정치학석사학위논문

Cheap Talk, Network Structures, and Coordination: An Experimental Study

칩톡과 의사소통 연결망이 집합적 의사결정에 미치는 영향에 대한 실험연구

2014년 8월

서울대학교 대학원

정 치 학 전 공

이 보 미

Abstract

Cheap Talk, Network Structures, and Coordination:

An Experimental Study

Lee, Bomi
Department of Political Science
The Graduate School
Seoul National University

This research was designed and conducted in order to examine the role of cheap talk communication in decision making process, especially when people have to make a decision collectively. People face myriads of matters which need to be decided in their daily lives and during this process, information plays a pivotal role. Then what would be the most effective way of obtaining a piece of information? Many people try to obtain information indirectly, using information shortcut such as discussion with people with better knowledge. The impact of communication among individuals as the means of managing information, however, has not been studied widely comparing to the interest from the media and the mass.

This research tries to study communication in the three-person Battle of the Sexes game. The aim is to verify the effect of communication network structures to group decision making using experimental methods based on behavioral formal model. By using experimental method, the analysis of causal inference between information and decision making, strategic choice of the player and the actual effect will be analyzed. Specifically, the study tries to find out how players make decisions under asymmetric information status. The subjects of the experiment are to play three-person Battle of the Sexes game of choosing between two options. They would get paid off when all of the three people in one group choose the same option. However, the amount of the profit following coordination is various depending on the type of the players which is given randomly by the computer when each period starts. Before making a decision between two options, participants have an opportunity to communicate with each other according to one of four communication network structures.

The analysis focuses on the information management process. Which would be more significant and advantageous, to have higher level of information, or to have the power of disseminating information? In some network structures, there exist "the hubs" who have more connection with people from others. Depending on the structures, these hubs gain more information about the type of the others and/or have an opportunity to let others know about their own plan or type. The result shows that for group coordination, the ability to influence others is most beneficial.

It is also shown that more communication brings higher coordination rate. Although the subjects were under asymmetrical payoff function, they were willing to cooperate for the group coordination. When the decision making is done at the individual level, as the previous studies has already asserted, it is important to obtain information needed at the lowest cost as possible. In this case, the people having large amount of knowledge or available shortcuts would have advantage. However, when it comes to group decision, and when my possibilities of gaining profit is also depending on other's choice, the situation changes. Rather than information itself, the way information is delivered become more important. This is the point this research tried to suggest: the importance of information sharing networks to making decision.

Keywords: cheap talk, coordination, communication network, battle of the sexes game

Student Number: 2012-20199

Table of Contents

I. Introduction 1

1. Background Questions..1
2. Research Outline 4

II. Theoretical Background 7

1. Game Theoretic Models of Cheap Talk..7
2. Experimental Methodology 9
3. Network Studies in Political Science 12

III. The Setup..16

1. Research Models 16
   A. Model 1: Partisan Voter Model..17
   B. Model 2: Swing Voter Model 19
2. Network Structures..21

IV. Experimental Design 23

1. Why the experiment: the methodology 23
2. Treatments..23
   A. Communication Network Structures..24
   B. Preferences: Payoff Function 25
3. Procedure 26
4. Predictions..29

V. Results 34

1. Coordination Outcomes 34
2. Network Structures..37
3. Type: the Role of the Hub..38
4. Coordination Success versus Social Profit?..46

VI. Conclusion 51
1. Conclusion 51
2. Further Discussion 52
References 55
Appendix 59
Abstract (Korean) 64

List of Tables

Table 1. A Battle of the Sexes Game 2
Table 2. Stag-Hunt Game 10
Table 3. Prisoner's Dilemma Game 10
Table 4. Chicken Game 11
Table 5. Payoff Function 25
Table 6. Number of Participants and Observations by Main Treatment 34
Table 7. Frequencies of Coordinated Actions 35
Table 8. Chi-Square Nonparametric Test on Coordination Rates 38
Table 9. Coordination Rates by Type of the Hub 40
Table 10. Relationship between the Message from the hub (or X) and the Coordinated Action (When the type of the hub is S) 42
Table 11. Relationship between Type of the Participants and the Final Choice 43
Table 12. Frequencies of Profit 47
Table 13. Relationship between Changing the Choice and Profit 50

List of Figures

Figure 1. Communication Network Structures in the Experiment................6
Figure 2. Type Distribution and Networks in Model 2 21
Figure 3. Star-in and Star-out Network 22
Figure 4. Four Kinds of Network Structures 24
Figure 5. Experimental Procedure...28
Figure 6. Coordination Rates by Network Structure...................................36
Figure 7. Switching Rates when the subjects' type is A or B 45
Figure 8. Average Profit Produced within Networks 47
Figure 9. Average Profit of the Player at the Location X 48

I. Introduction

1. Background Questions

People face myriads of matters which need to be decided in their daily lives and during this decision-making process, information plays a pivotal role. When a man tries to buy a jar of jam, for example, he may have hard time choosing one because he confronts a tremendous collection of jam with various kinds in the supermarket. He would choose one to his taste by using the information – this could have been obtained from the experience of eating jam before, from the advertisement, or any advice from the friend who knows everything about jam.

Similarly, when voters choose a candidate to throw their vote in the election, they make a decision on the basis of information. The information would be such as the candidates' personal characters, capabilities, possibility of winning or perspective on specific issues, and can be obtained by one's personal experience and knowledge, from the media, or from other people having high interests in politics. What would be the most effective way of obtaining a piece of information?

The problem is, the amount of information each voter possess varies, and the cost he needs to pay in order to obtain additional piece of information also varies vastly (Downs 1957). Therefore, many people try to obtain information indirectly, using information shortcut (Lupia 1994) such as discussion with people with better knowledge. That would be cheaper since not everyone have ability or willingness to actively study the topic himself. This way of information obtaining became more important because nowadays, development of technology let people use Social Network Services to communicate actively. The impact of communication among individuals as the means of managing information, however, has not been studied widely comparing to the interest from the media and the mass.

Specifically how can communication play a role as the way of sharing information? Table 1 is the payoff matrix of a young couple choosing what to do when they go out. They have two options: the movie or the baseball.

1 \ 2	Movie	Baseball
Movie	5,2	0,0
Baseball	0,0	2,5

Table 1. A Battle of the Sexes Game

Player 1 prefers to go to the movie than go to the baseball park. On the other hand, player 2 prefers to go see baseball than going to the movie. However, the important thing is, both prefer to meet each other at the same place than go to the favorite place alone. This is the typical Battle of the Sexes game. A Battle of the Sexes game is one of the typical coordination games, which is symmetric game that has two pure-strategy nash equilibria and a symmetric mixed-strategy nash equilibrium. Here the pure-strategy equilibrium is (Movie, Movie) and (Baseball, Baseball). The mixed-strategy equilibrium would be player 1 choosing Movie with the possibility 5/7, and choosing Baseball with possibility 2/7: and player 2 choosing vice versa. The problem is, without communication between two, the players cannot tell what pure strategy to choose since this is a symmetric condition.

But what if the player 1 has the chance to send a message to the player 2? Player 1 would text a message “let’s go to the movie” and the player 2 would prefer to go to the movies rather than they end up in different place although the movie is not his/her most preferred choice. Therefore in this case, the communication can actually convey meaningful information, and brings the coordination success. What would happen, however, the player 1 and the player 2 send a message to each other at the same time? The result would not much successful than the first case. They may not meet at the same place if there message indicates different places. This phenomenon was actually verified in a lot of experiment literature (for example, Cooper et al. 1989).

Yet what meaning does this presumption have? This is an important problem in game-theoretic world. This kind of communication, i.e., cheap talk, was not considered as the alternative to the coordination failure extensively at first. Counting out the game theoretic explanation, there is a significant flaw in the communication: that it is difficult to assume a group of people communicating under the same circumstances. However, as people find more and more way to share information and communicate each other throughout the web, communication as the way of obtaining information becomes more important.

2. Research Outline

This research tries to study communication in the three-person Battle of the Sexes game. The aim is to verify the effect of communication network structures to group decision making using experimental methods based on behavioral formal model. By using experimental method, the analysis of causal inference between information and decision making, strategic choice of the player and the actual effect will be able to be analyzed.

Specifically, the study tries to find out players making decisions under asymmetric information status. The subjects of the experiment are to play three-person Battle of the Sexes game of choosing between two options. They would get paid off when all of the three people in their group choose the same option. However, the amount of the profit following coordination is various depending on the type of the players which is given randomly by the computer when each period starts. Before making a decision between two options, participants have an opportunity to communicate with each other according to one communication network structures shown in Figure 1. There are four kinds of communication networks in this experiment. Complete network is the network in which all players simultaneously exchange the message. Star-in network is the network in which two players give information to one specific player. In Star-out network, on the other hand, one player sends information to other two. Then in Two-links network, there is one player connected to others, and exchange information respectively.

The study focuses on the information management process. Everybody knows that the information is important. However, which would be more significant and advantageous, to have higher level of information, or to have the power of disseminating information? This is not easy to answer. In some network structures, there exist “the hubs”who have more connection with people from others. Depending on the structures, these hubs gain more information about the type of the others and/or have an opportunity to let others know about their own plan (or type). Which would earn the hub more profit after all? Which would be helpful for coordination success of a group? These questions would be answered throughout the experiment.

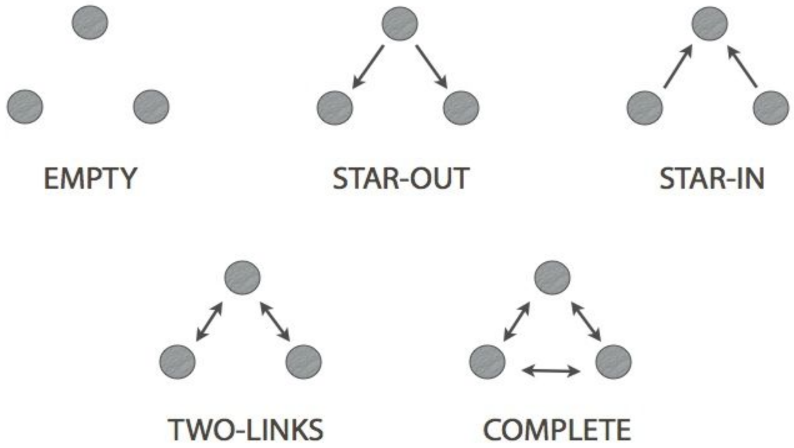


Figure 1. Communication Network Structures in the Experiment

II. Theoretical Background

In this chapter the review on the previous researches on cheap talk, network in political science, and experimental methodology will be given.

1. Game Theoretic Models of Cheap Talk

In the perspective of classical game theory, cheap talk, the pre-play communication with no binding force or effect to the payoff function, is thought not to affect the result of the game. This view is well shown in the word itself – the word "cheap talk" is from the saying "Talk is cheap." Some economists like Crawford, Farell, or Rabin, however, had some different views. They have proven that communication by cheap talk can actually affect the result of the game. In these kinds of studies, cheap talk has been suggested as an alternative to coordination failure.

Crawford and Sobel(1982) did a pioneering research making game theoretic model of cheap talk conveying private information. They showed that costless, non-binding message can convey information as much as the preferences of the players coincide. Their model has a sender who has the private information, and a receiver who receives a message from the sender and then makes a decision. In this case, how honestly would the sender convey the private information he gathered? According to Crawford and

Sobel, this relies on the difference between the preferences of two players. If the preferences do not overlap at all, there exists a babbling equilibrium in which messages have no meaning and the receiver ignores them. So they introduced a partition equilibrium. They divide the parts of sender giving the private information, and they see that in each part the signal sent is the same, so more overlapped preferences between the sender and the receiver would mean more partition and the receiver would receive better information.

Farell (1987) showed how non-binding costless communication can achieve a partial coordination in the industrial entry model. Here the equilibrium in which two players play one kind of battle of the sexes game after one time or twice communication. He concluded that cheap talk partially help to coordinate when the multiple pure-strategy equilibrium is preferred.

After, Farell and Rabin (1996) refute the existing theory on transmission of private information in that most cases of the information sharing in reality is done by simple unofficial conversation, i.e. cheap talk and neither by costly signaling like Spence asserted nor incentive mechanism like Hurwicz insisted.

Some scholars divide cheap talk study in two parts according to the content of information the cheap talk conveys. So the cheap talk in game can be divided into (a) cheap talk that transfer private information of a player, and (b) pre-play communication that shows which action a player would choose. This research may use both definitions since the cheap talk here indicates pre-play communication under asymmetric information like in Guarnaschelli et al. (2000).

2. Experimental Methodology

Experimental studies of cheap talk have been focused on coordination games or negotiation games based on theories mentioned above. These kinds of literature specify factors such as the direction of the communication (one-way, or two-way) and whether the players should break the equilibrium to have better result. According to those studies, one-way communication is effective when breaking the equilibrium brings better results. For instance, in one study, in the battle of the sexes game, one-way communication succeeds to coordinate (mainly to the sender's preferred equilibrium) yet two-way communication showed 55% of success rate, and when there is no communication among the players, the success rate was 41%. On the other hand, when the player has no incentive to break the equilibrium (e.g. Stag-Hunt game), two-way communication was more effective (Cooper et al. 1989; 1992).

Van Huyck et al. (1992) studied how effective it is to provide non-binding public equilibrium (public equilibrium is an equilibrium that every players can have information about it, not between some players.). In this case, when efficient or fair equilibrium is provided the coordination rate was very high; when the provided equilibrium is inefficient or unfair, the rate was very low.

Blume et al. (1998) tested the case of partial common interest among players. In this study, there were three kinds of private information and five actions for players. The result was the similar: if there is any (partial) common interest, (limited) communication happens. It was difficult, however, to bring further rule in this experiment. Duffy and Feltovich (2002) tested which is more effective to make coordination, observation of past action of the players or the cheap talk. There were three games: Prisoner's Dilemma, Stag-Hunt, Chicken game and the effective way depends on the type of game.

1 \ 2	C	D
C	70, 70	10, 55
D	55, 10	55, 55

Table 2. Stag-Hunt Game

1 \ 2	C	D
C	70, 70	10, 80
D	80, 10	40, 40

Table 3. Prisoner's Dilemma Game

1 \ 2	C	D
C	70, 70	50, 80
D	80, 50	40, 40

Table 4. Chicken Game

However, there are not a lot of researches done with the network structure itself. Therefore this study aims to bring communication structures and decision making problem into political context which was mainly in the economic context, and make an experiment of decision making model of people with different, or partial common interest. Especially this study is influenced by following two studies. First of all, Choi et al. (2011) found out how network structure influences the decision making of the players in the three-person Public Good game. This research tests similar network structures, yet testing Battle of the Sexes game so the people may receive different payoff to the same group decision. Also there is the study of Choi and Lee (2009) that studies how the fairness and effectiveness can be achieved depending on communication networks of four-person Battle of the Sexes game. In this study, they have networks like Complete network that the players are all connected; Star network that has one hub, Line network that the players connected in one line; Kite network that three people are connected and one player is just connected to the hub. The players exchange messages two or more times. On the other hand, in this research, four-person game is simplified to three-person game, and the payoff function is separated from the location on the network structure, so the preference treatment is newly introduced.

3. Network Studies in Political Science

In political science, network is mostly studied in the context of voting behavior. In one of the most influential studies of voting behavior, Berelson et al. (1954) argue that social contexts such as where he lives, which social groups he belongs do matter. They further argue that it is because individual's interpersonal networks are built based on the shared political preferences that are relatively homogeneous. They conclude that network formation is characterized by homophily. According to them, an individual's political preference is largely shaped by the social contexts around him and eventually is strengthened by the homogeneous discussion network.

Huckfeldt and Sprague also reconfirm that homophily is observed in network formation (Huckfeldt and Sprague 1995). Despite the homophily tendency, they also note that even among the seemingly homogenous network arises constant political disagreements and also, despite the continuous disagreements the discussions usually neglects the socially minor perspectives. They used snowball sampling to check if a respondent's perceived preferences of discussants in his network actually correspond to the discussants' actual preferences. Using this research design, they could explain how important perception bias is.

Mutz's approach has a different perspective (Mutz 2002). She acknowledges that although there is homophily, individual preferences cannot be completely homogenous therefore at least on some occasions, disagreements occur inevitably. Second, these political disagreements among interpersonal discussion network have a significant importance in normative perspectives, such as tolerance. Later, Mutz and Mondak argue that individuals can have cross-cutting network where individual's selection criteria is not related to political preferences, such as work place (Mutz and Mondak 2009).

However, recent research (Huckfeldt 2001; T.K.Ahn et al. Forthcoming) argue otherwise saying that the most important variable in network formation is not based on a mutual political preference but rather on the level of political expertise a discussant shows. Downs further argue that this is the grounds on which 'rational' voters base their network formation (Downs 1957). Even if a voter shares relatively similar political preferences with a discussant, if the discussant does not have any political expertise, the voter will not benefit any relevant information.

The question regarding which factors decide network formation has a significant meaning in normative perspectives. If a network shows extreme homophily in its formation, citizens can be polarized (Sunstein 2009), can be less tolerant (Mutz 2002), and so on. On the other hand, if political expertise is most important factor in network formation, there can be ‘self-educating’ electorate (T.K. Ahn et al. Forthcoming). Citizens as individuals have little incentive to seek information therefore may end up with small amount of information (Downs 1957; Popkin 1994), but citizens as whole can be ‘rational public’ in this case.

Previous researches argue that the social contexts and interpersonal discussion networks have independent effects on political participation, political preferences, and voting decisions (Bek et al. 2002; Berelson et al. 1954; Bond 2012; Huckfeldt and Sprague 1995; Knoke 1990; McClurg 2006; T.K.Ahn et al. Forthcoming). However, there is disagreement on whether social contexts directly influence individuals’ political attitudes or if they only have indirect effects. Mutz and Mondak argue that social contexts influence how discussion networks are formed, but do not have any direct effect on political attitudes (Mutz and Mondak 2009). Huckfeldt and Sprague say that social contexts can have indirectly effect on political attitudes by influencing the formation of networks, but also can directly influence political attitudes.

Previous researches confirmed that the positive information networks that consists of each candidate's supporters has a substantial effect on a discussant's political preferences and voting decisions, but on the another hand, said nothing on the negative information network that consisting of each candidate's opponents. However, the fact that negative information has more credibility and therefore is more influential compared to positive information (Ansolabehere and Iyengar 1997), and also the fact that 'negative voting' is a frequent phenomenon (Fiorina and Shepsle 1989), all indicates that such research needed.

III. The Setup

1. Research Models

The basic model of the experiment is a three-player coordination game making decisions between two actions. Before the players decide, they share information by exchanging messages according to several network structures. Here the message would be costless, non-binding cheap talk. If all three players choose one same action, they get the payoff; otherwise, they do not get any. To be specific, there are two models, mainly similar but different in preferences of the players. To make the models easier to understand, they will be explained as choosing a candidate to cast the vote considering the situation in the voting context. Therefore the first model can be called partisan voter model, since the players within this model are passionate partisans of each candidate. In the second model, there exists a swing voter-type player, so they do not care which candidate is elected as the result of a group's decision. In these models, the players have the benefit of coordination success – that means election of the least preferred candidate still benefits the player.

A. Model 1: Partisan Voter Model

In this model, each group consists of three players. The player is $i \in \{1,2,3\}$. Each player is given a type and there are two kinds of type: $T = \{A,\ B\}$. The type shows the player's preference. One's type is only known to the player oneself, and others cannot know (private information). The players simultaneously and independently choose an action – or, a candidate – $a \in \{A, B\}$. If all three players choose the same one action, they get paid off (unanimity rule). The amount of payoff each player receives, however, is different depending on the type of the players. Player i receives higher payoff if the group's decision is same with one's own type. Each player's action would be $a_i = (a_1, a_2, a_3)$. Then player i's payoff $u_i(a)$ would be as follows:

$$u_i(a) = \begin{cases} 0\ if\ a_i \neq a_j\ for\ some\ j \neq i \\ k_1\ if\ a_i = a_j \neq t_i\ for\ all\ j \neq i \\ k_2\ if\ a_i = a_j = t_i\ for\ all\ j \neq i \end{cases}$$

$$k_2 > k_1 > 0$$

Therefore this game is a three-person Battle of the Sexes game. This is a game of choosing a place to hang out, or a candidate to work for the group.[1]

---

[1] Like in the reality, although absolute benefit from the coordination is guaranteed, there are people who benefit more than others from the decision (or less). What

Yet before making the decision, players are to communicate with each other according to the network structure, which is given when each period of the experiment begins. The structure of communication network is a common knowledge, known to every player. To be specific, players are sending message $m \in \{A, B\}$ following arrows in the structures. This message does not necessarily indicate the action the sender would choose afterwards (no binding), and it is costless.[2] The content of the message is only known to the receiver.

This model is quite straightforward, and the players' behavior can be predicted as follows. Three players are to vote for A or B. If all three votes for one candidate, the group coordination succeeds and the players would get positive payoffs; the coordination success brings the members some profit. Yet each player is divided to A type endorsing A, or B type endorsing B. A-type player would get higher payoff if A is selected as group coordination result, and B-type player would if B is selected. Therefore each type of players has incentives to make others to choose their own preferred action. This is also like a committee meeting hiring a professor. Two of them votes for A and one of them votes for B. Under

---

would be interesting in the experiment is how people may react when it comes to the problem of relative benefit.

[2] This makes the message a cheap talk.

the unanimity rule, then, both candidates cannot be hired. However, the committee would be better off if the place is filled; so they can communicate (in a limited way) before the one-shot voting.

If the three players are all the same type, there would be no problem since the result would be obvious. What would happen if there are both type A and type B in the same group? Then the possibility that coordination naturally happens is very low. Here is where the cheap talk works.

The players are not bound to their previous message when they make a final choice, however, the network structure and the game left no incentive for the players to lie or hide their types from others in the perspective of profit-making.

B. Model 2: Swing Voter Model

However, in real world, not everyone has strong opinions on every matter (since it is not always easy to know what one really wants to do oneself). In this model, there are also three players in one group playing a three-person Battle of the Sexes game. Like above, the payoff function and the network structure is common knowledge, and the type of the player and the content of the message is private knowledge. However, in this model, there is an additional type of player so there are three types of players: $T = \{A, B, S\}$. Player with type S has the payoff function as below.

$$u_i^s(a) = \begin{cases} 0\ if\ a_i \neq a_j\ for\ some\ j \neq i \\ k_3\ if\ a_i = a_j\ for\ all\ j \neq i \end{cases}$$

$$k_2 > k_3 > k_1 > 0$$

In other words, this player S receives payoff when all the players in the group choose the same action, but is indifferent of which action is selected. When the period begins, the players are given type A with possibility p, type S with possibility q, and type B with possibility (1-p-q). Each player simultaneously and independently chooses action/candidate $a \in \{A, B\}$ and get paid when the three ends up in coordination.

Players are to communicate before making a decision, according to the network structures given at the beginning of a session. The network structures are same with the model 1; there are four kinds of communication networks. Players send a message, $m \in \{A, B\}$ and the message does not necessarily indicate the sender's action in the future (non-binding), and costless. Type S player would also send a message saying either A or B.

Player S, the new type, would be compared to a swing voter in the voting context. This type of player always benefits from coordination success, but is indifferent with the result unlike A and B. Yet S's payoff is lower than the selected action's supporters and higher than the opponents.

In model 2, we may take a closer look at two-way communication. In this model, S player send a message, either A or B, so the message only partially accord to the sender's interest. Then in Star network with one-way communication, for example, the distribution of types would affect more than the message of the player. In Figure 3-1, coordination is unlikely after the communication. However, in 3-2, the swing voter player may have several action possibilities according to the others' messages.

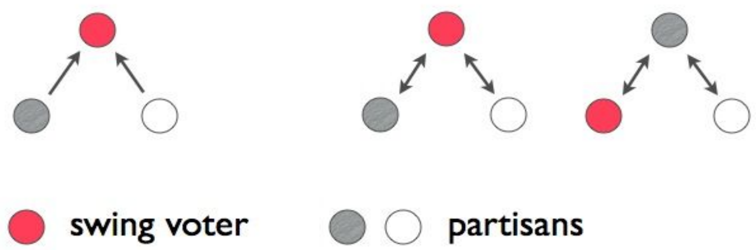
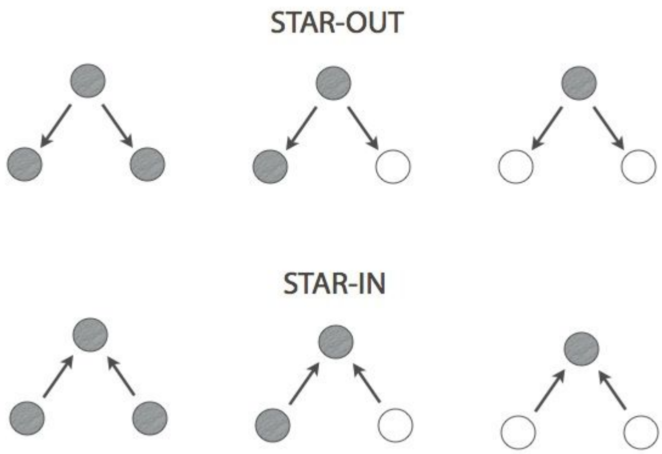


Figure 2. Type Distribution and Networks in Model 2

2. Network Structures

For the case of three player communication, there are more possibilities of communication rather than just one-way or two-way communication. This research selected four kinds of structures of communication network as shown in Figure 1. In Complete network for example, three players – decision makers – exchange the information equally. However, symmetric communication may not be the most efficient way of sharing information as mentioned. Then more amount of information does not always help make a decision and then succeed into equilibrium. Rather, Star-out or Star-in network would be more successful in the perspective of successful coordination (Figure 3). Especially this Star networks stands for the communicating situation in real life because in reality, the individuals are connected asymmetrically in the communication networks. In Star-out network, the hub, sending messages to the other two players can be called an opinion leader. The other two players may have the same preference with the opinion leader or not, and this would also change the result of decision making process. On the other hand, in Star-in network, one player receives information from two players respectively. In this case, if the sender has the same preference, the decision would not be difficult to make. However, if not, what would the players choose to do? This research aims to answer these questions.

Figure 3. Star-in and Star-out Network



IV. Experimental Design

1. Why the experiment: the methodology

To test the models above, the experimental methodology was selected. Although lab experiment may have to sacrifice some sense of direct applicability, it is the most useful means of measuring the interaction among the players without unwanted intervention: the strength of experiment using computer is to minimize the interaction of the researcher and the participants and therefore prevent arbitrary intervention of the researcher and bias. Moreover, since anonymity at decision making is guaranteed, researcher can control the communication among participants and control the various environmental factors which can affect decision. The experiment was programmed and conducted with the software z-Tree (Fischbacher 2007). z-Tree connects experiment conductor's computer and participants' computer so that each decision making of the participants is recorded as data.

2. Treatments

In this experiment, there are two main treatments: communication network structures and players' preferences which are reflected in the payoff function.

A. Communication Network Structures

Figure 4. Four Kinds of Network Structures

As we have seen in Figure 1, there are four kinds of communication networks. The subjects are to play 10 periods of non-communication making decision games first, and this will be the baseline of the experiment. Also, this would prepare the participants to understand the more complex communication game. There would be four sessions over all and in each session, the subjects would play 10 periods of no-communication games, and then 40 periods of communication game according to one of four network structures in Figure 4. This communication game played for 40 periods consists of two stages: communication stage and voting stage. In the Complete network session, all the three players in a group should send each other a message. On the other hand, in the Star-out network, the person in the location X only sends the message to Y and Z. This location is assigned by the computer randomly when each period begins. The participants do not know whom they play game with. Every process is done sitting in front of the computer; and the group member is changed randomly by the computer so there is no chance of considering revenge or long-term cooperation.

B. Preferences: Payoff Function

Second treatment of the game is players' preferences. There exist three kinds of players: A-type who benefits from coordination to A, B-type who benefits from coordination to B, and S-type who benefits from coordination but indifferent between A and B. The specific payoff function is as follows.

		Result		
		Coordinated to A	Coordinated to B	Coordination fails
Player	Type A	50	10	0
	Type B	10	50	0
	Type S	30	30	0

Table 5. Payoff Function

However, in the actual experiment, A, B, and S are replaced with ♧, ☆, and △, respectively. This is to prevent the focal point effect: the subjects tend to choose the particular option implicitly if the options imply any ordinal or superiority. In the pre-tests, using A, B, and S-type, people are evidently choosing option A when they don't know what to do.

Therefore using symbols without ordinal meaning was important. However using the symbol has drawbacks in that it is difficult for people to recognize and tell the difference of. Therefore the symbol of S-type was selected to show its characteristics and the symbol of A and B was selected to reduce any bias.

3. Procedure

The experiment was conducted throughout four sessions at the computer lab in College of Social Sciences, Seoul National University on December 26 and 27, 2013.

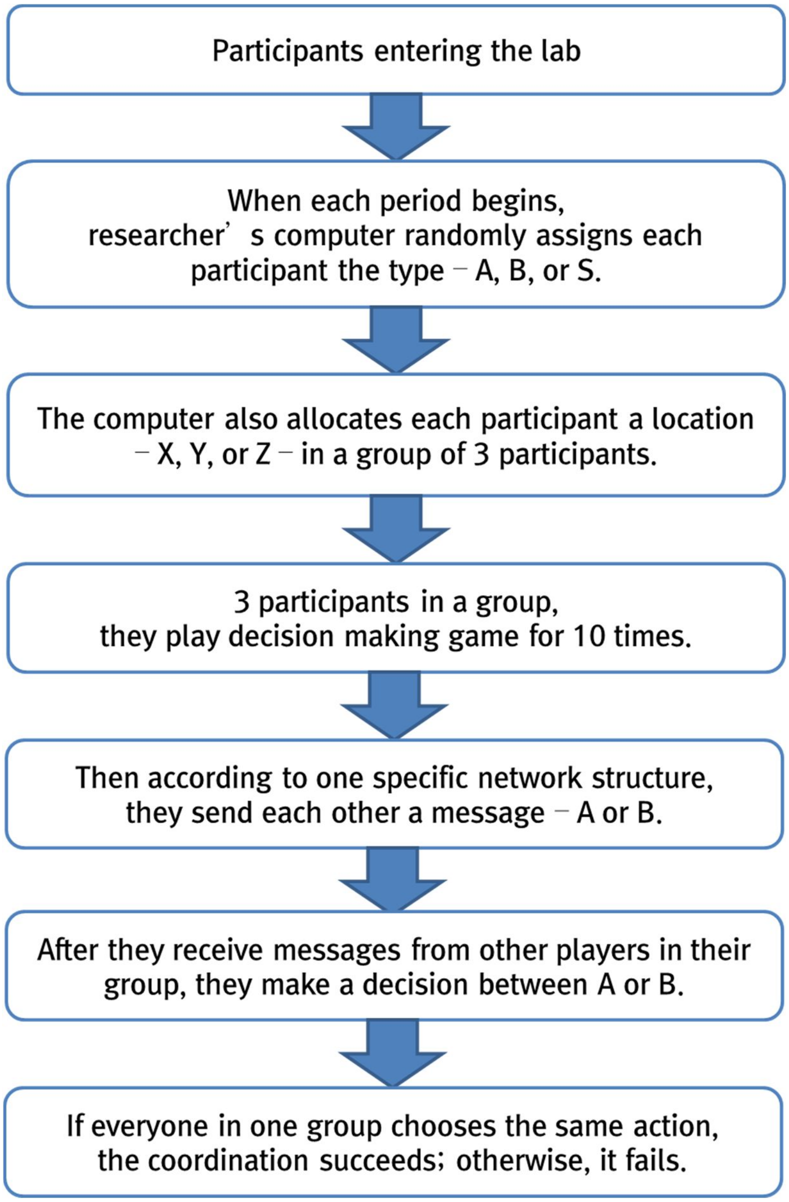
	Session 1	Session 2	Session 3	Session 4
10 periods	No communication			
40 periods	Two-links	Star-in	Complete	Star-out

Every participant is announced at the time of beginning to receive money reward proportional to their total profit in 50 periods plus show-up fee, 5,000 KRW afterward. Students did not know whom they were playing game with, and every step of communication was done using the computer monitor. Any other kinds of interaction among subjects were prohibited strictly.

When all the participants attended, they received a piece of guideline on paper (see Appendix B) and listened to the explanation of the experiment. Each period is independent and identical. When each period begins, the computer randomly assigns type ♧, ☆, or △ and subjects play 10 periods of decision making battle of the sexes game choosing between ♧ and ☆. For the next 40 periods, after participants understanding the process and the payoff function, when each period begins, the computer randomly assigns type ♧, ☆, or △, and location X, Y, or Z on the network structure. This type and location were kept shown on the monitor screen so that the participant could recognize.[3] On the communication stage, the players send messages ♧ or ☆ as the arrows in the network structure indicate. Then on the next page, they see the message they sent and received. With this information, they choose between ♧ or ☆. After voting, the result is shown; people can see what other players in their group choose. If all the three players in one group choose the same symbol, they receive the payoff. If not, they receive nothing. The exact amount of payoff is as shown on Table 5. When the game finished, the players are announced that they would receive 5 times of their total profit of the day plus 5,000 KRW show-up fee.

[3] See Appendix A for the monitor screens the participants have seen.

Figure 5. Experimental Procedure



4. Predictions

By performing this experiment, the following serves as the foundation of the research questions.

- What kind of network structure can deliver the information most effectively? Would more communication bring much easier coordination?

This can be easily verified by comparing no-communication periods with other periods with communication stage. According to the previous literature and common sense, the coordination rate would much higher in games with communication when compared to games without cheap talk. However, since it is three-person game, the rate would be lower than expected when compared to in two-person battle of the sexes game. Overall, coordination rate would be different depending on communication network structures. It is predicted that Complete network would score highest success rate because the players do know almost full information. However, since the communication is done only once, and talk here is two-way communication, there is a possibility of subjects being confused. In the terms of effectiveness, Star-out communication network may be the most effective.

There are no possibilities of confusion. If the group members are cooperative enough, the coordination rate can even be 100 %. This is also connected to the second question followed.

Also, there is Star-in network. Star-out network and Star-in network look very similar: and here the communication is minimal. However, Star-in network may not be the best condition for making coordination with various preferences. In this case, how the players, especially the hub with better information would react? Two-link network would be also interesting because they have two-way communication and very similar to compete network structure, but how similar would the result be? Would the concentration of information help coordination?

- Would the players accept the asymmetrical payoff function and be willing to cooperate to the coordination?

In this game, the players have incentives to coordinate in order to maximize profit so that they can earn a lot of money as possible after the experiment. However, is that the only motivation of the subjects?[4] Will they behave as the theory rationally expect?

---

[4] During the pre-test session when preparing this experiment, many participants share their thoughts about the goal of this experiment. They were aware that it is

Previous experimental researchers had the same question. The most famous one about this topic would be the ultimatum game. Ultimatum game is a game played by two players, splitting specific amount of money. One person, the proposer, offers the ratio of dividing the money to another. If the second person, the decider, agrees with the ratio of the offer, they divide the money according to the proposer's offer. However, if the decider refuses, both of them cannot earn the money. In this case, in the theoretically rational world, the decider should accept the offer if there exist a little amount of profit one can gain. However, in the real world, many people just refuse the offer because they cannot stand the fact that the others getting more than themselves (Kahneman et al. 1986; Roth et al. 1991).[5] Individual profit versus Group coordination – is there any difference in the result?

In this game, the sense of relative deprivation would be less direct than in ultimatum game. However, the subjects can see, after each decision making, how much other players in their group earn. For example, when after they exchange the information, assume that one find out that he would

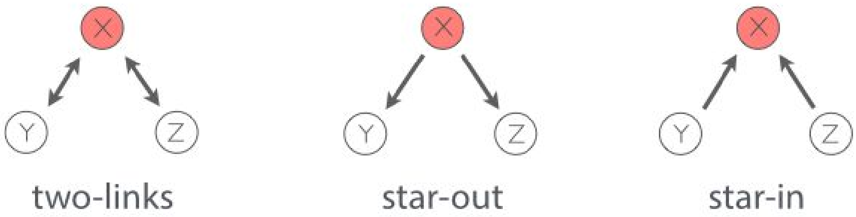
---

important to cooperate to others when it is evident that changing the choice would make everyone in the group better off. However, some did not want others to get more profit than themselves, so they disturb the coordination on purpose sometimes.

[5] This tendency, however, is also affected by the amount of money itself; if the amount is huge then people do not want to sacrifice a lot of money because of the sentiment of unfairness.

earn 10 points and make the others earn 50 points only if he yield. Would he cooperate? What about after 10 periods of yielding? This experiment tries to answer this question.

- Who is the hub?



The hub means the player can communicate to other players when not everyone is connected. For example, in Two-links network, Y and Z can only talk with X. In Star-out network, X is the only person who can speak out. In Star-in, X cannot send messages but Y and Z tell X something.

Then is the hub player more beneficial? What kind of hub is more advantageous, to receive more information or to send more information? This became more important in the era of the World Wide Web. Traditionally the political expert with more knowledge is literally the one who knows more than others. However, nowadays, it may be the person with influence who can affect more in other people's decision making. In this experiment, the role of the hub, and the effect of its message would be analyzed. Then importantly, would the preference of the hub change the coordination result? This would also be led to the question: will there be any conflict in pursuing individual profit versus group coordination? Would all the location in the network structures have similar amount of profit when whole periods end?

V. Results

1. Coordination Outcomes

Throughout four sessions of experiment, the number of participants attended was 87 and 4,270 observation was obtained in total (Table 6). The experiment was conducted between December 26th and 27th 2013. The subjects were the undergraduate students in Seoul National University. In each session, the participants were to play 10 periods of none communicating game before they play treatment games. Then they played 40 periods of network game. One network structure is assigned to each session.

(participants / observations)

Network	Session				Total
	1	2	3	4	
No communication	21/210	24/240	21/210	21/210	870
Two-links	21/840	-	-	-	840
Star-in	-	24/960	-	-	960
Complete	-	-	21/840	-	840
Star-out	-	-	-	21/840	840

Table 6. Number of Participants and Observations by Main Treatment

Table 7 shows the frequencies of the coordinated actions in the whole observations. The ratio of A and B is almost the same; this would be the result of types of the subjects being randomly distributed.

	Freq.(Percent.)
A	494 (34.07)
B	492 (33.93)
Failure	464 (32.00)
Total	1,450

Table 7. Frequencies of Coordinated Actions

Figure 6 shows coordination success rates by network structures. The overall outcome was very similar with what was expected. As expected, games with communication stage show much higher coordination rates. Without any communication before making a decision, the coordination rate was 23.45%. The highest coordination rate was from Complete network (97.86%) and players in Star-in network found it most difficult to coordinate (50.62%). However, although the coordination rate in Star-in network was the lowest, it was still twice more than under no communication.

The interesting thing is, yet somewhat predictable, the difference of coordination rate between Two-links and Star-out network. It is expected that since Two-links network use one-shot two-way communication, it would be harder for participants to decide final choice when the information sent and received conflicts. Yet considering the network structure was a common knowledge, the coordination rate should not show such difference, because the only factor changing is the information the hub obtains. This might imply that people may not think long enough to consider the structure of the network in mind. There were two possibilities: (a) people think too much, and the two-way communication causes confusion, or (b) more information help the participants to make the better decision.

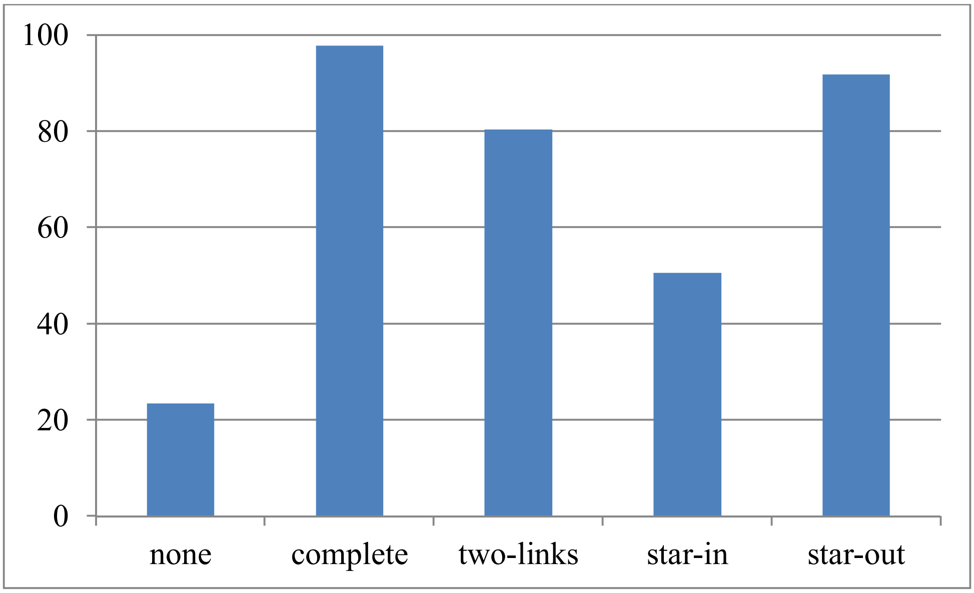


Figure 6. Coordination Rates by Network Structure

When the players play the game according to the Complete network, they had the tendency to follow the action that is equal to majority of expressed type (i.e. message). The players behave almost like under the full information status. This was why, in spite of the confusion of one-shot two-way communication, the Complete network showed the highest coordination rate.

2. Network Structures

Then how can network structures affect the coordination? Chi-square nonparametric test was conducted to examine the effect of network structures on coordination rates. The result is shown in Table 8. As expected, there were significant differences between the actual frequencies of coordination and expected ones. Null hypothesis, that the communication network factor is independent from coordination rate, is not adopted because the p-value is lower than the level of significance. Therefore it is evident that network structures affect the coordination rates.

Table 8. Chi-Square Nonparametric Test on Coordination Rates

(frequencies, expected frequencies, and chi-square contribution in parenthesis)

	Coordination		Total
Model	Failure	Success	
No Communication	222 96.5 (179.9)	68 197.2 (84.6)	290 290.0 (264.5)
Complete	6 96.3 (78.0)	274 190.4 (36.7)	280 280.0 (114.7)
Two-links	55 134.4 (13.4)	225 190.4 (6.3)	280 280.0 (19.6)
Star-in	158 102.4 (30.2)	162 217.6 (14.2)	320 320.0 (44.4)
Star-out	23 89.6 (49.5)	257 190.4 (23.3)	280 280.0 (72.8)
Total	464 464.0 (350.9)	986 986.0 (165.1)	1,450 1450.0 (516.1)

Pearson Chi-square(4) = 1.5e+03, Pr = .000

3. Type: the Role of the Hub

Can the player in the hub really affect the coordination result? It was predicted that the type of the hub be the crucial factor of the coordination. The hub player can be found in the following three network structures: it is player at the location X in Two-links, Star-in, and Star-out network.

However, the behavior of the hub is different by network structures, because the role given is dissimilar.

In Two-links network, the hub sends and receives a message at the same time, so it has more information than others in addition to the ability to affect the others. In this network, Y and Z can also affect X's behavior too by sending messages, but they have lower level of information. The hub in this network seems most powerful.

In Star-out network, the hub only affects others, and do not have more information. The hub in this network can be thought as either a dictator or a public figure with fame (regardless of knowledge or intelligence). They are influential not because they are more clever and know better, but because they are popular.

Lastly, in Star-in network, the hub is the one with higher level of information. The other two players send the hub a message. The hub has better knowledge than other two. The sad thing is, it has no means to use that information. That is, it cannot exert its influence.

Table 9 shows the relationship between the type of the hub and the result. Surprisingly, when the type of the hub is A, the coordinated action in a group is one hundred percent A. Also in general, when the type of the hub is B, the coordinated action is likely to be B.

Table 9. Coordination Rates by Type of the Hub (%)

A. Two-links Network

Type of the hub	Coordinated Action			Total
	A	B	Failure	
A	100	0	0	100
B	1.41	76.06	22.54	100
S	30.54	50.25	19.21	100

B. Star-in Network

Type of the hub	Coordinated Action			Total
	A	B	Failure	
A	100	0	0	100
B	46.67	9.33	44.00	100
S	32.50	15.42	52.08	100

C. Star-out Network

Type of the hub	Coordinated Action			Total
	A	B	Failure	
A	100	0	0	100
B	5.71	84.29	10.00	100
S	39.22	52.94	7.84	100

However, when it comes to the case of the hub being B, the result was slightly different. The noteworthy thing happened in Star-in network. When the hub was A, the group *always* coordinated to A. However, if it is

B, they succeeded with the possibility about 1/2. In other networks, the difference between the hub being A and being B is pretty close but still, the former is always higher. Is this another kind of focal point effect? It is possible because although the ordinal meaning of the action is deleted, the screen the players choose the action was all the same, so there still exists the possibility of people choosing the first choice when unsure. This should be further looked.

Since S-type player has to make a decision what to tell others when they has to send a message (A or B does not have to think too much – they have no incentive to lie if they fully understand the payoff mechanism), it is also important to see the relationship between the message sent by the player with type S and the coordinated action in order to verify the role of the hub. Table 10 shows what happens when the hub is a swing voter. The result is obvious. The coordination result was usually made following the hub's message.

Table 10. Relationship between the Message from the hub (or X) and the Coordinated Action (When the type of the hub is S)

	Coordinated Action			Total
Message	A	B	Failure	
A	78.03	8.01	13.96	100
B	11.79	73.96	14.25	100
Total	46.09	39.81	14.10	100

A. Two-links Network				
	Coordinated Action			Total
Message	A	B	Failure	
A	73.58	9.43	16.98	100
B	12.07	68.97	18.97	100
Total	35.36	46.43	18.21	100
B. Star-out Network				
	Coordinated Action			Total
Message	A	B	Failure	
A	95.24	0	4.76	100
B	0.00	90.00	10.00	100
Total	39.22	52.94	7.84	100

Then below is the table showing the relationship between type of the participants and the final choice. Considering the payoff function, it is reasonable for players to want the equilibrium be their own type. Here, the famous problem with the Ultimatum game mentioned above again arises. Will people behave rationally?

In this experiment, will people choose to gain absolute profit not considering unfair outcome of receiving less than others? There is no other incentive for players to choose the action other than their own type if it is not for coordination. "Switching" in the (Table 11) means that the player chooses the action which is not their type.

When the participants have to make a decision without any communication, there were still 18.62% people choosing other actions. When it comes to Complete network, the rate arises. Two-links network and Star-out network shows incredibly high rate of switching. However, Star-in network, compared to no communication, shows low rate of switching.

Table 11. Relationship between Type of the Participants and the Final Choice (%)

A. No Communication

	Choice		Total	Switching
Type	A	B		
A	84.48	15.52	100	18.62
B	21.72	78.28	100	
S	68.28	31.72	100	-
Total	58.16	41.84	100	-

B. Complete Network

	Choice		Total	Switching
Type	A	B		
A	79.64	20.36	100	27.50
B	34.64	65.36	100	
S	66.07	33.93	100	-
Total	60.12	39.88	100	-

C. Two-links Network

	Choice		Total	Switching
Type	A	B		
A	32.50	67.50	100	44.64
B	21.79	78.21	100	
S	44.29	55.71	100	-
Total	32.86	67.14	100	-

D. Star-in Network

	Choice		Total	Switching
Type	A	B		
A	94.06	5.94	100	14.68
B	23.44	76.56	100	
S	68.44	31.56	100	-
Total	61.98	38.02	100	-

E. Star-out Network

	Choice		Total	Switching
Type	A	B		
A	39.64	60.36	100	42.67
B	25.00	75.00	100	
S	41.43	58.57	100	-
Total	35.36	64.64	100	-

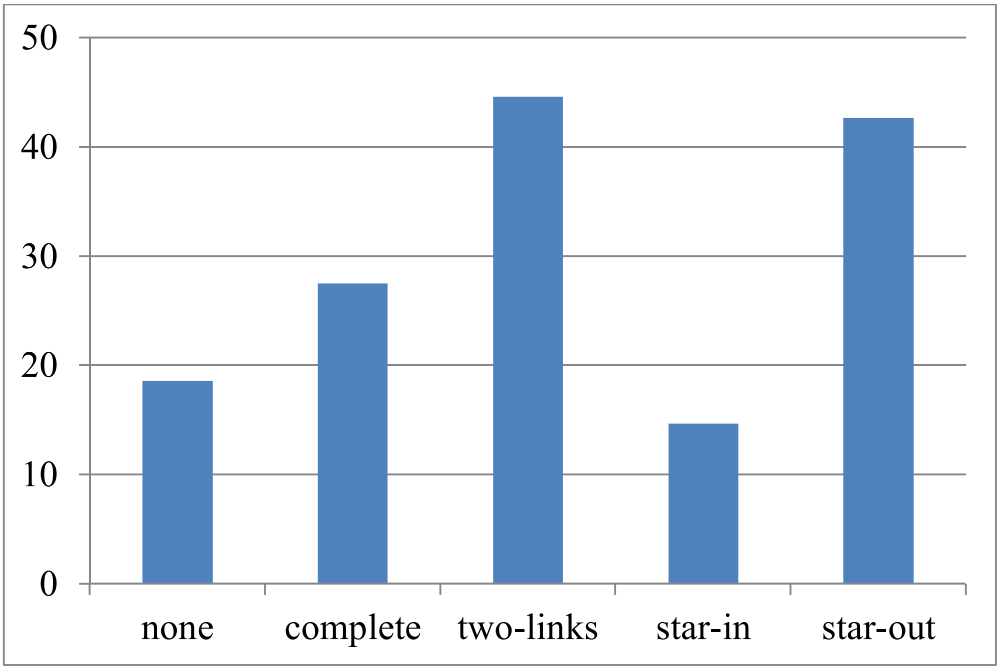


Figure 7. Switching Rates when the subjects' type is A or B (%)

The interesting thing is, almost half of the participants change their choice and yet the coordination rate is very high in the Two-links network. Star-out network also shows the high rate of changing and coordination success, but this is not surprising because in this network, the coordinated equilibrium is unilaterally given by the hub. Yet, in Two-links network, the feature of communication being two-way was thought to confuse people but it turns out that it did not. The subjects were surely following the message from the hub and the hub knew the others would.

Therefore these results draw two inferences. First, people tend to follow others message than thought. This means that people regard coordination important although it conflicts with the desire to be relatively successful. Second, without any information on “right” decision, people tend to change their decision.

4. Coordination Success versus Social Profit

We have mainly seen the result in a perspective of a group: is it coordinated or not? However, as the level of individuals, the amount of profit might matter more. Table 12 shows the frequencies of profit the players earn by network structures. The result mainly goes with the coordination success rate. However, although in coordination rate, Complete network and Star-out network was pretty close, the distribution of profit is far different. In Complete network, there are few 0 points and a lot of 50 points. This means there are many players succeeded to make others vote for them under open information. In Star-out network, there are some 0 points, and similar amount of 10, 30, and 50 points.

Then how the profit distributed among players themselves? Figure 8 and 9 compare average profit produced within networks with the profit of the hub (location X). This shows that it is more advantageous to have the opportunity to speak out rather than have the information of others' type (Compare the gap between Star-in and Star-out).

	Network					Total
Profit	None	Complete	Two-links	Star-in	Star-out	
0	666	18	165	474	69	1,392
10	34	152	190	60	226	662
30	73	276	229	147	263	988
50	97	394	256	279	282	1,308
Total	870	840	840	960	840	4,350

Table 12. Frequencies of Profit

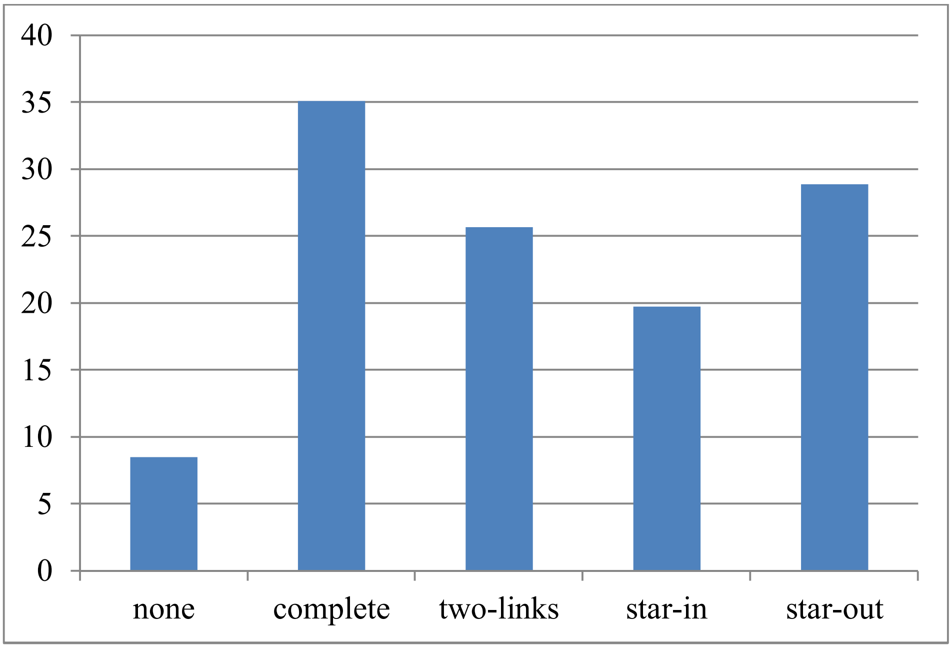


Figure 8. Average Profit Produced within Networks

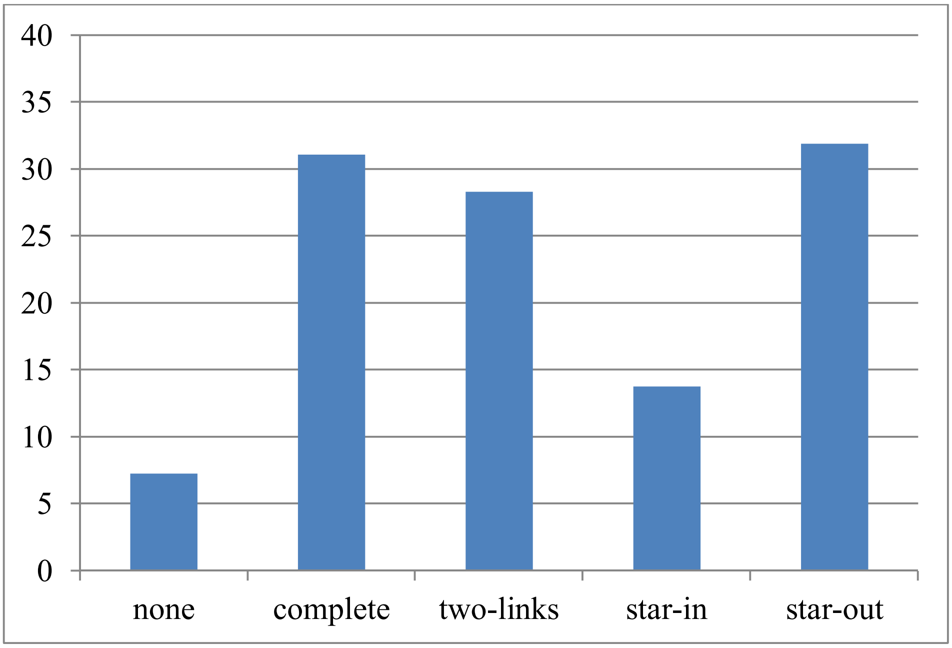


Figure 9. Average Profit of the Player at the Location X

Table 13 shows what happened to the message-senders. In Complete network, everyone sends message. Here, the dominant strategy is to keep the content of the message. This is understandable because the others have the same information. However, in the case of type S, it is especially important to keep their message – this is when the S has the casting vote. In Two-links network, it is noteworthy that changing is the dominant action. This is because when the information is shared, the one should adjust their choice to make coordination. Still it is surprising the change can make the profit this much when it is only one-shot communication.

In Star-in network, in fact, the sender has no special reason to change their choice because the information status before sending the message and before making a decision is the same. However, more than 80 cases people change and earn 50 points. This does not happen in 10 or 30 points. In Star-out network, also, it is thought to be advantageous to keep the message, because it would be the only information to the receivers. However, almost every A and B that earn the profit has changed their choice.

Table 13. Relationship between Changing the Choice and Profit

A. Complete Network

	Do not Change	Change	Total
0	10	8	18
10	95	57	152
30	182	94	276
50	218	176	394
Total	505	335	840

B. Two-links Network

	Do not Change	Change	Total
0	69	96	165
10	42	148	190
30	99	130	229
50	66	190	256
Total	276	564	840

C. Star-in Network

	Do not Change	Change	Total
0	158	158	316
10	22	3	25
30	28	4	32
50	186	81	276
Total	394	246	640

D. Star-out Network

	Do not Change	Change	Total
0	4	19	23
10	4	0	4
30	80	108	188
50	6	59	65
Total	276	564	280

(Changing is measured by difference of one's first message and final choice.)

VI. Conclusion

1. Conclusion

This research was designed and conducted in order to examine the role of cheap talk communication in decision making process, especially when people have to make a decision collectively. When the decision making is done at the individual level, as the previous studies has asserted, it is important to obtain information needed at the lowest cost as possible. Therefore people rely on information shortcuts, because it is rather cheaper to gain secondary information interpreted from the media or from the acquaintances. In this case, the people having huge amount of knowledge or available shortcuts would have advantage. However, when it comes to group decision, and when my possibilities of gaining profit is also depending on other's choice, the situation changes. Rather than information itself, the way information is delivered become more important. This is the point this research tried to suggest: the importance of information sharing networks to making decision.

At the social level, therefore, it is important to make an effective and fair route of communication network in order to ensure that social decision is made on the basis of enough information. Otherwise, when the hub of the network is not the expert and have enough knowledge, the group decision would be an inferior one compared to full information equivalent.

2. Further Discussion

Nowadays, sometimes it has been more important to become influential than to know more. Especially when it comes to general voters not policy makers, the significant matter would be to secure a communication line by which the information is equally disseminate.

Can internet be our effective public sphere in new era to accomplish this purpose? Some theorists have been suspicious of potential possibilities of the Internet. In their opinion, the Internet only increases the probability of selective exposure, so that people would expose themselves only to like-minded perspectives and this leads to fragmentation and polarization in society (Stroud 2010; Sunstein 2009).

Political polarization, as the consequence of coordination failure, is suggested by many scholars as the result of online deliberation. Regarding political polarization nowadays, there seems to exist an agreement that political elites being polarized; but there are debates on polarization of the public. Jacobson (2003) insists that the Iraq war encourage the separation of ideological partisans. Abramowitz and Saunders (2008) also suggest that polarization of the public is getting serious.[6]

Based on these polarization arguments, studies arrange polarization with new media. Iyengar and Hahn (2009) there exists ideological polarization due to self-selective news media use. Yet Mutz and Martin (2001) showed findings that consumption of news media in 2000s increase the exposure to various political interests.

Since the social network services have been widespread, there are studies, especially on Twitter, working on this. Conover et al. (2011) explore how social media shape the networked public sphere and facilitate communication between communities with different political orientations. In their study on Twitter, They separates mention network from retweet network. The network of political retweets exhibits a highly segregated partisan structure, with extremely limited connectivity between left- and right-leaning users. However, in the case for the user-to-user mention network, which is dominated by a single politically heterogeneous cluster of users in which ideologically-opposed individuals interact at a much higher rate compared to the network of retweets.

---

[6] However, there are scholars like Fiorina (2011) insisting that the electorate is being more independent; they become more tolerant and non- partisan.

Kim (2011) examines that SNSs contribute to individuals' exposure to cross-cutting political views. He proposed that SNSs contribute to expanding exposure to dissimilar political views across individuals" partisanship. Yardi and Boyd (2010) proved homophily and group polarization on Twitter: replies between like-minded individuals strengthen group identity, whereas replies between different-minded individuals reinforce in-group and out-group affiliation. They suggest that people are exposed to broader viewpoints than before, but limited to engage in meaningful discussion, and coordination.

Therefore the future task of new media research would be to find the way to reduce polarization and extremity and make cyberspace the area that can reflect the real world deliberation and work as a communication path to coordination.

References

Abramowitz, A I, and K L Saunders. 2008. “Is Polarization a Myth?.” *Journal of Politics*.

Ahn, T K et al. Forthcoming. *Experts, Activists, and Democratic Politics : Are Electorate Self-Educating*? Cambridge University Press.

Ansolabehere, Stephen, and Shanto Iyengar. 1997. *Going Negative : How Political Advertisements Shirink & Polarize the Electorate*. Free Press.

Berelson, Bernard et al. 1954. *Voting: A study of Opinion Formation in a Presidential Campaign*. Chicago University Press.

Blume, A., DeJong, D. V., Kim, Y.-G., & Sprinkle, G. B. 1998. Experimental evidence on the evolution of meaning of messages in sender-receiver games. *The American Economic Review*, 88(5), 1323-1340.

Bond, Robert M. et al. 2012. “A 61-million-person Experiment in Social Influence and Political Mobilization.” *Nature* (489), 295-298.

Choi, S., & Lee, J. 2009. Communication, coordination and networks. *Coordination and Networks* (November 22, 2009).

Choi, S., Gale, D., Kariv, S., & Palfrey, T. 2011. Network architecture, salience and coordination. *Games and Economic Behavior*, 73(1), 76-90.

Conover, M D, J Ratkiewicz, M Francisco, B Gonçalves, A Flammini, and F Menczer. 2011. “Political Polarization on Twitter.” *Proc. 5th Intl. Conference on Weblogs and Social Media*: 1–8.

Cooper, R., DeJong, D. V., Forsythe, R., & Ross, T. W. 1989. Communication in the battle of the sexes game: some experimental results. *The RAND Journal of Economics*, 568-587.

Cooper, R., DeJong, D. V., Forsythe, R., & Ross, T. W. 1992. Communication in coordination games. *The Quarterly Journal of Economics*, 107(2), 739-771.

Crawford, V. P., & Sobel, J. 1982. Strategic information transmission.

Econometrica: Journal of the Econometric Society, 1431-1451.

Crawford, V. 1998. A survey of experiments on communication via cheap talk. *Journal of Economic Theory*, 78(2), 286-298.

Downs, Anthony. 1957. *An Economic Theory of Democracy*. Harper & Collins.

Duffy, J., & Feltovich, N. 2002. Do Actions Speak Louder Than Words? An Experimental Comparison of Observation and Cheap Talk. *Games and Economic Behavior*, 39(1), 1-27.

Eveland, William P, and Myiah Hutchens Hively. 2009. "Political Discussion Frequency, Network Size, and 'Heterogeneity' of Discussion as Predictors of Political Knowledge and Participation." *Journal of Communication* 59(2): 205–24.

Eveland, William P, and Steven B Kleinman. 2011. "Comparing General and Political Discussion Networks Within Voluntary Organizations Using Social Network Analysis." *Political Behavior.* Published online.

Farrell, J., & Rabin, M. 1996. Cheap talk. *The Journal of Economic Perspectives*, 10(3), 103-118.

Fiorina, Morris, and Kenneth Shepsle. 1989. "Is Negative Voting an Artifact?" *American Journal of Political Science 33(2):* 423-39.

Fiorina, M P, Samuel J Abrams, and Jeremy C Pope. 2011. *Culture War?* Addison-Wesley Longman.

Fischbacher, U. 2007. Z-Tree: Zurich toolbox for ready-made economic experiments. *Experimental Economics*, 10, 171-178.

Guarnaschelli, S., McKelvey, R. D., & Palfrey, T. R. 2000. An experimental study of jury decision rules. *American Political Science Review*, 407-423.

Huckfeldt, R R. 2001. "The Social Communication of Political Expertise." *American Journal of Politics* 45(2): 423-38.

Huckfeldt, R R, and J M Mendez. 2005. "Managing Disagreement Within Communication Networks: Moths, Flames, and Political Engagement."

The Journal of Politics 70(1): 83-96.

Huckfeldt, R R, and J Sprague. 1995. *Citizens, Politics and Social Communication: Information and Influence in an Election Campaign*. Cambridge University Press.

Huckfeldt, R R, and P E Johnson. 2001. “Communication Networks, Complex Interdependence, and the Survival of Disagreement Among Citizens.” *Presented at a colloquium at the Workshop in Political Theory and Policy Analysis, Indiana University*

Huckfeldt, R R et al. 2004. “Disagreement, Ambivalence, and Engagement: the Political Consequences of Heterogeneous Networks.” *Political Psychology* 25(1): 65–95.

Huckfeldt, R R et al. 2004. *Political Disagreement*. Cambridge University Press.

Iyengar, Shanto, and Kyu S Hahn. 2009. “Red Media, Blue Media: Evidence of Ideological Selectivity in Media Use.” *Journal of Communication* 59(1): 19–39.

Jacobson, G C. 2003. “The Bush Presidency and the American Electorate.” *Presidential Studies Quarterly* 33(4): 701–29.

Kahneman, Daniel, Knetsch, Jack L. And Thaler, Richard H., 1986. "Fairness as a Con- straint on Profit Seeking: Entitlements in the Market," *American Economic Review*, September 1986, 76, 728-41.

Kim, Yonghwan. 2011. “The Contribution of Social Network Sites to Exposure to Political Difference: the Relationships Among SNSs, Online Political Messaging, and Exposure to Cross-Cutting Perspectives.” *Computers in Human Behavior* 27(2): 971–77.

Knoke, David. 1990. *Political Networks.* Cambridge University Press.

Lazer, David et al. 2010. “The Coevolution of Networks and Political Attitudes.” *Political Communication* 27(3): 248–74.

McClurg, Scott D. 2006a. “Political Disagreement in Context: the Conditional Effect of Neighborhood Context, Disagreement and Political Talk on Electoral Participation.” *Political Behavior* 28(4): 349–66.

McClurg, Scott D. 2006b. “The Electoral Relevance of Political Talk: Examining Disagreement and Expertise Effects in Social Networks on Political Participation.” *American Journal of Political Science* 50(3): 737–54.

Mutz, D C. 2002a. “The Consequences of Cross-Cutting Networks for Political Participation.” *American Journal of Political Science* 46(4): 838–55.

Mutz, D. C. 2002b. “Cross-Cutting Social Networks: Testing Democratic Theory in Practice.” *American Political Science Review* 96(1): 111-26.

Mutz, D C, and Jeffrey Mondak. 2006. “The Workplace as a Context for Cross-Cutting Political Discourse.” *The Journal of Politics* 68(1): 140-55.

Popkin, Samuel. *The Reasoning Voter : Communication and Persuasion in Presidential Campaign*. University of Chicago Press.

Rabin, M. 1993. Incorporating fairness into game theory and economics. *The American Economic Review*, 1281-1302.

Roth, A. E., Prasnikar, V., Okuno-Fujiwara, M., & Zamir, S. 1991. “Bargaining and market behavior in Jerusalem, Ljubljana, Pittsburgh, and Tokyo: An experimental study.” *The American Economic Review*, 1068-1095.

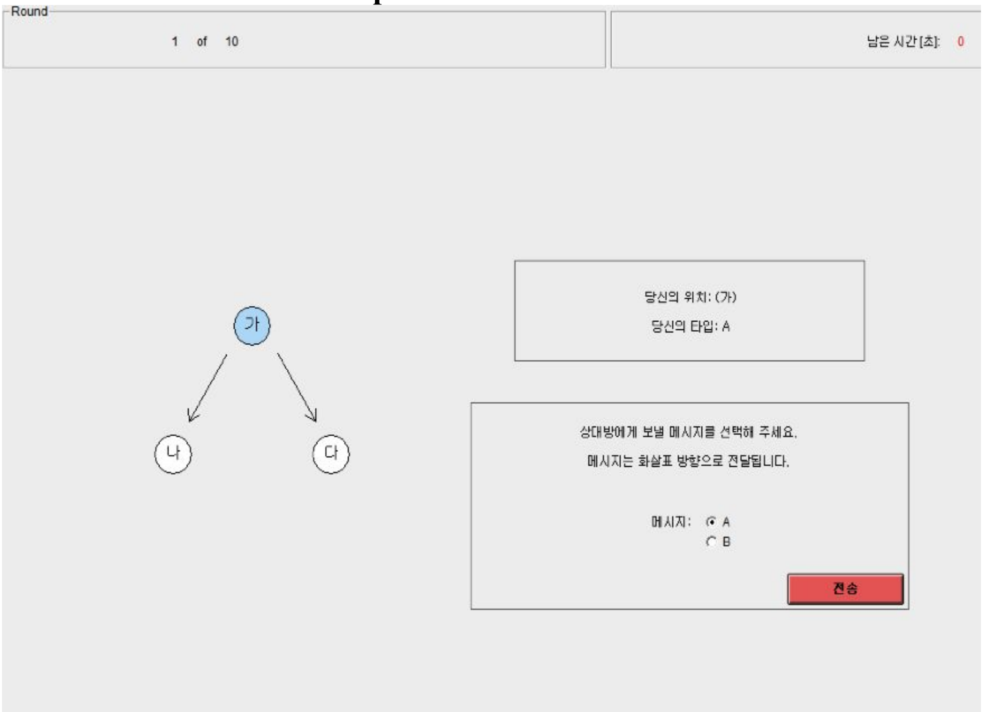
Stroud, Natalie Jomini. 2007. “Media Effects, Selective Exposure, and Fahrenheit 9/11.” *Political Communication*, 24:415–432.

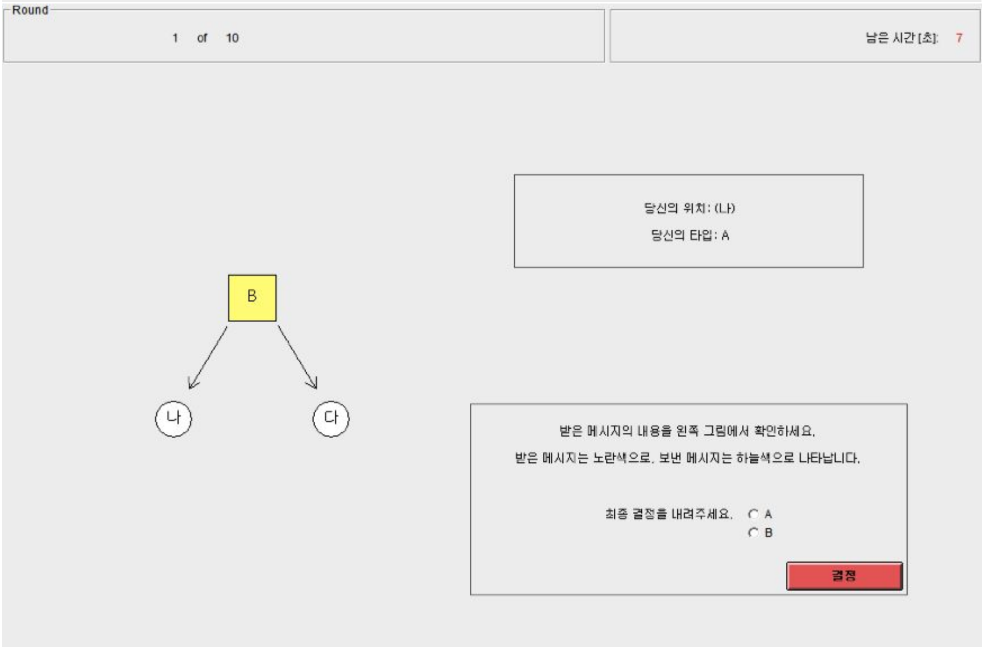
Sunstein, R. Cass. *Why Societies Need Dissent.* Harvard University Press.

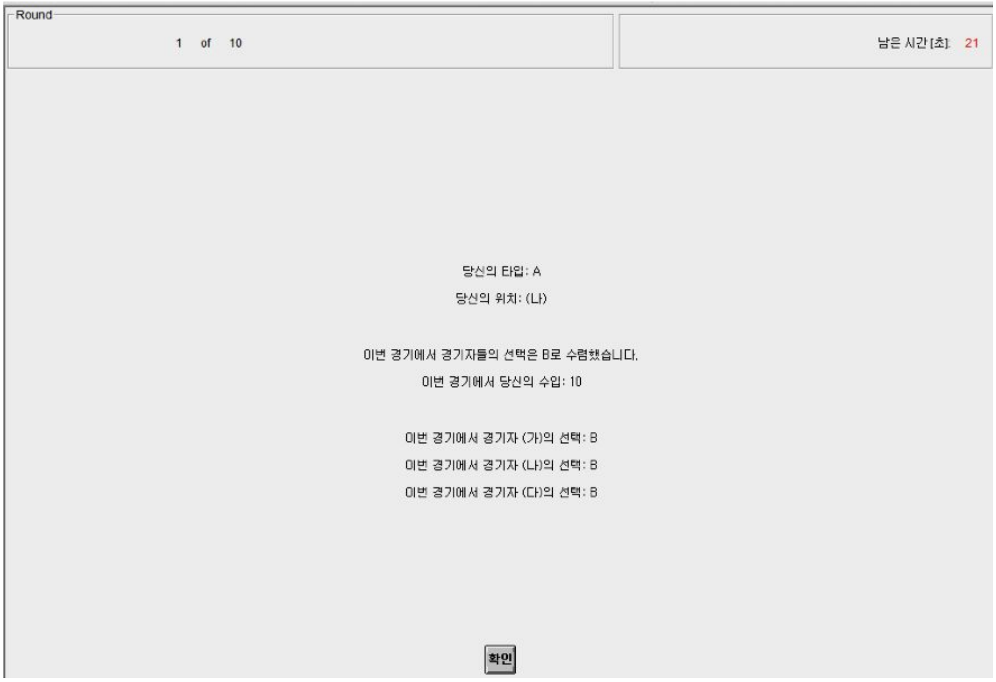
Yardi, S, and D Boyd. 2010. “Dynamic Debates: an Analysis of Group Polarization Over Time on Twitter.” *Bulletin of Science, Technology & Society* 30(5): 316–27.

Appendix

A. Screenshots from the Experiment






Round
1 of 10
남은 시간[초]: 21
당신의 타입: A
당신의 위치: (나)
이번 경기에서 경기자들의 선택은 B로 수렴했습니다.
이번 경기에서 당신의 수입: 10
이번 경기에서 경기자 (가)의 선택: B
이번 경기에서 경기자 (나)의 선택: B
이번 경기에서 경기자 (다)의 선택: B
확인

B. Sample Instructions (Session 01)

[실험 안내문]　　　　　　　　　　세션 1: 2013 년 12 월 26 일

오늘 실험에 참가해주셔서 감사합니다. 여러분은 지금부터 개인들 간의 의사소통과 의사결정을 연구하는 실험에 참여하시게 됩니다. 실험 소요 시간은 약 한 시간입니다.

실험 도중 휴대폰을 비롯한 개인용 휴대전자기기의 사용은 금지되며, 실험이 시작된 후에는 중간에 자리를 이동하거나 실험실 밖으로 나가실 수 없습니다. 또한 실험 도중 타인과 대화하거나 수신호를 보내는 등의 의사소통도 하실 수 없습니다. 이 점을 꼭 숙지하시기를 부탁드립니다. 실험 도중에 질문이 있으신 경우에는 언제라도 손을 들어 도움을 요청해 주십시오.

[1단계]

자신의 타입 확인: ♧, ☆, △	⇒	의사결정: ♧ 또는 ☆	⇒	결과 확인: 3명 모두 같은 선택지 고르면 점수 얻음

– 타입, 조 배정

실험이 시작되면 여러분은 컴퓨터에 의해 ♧, ☆, △ 타입으로 나뉘게 됩니다. 참가자들은 자신의 타입만을 알 수 있을 뿐, 다른 사람의 타입은 알지 못합니다.
이후 컴퓨터는 여러분을 무작위로 3명을 하나의 조로 편성할 것입니다. 누가 같은 조에 편성되었는지는 알 수 없습니다. 이 조는 매 회 무작위로 변화합니다. 따라서 여러분은 계속 새로운 사람들과 한 조가 되지만 상대방을 알 수는 없습니다.

– 의사결정

여러분은 ♧ 또는 ☆를 선택하게 됩니다(10회 반복).

– 결과 및 점수

같은 조의 3명이 모두 같은 선택지를 고르면 여러분은 10점을 얻습니다. 이 때, ♧ 타입인 사람은 사람들이 모두 ♧를 선택할 경우 40점의 보너스를 얻습니다. ☆ 타입인 사람은 사람들이 모두 ☆를 선택할 경우 40점의 보너스를 얻습니다.

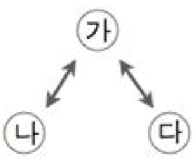
※ 따라서 ♧ 타입은 의사결정 결과가 ♧일 경우 50점을, ☆일 경우 10점을 얻게 됩니다. ☆ 타입은 의사결정 결과가 ☆일 경우 50점, ♧일 경우 10점을 얻게 됩니다.
한편 △ 타입은 ♧, ☆에 상관없이 3명이 한 선택지를 고르기만 하면 30점을 얻습니다.
그러나 한 명이라도 다른 선택지를 고르면 세 명 모두 0점을 얻게 됩니다.

[2단계]

타입: ♧, ☆, S 위치: 가, 나, 다	⇒	메시지 보내기: ♧ 또는 ☆	⇒	의사결정: ♧ 또는 ☆	⇒	3명 모두 같은 선택지 고르면 점수 얻음

– 타입, 위치, 조 배정

실험이 시작되면 여러분은 컴퓨터에 의해 ♧, ☆, 또는 △ 타입으로 나뉘게 됩니다. 컴퓨터는 여러분을 무작위로 3 명을 하나의 조로 편성합니다. 마찬가지로 누가 같은 조에 편성되었는지, 타입이 무엇인지는 알 수 없습니다. 이 조는 매 회 무작위로 변화합니다.



그리고 이 단계에서 여러분은 각각 왼쪽 그림에서 가, 나, 다 중 하나의 위치를 배정받게 됩니다. 이 위치에 따라 여러분은 상대방과 메시지를 주고받게 됩니다.

– 의사소통

여러분은 같은 조의 상대방에게 ♧ 또는 ☆라는 메시지를 보낼 수 있습니다. 메시지는 화살표 방향으로 전달되며 메시지의 내용은 받은 사람만 확인할 수 있습니다. 메시지를 받은 사람은 그 메시지를 받고 의사결정에

참고할 수 있습니다. 그러나 메시지를 ‘♧’ 라고 보내도 얼마든지 ‘☆’를 선택하는 일이 가능하다는 점을 염두에 두시기 바랍니다.

- 의사결정

여러분은 ♧ 또는 ☆를 선택하게 됩니다(40회 반복).

- 결과 및 점수

1단계에서와 같습니다. 즉, 같은 조의 3명이 모두 같은 선택지를 고르면 ♧ 타입은 결과가 ♧일 경우 50점을, ☆일 경우 10점을 얻게 됩니다. ☆ 타입은 의사결정 결과가 ☆일 경우 50점, ♧일 경우 10점을 얻게 됩니다. 한편 △ 타입은 ♧, ☆에 상관없이 3명이 한 선택지를 고르기만 하면 30점을 얻습니다.
그러나 한 명이라도 다른 선택지를 고르면 세 명 모두 0점을 얻게 됩니다.

Abstract (Korean)

사회 구성원들은 여러 가지 부문에서 끊임없이 집합적 의사결정의 문제를 만나게 되고, 이러한 의사결정 과정에서 정보는 매우 결정적인 역할을 한다. 그러나 유권자들마다 가지고 있는 기존 정보의 양이 다르며, 새로운 정보를 얻기 위해 필요로 하는 비용도 천차만별이기 때문에 많은 사람들은 직접적인 정보원으로부터 정보를 수집하고 이를 분석하는 비용을 들이는 수고를 하기보다는 주변 사람들과의 의사소통과 같은 방식으로 간접적으로 정보를 손쉽게 얻고자 한다. 그러나 지금까지 정치학에서 의사소통을 통한 정보 습득 과정에 대한 연구는 뜨거운 언론과 대중의 관심에 비하여 설문조사나 내용분석과 같은 제한적인 방식으로만 연구되어 왔다.

그리하여 본 연구에서는 행태주의 게임이론에 입각한 실험연구 방법을 활용하여 의사소통 연결망과 집합적 의사결정에 대한 연구를 진행하였다. 실험연구 방식을 택함으로써 기존의 데이터 분석만으로는 밝히기 어려웠던 정보와 의사결정간의 인과관계나 행위자의 전략적 선택, 그리고 의사소통의 방식과 방향성이 집합적 의사결정 결과에 미치는 영향 등을 직접 분석하고자 한 것이다. 구체적으로 본 연구에서 살펴보고자 하는 것은 비대칭적인 정보상황에서 게임 경기자들이 정보를 주고받는 의사소통 연결망의 구조와 방향성이 달라짐에 따라 의사소통을 하지 않을 때와는 어떻게 다른 의사결정을 내리는가의 문제이다.

본 실험에서 참가자들은 3인이 한 조로 무작위 편성되어 A 또는 B를 선택하는 성대결 게임을 실시하였다. 여기에서 서로 다른 보수 함수를 갖는 행위자의 타입과, 사전 의사소통을 할 수 있는 네트워크 구조가 처치(treatment)로 적용되었다. 그리하여 어떠한 네트워크 구조가 가장 효과적으로 행위자들의 선호를 반영하고 완전정보등가에 가까운 집합적

결정을 내리게 해줄 것인지를 알아보고자 하였다.

실험 결과는 이론적 예측과 대체로 들어맞는 결론을 보여주었다. 참가자들은 자신이 상대적으로 적은 이득을 얻더라도 집단 결정에 협조적인 태도를 보였고, 여러 사람과 정보를 교환하는 “허브(hub)” 위치에 있는 행위자의 말을 대체로 잘 따랐다. 따라서 더 많은 의사소통은 대체로 더 많은 조정 성공을 가져왔다. 그런데 의사결정의 차원을 개인적 차원과 집단적 차원으로 나누어 보았을 때, 집단적 차원에서 조정을 성공적으로 이루어내기 위해서는 정보를 다른 사람에게 효과적으로 전달할 수 있는 의사소통 구조를 확보하는 것이 중요했다. 따라서 기존의 통념과 같이 더 많은 정보를 효과적으로, 적은 비용으로 취득하는 것뿐만 아니라 자신에게 유리한 정보를 타인에게 퍼뜨릴 수 있는 능력이 보수 결과에 가장 중요한 영향을 미쳤다. 이러한 결과는 인터넷과 기술의 발달을 통해 의사소통이 훨씬 자유로워진 사회에서 반드시 고급 정보가 의사결정을 좌우하는 것은 아니라는 점을 시사하며, 보다 바람직한 사회적 차원에서의 의사결정을 위해서 왜곡되지 않은 의사소통 통로를 만드는 것의 중요성을 상기시켜 준다.

주요어: 조정, 성대결 게임, 의사소통 네트워크, 실험연구

학번: 2012-20199