BodyTalk: Using Body Language Communication in Online Cooperative Games

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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 presents them as avatars in real-time with other users over the Internet, and uses Wii remotes to navigate. Our 48-person user study using our prototype game showed that adding body language to cooperative experiences was more fun and less frustrating, and improved co-experience for participants without common languages. Also, 83% of the participants preferred having body language communication.

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) [18] and Cooperative Performance Metrics (CPMs) [19], 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. (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 [22], 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 language 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.

RELATED WORK

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

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 [15]. Bjork and Holopainen presented a large quantity of game design patterns [10], 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 [19].

Wolmet et al. reported a study of how parents and children play several cooperative co-located games with different characteristics [8]. Mark et al. [20] 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 communication manner in cooperative game design, and analyzed the communication pattern with players.

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[22], 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, 17]. We believe that body language communication should enhance game engagement and enjoyment.

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.

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 ecsape.

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[18] questionnaire after each game. We also conducted open-ended interviews to understand their gaming experience at the end of the sessions.

Results

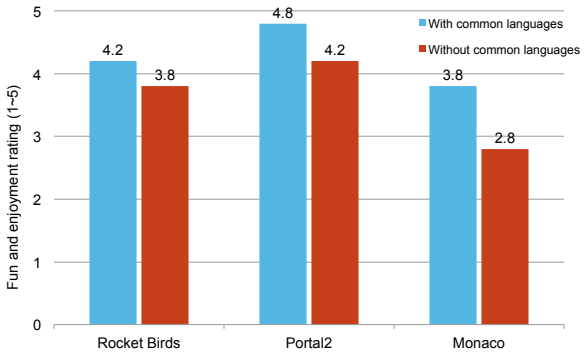

Figure 2. The eSFQ Fun and Enjoyment rating (on a scale of 1 to 5) of three cooperative games for players *with* and *without* common languages.

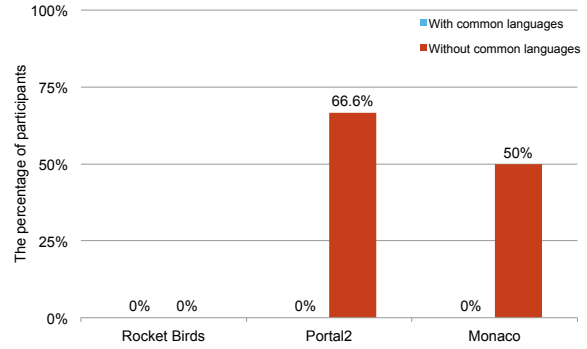

Figure 3. The eSFQ Frustration index, which is the percentage of players who reported a frustrating experience, of three cooperative games for players *with* and *without* common languages.

eSFQ[18] 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 2, 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 common languages compared to those who could communicate using a common spoken language.

Figure 3 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 than those who did. In fact, none of the players with a common spoken languages reported any of the games as frustrating.

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 collaboration 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 1. Interview comments by players without common languages.

BODYTALK PLATFORM AND GAME DESIGN

GameFlow[21] discussed how game difficulty and players' skill levels affect whether players would perceive the experience as boring, fun, or frustrating. As shown Figure 4, 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).

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 controllers 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 movement are rendered as 3D avatars in real-time (see Figure 5).

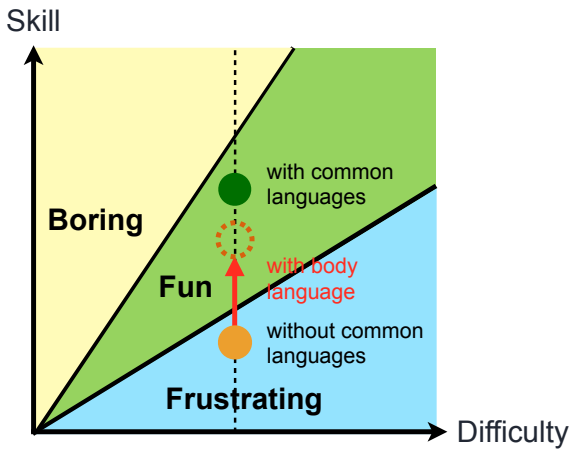

Figure 4. Players cooperative skill levels are lower without a common language. Adding body language communication increases them, and may move the experience from being frustrating to fun.

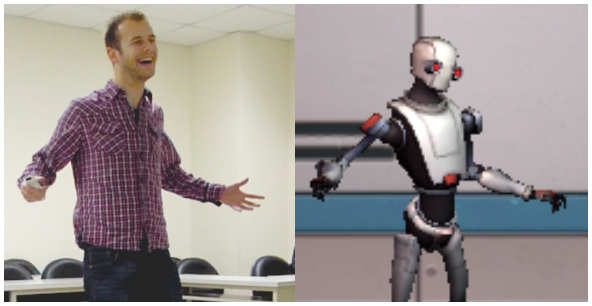

Figure 5. Body movement mapping between player and avatar by Kinect

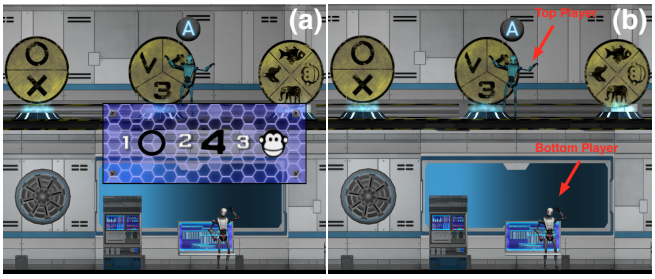

Figure 6. The asymmetric puzzle game design in one of Mute Robot's stages. (a) Bottom player's view, (b) Top player's view

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

Figure 6 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 6, 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 are 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.

USER STUDY

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

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 were counterbalanced to eliminate the effects of ordering. Each time the players completed Mute Robot using one of the communication modes, they filled out an Short Feedback Questionnaire (eSFQ)[18] 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)[19].

We recruited 48 participants (15 female) 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).

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.

Fun/Enjoyment Ratings

Figure 7 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%), "simple" (63%) and "exciting" (33%).

For players without common languages (see Figure 7), their mean rating for Speaking mode was 4.08 (SD = 0.97), and

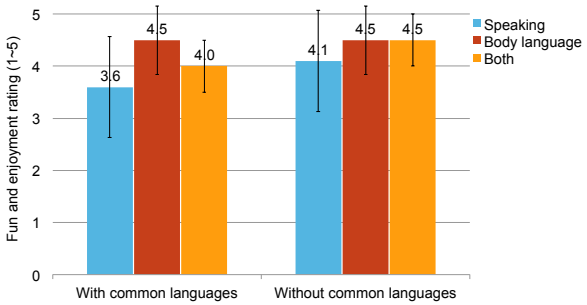

Figure 7. eSFQ: fun/enjoyment rating for players *with* and *without* common languages.

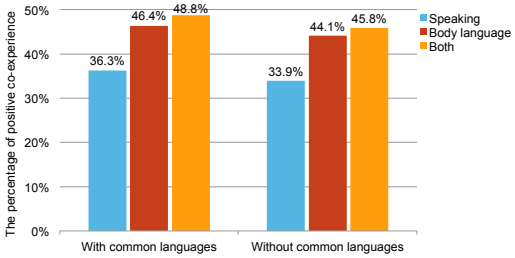

Figure 8. eSFQ: average co-experience of positive indexes (Cooperative, Happy, Fun, Fair, Encouraging, Triumphing, Satisfying).

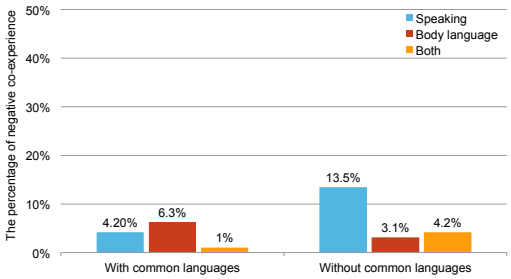

Figure 9. eSFQ: average co-experience of negative indexes (Defeat, Angry, Frustrating, Boring).

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 7, 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).

Positive and Negative Co-experience

Figure 8 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 9 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 10 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 11 shows the individual negative co-experience indexes for players without 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%.

Cooperative Performance Metrics (CPM) Results

Cooperative Performance Metrics (CPM)[19] 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 no 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, the researchers were given four videos to analyze and we calculated inter-rater agreement using kappa values[11, 16].

Table 2 shows the results of our validation 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 were coded by oth researchers, and the results were averaged.

Figure 12 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 lead 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 13 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

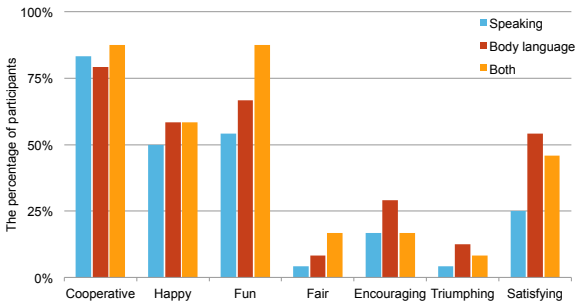

Figure 10. Positive co-experience indexes for players without common languages.

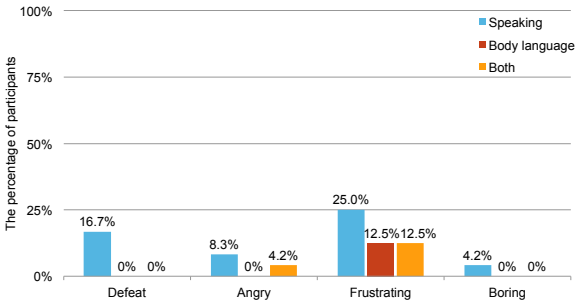

Figure 11. Negative co-experience indexes for players without common languages (lower is better).

Inter-rater	Kappa for Metrics			
	Laughter together	Work out strategies	Helping each other	Waited for each other
Session1	0.75	1	0.79	1
Session2	1	0.8	1	1
Session3	0.75	1	0.87	1
Session4	1	1	0.96	1
Average	0.88	0.96	0.91	1

Table 2. Inter-rater Agreement (M stands for CPM)

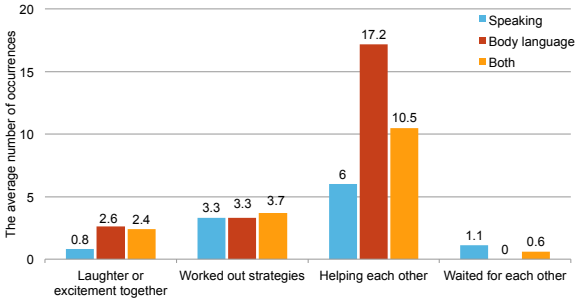

Figure 12. CPMs result for players with common languages.

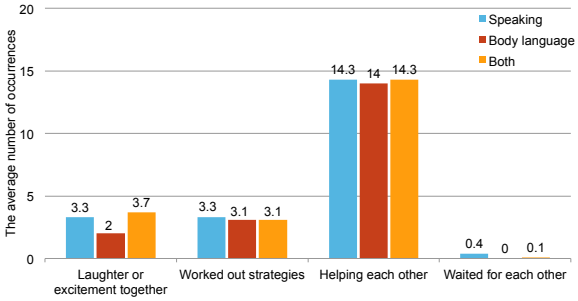

Figure 13. CPMs result for players without common languages.

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.

Final Questionnaire Results

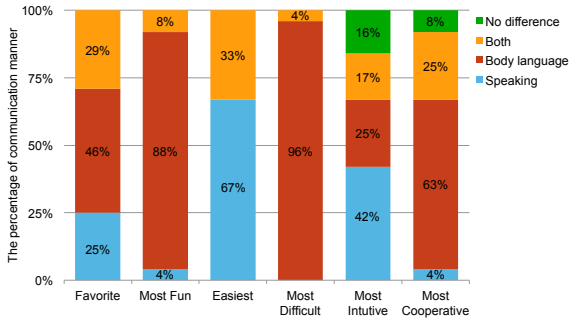

Figure 14. Overall preference for players with common languages.

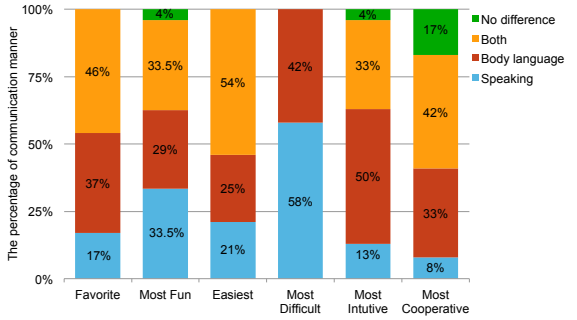

Figure 15. Overall preference result for players without common languages.

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

Figure 14 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, 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 15 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 language together (46%) and found it most fun (33.5%), easiest (54%), and most cooperative (42%).

DISCUSSION

Body Language Consistency

	average difference of eSFQ game experience
Speaking	22.40%
Body Language	6.25%

Table 3. Average Difference between players *with* and *without* common languages from Figure 16

As we can see in Figure 16 and Table 3, we can observe that, with traditional setting (speaking), the eSFQ index patterns

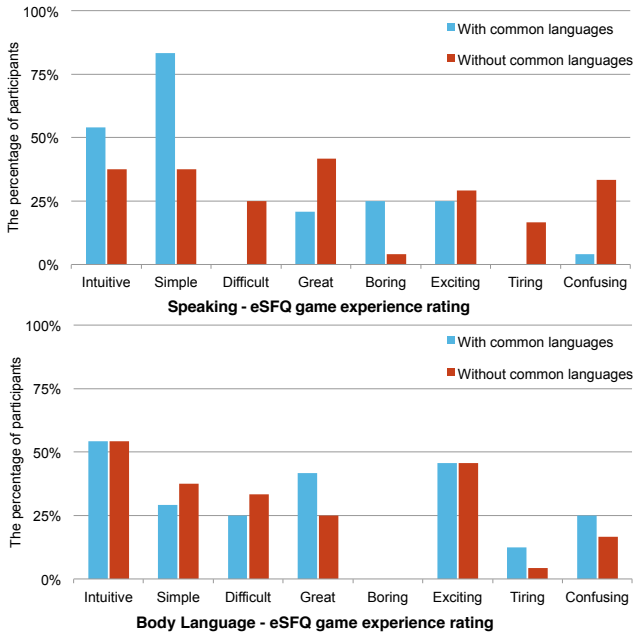

Figure 16. Index patterns of eSFQ game experience rating

are inconsistent(the average difference is 22.40%). In other words, it's a different game experience. However, with our body language communication manner design, the eSFQ index patterns are similar (the average difference is 6.25%). It implies cooperative game has more consistent game experience with body language communication.

Communication Pattern

We want to find out the difference between players with and without common languages. And we divided them into three sections (speaking, body language, and both) for discussion.

speaking

When we focus on speaking communication pattern, we compare players with and without common languages. We find out that the language boundary happened in different language groups. However, although there are some language obstacles for different language groups, they still can find some ways as below to communicate with each other.

1. Simple is better: users won't choose complicated or tediously long sentences. By contrast, they incline to use simple words to communicate.
2. Repeat Continuously: users will use the same words unceasing to express the same meaning until the other user understand.
3. Emphasized tone: users transmit additional information through different tone, such as using brisk tone to express "Everything is alright" and using urgent tone to express "Something wrong".
4. Move more: moving avatar constantly to express some elements such as position, direction etc.
5. Sound simulation: using animal's sound to express animal.

body language

After our observation, we concluded that there is no significant difference between players with and without common language when they are using body language to communicate. We integrated all three types of body language communication patterns as below.

1. Repeat after me: player who received puzzle-solving hints would perform all the puzzle-solving actions in one go for the other player to observe and emulate. For example, in one of our game stages (see Figure 17), the 3 buttons on the floor had to be stepped on one after another in a specific order. The top player would perform the answer all at once for the underside player to repeat.

2. Step-by-Step: player who received puzzle-solving hints would command the other player to do one action at a time. The next command would not be given until the previous command was executed correctly. For instance, a player jumped in place several times in order to imply that the other player should stand on the object at the corresponding position.

3. Pictogram: players would use their own body to express and mimic the hints. As showed in Figure 18, one participant wanted to express the letter "N" to the other player. Her solution was using her body to perform pictogram to show the character.

Figure 17. A sequence puzzle from Mute Robot. The top player knows the correct sequence and is showing the bottom player to step on the center yellow button among the three buttons.

Figure 18. A participant performing pictogram (letter "N") with body language.

We also observed that the Step-by-step style is most used across player groups and game stages. In spite of large diversity of body language communication, the players can still find a way to communicate effectively.

using speaking and body language together

In this section, we find out both groups have two communication patterns as below. The difference between groups was the proportion of communication patterns that they used.

1. Mixture usage: using both speaking and body language together to transmit messages and assist illustration.

2. Choosing only one pattern from speaking or body language: users will choose the most suitable or favorite communication manner, and maybe change when special condition happened.

User Feedback

We collected users feedback and organized them into different topics.

1. Fun: players thought if adding body language, cooperative gameplay experience will enhance game fun and enjoyment. For example, one player reported "Body language is intuitive, without restriction, really funny and becoming an innovative way for a cooperative game."(P34), and another player reported "For cooperative game, it's nice to be possible to be misunderstood, adding something to the game is better."(P18).

2. Voice: we found voice would affect the game experience between players. For instance, one player reported "It is funny to hear the other player as well"(P19) and "I feel lonely, because it is too silent when playing with body language only."(P5), and one player reported that "I feel embarrassed talking to stranger, but using body language is not."(P23).

3. Interactivity: players reported body language enrich the game interactivity. With body language, cooperative game becomed more interactivity, more real, and more sensory stimulation. Take some players for example, one player reported "Body language provides more challenges and feels like really playing with partner."(P37), and another player reported "It's great to move your body, and feel more interactive."(P11).

4. Communication manner: while playing cooperative game, using different communication manners would affect the complexity of information transmitting. For example, while using body language only, one player reported "Using body language to communicate is more challenging, and more rewarding."(P37). And if players can use speaking and body language together, one player reported "Different manner of communicating, you can use whatever you prefer to make your partner to get your meaning."(P48).

System Limitation

Non-verbal communication includes body movement and more subtle expression such as through eyes and faces. However, our prototype currently uses version 1 of the Kinect

sensors, which can only track the major skeletal movements (head, torso, arms, and legs). It can not track finger and hand movement, and can not track eyes and facial expression. As one participant reported: "The avatar can't fully express what people can express, like emotional reaction."

CONCLUSIONS AND FUTURE WORK

We are the first work to define the problem that cooperative game would be frustrating while playing with different language speaker. We suggest a probable solution to use body language as a communication manner. Thus we present a game prototype, Mute Robot, using body language in cooperative game design. With body language consistency, our user study shows that players will get more similar game experience. Moreover, body language enhances fun, improves their positive co-experience by 33% and decrease negative co-experience by 73%. According to our final questionnaire,

after adding the communication manner of body language, 83% and 75% (players with and without common languages) players choose our new communication manner ("Body language" and "Both") as the favorite manner. And we also report some interesting communication patterns. Game developer can go for a better game experience with these information.

About our future work, we will focus on improving system's sensitivity, accuracy and diversity. We are willing to use higher resolution devices or software correction. For example, using Kinect(v2) to capture player's subtle movements. Furthermore, we want to capture player's facial expression that not only can we enhace the accuracy of emotional detection but we can also analyze players' emotion in more detail. On the other hand, by using body language communication manner, we want to explore whether if passing players' sound of feeling expression, such as laughing, we can enhance the game experience or not. Last but not least, we will add more different levels to increase game's diversity. And testing in multi-player environment, whether it will increase once more players' fun and enjoyment or not. In summary, not only do we want to explore a better game play experience, but we will also hope to be able to inspire more exploration of using body language in game designs and spread game entertainment for more people.

REFERENCES

1. Britannica Encyclopedia. `http://www.britannica.com/EBchecked/topic/329791/language/292862/Most-widely-spoken-languages`.
2. Charades. `http://en.wikipedia.org/wiki/Charades`.
3. Essential Facts About the Computer and Video Game Industry. `http://www.theesa.com/facts/pdfs/esa_ef_2014.pdf`.
4. List of languages by total number of speakers. `http://en.wikipedia.org/wiki/List_of_languages_by_total_number_of_speakers`.
5. The status of French in the world. `http://www.diplomatie.gouv.fr/en/french-foreign-policy-1/promoting-francophony/the-status-of-french-in-the-world/`.
6. Unity3D. `http://unity3d.com/`.
7. A, H. Designing action-based exergames for children with cerebral palsy. In *Proc. CHI 2013*, ACM SIGCHI (2013).
8. Barendregt, W. You have to die!: parents and children playing cooperative games. In *Proc. IDC 2012*, ACM Press (2012).
9. Bianchi-Berthouze, N., K. W., and Patel, D. B. Movement engage you more in digital game play? and why? In *Proc. ACII 2007*, Springer-Verlag, 102-113. (2007).
10. Björk, S., and Holopainen, J. Patterns in game design. California, USA: Charles River Media (2004).
11. Cohen, J. A coefficient of agreement for nominal scales. In *Educational and Psychological Measurement, vol. 20* (1960), 37–46.
12. Isbister, K., S. U., and Frye, J. Wriggle: an exploration of emotional and social effects of movement. In *Proc. CHI EA 2011*, ACM press, 1885-1890 (2011).
13. J. B. Rocha, S. M., and Prada, R. Game mechanics for cooperative games. In *ZDN Digital Game* (2008).
14. J. P. Zagal, J. R., and Hsi, I. Collaborative games: Lessons learned from board games. In *Simulation and Gaming, vol.37* (2006), 24–40.
15. J. Zagal, M. Mateas, C. F.-V. B. H., and Lichti, N. Towards an ontological language for game analysis. In *Digital Interactive Games Research Association Conference (DiGRA 2005)* (2005).
16. Landis, J. R., and Koch, G. G. The measurement of observer agreement for categorical data. In *Biometrics, vol. 33* (1977), 159–174.
17. Lindley, S.E., L. C. J., and Berthouze, N. Stirring up experience through movement in game play: effects on engagement and social behaviour. In *Proc. CHI 2008*, ACM press, 511-514 (2008).
18. M., C. Rapid assessment of game experiences in public settings. In *Proc. FnG 2012*, ACM FnG (2012).
19. Magy Seif El-Nasr, Bardia Aghabeigi, D. M. M. E. B. L. H. M. S. M. Understanding and evaluating cooperative games. In *Proc. CHI 2010*, ACM SIGCHI (2010).
20. Rice, M. The dynamics of younger and older adult's paired behavior when playing an interactive silhouette game. In *Proc. CHI 2013*, ACM SIGCHI (2013).
21. S., P. Gameflow: a model for evaluating player enjoyment in games. In *Proc. CIE 2005*, ACM CIE (2005).
22. Yaffe, P. The 7% rule: Fact, fiction, or misunderstanding. In *Proc. Ubiquity 2011*, ACM Ubiquity (2011).