Gender difference in social behavior change on a coop-competition game

Ming-Yueh Hwang; Jon-Chao Hong; Li-Chun Liu; Wen-Ya Chang
Taiwan Normal University

Abstract

Social cognitive theory indicates that social behavior of participants will change as they interact with others. Interaction in different social environment also results different change degree. The purpose of this study is to identify the social behavior of children during games play in a cooperative and competitive setting. A game named Strike up was developed for the study. The objective of the game is to advance arithmetic practice through five card number calculations and strategies. In order to realize the initiative behavior and change behavior during the game, participants' dialogues were video-taped and its content was later analyzed and interpreted by triangulation. The results of this study suggest that most players tended to express more egalitarian behavior than altruistic, dominating, or individualistic behavior at the beginning. Whereas, female players were more willing to mutually help each other. As playing time going and close to the goal, both boys and girls have more willingness to altruistic play. This implies this type of highly cooperation/ competition game will be a useful tool for children to experience egalitarian and altruistic behaviors.

Keywords: Game behavior; Social behavior change; Coop-competition game.

1. Introduction

Social cognition changes appear to play an essential motivational role in game playing behaviors (Frey et al., 2005; Green & Rechis, 2006). Games children play generally influences social behavior (Green & Rechis, 2006; Milani, Osualdella, and Blasio (2009). Both antisocial behavior and prosaically behavior alike have important implications for social adjustments of children in game playing (Frey, Nolen, Edstrom & Hirschsten, 2005). During the game process, players would mutually help or display hostile behaviors to sustain their enjoyment during play. In game playing, individuals who attribute others' actions as hostile (rather than benign) tend to react with blame and anger when they are hurt (de Castro, Veerman, Koops, Bosch, & Monshouwer, 2002). To foster players' enjoyment, games should be developed in a community of caring through

cooperative learning (Donohue, Perry, & Weinstein, 2003), and sometimes generate hurting in the competitive situation. Under the cooperative/competitive situation, the caring or hostile behavior may occur which would ensure the interest of every player to continue to play or stop the game.

Most previous researches have focused on investigating novel forms of interaction to encourage collaboration, and techniques of gathering user for designing an enjoyment or playfulness games (Bekker et al., 2003). Wood, Williams, and McNeal (2006) suggest that increased complexity for children's expressed thinking is closely related to the types of behavior patterns interacting with differentiated change of community cultures. Moreover, Yee (2006) studies the model of player motivations in online games and suggests the gender relation to motivations, that reveales male players are higher on competition than females players. Following these excerptions, this study designs a mathematical game named "Strike up" for elementary school 6th grade students to play and to examine their social behavior change in different cooperative and competitive conditions. In line with this, the gender difference of interaction patterns related to the types of social behavior change from initiative to goal stages during game play would be identified.

2. Research Contents and Hypotheses

Social Exchange Theory postulates that social behavior is about working toward maximizing one's own rewards and minimizing one's costs (Burgess & Huston, 1979). In time, individuals begin to rely on social exchanges and the future benefits or opportunities. Participants focus on reciprocity and operate under the norms of equivalence (Laursen & Hartup, 2002). For example, under the equity norm, each participant in a relationship should only receive as much as they give. If there is an imbalance, participants become distressed and work toward restoring equity (Walster, Traupmann, & Walster, 1978) whereas under the norm of equality, players are more concerned with the fair distribution of rewards, which are evaluated equivalent to individual input (Sprecher & Schwartz, 1994). Furthermore, cooperating with opponents can also be beneficial if they operate under the premise of reciprocal altruism – the tendency for an individual to help another only if he or she is helped in return (Sheese & Graziano, 2002). In other sense, the beliefs individuals have about other people's goals and intentions are important predictors of behavior in playing a game (Frey, et al., 2005).

Children may have different social goals across different contexts and choose to compete or cooperate for different reasons (Green & Rechis, 2006). Hammerstein and

Leimar (2006) referred to "conditional cooperation" as people tend to cooperate if their counterpart behaves in the same way. The efficacy of such reciprocity can be experienced by both parties' social beliefs within relatively short periods of time. In the regard of social beliefs which affect social behavior pattern in playing game, Frey and his colleagues (2005) proposed four categories that reflect behaviors of game participants during decision making: (1) dominating behavior: whereby players select self-high outcome to dominate other members in a team or pair; (2) individualistic behavior: whereby players select self-high outcome to gain the greatest advantage; (3) egalitarian behavior: whereby players select equal-high outcome but self-high outcome is second choice; and (4) altruistic behavior: whereby players select equal-high outcome but self-low or equal-low outcome are second choices. To the current research, the conceptualization of Frey and his colleagues (2005) in regard to game participants' behavior types is adopted as the condition of game change. In brief, game play is one kind of social learning (Bandura, 1986), in playing the game, social behavior can be changed along with the interaction increased. Then, hypothesis 1 can be postulated that "*Will the players' socially competent behavioral change when they are grouped to play a coop-competition game?*"

2.2. Gender difference in social behavior change

Games vary in the ability of other players to reciprocate, the number of players, the number of iterations, the ability of outside observers to reward and punish selfish behavior, payoffs from cooperation versus defection, and the reputation of other players (Fehr & Fischbacher, 2003). They also differ in terms of stable individual differences of players, such as their age, sex, and culture (Henrich et al., 2005). With this form of social community, the proximate motivational and social dispositions that facilitate relationships and cooperative activities among boys and men should differ in some respects from those that facilitate relationships and cooperative activities among girls and women (Geary et al., 2003). By the elementary school years, there is an evidence to suggest that girls are more sensitive to any inequalities in their relationships and inequalities among females in general (Ahlgren & Johnson, 1979; Winstead, 1986). For instance, achievement of dominance in the peer group might in fact have both immediate and longer-term effects to both girl and boy's social behavior (Geary et al., 2003). To be sure, there are evolutionary influences of sex differences in social behavior (Geary et al., 2003; Wrangham & Peterson, 1996), girls express more enjoyment in game playing (Lin, 2010). Then, in this study, the difference of behavior change between girls and boys in the game contest would be taken into consideration. Thus, the hypothesis 2 of this study can be postulated

as "*Is there any significant difference of behavior change between girls and boys in the game*?"

2.3. Game Design

In a broader sense, game theory is pertinent to virtually every dynamic interaction between sentient beings (Wilson, 2006). In line with this, several game rules have been developed to examine subjects' behavior in cooperative scenarios, which differ in complexity according to the number of participants and repetitions of social exchange. In a dynamic game design, the game scenario should provide players to constantly evaluate and adjust the competition/collaboration strategies, thereby engaging themselves in logical thinking (Kiili, 2005). Specifically, the developmental activities may enable girls and boys to form cohesive and competitive coalitions and thus work out in-group dominance relations (Geary et al., 2003) or with more series competition in game playing. To reiterate, the aim of the study is to investigate children's social behaviors displayed during the competitive situation, cooperation among participants is required. Thus, researchers developed an evolutionary computer based game, named ***Strike Up***. In this game, six children were divided into two competing teams. The objective for each team is to move their flags from the start point to the end point (326 steps to the goal).

The numbers of steps to be taken at each round is relied on what was randomly drawn from the deck of virtual poker card shown on the screen. Five cards from 1 to 9 are retrieved by each player at each turn, and five card numbers can be used for counting the steps he or she can move The five card numbers counting approach is limited to use +, −, ×, ÷ once in a turn. In order to move forward to win the game, the players have to calculate out the maximum value or best value to step forward. 10 J Q K cards are function cards perform *support* or *set up* functions. Children can use function cards to bonus points or to 'tackle back' other opponents (**Appendix** 1).

All participants can contribute positively because the game is designed in a way that children are encouraged to generate their own strategies. Children must take turns to ensure equal distribution of opportunities for each player. In concerning win the game for a team, three members (or all members in the team) should reach the end before the other teams. According to Richard et al. (2002) statement, if any of the teammates is lagging too much behind, giving punishment or bump back by other team members, in this scenario, competitive and cooperative behaviors are overt and are therefore easy to measure.

The other feature of this game design corresponds to Menasche and his colleagues' (2005) principles, which includes: (1) Games are played among teams; (2) Player interaction continues as time elapses; (3) Players can choose from different game modes; (4) Player decisions are associated with valuable movements; and (5) Players adjust game strategies according to game dynamics. The research tool *Strike Up* enables players to interact with content, collaborate with peers, and benefit from player support. It also allows players to decide on game rules and boundaries. Then, the game for this study can be considered as a strategy game with contest and constructive learning situation.

3. Experimental Design

The research tool *Strike Up* is devised to elicit players' display of social behavior patterns as defined by Frey et al. (2005). This study uses evaluation checks to conduct observations and interpretations in order to examine behavior change of players. Analysis focuses on discourse analysis, students' transformative communication and behavior interpretation. Content logs were first created and it describes what happened during the course of video (Jordan & Henderson, 1995). Then, the patterns of emergent discourses were coded. That provided insight on how students' transformative communication occurred. The interaction patterns of social behavior was also observed and interpreted by using triangulation method.

This study includes six 6th grade elementary school students from a local elementary school in Taipei. They were divided into two teams. Three girls are in team A, they are labeled as A1, A2, and A3. The other three boys are in team B, they are labeled as B1, B2, and B3. The experiment was conducted after class hours. The participants played Strike Up as part of after class leisure activity. Three investigators were there to supervise, videotape, and to take field notes. To ensure validity of the study, three investigators read the data recorded from game playing by students to analyze and interpret the interactions among children. Each cooperation-competition scenarios were scrutinized.

3.1. Data collection and analysis

The contents of this game reflect the emphasis of on-line game. Then, the qualitative data can be carried out as exploratory work to identify themes for further exploration in a fuller study. Data analysis within interpretive methodology is complicated by the central assumptions analyzed by such researchers (Sandiford & Seymour, 2007). Miles and Huberman (1994, p. 9) suggested a variety of 'analytic practices' which could be summarized as: coding data, reflecting on data, sorting data, identifying patterns in data,

moving towards generalizations and developing or testing theories/conceptualizing (Sandiford & Seymour, 2007). Then, the process of analysis involves different stages as follows: 1) Preparation of data for analysis, 2) Coding and display, 3) Data reduction: Refining 'raw data' into clear text, 4) Componential analysis: Developing interpretations and verification, 5) Theme analysis: Developing interpretations and verification, and 6) Conclusion drawing.

In order to have a better reliability of data analysis, the triangulation method is applied in this study. Reliability has to do with the consistency or repeatability of assessments. Of the numerous types of reliability, estimating the internal consistency among items on an evaluation form and determining the number of responses needed to achieve precise evaluation ratings). Triangulation means an effort to define accurately the topic of study (Sim & Sharp, 1998), then, three investigators were there to supervise, videotape, and to take field notes. They read the data recorded from game playing by students to analyze and interpret the interactions among children. The reliability of data interpretation reached to .90 of this study, thus, those dialogues are based on the consensus from analyzing scenarios of the interaction

4. The Findings

Since children on the same team have varied understanding and expectations for interdependency. Individuals' coop-competition modes also differ. The observation was carried out for three rounds. Play sequence for one round constitute turn taking in the following order: A1-B1-A2-B2-A3-B3. Interactive dialogues in each round were classified into four types of social behaviors based on Frey et al. (2005) proposed theory.

4.1. Dominating behavior in the game

At the beginning of the game, the players with better arithmetic ability would figure out the value of the five number cards much sooner than those with lower arithmetic ability. Those players with better arithmetic ability would also spontaneously help those slow counting members and demonstrate some kind of dominating behavior.

Situation 1: To determine who to start first, the game was started by a game of "scissor, paper, and stone". It would be B1's turn to play but B2 stood beside and try to monitor B1's performance.   An excerpt of the conversation is as follows.

B2 （speaks to B3）："I hope you can draw out 9, 9, 9, and 9."

B2："9, 9, 9, 1, 1… how wonderful！"

B2："9×(9+9)."

B3："Divided by 1, then minus by 1."

B2："No, it should be minus by 1 then divided by 1."

B2："Listen to me, you will find out that the value will be the biggest."

B3："No, I insist on divide before subtracting."

B2："It is the same, either way is OK."

B3："But I prefer subtraction followed by division."(B2 tried to keep privilege)

(13'25"~14'00")

B2's math ability is somehow better than B1's (according to the math tests). So, B2 have more confidence in counting and giving someone a hand. Then, it is observed that B2 is a dominating character who tries to enforce others to take his suggestions. The other type of dominating behavior occurred while approaching toward the end of the game Round 4).

Situation 2: It was B3's turn to play (The card numbers were 2,7,1,5,8. B1 tried $2×（7+1－5）÷8$, yet he was hesitant, then B2 and B1 give some suggestions to him.

B3："6 divides by 8 is equal to?"

B1："6 divides by 8 is equal to 6 out of 8."

B2："No, the rules require us to round up, so the result is 0."

B3："Is 0?"(B3 spoke in a doubtful sound.)

B1："1 is goody！

B2："I count out，1 or 0." (He stood up and insisted his results.)

B3："Well, the result is…"(Ask B1 to confirm B2's results)

B3（speaks to B2）："I don't want your help. I will count it by myself…"

B1（speaks to B3）："You can take B2's idea. You can take B2's idea."

B3（speaks to B2）："No, I don't want to listen to you."(B1 used left hand to keep B2 away)

B2（speaks to B3）："OOXX" (Murmuring dirty words)

B3（speaks to B2）："Go away or shut up！"

B1（speaks to B2）："He counts out 1. Perfect！"

B2："Really?"

B3："Yes, it is right."

B3："So, I can work it out by myself and do better than others."(Show that he is confident by tapping his chest using right hand)

(13'15"~14'35")

Denotation: People with a proself inclination are either self-maximizing or competitive and will only cooperate when it is in their self-interest to do so (Van Lange, 2000). People on Machiavellianism display a combination of selfishness and opportunism (e.g., Wilson, Near, & Miller, 1998). From the above discourse, B3 as dominator tends to cooperate less and their cooperative behavior is purely default.

4.2. Individualistic behavior in the game

Those players with better arithmetic ability and more ambition in winning the game will show that they only concerned about themselves in counting or using functional cards.

Situation 1: It was B1's turn in the secondary round. B1 was counting his five cards to figure out the maximum value or best value (go by short) and B2 drew another five cards to count (A3 will be next player).

B1（speaks to B2）："I have 6, 7,8,3,7, how to arrange for best movement."(B1 tries to ask for B2's assistance)

B2："6,7,8,3,7…..Very good. But, I have 6,2,5,7,6. I have to figure out the best value."

B1（speaks to B2）："Please help me figure out this first, it is my turn to move."

B2："Let me figure out mine, then I will count for you."

B1："The scenario will be changed after this turn, the value you count out will be useless, please count mine first."

B2："No, after I figure out mine, I will count for you."

B1："You help me, then, I will help you."

B2："I count out mine already, now I can help you."

 (18'25"~23'00")

Situation 2: B2 played his turn by figuring out the best value of five cards. After moving his flag to that place which according to the calculation of the five card numbers, he drew the so called "function card" and got J card by which he can move forward 50 steps as bonus or give to one of his teammates to move forward 50 steps. Since B3 was lagging way behind and he wished that B2 could give him a hand.

B3: "B2 please use that card for me, I am so far behind everybody else."

B2 (making an excuse): "I want that card for myself. Do not be worried; you will get a lucky card during your turn."

B3: "You should help me; otherwise we will lose the game."

B2: "Don't worry; it is still very far from reaching the end. I would have helped you if I am close to the end."

B3: "… I might always be kicked back, then, it will be too late to rescue me later."

B2: "You are too noisy. I will wait for someone to give me a hand, and then I will help you."

(25' 25" – 28'40")

In order to promote the playfulness in the mathematic game, the cooperation and competition are two very important elements. If the players only approach the game competitively, then it will be very difficult for all members to finish the game. In particular, at the very final stage, the exact value needs to be figured out for the rest steps to the goal, if there are the remaining values after subtracting the steps to the goal, the player will move him or her further backward from where he or she started. Thus, players should realize that cooperation is important as the team needs to win the game together.

Situation 3: As the game went on, most players were having their flags close to the end. This meant that the chance of being bumped back would be increased. In addition, the function card could be used to help others and/or hinder others. If team members were too individualistic, it would be difficult to finish the game.

B2: "I got bumped back so many times; I stayed around the last part of the game for at least 10 minutes."

B3: "You deserved it."

B1: "B2 you should help B3 at the beginning of the game."

B2: "OK. I know I was wrong."

(14'00"-14'10")

Denotation: Individualisms showed that their social strategies are more calculative and adapted to the situation at hand. It is not unlikely that behavior should predominate among individuals with other-regarding preferences (Bogaert, Boone, & Declerck, 2008; Gintis et al., 2003). In line with this, the above discourse indicated that B2cooperation in a social dilemma was more likely to proself before he can help others. B2's willingness to cooperate in one-shot social dilemmas has further been related to individualism in stable personality traits.

4.3. Egalitarian behavior in the game

At the beginning of the game, opposing teams sought possible assistance by exchanging

benefits. However, it was uncertain if the other members could be trusted. Exploratory talks were frequently conducted to test each other and to determine whether the other team could be trusted. Mutual improvements were pursued throughout the process with optimistic attitude.

Situation 1: A1 believed that the game was just a game. She did not take it too serious but still tried to seek reciprocally help. At the beginning of game, she ever gave some benefits to B2. It was interesting that one of her teammates (A2) tried to compete to hurt one of opposite teammates, so when A1 got a number, she can decide t to bump back B2 or recalculate out other number to move forward, A2 asked her to take the first action to bump back B2.

A2："Try to bump back B2."

A1："Never mind, I will give way to B2, he will repay me later!"

B2："A2 (Calling her by the name) I will revenge, watch out!"

A1："Just remember to add 90 steps for me!"

B2："No way, your friend did this to you, blame her."

B1："If we get a King, we will set her (A2) up"

……

A1："Your thoughts are evil!"

B1："You call me evil! B2 is worse than me!"

A1："But I just descended him and revenged!"

It is the turn of B2 to draw the function card, and he got the King card.

B2："K, according to the rules of this game, I will move A2 50 steps backward."

A2："Please help me, don' hurt me. You can use it to help your teammate B1"

B2："Ok. I will let you know what revenge is" (B2 set A2 to move backward 50 steps) (39'40~43'30)

By Round 3, there were more descend short-cut close to the target. The possibility of setting up rivals using function cards increased. The desire for the children to win resulted in attitude inconsistencies and conflicts. Different strategies to handle conflicts reflected the individuals' varied characteristics. It was even possible for the members to alter individual social behaviors in order to solve the conflicts.

Situation 2: In the scenario below, A1 and B1 insisted on keeping promises (Egalitarian) at the beginning of the game. However since B3 wished to win, his attitude was more individualistic at this stage. A1 was displeased and B1 tried to change the mind of his teammate. In the process, B3 altered his social behavior.

B3："J, according to the rules of this game, I got J, I can assign one opponent to the

nearest ladder to go up or descend." (B3 assigned A1 to descend.）

B1： "Really?" (His teammate was surprised in B3's decision)

B3："Why not?"

B1："Didn't A1 just descend a while ago?"

B3： "Why can't she (A1) be moved down again?

A1： "Why did you descend me again?"

B3： "Why should I be nice to you? You'd better go down from here."

B2： "Oh, let them both go down, so I can get rid of them both!"

A1： "B3, you shouldn't do that."

B3： "I'd do anything to win, so I don't really want you to go up."

A1： "All right then, you owe me 3 square magnets! It's unfair! You broke your promise! You will be condemned by God!"

B3： "I honestly want A2 to descend some more, but I can't." (A2 is closed to the end)

A1： "Never mind just let her go up. It gets harder the closer she gets." (The rule of this game require the players to find the right numbers to step forward to the end, otherwise, the players have to move backward based on the rest of numbers deducing from the forward steps)

B3： "Ok! I will let A2 go up."。

(Meanwhile, B1 interrupted their conversation and ask B3 to help A1)

B1: "Look! B3 let you go up!"

A1： "Ok, then. We are even B3！

（53'15"~55'50"）

Denotation: Not surprisingly, the term "strong reciprocator," commonly used by Egalitarian, refers to those individuals that are inclined to both cooperate in one-shot interactions, and support those who do (Fehr & Fischbacher, 2004). From the above discourse, the study indicated that A1is a strong reciprocator even willing to help a defector when they themselves were merely the opposite party of a fair interaction.

4.4. Altruistic behavior in the game

In a game, not all people share common interests and help one another strategically. In a group, there are those who do not expect returns. After multiple "gives", a positive stimulus is produced within the group. Subsequent mutual help and teamwork attitude are then produced. Based on observed records, A2 is the altruist. The dialogue below shows how she repeatedly assisted her teammates in conducting computations:

Situation 1: At the game, basically, nobody can use calculator to count his or her number cards. Not every participant is good at arithmetic. Those who did better at math would need to wait longer for his or her turn and might feel impatient. As such, it was observed that effort was made to help those who were poor at arithmetic, even for the opponents.

A3: "B3, what cards have you got?"

B3: "8, 9, 3, 8, 1…"

A3: "let me count, 8, 9, 3, 8, 1…"

B2: You can't calculate for the opponents."

A3: "Yes, I can."

(73'23"- 75'15")

Toward the last part of the dialogue during the game, A3 actively helped others but was not dominating. She sought the greatest benefits by calculating on behalf of others.

Situation 2: Also, A2 displayed "self-sacrifice" characteristics in the group. She sacrificed herself to achieve greater good for the group. It is A1's turn, A2 asked others to descend her as shown in the dialogue below:

A1： "Let's calculate together (referring to A3), and see who's better."

B3： "You can't help her calculate!"

A2： "Let's compare if the equation she just wrote is better than mine."
（76'20"~76'53"）

A2： "I descended the least, descend me please." (She tried to work out the most possible ways to get the end for other teammates)

A1： "Why do we descend all the time in the game"? (She seemed to ask all players to give helps to opponents instead of giving hurt)
（77'00"~77'10"）

Toward the end of the game, A2 and A3 even helped their opponents compute. The mutual help mode not only applied among teammates but also between opposing teams.

Situation 3: At the final stage, if players choose not to use negative strategy, due to it was likely that all members of the team would be descended. Then, it would be difficult to get to the end.

A3： "B3, my calculations turn out to be 16."

A2： "16 means B3 has to go back a long way, 12 steps will be better."

A3： "B3 wait a moment, I re-calculate and come up to 10, take a look for you!"
（90'05"~90'30"）

Denotation: After being treated fairly and unfairly in a cooperative/competitive game, altruistic express cooperative emotions more frequently than do dominators or individuals (Schug et al., 2010). From the above discourse, that is, by expressing help emotions in the game playing, A2 and A3 are altruistic cooperators reveal their honest motivational intentions which serve to attract potential interaction partners and deter defection.

5. Discussion and Conclusion

Social behavior changes refer to the phenomena that people seem to care about certain "social" goals, such as a "fair" allocation among members in society, in addition to their own material benefits (Li, 2008).

To answer the first research question: "*Will the players' socially competent behavioral change when they are grouped to play a coop-competition game?"* The results of this study showed that at the beginning, individualistic behavior displayed frequently in the boys' team and dominating behavior was displayed at the final stage in the boys' team. Evidence of 'conditional cooperation' is identified: when students expect others to contribute, they themselves tend to donate more (Frey & Meier, 2004). In the manifestations of children's game behavior, the interaction frequency increases as they get closer to the target, their altruistic behavior appeared at the final competitive stage in female team. The Strike Up game involved activities in creating coalitions and dominance result in many of the social behaviors of boys that are sometimes viewed unfavorably, this result is agreed to the study of Geary et al. (2003) which indicates that boy are more serious to win then their proself behavior is displayed at the beginning stage of competition, because they do not want to be the suckers (Croson, 2007; Gachter et al., 2003)

To answer the second research question: "*Is there any significant difference of behavior change between girls and boys in the game*?" It is observed that the numbered cards utilized in Strike Up help promote arithmetic competence of children. Function card use also helps enhance interactions between teams. The function cards in the game design can be used to help or to set up opponents. At the beginning of the game, girls mostly interacted in egalitarian mode, or chose to be outsiders. When competition grew fiercer at the end of the game, children changed from egalitarian to individualistic or altruistic. If an altruist is present in a group such as A2, there will be mutual help between groups, and harmony can be maintained. The results are agreed to the studies of Geary et al. (2003) and Trivers (1971) which state that among the proximate mechanisms of cooperation,

if they feel guilt for a failure to reciprocate, they will monitor the give-and-take of the relationship and maintain the cooperation. In comparison to girls, the relationships of boys are predicted to be and are more readily maintainable (Whitesell & Harter, 1996).

In conclusion, this study found that that apart from a few unconditional cooperators ("altruists"), most 5th grade male students are *only* willing to cooperate when they expect others to cooperate as well. The most powerful support for the importance of social norms for altruistic behavior directed towards genetically unrelated individuals stems from studies of strong reciprocity. Consequently, people who contribute apparently trust the others after several runs in this game. These results of this study may imply grouping system for allocating different characters of students in the game of *Strike up* to promote the awareness of prosocial behavior and maintain the behavioral intention more stable.

6. Limitation and Future study

This study has been conducted in qualitative method, the case analysis was employed which might not be enough to predict all other cooperative and competitive contest settings, and the quantitative method should further be applied to analyze the research data to imply the better grouping for students to have behavior change.

Social information processing models can be used to explain the development and maintenance of prosocial behavior (Nelson & Crick, 1999). More precisely, relationships based on reciprocal altruism should result in the evolution of proximate social and emotional mechanisms that function to ensure equality of the benefits received from the relationship. This model would be examined in relation to the development of behavioral intention, future study may place at examining the relation between prosocial behaviors and the evolutionary change of 4 types of game behavior in a coop-competitive game.

Acknowledgments

Reference

Ahlgren, A., & Johnson, D. W. (1979). Sex differences in cooperative and competitive attitudes from the 2nd to the 12th grades. *Developmental Psychology, 15*(1), 45–49.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory.* Englewood, NJ: Prentice Hall.

Bekker, M., Beusmans, J., Keyson, D., & Lloyd, P. (2003). Kid reporter: A user requirements gathering technique for designing with children. *Interacting with Computers, 15*(2), 187–202.

Bogaert, S., Boone, C., & Declerck, C.H. (2008). Social value orientation and cooperation in social dilemmas: A review and conceptual model. *British Journal of Social Psychology*, *47*, 453-480.

Burgess, R. L., & Huston, T. L. (1979). *Social exchange in developing relationships.* New York: Academic Press.

Croson, R. (2007). Theories of altruism and reciprocity: Evidence from linear public goods games. *Economic Inquiry, 45*(2), 199-216.

De Castro, B. R., Veerman, J. W., Koops, W., Bosch, J. D., & Monshouwer, H. J. (2002). Hostile attribution of intent and aggressive behavior: A meta-analysis. *Child Development, 73,* 916-934.

Donohue, K. M., Perry, K. E., & Weinstein, R. S. (2003). Teachers' classroom practices and children's rejection by their peers. *Journal of Applied Developmental Psycholoy, 24*(1)*, 91-118.*

Fehr, E., & Fischbacher, U. (2003). The nature of human altruism. *Nature, 425*, 785–791.

Fehr, E., & Fischbacher, U. (2004). Third-party punishment and social norms. *Evolution and Human Behavior, 25*, 63-87.

Frey, K. S., Nolen, S. B., Edstrom, L. V. S., & Hirschstein, M. K. (2005). Effects of a school-based social-emotional competence program: Linking children's goals, attributions, and behavior. *Journal of Applied Developmental Psychology, 26*(2), 171-200.

Geary, D. C., Byrd-Craven, J., Hoard, M. K., Vigil, J., & Numtee, C. (2003). Evolution and development of boys' social behavior. *Developmental Review, 23*(4), 444-470.

Gintis, H., Bowles, S., Boyd, R., & Fehr, E. (2003). Explaining altruistic behavior in humans. *Evolution and Human Behavior, 24*(3), 153–172.

Green, V. A., & Rechis, R. (2006). Children's cooperative and competitive interactions in limited resource situations: A literature review. J*ournal of Applied Developmental Psychology, 27*(1), 42-59.

Hammerstein, P., & Leimar, O. (2006). Cooperating for direct fitness benefits. *Journal of Evolutinary Biolology, 19*(5), 1400–1402.

Henrich, J., Boyd, R., Bowles, S., Camerer, C., Fehr, E., Gintis, H., McElreath, R., Alvard, M., Barr, A., Ensminger, J., Henrich, N.S., Hill, K., Gil-White, F., Gurven, M., Marlowe, F. W., Patton, J. Q., & Tracer, D. (2005). Economic man' in cross-cultural

perspective: Behavioral experiments in 15 small-scale societies. *Behavioral and Brain Sciences, 28*, 795–855.

Jordan, B., & Henderson, A. (1995). Interaction analysis: Foundations and practice. *The Journal of the Learning Science, 4*(1), 39-103.

Laursen, B., & Hartup, W. W. (2002). The origins of reciprocity and social exchange in friendships. In: W.G. Graziano & B. Laursen, (Eds.), *New directions for child and adolescent development: Special issue: Social exchange in development* (No. 95, pp. 27- 40), San Francisco: Wiley.

Li, J. (2008). The power of conventions: A theory of social preferences. *Journal of Economic Behavior & Organization, 65*(3-4), 489-505.

Lin, S. F. (2010). Gender differences and the effect of contextual features on game enjoyment and responses. *Cyberpsychology, Behavior, and Social Networking, 13*(5), 533-537.

Menasche, D. S., Figueiredo, D. R., & de Souza e Silva, E. (2005). An evolutionary game theoretic approach to congestion control. *Perform Evaluation, 62*(1–4), 295–312.

Milani, L., Osualdella, D., & Blasio, P. D. (2009). Quality of interpersonal relationships and problematic internet use in adolescence. *CyberPsychology & Behavior, 12*(6), 681-684.

Richard, J. F., Fonzi, A., Tani, F., Tassi, F., Tomada, G. & Schneider, B. H. (2002). Cooperation and competition. In: P.K. Smith & C.H. Hart, (Eds.), *Blackwell handbook of childhood social development* (pp. 515-532.), Oxford: Blackwell.

Sandiford, P. J., & Seymour, D. (2007). A discussion of qualitative data analysis in hospitality research with examples from an ethnography of English public houses. *International Journal of Hospitality Management, 26*(3), 724-742.

Schug, J., Matsumoto, D., Horita, Y., Yamagishi, T., & Bonnet, K. (2010). Emotional expressivity as a signal of cooperation. *Evolution and Human Behavior, 31*, 87-94.

Sheese, B. S., & Graziano, W. G. (2002). Evolutionary perspectives on the development of social exchanges. In: W.G. Graziano & B. Laursen, (Eds.), *New directions for child and adolescent development: Special issue: Social exchange in development* (No. 95, pp. 73–85.). San Francisco: Wiley.

Sim, J., & Sharp, K. (1998). A critical appraisal of the role of triangulation in nursing research. *International Journal of Nursing Studies, 35*(1-2), 23–31.

Sprecher, S., & Schwartz, P. (1994). Equity and balance in the exchange of contributions in close relationships. In: M. J. Lerner & G. Mikula,(Eds.), *Entitlement and the affectional bond: Justice in close relationships* (pp. 11-41.), New York: Plenum Press.

Trivers, R. L. (1971). The evolution of reciprocal altruism. *Quarterly Review of Biology, 46*(1), 35–57.

Van Lange, P. A. M. (2000). Beyond self-interest: A set of propositions relevant to interpersonal orientations. In W. Stroebe & M. Hewstone (Eds.), *European Review of Social Psychology* (Vol. 11, pp. 297-331). New York: Wiley.

Whitesell, N. R., & Harter, S. (1996). The interpersonal context of emotion: Anger with close friends and classmates. *Child Development*, *67*(4), 1345–1359.

Wilson, D. R. (2006).The evolutionary neuroscience of human reciprocal sociality: A basic outline for economists. *Journal of Socio-Economics, 35*(4), 626–633.

Wilson, D. S., Near, D. C., & Miller, R. R. (1998). Individual differences in Machiavellianism as a mix of cooperative and exploitative strategies. *Evolution and Human Behavior, 19*, 203-212.

Winstead, B. A. (1986). Sex differences in same-sex friendships. In: V.J. Derlaga & B.A. Winstead, (Eds.), *Friendship and social interaction* (pp. 81–99), New York: Springer.

Wood, T., Williams, G., & McNeal, B. (2006). Children's Mathematical Thinking in Different Classroom Cultures. *Journal for Research in Mathematics Education, 37*(3), 222-255.

Yee, N. (2006). Motivations for play in online games. *Cyberpsychology & Behavior*, 9(6), 772-775.

Appendix 1: The objectives and rules of Strike up game

A **Objectives of the game**

1. To improve the four arithmetic operation abilities in players
2. To foster group unity and highlight team work
3. To encourage long-term planning with the design of elevators, for example. Students learned that what seems to be a shortcut may be a trap in disguise.
4. To enhance teachers' understanding of students' personality—may they be conservative or aggressive players— with the design of Safety Area.
5. To train students in making decisions with optimized game strategies.
6. To increase difficulty in using four arithmetic symbols with five Number Cards instead of four.

B **Basic game rules**

1. The game is played between two teams: Team A and Team B. Each team is composed of 2-3 members, coded as A1-A3 and B1-B3.
2. Every player begins from the *Start*. Players take turns drawing cards in the order of A1 → B1 → A2 → B2, and so on.
4. Player first draw designed *Number Cards* (1 to 9), and create a math equation with these numbers in addition to math symbols including *addition, subtraction,*

multiplication, division, and *parenthesis*.

5. Each symbol can only be used once.

6. Then players round up the number they come up with at this stage before continuing with the calculation and move to that position.

7. Next, players draw one Function Card (10, J, Q, K, and Joker) and calculate accordingly to reveal with the final number of steps for them to take.

8. The process repeats with every player.

C   Player advancement

1. *Shortcut*: players must take any elevator they happen to encounter on their way to the finish. Elevators may be going upward or downward depending on game design.

2. *Bumping back*:

2.1.   players from opposing teams may find themselves in close proximity to each other during the game.

2.2.   When a *late comer* approaches to within 5 steps form an *early arriver*, the early arriver would be *bumped off* its leading position and relocated to the late arriver's previous position.

2.3.   This rule does not apply to situations where the late comer approaches by using a Function Card or a shortcut.

3. *Safety Area*: when players stop in a *safety area*, they are exempted from losing their leading position when a late comer catches up.

D   Function Cards

1. *10*: Take the nearest elevator to move yourself up or down regardless of where it goes.

2. *J:*   Make one player take the nearest elevator to move up or down

3. *Q*:   Go 50 steps forward or backward for yourself.

4. *K*:   Make one player go 50 steps forward or backward.

5. *Joker*: The player is suspended from the game for the next round.

E   Condition for winning

A team is considered the winning team only when every team member arrives at the finish. Players have to stop exactly at the finish for them to conclude the game.

Appendix 2: The Scene of Strike up game