國立臺灣大學電機資訊學院資訊工程學系

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肢體談話：使用肢體語言溝通的網路合作遊戲設計

BodyTalk: Using Body Language Communication in Online Cooperative Games

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肢體談話：使用肢體語言溝通的網路合作遊戲設計

BodyTalk: Using Body Language Communication in Online Cooperative Games

本論文係王偉翰君 (R01944015) 在國立臺灣大學資訊工程學系完成之碩士學位論文，於民國 103 年 7 月 8 日承下列考試委員審查通過及口試及格，特此證明

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誌謝

感謝實驗室的夥伴們對於我的幫助，尤其是同組的夥伴們，我們互相學習、互相加油打氣，我們一起努力的日子是我最難忘的回憶。也感謝我的指導教授陳彥仰老師，給予了我許多的建議，且十分支持我的研究。感謝所有在過程中給予我幫忙的朋友，你們的每一分付出，都成就了這篇論文的每字每句，謝謝你們。

摘要

在網路快速發展之下，數以百萬計的人透過網路分享照片，撰寫網誌，或是與其他人遊玩遊戲。然而，語言仍然阻礙了人們聯繫、社交以及合作。為了了解語言障礙對於合作遊戲體驗的影響，我們進行了一個 12 人的使用者測試，透過使用者遊玩三款知名的合作遊戲，我們得到的結果是，無共通語言的受測者遊玩體驗獲得了較高的挫折感以及較低的遊戲樂趣。因此我的提出透過肢體語言來跨越合作遊戲中的語言障礙，我們的系統使用了 Kinect 來偵測使用者的姿勢並對應到遊戲中的虛擬角色。共 48 位使用者參與了我們遊戲原型的使用者測試，我們發現了肢體語言可以提升遊戲樂趣以及降低挫折感，並加強合作體驗，尤其對於無共通語言的使用者來說效果更是明顯。此外，有 79% 的受測者偏好有肢體語言的溝通方式。

Abstract

The rapid growth of the Internet has enabled billions of people to share photos, to blog, and to play games with each other. However, languages remain a barrier for people to connect, socialize, and cooperate around the world. We conducted a 12-person user study to understand how language barriers affect cooperative experiences through 3 popular cooperative games. Results showed that participants without common languages rated their experience as significantly more frustrating and less fun. We propose using body language to transcend language barriers for cooperative games. Our system, BodyTalk, uses Kinect sensors to track users' postures and share them as avatars in real-time with other users over the Internet. Our 48-person user study using our prototype game showed that cooperative experience with body language was more fun and less frustrating, and co-experience was improved for all participants, especially for those without common languages. Also, 79% of the participants preferred having body language communication.

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Chapter 1

Introduction

The Internet has enabled billions of people around the world to connect, communicate, and cooperate. However, even the most widely spoken language, Mandarin, is only spoken by 12% of the world population. Other official languages of the United Nations, like English and French, are only spoken by 4.8% and 1.0% of the world, respectively [1]. Even if we include non-native speakers who are able to communicate in that language, they still only represent 12% and 3% of the world, respectively [4, 5]. This means that even for someone who speaks two of the most popular languages in the world, the person is only able to communicate with a small percentage of the world population.

One of the most popular activities on the Internet is playing cooperative games, with three of the top online cooperative games having sold more than 50 million copies. The Entertainment Software Association (ESA) indicated that there were 59% Americans played video games, and 62% of gamers played games with others [3]. To understand how language barriers affect cooperative gaming experience, we conducted a 12-person user study with three popular online cooperative games. We collected participants' experience and rating using extended Short Feedback Questionnaire (eSFQ) [17] and Cooperative Performance Metrics (CPMs) [11], as well as interviews. The study results showed that while none of the participants with common languages reported the gaming experience as frustrating, up to 67% of the participants without common languages did. Also, participants without common languages rated fun and enjoyment significantly lower at 3.6 vs 4.3 on average (on a scale of 1 to 5) compared to participants with common languages.

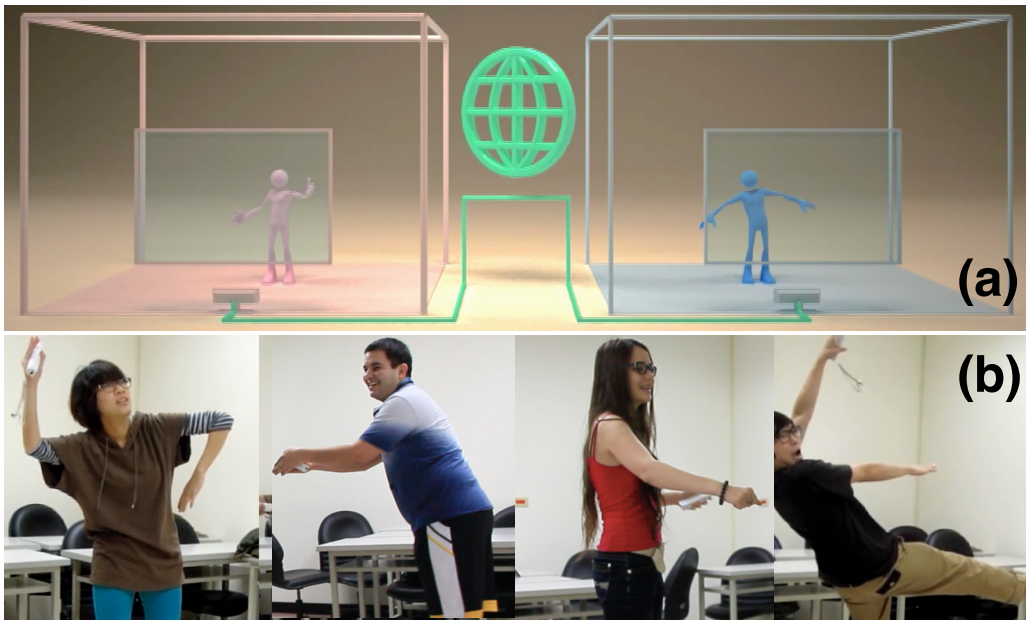

Figure 1.1: (a) Playing cooperative games with body language over the Internet, (b) Body language expression from actual BodySense gameplay.

Because a significant portion of human communication is expressed through body language [21], this paper explores the effects of using body language in cooperative games for players with and without language barriers. We developed an online cooperative platform, BodyUp, that uses Microsoft Kinect sensors to capture body postures (i.e. skeletal tracking), Wii controllers to move the avatars, and microphones to capture voice and transmit these data in real-time over the Internet (as shown in Figure 1a).

We also developed a game using the BodyUp platform, called Mute Robot, that supports cooperative gaming in three communication modes: 1) speaking only, 2) body language only, and 3) both speaking and body language. We designed Mute Robot to enable pairs of players to cooperate to solve puzzles. It consists of three asymmetric puzzle stages, where only one player can see the solution hints and needs to guide the other player to solve the puzzles. Figure 1b) shows examples of body language expression during actual gameplay.

We conducted a 48-person user study using these three communication modes, with half of the users having common languages and half without. The study results showed that adding body language to cooperative games increased the fun and enjoyment ratings for all players (both with and without common languages) from an average of 3.8 to 4.4

(on a scale of 1 to 5).

Also, in speaking-only mode, the negative co-experience reported by players without common languages was more than 3 times than that reported by players with common languages. Adding body language improved their positive co-experience by 33% and reduced their negative co-experience by 73%.

In terms of preference, 75% of the players with common languages and 83% of the players without common languages preferred having body language communication. Overall, 83% of the players found having body language to be more cooperative.

Chapter 2

Related Work

Related works fall within two areas: cooperative game design, and body language.

2.1 Cooperative Game Design

Several prior works have explored and analyzed cooperative game design patterns. Zagal et al. explored cooperative patterns within board games and yielded some observations that game designers might consider useful for designing collaborative game [14], and it also presented an ontology with a view to analyzing game play [22]. Bjork and Holopainen presented a large quantity of game design patterns [20], including cooperative and social interaction patterns. Rocha et al. presented a framework of several cooperative game design patterns and analyzed the actual impact of using these game mechanics to design a cooperative video game [13]. El-Nasr et al. extended Rocha et al.'s model and proposed Cooperative Performance Metrics (CPMs) to evaluate game experience [11].

Wolmet et al. reported a study of how parents and children play several cooperative co-located games with different characteristics [8]. Mark et al. [18] evaluated the communicative and cooperative behavior of same-age and mixed-age pairs (Young-Young, Young-Old, Old-Old), and identified noticeable difference between group types. Hamilton et al. [7] explored how to design games for children to play with cerebral palsy, and it also presented several cooperative gameplay prototypes.

In our work, we explored and evaluated the possibility to use body language as a com-

munication manner in cooperative game design, and analyzed the communication pattern with players.

2.2 Body Language

Consist of human communication, there is not only speech but also inclusive of various gestures and body motions. Body language, a non-verbal way to transmit your thoughts without verbalizing. According to The 7% Rule[21], the influence of communication for verbal is only 7% but is 93% for non-verbal expression. And the non-varbal expression is made up of body language (55%) and tones of voice (38%).

Charades[2] is a word guessing game. It is an acting game in which one player act as a word or a phrase, and sometimes imitates a similar pronounced words, while the other players guess the answer. The main idea is to use the body to make physical expression rather than using verbal language.

Inspired by The 7% Rule and the Charades, we suggested using body language as a communication manner in cooperative game to normalize player's communication skill. With this idea, whether players are playing with different language speakers or not, their communication skill is near enough for a game developer to design a proper difficulty to entertain players. On the other hand, many researchers have argued that the body movement brings about a positive emotional and social response [9, 12, 16]. We believe that body language communication should enhance game engagement and enjoyment.

Chapter 3

Cross-Language Experience for Current Cooperative Games

To understand how language barrier affects the cooperative experience for current games, we conducted a 12-person user study where half the participants shared common languages and half did not.

3.1 Study Design

We recruited 3 Japanese speakers and 9 Taiwanese speakers, and confirmed that none of the Taiwanese speakers understood Japanese and vice versa. 3 pairs of the participants did not have a common language (Japanese-Taiwanese) and 3 pairs did (Taiwanese).

We selected 3 popular cooperative games currently on the market that had distinct gameplay and cooperation needs. Also, all three games supported real-time voice chat.

1. Rocketbirds - Hardboiled Chicken: a cooperative action game, in which players shoot enemies with different weapons.

2. Portal 2: a cooperative puzzle game, in which players can create portals that teleport players and must use them intelligently to solve the puzzles.

3. Monaco: a cooperative stealth game, in which players can evade guards, collect coins, and escape.

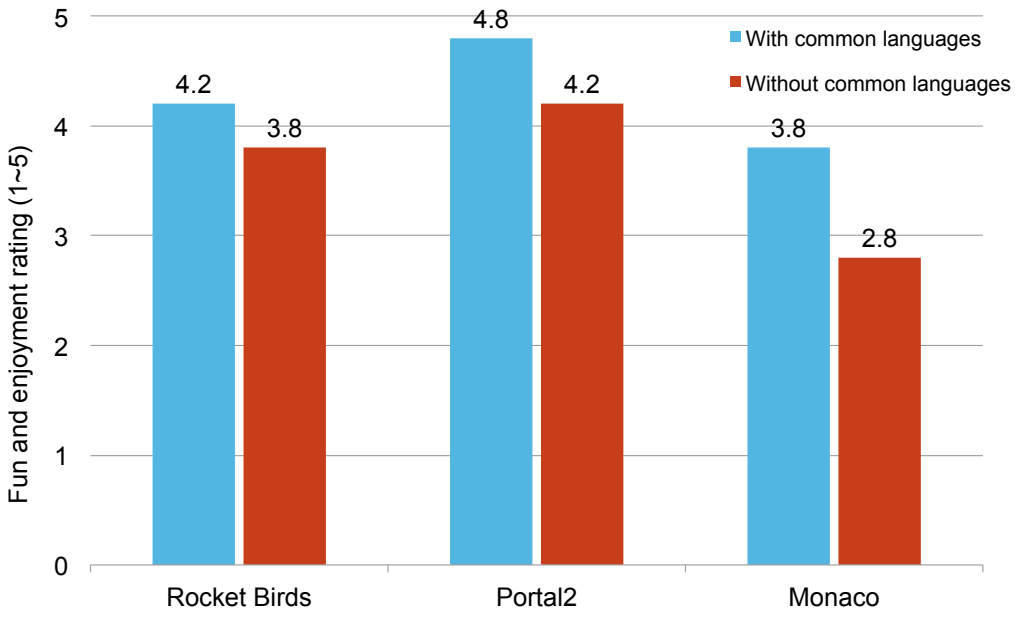

Figure 3.1: The eSFQ Fun and Enjoyment rating (on a scale of 1 to 5) of three cooperative games for players *with* and *without* common languages.

In order to simulate cooperative gameplay over the Internet, pairs of players were placed in two different rooms and used headsets to communicate with each other. Participants played each of the three games for 30 minutes, and filled out an eSFQ[17] questionnaire after each game. We also conducted open-ended interviews to understand their gaming experience at the end of the sessions.

3.2 Results

eSFQ[17] has been widely used for rapid assessment of game experience. Players are asked to provide Likert-scale ratings (on a scale of 1 to 5) and to select multiple keywords to describe aspects of their experience. For this study, we focus on the fun/enjoyment ratings and the frustrating co-experience.

Figure 3.1, shows the average eSFQ Fun and Enjoyment rating for each game, for players *with* and *without* common languages. A rating of 5 is the highest level of fun and means "Yeah, fun", and a rating of 1 is the lowest level of fun and means "Yawn, boring". The rating was lower for all three games when the players did not have common languages. Overall, the Fun and Enjoyment rating was 3.6 vs 4.3 for players without

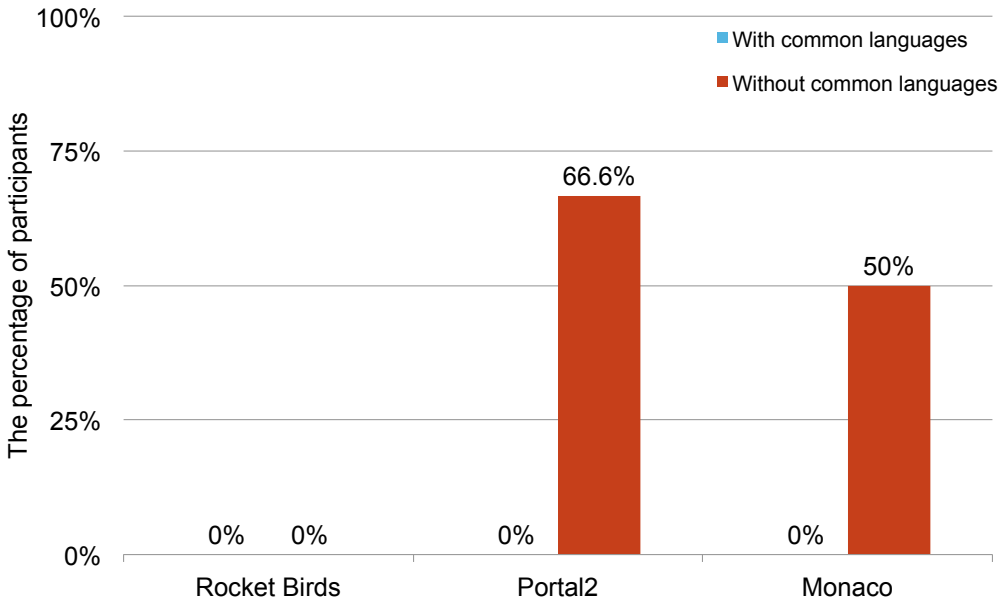

Figure 3.2: The eSFQ Frustration index, which is the percentage of players who reported a frustrating experience, of three cooperative games for players *with* and *without* common languages.

common languages compared to those who could communicate using a common spoken language.

Figure 3.2 shows the eSFQ Frustration index, which is the percentage of players who reported the experience as frustrating, for players *with* and *without* common languages. For two out of the three games, Portal 2 and Monaco, frustration is significantly higher for players without common languages than those who did. In fact, none of the players with a common spoken languages reported any of the games as frustrating.

3.3 Discussion

The Rocketbirds' gameplay mainly consists of dodging and shooting, and required the least communication outside the game. As player P5 commented (shown in Table 1): "We couldn't talk to each other, but communicated through moves and jumps." None of the players reported Rocketbirds as frustrating, and language barriers had the least effect on its fun and enjoyment rating as well.

Portal 2 was reported as the most frustrating by players without common languages. Portal 2's primary gameplay is to solve complex puzzles, which requires precise collabo-

ration between the two partners. As some of the players mentioned: “I couldn’t tell what my partner was trying to do without talking to each other.”(P5), and “It was tiring because it was hard to express my ideas.” (P4).

Monaco’s gameplay allowed a single player to solve a challenge, although cooperation would make it significantly easier. Player P4 mentioned: “I didn’t know where the exit was, and my partner couldn’t tell me.”, yet P9 stated: “This game is simple. We didn’t really need any communication with each other.”.

Game	Feedback from Players without Common Languages
Rocketbirds	• “Although it was slower without talking, the challenges could still be beaten with patience.”(P2) • “We couldn’t talk to each other, but communicated through moves and jumps.”(P5)
Portal 2	• “It was tiring because it was hard to express my ideas.”(P4) • “I couldn’t tell what my partner was trying to do without talking to each other.”(P5)
Monaco	• “I didn’t know where the exit was, and my partner couldn’t tell me.”(P4) • “This game is simple. We didn’t really need any communication with each other.”(P9)

Table 3.1: Interview comments by players without common languages.

Chapter 4

BodyTalk Platform and Game Design

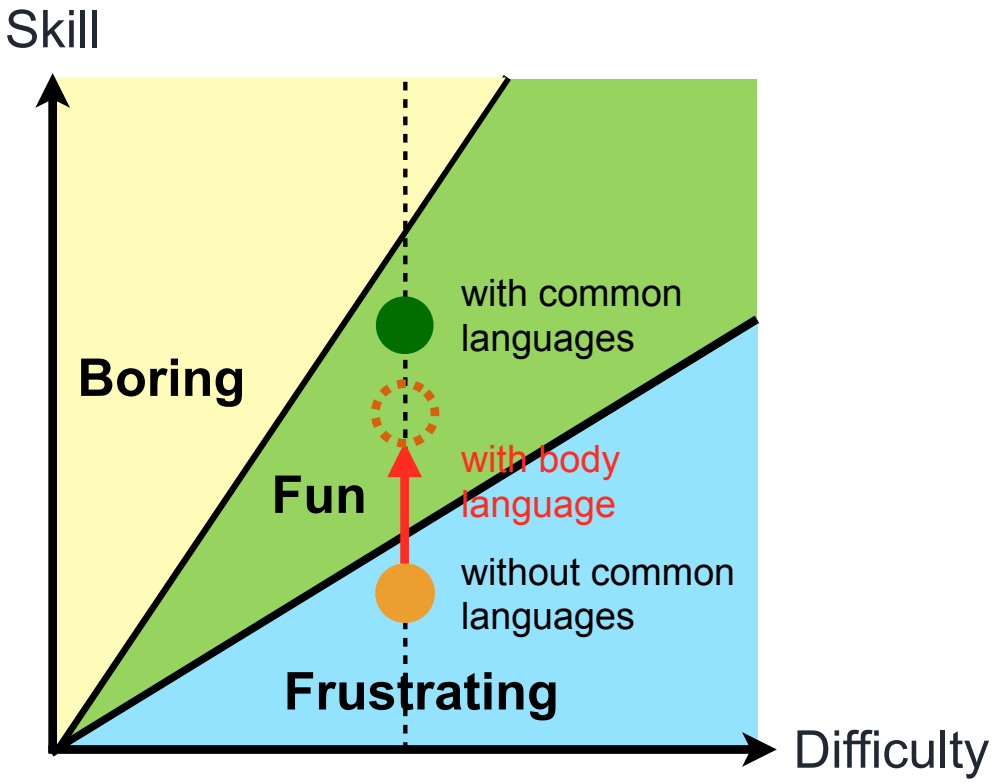

Figure 4.1: Players cooperative skill levels are lower without a common language. Adding body language communication increases them, and may move the experience from being frustrating to fun.

GameFlow[19] discussed how game difficulty and players' skill levels affect whether players would perceive the experience as boring, fun, or frustrating. As shown Figure 4.1, when the difficulty is greater than the player's skills, the experience is frustrating. On the other hand, when the difficulty is less than the player's skills, the experience will be

boring.

Observation from our study indicated that playing a cooperative game with a partner that did not have a common language significantly decreased players' skill level. At a difficulty level that was designed to be fun for players with common languages, that difficulty level was too challenging for players that could not communicate through languages, which lead to a frustrating experience.

One way to solve this problem is to decrease the game's difficulty. However, this method makes the experience boring for players that had common languages. By adding body language to the gameplay, players without common languages would be able to increase their skill level, and potentially move the experience from frustrating to fun (as shown in Figure 4.1).

4.1 System Design and Implementation

Our BodyTalk platform uses a Kinect depth camera (v1) and Micrsoft's Kinect SDK (v1.8) to capture each player's skeletal movement. Wii controller is used for navigation (e.g. move left, right, up, down) and selection (e.g. OK, Cancel). This combination of input modality enables users to use both arms and both legs freely for expressive body language communication. These data are sent using Unity engine's[6] Network View over the Internet in real-time.

We developed a cooperative puzzle platformer game, called Mute Robot, using our BodyTalk platform. Two players at two distinct locations cooperate to solve a series of puzzle challenges, and their body movements are rendered as 3D avatars in real-time (see Figure 4.2).

4.2 Game Stage Design

In order to have the players cooperate closely, we designed an asymmetric puzzle gameplay. The two players each sees a different view of the game with only one player receiving the hints to solve a puzzle, and must guide the other player to solve it. The roles

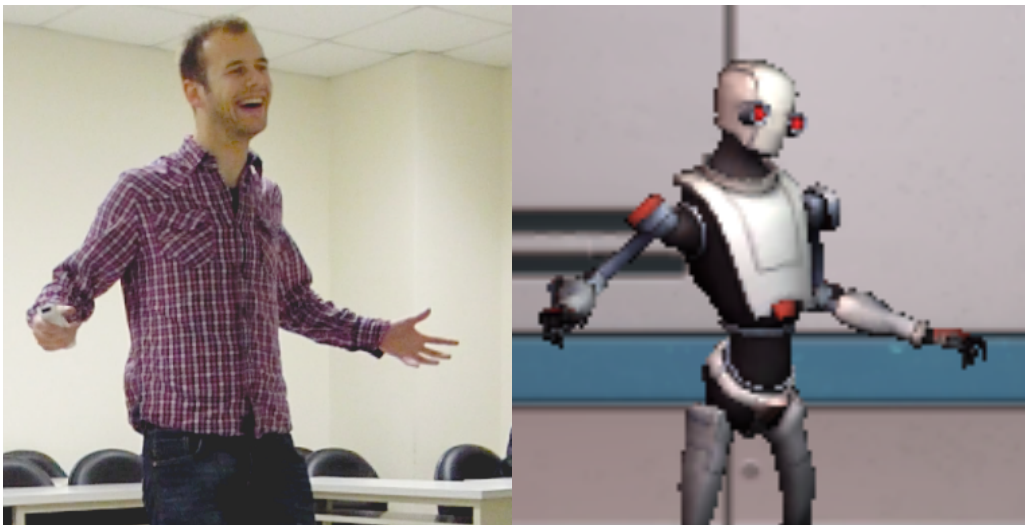

Figure 4.2: Body movement mapping between player and avatar by Kinect

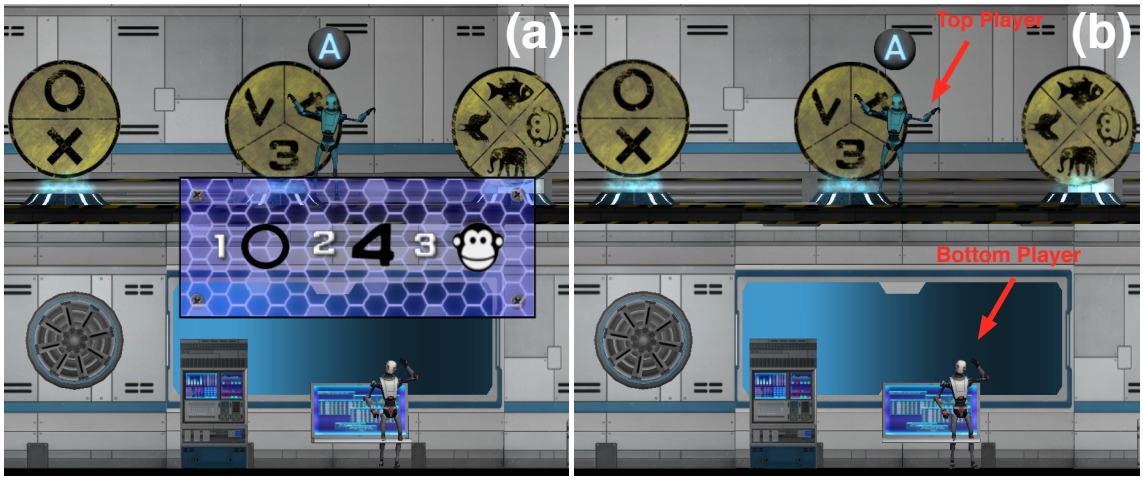

Figure 4.3: The asymmetric puzzle game design in one of Mute Robot's stages. (a) Bottom player's view, (b) Top player's view

of the hint giver and the hint receiver alternate after each stage, and the puzzles increase in difficulty.

Figure 4.3 shows an example of the two distinct views as seen by the two players. The left view shows the bottom player's view with the puzzle hints, and the right view shows the top player's view (which does not have the hints).

Our prototype game has three stages. The first stage is a classic puzzle in cooperative games, where one player has to express a randomly generated secret sequence to the other player. In our design, the player must press three spatially separated buttons in the correct order to unlock a door to advance to the next stage.

The second stage, as shown in Figure 4.3, has a combination lock with three wheels.

All three wheels must be turned to the correct selection in order the unlock the door. The first wheel's symbols are two boolean values (O and X). The second wheel's symbols are three numbers (3, 4, 7), and the last wheel's symbols are animals (fish, chicken, monkey and elephant). The set of correct symbols is randomly generated each time.

For the third stage, we wanted to explore abstract concepts. So it randomly selects one of three emotions (angry, happy and tired), for one player to pass to the other player. That player must spell the emotion correctly by selecting from a set of on-screen letters in the correct order to pass the stage.

Chapter 5

User Study

Our goal is to explore how body language affects cooperative experience for players with and without common languages.

5.1 Study Design and Participants

We set up our prototype game with three distinct communication modes: speaking only, body language only, and both speaking and body language.

Each pair of players were placed into two separate rooms, so that they could not see nor hear each other. The rooms were on the same local area network to minimize network latency. At the beginning of each session, players practiced controlling the avatars via Kinect and Wii controllers and speaking to their partners through voice over IP (VOIP).

Each pair of players completed all Mute Robot stages three times, each time using one of three communication modes. The order of the communication modes was counterbalanced to eliminate the effects of ordering. Each time the players completed Mute Robot using one of the communication modes, they filled out a Short Feedback Questionnaire (eSFQ)[17] questionnaire to rate their experience.

At the end of the session, the players filled out a final questionnaire comparing their preferences, and we conducted interviews to get their qualitative feedback. Each session took about 1 hour to finish. In addition, all the gameplay was recorded on video and we manually coded them using Cooperative Performance Metrics (CPM)[11].

We recruited 48 participants (15 females) with average age of 22.6, for a total of 24 pairs of participants. Half of the participant pairs shared a common language (Mandarin). The other half of the pairs were ask to speak in a language that could not be understood by their partners (12 Taiwanese speakers paired with 5 Japanese, 2 German, 1 Netherlander, 1 Chilean, 1 Iraqi, 1 Russian, and 1 Guatemalan).

5.2 Short Feedback Questionnaire (eSFQ) Results

In our analysis, we focus on the fun/enjoyment ratings and both the positive and negative co-experience as described through the selected keywords.

5.2.1 Fun/Enjoyment Ratings

Figure 5.1 shows the fun/enjoyment rating for players with and without common languages using the three communication modes. For players with common languages, their mean rating for Speaking mode was 3.58 (SD = 1.14), and the most popular keywords selected were "simple" (83% of the users) and "intuitive" (54%). Their mean rating for Body language mode was 4.54 (SD = 0.66), and the most popular keywords selected were "intuitive" (54%), "exciting" (46%) and "great" (42%). Their mean rating for Both mode was 3.96 (SD = 1.00), and the most popular keywords selected were "intuitive" (63%),

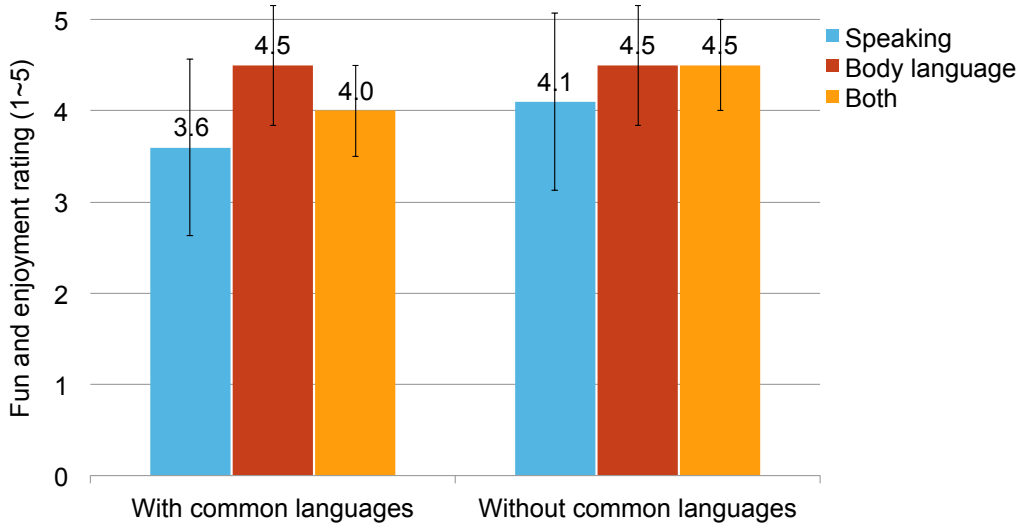

Figure 5.1: eSFQ: fun/enjoyment rating for players *with* and *without* common languages.

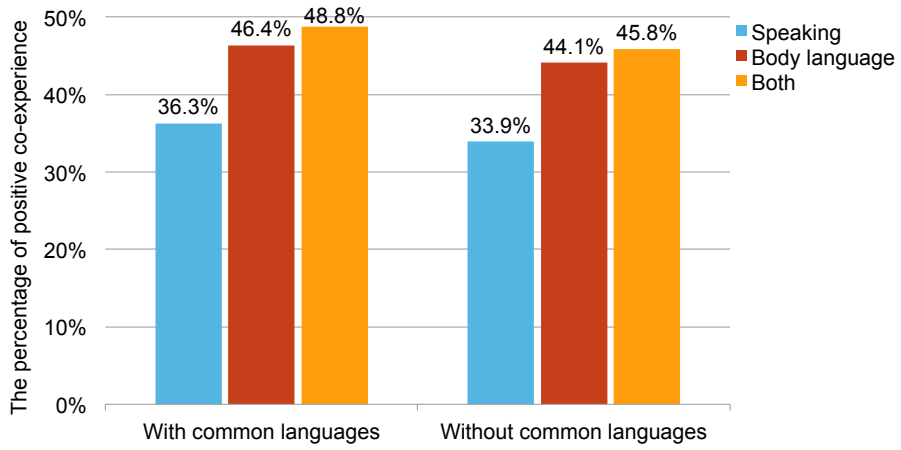

Figure 5.2: eSFQ: average co-experience of positive indexes (Cooperative, Happy, Fun, Fair, Encouraging, Triumphing, Satisfying).

"simple" (63%) and "exciting" (33%).

For players without common languages (see Figure 5.1), their mean rating for Speaking mode was 4.08 (SD = 0.97), and the most popular keywords selected were "great" (42% of the users), "intuitive" (38%), "simple" (38%), and "confusing" (33%). Their mean rating for Body language mode was 4.46 (SD = 0.66), and the most popular keywords selected were "intuitive" (54%), "exciting" (46%), "simple" (38%) and "difficult" (33%). Their mean rating for Both mode was 4.50 (SD = 0.59). , and the most popular keywords selected were "intuitive" (67%), "exciting" (42%), "simple" (42%), "great" (34%) and "confusing" (33%).

As we can see in Figure 5.1, the two communication modes with body language had higher fun/enjoyment ratings compared to the speaking-only mode for all players (both with and without common languages).

5.2.2 Positive and Negative Co-experience

Figure 5.2 shows the average positive co-experience indexes for players with and without common languages. The positive co-experience is higher for communication modes with body language. Compared to speaking-only mode, adding body language improved positive co-experience by an average of 31% and 33% for players with and without common languages, respectively.

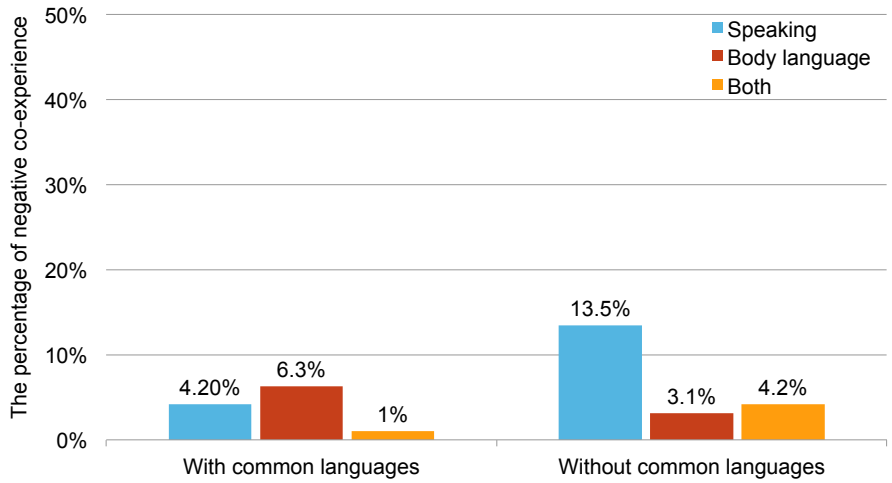

Figure 5.3: eSFQ: average co-experience of negative indexes (Defeat, Angry, Frustrating, Boring).

Figure 5.3 shows the average negative co-experience indexes for players with and without common languages. Compared to speaking-only mode, adding body language improved negative co-experience by an average of 13% and 73% for players with and without common languages, respectively.

Figure 5.4 shows the individual positive co-experience indexes for players without common languages. Compared to speaking-only mode, we can see that all of these positive indexes increase when body language is added (except for cooperative in body language only mode). Specifically, satisfaction improved by an average of 99.5%.

Figure 5.5 shows the individual negative co-experience indexes for players without

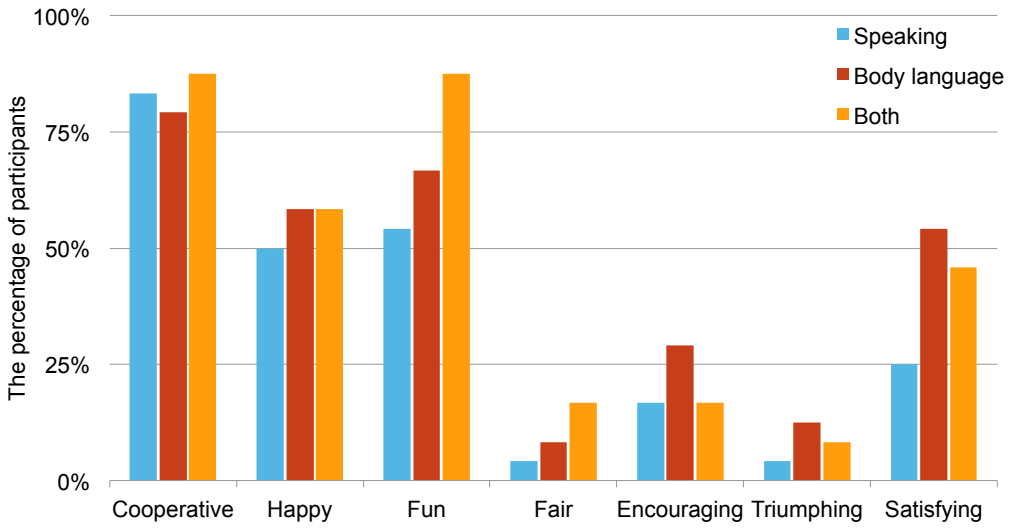

Figure 5.4: Positive co-experience indexes for players without common languages.

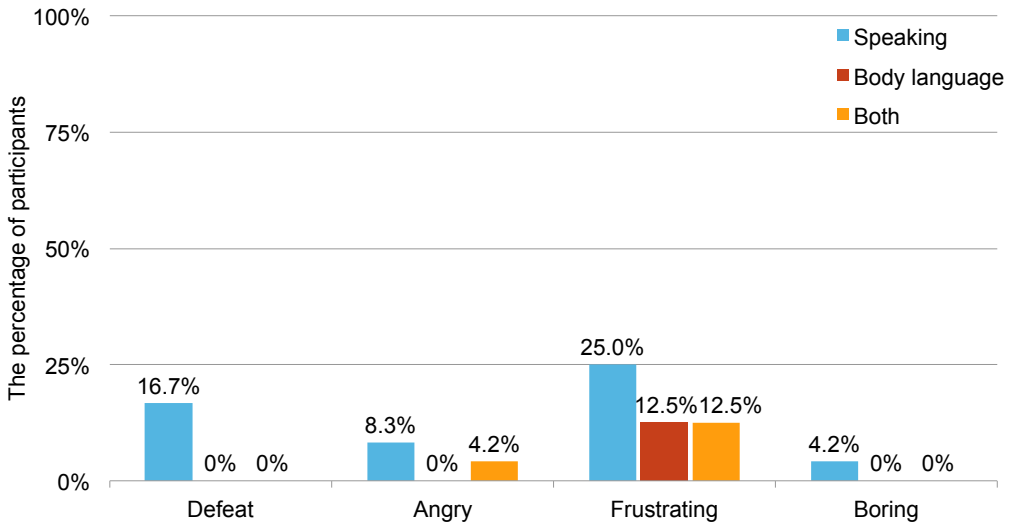

Figure 5.5: Negative co-experience indexes for players without common languages (lower is better).

common languages. Compared to speaking-only mode, we can see that all of these negative indexes decrease when body language is added. Specifically, defeat and boring dropped from 16.7% to zero, and frustration improved by an average of 48%.

5.3 Cooperative Performance Metrics (CPM) Results

Cooperative Performance Metrics (CPM)[11] is designed to analyze cooperative gaming experience, typically through manual coding of the video recordings of players' facial expression (e.g. laughter) and body movement. CPM counts the occurrences of the following six types of co-behavior: "Laughter or excitement together", "Work out strategies", "Helping each other", "Global Strategies", "Waited for each other" and "Got in each other's way ". Because 'Global Strategies" and "Got in each other's way" do not apply to our game, they are not shown in the subsequent analysis.

Before we started coding CPMs, we performed a formal validation process to ensure inter-rater consistency. We asked two independent researchers to understand CPMs in depth and were shown examples of how to apply them using video of a gameplay session. Afterwards, researchers were given four videos to analyze and we calculated inter-rater agreement using kappa values[10, 15].

We calculated the kappa values for each metric and for each of the sample videos. The

lowest Kappa value, 0.75, is greater than 0.6 and is sufficient to establish validity. To further ensure accurate coding of CPMs, each of the 24-pairs of user study sessions was coded by oth researchers, and the results were averaged.

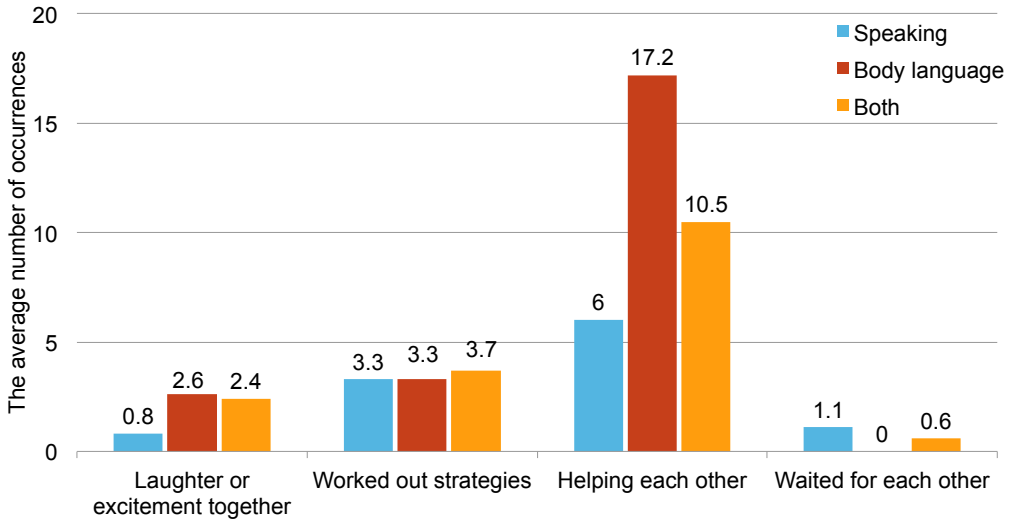

Figure 5.6: CPMs result for players with common languages.

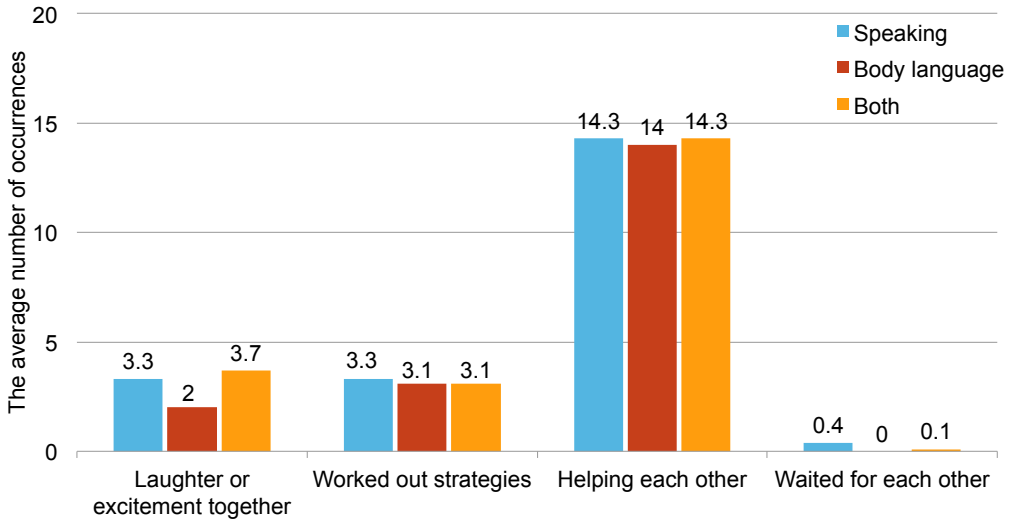

Figure 5.7: CPMs result for players without common languages.

Figure 5.6 shows the CPM results for players with common languages. Compared to speaking only, adding body language communication increased “laughter or excitement” and “helping each other”. “Laughter or excitement” increased because body language sometime led to unexpected and funny body movement. “Helping each other” increased because players were communicating with shorter but more frequent instructions, leading to more occurrences of helping each other being recorded.

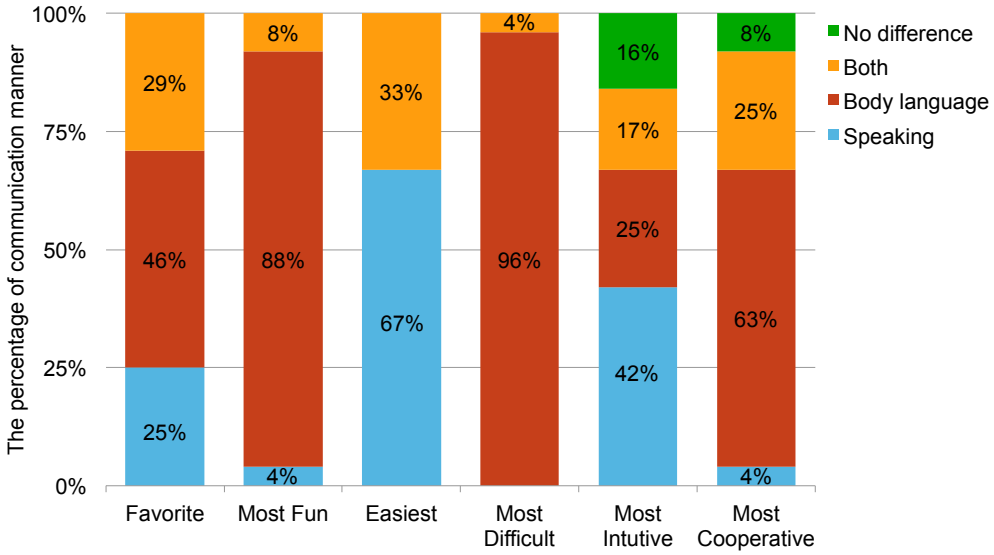

Figure 5.8: Overall preference for players with common languages.

Figure 5.7 shows the CPM results for players without common languages. "Laughter or excitement" was lowest for the body language mode. We observed funny sounds and tones the players would make, such as when someone fumbled and made a clumsy mistake, and would lead to laughter. Also, laughter by one player was often mirrored by the other player.

5.4 Final Questionnaire Results

Our final questionnaire asked the preferences among the communication modes: "Favorite", "Most fun", "Easiest", "Most difficult", "Most intuitive", and "Most cooperative".

Figure 5.8 shows the preferences for players with common languages. Body language without speaking was found to be most difficult by 96% of the players, yet had the highest proportion in the index of "Favorite" (46%), "Most fun" (88%), and "Most cooperative" (63%). Using the GameFlow model shown in Figure 4.1, the experience in speaking mode may be boring, and the body language mode may lower the skill level and make the experience more fun.

Figure 5.9 shows the preferences for players without common languages. Most of the users (58%) found the speaking mode as the most difficult, and found the body-language mode as the most intuitive (50%). Most users preferred using both speaking and body

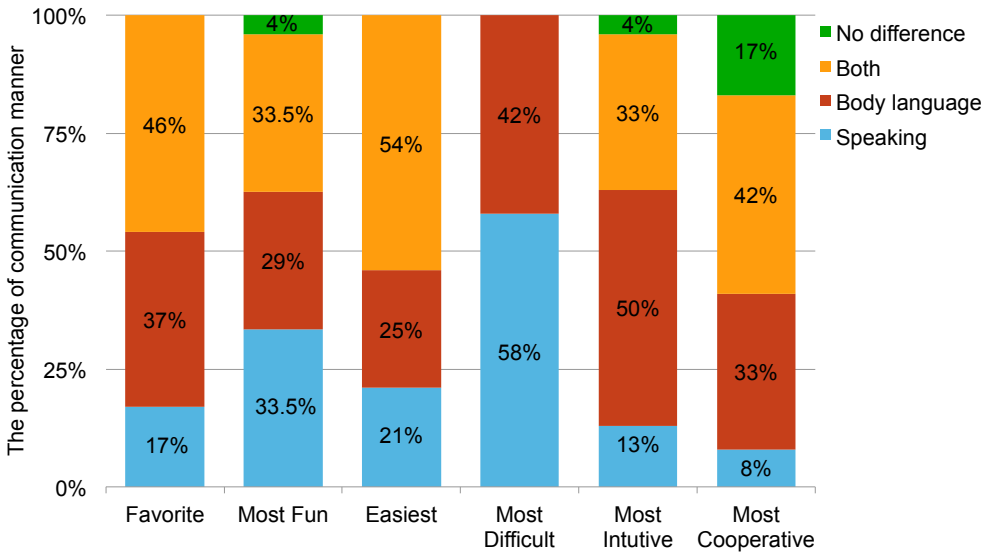

Figure 5.9: Overall preference for players without common languages.

language together (46%) and found it “Most fun” (33.5%), “Easiest” (54%), and “Most cooperative” (42%).

Chapter 6

Discussion

6.1 Consistency in Game Experience

Figure 6.1 shows the eSFQ game experience ratings for players with and without common languages, when communicating only by speaking. The experience ratings by the two player groups varied significantly. However, as shown in Figure 6.2, the ratings between players with and without common languages was much more consistent when communicating via only body language. The average absolute difference in ratings was 22.4% across the 8 indexes when communicating by speaking, compared to 6.25% by body language only.

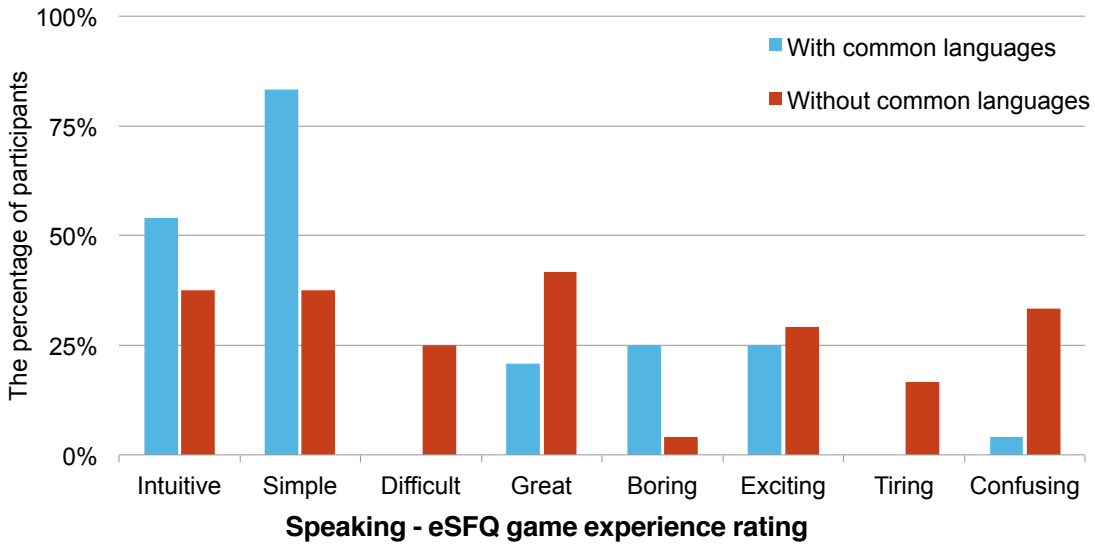

Figure 6.1: Index patterns of eSFQ game experience rating for speaking

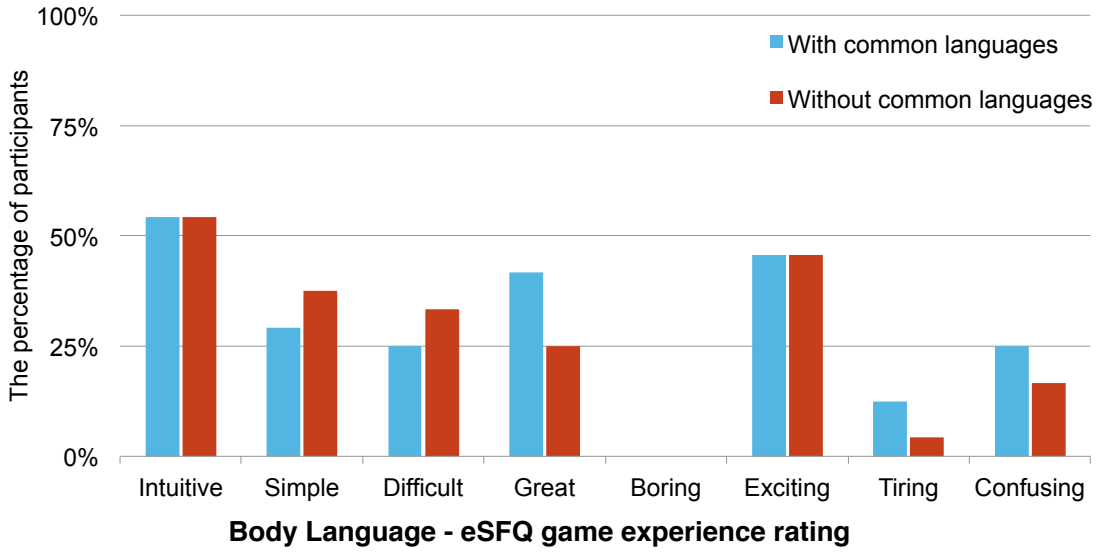

Figure 6.2: Index patterns of eSFQ game experience rating for body language

6.2 Communication Patterns

We summarize the communication patterns we observed when participants were communicated by: speaking, body language, and both speaking and body language.

6.2.1 Speaking

For participants with common languages, communicating by speaking was straightforward. For participants without common languages, although there were language barriers, they still found ways communicate with each other by tones, short words, and sounds.

1. Simple words: participants spoke simple words and short sentences. For example, Japanese speakers would say “hai (yes)”, “ie (no)”, “koko (here)”, and “soko (there)”.

2. Repeating continuously: participants often repeated the same simple words until the other player performed the corresponding action. For example, Japanese speakers would repeat “kuru (come)” until the the other player come. The player receiving the words would try different actions until the repeating stops.

3. Emphasized tones: participants frequently used different tones to express doing things right vs doing things wrong. They often used calm and longer repeating

tones to express doing alright, and used urgent repeating tones to express doing things wrong. For example, Japanese speakers would say “hai (yes)” in a calm tone to express correct, and say “ie (no)” in an urgent tone to express wrong.

4. Sound imitation: we observed participants mimicking animals’ sounds to express the corresponding animals, such as roosters.

6.2.2 Body Language

We observed similar body languages communication for players with and without common languages. We summarize them below:

1. Divide and conquer: player who received puzzle-solving hints would perform one action at a time, then stops until the other player completes the corresponding action. For example, a player jumped in a particular place several times in order to imply that the other player should move to and jump at the corresponding position (see Figure 6.3). This was the most frequently used communication pattern.

2. Repeat it all: player who received the puzzle-solving hints would perform all the actions in one go before stopping for the other player to follow. For example, in one of our game stages shown in Figure 6.3, the 3 buttons on the floor had to be stepped on one after another in a specific order. The top player would perform the sequence all at once for the bottom player to repeat.

3. Pictogram: players would use their own body to express and mimic the hints. As shown in Figure 6.4, one participant wanted to express the letter “N” to the other player. Her solution was using her body to perform a pictogram.

6.2.3 Both Speaking and Body Language

When both speaking and body language were available for communication, the players without common languages primarily used body language communication, and used tones

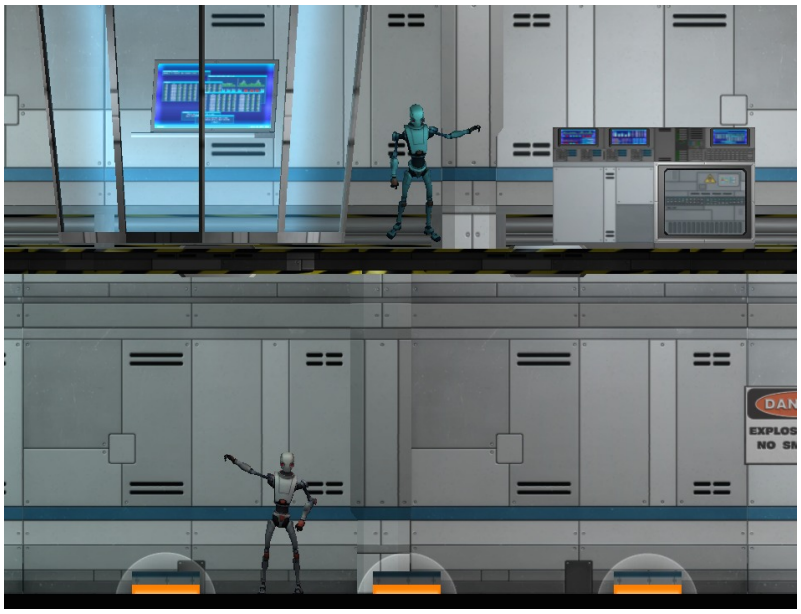

Figure 6.3: A sequence puzzle from Mute Robot. The top player knows the correct sequence and is showing the bottom player to move to and jump on the center yellow button among the three buttons.

Figure 6.4: A participant performing a pictogram (the letter “N”) using body language.

and word to facilitate, such as when confirming a correct action. Players with common languages primarily communicated by speaking, and used body language to facilitate.

6.3 Player Feedback

We summarize participants' feedback below:

1. Fun: players reported that adding body language to cooperative gameplay enhanced gaming experience and enjoyment. For example, one participant reported "body language is intuitive, without restriction, really funny and becoming an innovative way for a cooperative game." (P34), and another reported "For cooperative games, it's nice to be possible to be mis-understood, add something new to the gameplay" (P18).

2. Voice: players found that voice improved the gaming experience compared to only using body language. For example, one participant reported that "it is too silent when playing with only body language, I feel less lonely with voice." (P5) and another said "it is more fun to hear the other player in addition to body language" (P19).

3. Interactivity: players reported that having body language enriched the game's interactivity. For example, players reported "Body language provides more challenges and feels like really playing with my partner."(P37), "I feel embarrassed talking to a stranger, but using body language is not." (P23), and another player reported "It's great to move your body, and it's more interactive" (P11).

4. Preferred communication methods: one player reported "Using body language to communicate is more challenging, and more rewarding."(P37), yet another player reported preference for having both speaking and body language because "you can use whatever you prefer to communication to your partner to convey your meaning."(P48).

6.4 System Limitation

Our prototype currently uses version 1 of the Kinect sensors, which can only track the major skeletal movements (head, torso, arms, and legs). It could not track more sub-

tle expression such as eyes and facial expression, that are also important for non-verbal communication. In addition, it can not track finger and hand movement. As one participant reported: "The avatar can't fully express what people can express, like emotional reaction."

We plan to use improved sensors, such as the Kinect v2 sensors, that can capture players' more subtle movements such as hands and fingers. Furthermore, we plan to use computer vision techniques to capture and relay players' facial expressions.

Chapter 7

Conclusion

Our 12-person study with three popular online co-operative games showed that language barrier significantly degraded players' experience. We proposed and developed a platform, called BodyTalk, to explore how body language communication affects co-operative experiences. It used Kinect sensors to track users' postures and shared them as avatars in real-time over the Internet, and uses Wii remotes to navigate the avatars.

Our 48-person user study using our prototype game built on BodyTalk showed that adding body language to cooperative experience made it more fun and less frustrating, and improved the co-experience for all participants, especially for those without common languages. Also, 79% of the participants preferred having body language communication.

In addition to exploring improved sensors to better support non-verbal communication, we also plan to explore how body language affects other types of co-operative experiences.

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