Player#1 was eliminated. The third route is the last teammate’s, which began at the Connector and ended in the Middle. The high-level actions of this sequence are shown in Table 14.

Time stamp in video at the beginning of a higher-level mediated action	Brief description of a higher-level mediated action
0:00:00	Change Weapon
0:00:01	Moving
0:00:12	Change Weapon
0:00:12	Moving (Silent walk)
0:00:23	Pre-firing
0:00:23	Teammate Crouching
0:00:27	Teammate Jumping
0:00:29	Teammate Jumping
0:00:30	Teammate Jumping
0:00:33	Teammate Firing
0:00:33	Teammate Eliminate Enemy
0:00:34	Teammate Moving
0:00:35	Pre-firing
0:00:36	Teammate Moving
0:00:37	Teammate Attacking
0:00:38	Teammate Jumping
0:00:38	Teammate Moving
0:00:40	Pre-firing
0:00:40	Moving
0:00:44	Pre-firing
0:00:48	Firing
0:00:50	Teammates Eliminated
0:00:50	Change Weapon
0:00:51	Deploy Items
0:00:51	Moving
0:00:55	Pre-firing
0:00:57	Firing
0:00:57	Teammate Eliminated
0:00:58	Elimianted by Enemy
0:01:01	Teammate Prefiring
0:01:04	Enemy Attacking Teammate
0:01:06	Teammate Eliminate Enemy
0:01:08	Teammate Moving
0:01:09	Teammate Firing
0:01:10	Teammate Eliminated

Table 14 Higher-level Mediated Action Table of CS: GO (4)

According to the higher-level mediated actions of this round, the general patterns are similar to the last round, but the tactic of overtaking into the Window was conducted by three teammates and with teammate's interactions actions, unlike the last round where Player#1 attempted this twice by himself and failed. In this round, the role of Player#1 was more like a supporter to protect those teammates who are implementing tactics, so a higher frequency of the higher-level action of "Prefiring" and moving are seen in comparison with other higher-level actions such as Jumping and Firing. Because the role of Player#1 was mostly to become an observer and protector in the game, the higher-level action that was conducted by his teammates is also recorded while Player#1 was using the action of "Prefiring" to defend them. The patterns of teammates' higher-level action were shown in jumping and moving, due to the reason of most of the higher-level actions of them were recorded while they implement tactics.

Some designed game mechanics by conducting an unstable specific technique such as run and jump to build a shortcut to bypass areas of the map could be the trigger of losing the round. Because it could be conducted by a single player, it does not require any interaction and communication with other teammates. And in this round, by using interaction action to provide a stable shortcut that could also easily provide a way to provide access to an area. And the whole team could build some alternative tactics that around their interactions function such as the crouching platform mentioned in this case study instead of attempting to use the unstable way which is also mentioned in the last case study.

4.3 Discussion

The use of multimodal transcription in analysing game play has highlighted a number of different scenarios involving multimodal interaction and communication in two different games. Comparing the multimodal transcription of the two games, the frequency of using voice communication during the gameplay has indicated that PUBG is a game where effective team interaction appears to be facilitated by voice communication in all aspects of the game, including play in Duo mode, and in either the middle or end phases of the game. In all of the cases of PUBG gameplay many higher-level actions, such as Moving and Firing emerge in accordance with the higher-level action of communication. In general, by analyzing the three cases of PUBG, the player experience, and the process tends to be:

1. Receiving information from teammates, or providing information to teammates by higher-level action of communication
2. Based on the information received from higher-level action of communication, the teammate or player himself would decide what kind of higher-level actions needs to be conducted.

The second PUBG case also indicated that the final phase of Duo Mode of the game would typically be highly dependent on the higher-level action of hiding. In the second case, combat only occurred in the last period of the sequence. Prior to this, all the remaining players were hiding unless another player had exposed their location. The feature of this case is mostly seen in Duo Mode, though may also occur in other modes of play based on the number of members of a team that are still alive. In Duo mode, the player experience and the process would be best described as staying low-profile and trying not to engage with the enemy unless it is necessary.

The third case has also indicated some different features of PUBG's player experience that are different from other cases. The third case happened in the final phase of the game and the location of this case was in a location that includes plenty of buildings that could be used as cover. In this case, the feature of taking cover and engaging in combat around the buildings in PUBG has been identified by analyzing the multimodal transcription. This shows the potential for how multimodal interaction analysis could be useful in the playtesting of maps. For example, if the design intent was to provide cover and interesting engagements, the method would allow this to be tested. In the case of the video being analyzed, most of the higher-level actions were conducted whilst utilizing the cover provided by the buildings. Besides, the shortcomings of PUBG's communication system have also been identified. The overlapping communication content during the battle have been affecting the player experience for some players. Again, if this were a particular design feature of the game that the development team wished to playtest, the transcription process has identified the potential for it to be used ineffectively which may lead to ideas on how to change or improve the voice system.

In contrast, the analysis of CS: GO shows that this game was totally different from PUBG, even though both games are filled with factors of shootings and tactics. Comparing the gameplay makes it very clear that the implications of both the MDA and DDE frameworks are worth noting, namely that the final player experience is highly dependent on the mechanics of the game that are implemented by the developers. As a general comparison, CS: GO has a much different player experience, for example, the higher-level actions conducted by the player were more dependent on the map and chokepoints rather than voice communication. The reason for that is because CS: GO has a compact structure and a compact, small-scale map. The compact structure means that CS: GO has a strict mechanic system that covers the time limit, bonus, condition of winning and losing, et cetera. In general, the mechanic system of the CS: GO has covered all conditions and limits the higher-level actions that could be conducted for the player during the game. Besides, the maps of the CS: GO is small, compact, and having some constant mechanics such as each map has two constant spawn sites, each game consists of the terrorist team and the counter-terrorist team, each map has two constant bombsites A and B that allow the terrorist team to plant the bomb. Besides, each map of CS: GO has a map designed to include several chokepoints that were intended to create conflict between the two teams. The fact that the multimodal interaction analysis approach has identified sequences of gameplay around these chokepoints also supports the potential value of the approach during playtesting.

Unlike with PUBG, the description of a specific location would only be shown as describing the direction and the form of certain objects that are near the location you need to describe in PUBG. In CS: GO, as the multimodal transcription shown, the higher-level action of communication was not observed with a high frequency, and most of the content is sharing information by using callout names directly, leading to a more streamlined and coherent set of communication in comparison to PUBG.

The resulting reduced voice communication in CS: GO is related to the compact mechanic system and the size of the map. By analyzing the transcription and the higher-level action table, the combat time for each engagement is very short, and whilst in progress, a teammate might be gathering information by listening to the enemy's footsteps in a different location, the voice communication would distract a teammate's decision. According to the multimodal transcription of CS: GO, most of the communication happened in the beginning phase of the game, defending the bomb, non-combat periods, and information sharing by a player that has been eliminated by the enemy. Each time of communication from the 4 selected cases was short and brief, and the responses from the teammate were also short and brief as well. Most of the time the player that was under observation they were not getting a response from the teammate. The overlapping communication was also not shown in the CS: GO due to the reason for this feature that is shown in the PUBG cases.

Because communication is not the highest frequency higher-level action that occurred in the analysis, the feature of chokepoint design has been discussed in this chapter. As mentioned before, each map of CS: GO is characterized by number of chokepoints and some constant mechanics designed such as spawn sites and bombsites. The player needs to conduct a specific precaution action of preparing to fire and aiming the potential area that could easily eliminate the enemy, and this action is called "Prefiring". This action has been considered as a higher-level action and it also is a high-frequency high-level action of the game according to the higher-level action presented earlier. This higher-level action was derived from the design of the chokepoints in the game, because the map is small but includes many well-spaced chokepoints, the player needs to use this higher-level action to defend those enemies who might attack from those chokepoints. And most of the higher-level actions such as moving, firing, also depends on the chokepoint's location, for example, .in the second case of the CS:

GO, the last teammate of terrorist used a “Saving” tactic rather than keep moving between locations, at the same time this teammate has also using the higher-level action of “Prefiring” to prepare to engage with the enemy. In general, the higher-level actions conducted by the player mostly depended on the design of the chokepoint.

Overall, the multimodal interaction analysis method has been used to identify interesting engagements in two video games with very different mechanics. In both cases, specific mechanics or game design features can be related to the observed gameplay experience. Considering the length of the original videos, much of the process was focused on trimming down the gameplay to specific segments of interest. The potential for using this analysis in game playtesting is clear, however this potential would best be realized by utilizing the approach in playtesting specific “skirmishes” based around the inclusion of a given feature. By limiting the gameplay to just a few minutes, it would be possible to conduct A/B testing (King, Churchill & Tan, 2017) with rapid turnaround times and evaluate either variations on the feature, or with or without the feature. Capturing screen and voice, particularly if a talk-aloud protocol was used, and potentially also videos of the players and their facial expressions would allow the use of multimodal interaction analysis to displace the shortcomings of traditional playtesting approaches.

5 Conclusion

In this chapter, the findings of the research will be further discussed in addition to consideration of the limitations of this research, and possible directions for further research to extend this work. At the end of this chapter, the conclusion of this research will be elaborated.

5.1 Summary of Findings

In this thesis, two games were selected for analysis using multimodal interaction analysis, and a total of 7 cases were used to probe into the feasibility of using this method to improve the playtesting of games. Due to possible restrictions of the covid-19 pandemic that was prevalent at the time this research was conducted, the analysis was conducted on existing game stream videos rather than observing live players.

Based on the multimodal analysis, for the video game PUBG it has been shown that the features of the communication function play an essential and irreplaceable role in this game, with the higher-level action of communication leading players to conduct other higher-level actions during the gameplay in the first case video. The analysis of the second PUGB case has identified that in Duo mode of this game, the player's style of playing in the final phase of the game generally becomes a serial high-level action of moving in a hidden way, instead of a massive amount of battling with the enemies. This emergent gameplay in the Duo mode potentially lowers a player's expectations while playing this game because of the decreased frequencies of between the shooting elements and the map design. In the third case of PUBG, the process of communication that happened within this case was shown to be chaotic and overlapping, which resulting in the squad missing details about the engagement when

the squad was communicating. But as mentioned before, PUBG is a game that builds on the communication within the game as most of the higher-level actions were conducted under the higher-level action of communication. Therefore, chaotic communication could also lower the player experience during the game, especially considering if this phenomenon of communication chaos happened in the final phase of the game, any failure or setbacks happening in the last minute of the game could translate into a much worse player experience for the player.

On the other hand, based on the multimodal analysis of four cases of the CS: GO, several features and shortcomings have been found during the analysis. As mentioned before, the CS: GO has a number of chokepoints distributed in each map, including the map that is used in these four cases. In the first case, the route connects the terrorist team spawn site to the bombsite B through the location knows as the Apartment which is essentially a series of chokepoints and access shortcuts that could enable the counter-terrorist team to engage the enemy and defend easily. To some extent, the chokepoints located in this route have increased the difficulty of taking control of the location. The second case of the CS: GO has shown that an alive player could receive help and advice from eliminated players because the eliminated player continues to observe the alive player after they are eliminated by the enemy. And these eliminated players could use the communication system to talk to and advise the alive player. The second case was a successful example of an eliminated player providing tactic suggestions to the alive player and the alive player successfully conducting it. But it still could be affecting the alive player's judgment and the information gathering process because sometimes the player needs to pay attention to listening to the enemy's footsteps to conduct the higher-level action of "Prefiring" to prepare to fight. This communication system that allows eliminated players to talk to the alive player, could be the trigger the alive players to miss these details.

The third case and the fourth case are different from the last two cases. In CS: GO, there are some designed mechanics that could use specific continuum action to create a shortcut that could enter a specific location from a given entrance. In the third case of CS: GO, this continuum action that is used as a shortcut has shown its features of instability and is easy to fail to conduct. Besides, this action could be leading to a waste of the time of this round and causing the failure of conducting teamwork tactics. It could be the potential trigger of losing this round as well. In the fourth case of CS: GO, the squad used collaboration tactics which using a crouching teammate as a stepstone to provide a stable shortcut for other teammates to enter the location. This collaboration tactic has indicated that this designed mechanic shortcut could be considered as a group tactic instead of a solo tactic which is also an unstable action and might be the loss factor of the game as well. In general, these kinds of design could be the factor, even though it is playable content, but it still could be the trigger of causing unsatisfied for the player experience because of the lose the game.

5.2 Limitations

Although the multimodal analysis has provided a simple and convenient method to analyze the features of the design from the game and locate those mechanics and design elements that could lead to reducing the quality of the player experience. Especially for those video games that include complex high-level actions, such as CS: GO and PUBG, both games required players to conduct massive amounts of higher-level actions during the gameplay. Because of it, data could be easily extracted from these games and analyzed. And for other genres of games, the multimodal analysis might not be able to provide much data because some genres of the games are not involved with a complex combination of higher-level actions, such as those visual novel games, narrative-based role play games,

et cetera. Some of these games are only focusing on providing an immersive visual and text adventure instead of providing the actual controllable and playable content as PUBG has provided for the player. This research has not considered applying the multimodal analysis as an improvement of playtesting for those less higher-level actions games, and it also ignores the platform of the game, because both two games that have been selected for research objects are on the PC platform. Nowadays, the modern video game has always aimed the console players and PC players as one market, most of the games would sell on different platforms at the same time, even though the game remains the same content of the game, but the player experience could be different due to the different of the platform.

Furthermore, even though the data of the research was collected from public video websites, but most of the playtesting was conducted on the phase before rolling out to the market, which might still be on a period of confidentiality. That means the developer needs to recruit a team of participants to play the game for collecting the data to conduct multimodal analysis. And by that, comparing with traditional playtesting, conducting multimodal analysis would require recording the process of participants playing the game, which would increase the budget of conducting the playtesting. And if the games include long narrative content and complex mechanics, conducting multimodal analysis still needs developers to hold a formal playtesting which includes a larger scale of participants because, in this research, both games were played as in squad and has a short period of the playing process.

5.3 Further Research

This research has a number of limitations as mentioned in the previous section, however there is much potential for extending this initial, exploratory project in order to develop a mature and thorough

method for conducting playtesting to video games. The limitation of this research, which is only using two video games as for research objects, could be a clear direction of conducting further research on refining playtesting. There are plenty of genres of games in the world, and the effects of applying multimodal analysis as a method to different genres of the game as a method of playtesting, or the refinement of playtesting are remaining unknown. And it could be also developed as a tool that allows the game developers to use that to learn different game mechanics and features, to help themselves with game designing.

In addition, applying the process to scenarios involving real players also allows the method to be extended. This research was restricted to video analysis as a result of the covid-19 pandemic; however, it was originally envisaged to observe and record real players. Capturing gameplay on a screen whilst simultaneously recording facial expressions would provide a much richer dataset that would allow developers to triangulate a player's subconscious reactions to a given playtest scenario with the actual gameplay. This would allow the lived experience of playing the game to be better understood. This would, of course, also increase the complexity of the analysis. It is likely that multimodal interactional analysis would best be deployed in small scale testing around specific design features, potentially in the means of A/B testing (also known as split testing) to quickly evaluate alternative designs and features rather than playtesting a whole game.

This research has also not focused on specifically testing design features and how they influence gameplay, instead it has analysed gameplay and made observations around game mechanics and designs that seem relevant to a particular scenario. The next steps for research would be to develop some controlled experiments involving real players, that are intended to test specific game features.

This could be conducted as a series of small A/B tests where the impact of a given feature is evaluated. Also, to ensure that the multimodal interaction analysis has real value (as opposed to potential), it would be necessary to undertake a comparison with traditional playtesting methods in order to reach a decision over the efficacy of the approach. To ensure that bias were removed from such a study, this would need to be a larger scale study.

5.4 Conclusion.

In conclusion, this research has explored the feasibility of using multimodal analysis to conduct the playtesting on video games which aims to improve the player experience. In the research, specific features of the video games that have been selected for the research have been analyzed from the perspective of high-level actions and it also has successfully located the factors that might lead to the unsatisfied player experience. To those video game which needs the player to engage with a different type of higher-level actions, the multimodal analysis could easily extract these higher-level actions and transcript it into retrievable data. And by analyzing these data, could provide a clear understanding of specific game-designed mechanics and elements. Besides, based on the understanding from analysis, it could also become reveal the direction for developers to improve the player experience.

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