Communication, Coordination and Networks: Online Appendix

Syngjoo Choi[*]
University College London

Jihong Lee[†]
Seoul National University

July 2012

Online Appendix I - Equilibrium Constructions

I.1 Complete network

Symmetric equilibria with alternative definitions of agreement Consider the following strategy profile:

- $t = 1$

  Each player $I \in \{N, E, S, W\}$ plays each message $j \in \{n, e, s, w\}$, $j \neq i$, with probability q_1 and message i with probability $1 - 3q_1$;

- $t = 2, \ldots, T$

  If there was an "agreement" in $t - 1$ (we define an "agreement" below), each I plays the corresponding message with probability 1; otherwise, I plays each message $j \neq i$ with probability q_t and message i with probability $1 - 3q_t$;

- $t = T + 1$ (underlying game)

  If there was an "agreement" in T, each I plays the corresponding action with probability 1; otherwise, I plays action i with probability $\frac{k_2}{3k_1+k_2}$ and each $j \neq i$ with probability $\frac{k_1}{3k_1+k_2}$.[1]

[*]Department of Economics, University College London, Gower Street, London WC1E 6BT, UK (Email: syngjoo.choi@ucl.ac.uk, URL: http://www.homepages.ucl.ac.uk/∼uctpsc0)

[†]Department of Economics, Seoul National University, Gwanak-gu, Seoul 151-746, Korea (Email: jihonglee@snu.ac.kr, URL: http://sites.google.com/site/jihong33)

[1]Any observed deviation during the communication stage is punished by continuation play of the pure strategy Nash equilibrium of the underlying game in which each player I plays action i for sure.

An "agreement" in period t takes one of three forms - (i) unanimity; (ii) unanimity and super-majority; or (iii) unanimity, super-majority and majority (each of these terms are defined in the main text above). We next describe a recursive process that gives the equilibrium mixing probabilities q_t under each agreement form. For $t = 1, \ldots, T+1$, let u_t denote the equilibrium continuation payoff to each player at the beginning of period t, conditional on no agreement having been reached.

(*i*) Unanimity

For each $t = 1, \ldots, T$, the following indifference condition characterizes the equilibrium:

$$u_t = q_t^3 k_2 + (1 - q_t^3) u_{t+1} = q_t^2 (1 - 3q_t) k_1 + [1 - q_t^2 (1 - 3q_t)] u_{t+1}.$$

Letting $k_1 = 1$ and $k_2 = 3$ as in the experiments, we obtain a recursive equation system

$$\begin{aligned} q_t &= \frac{1 - u_{t+1}}{6 - 4u_{t+1}} \\ u_t &= 3q_t^3 + (1 - q_t^3) u_{t+1} \\ u_{T+1} &= \frac{1}{72}. \end{aligned}$$

Let the probability of agreement/coordination at t be denoted by μ_t. We have $\mu_t = 4q_t^3(1 - 3q_t)$. The probability of coordination is then equal to

$$\mu_1 + (1 - \mu_1)\mu_2 + \cdots + \prod_{t=1}^{T} (1 - \mu_t) \mu_{T+1}. \tag{1}$$

(*ii*) Super-majority

Fix any $t \leq T$, and suppose that there was no agreement in $t - 1$. Given symmetry, without loss of generality, consider player N playing message n and any other message, say, e. For each case, we summarize all possible events and their likelihoods, together with the corresponding continuation payoffs:

- N chooses n.

outcome	likelihood	continuation payoff
unanimity (on n)	q_t^3	3
super-majority on n	$3\left(q_t^2 - q_t^3\right)$	3
super-majority not on n	$3(1 - 3q_t)q_t^2$	1
disagreement	$1 - q_t^2(6 - 11q_t)$	u_{t+1}

- N chooses e.

outcome	likelihood	continuation payoff
unanimity (on e)	$q_t^2(1-3q_t)$	1
super-majority on n	q_t^3	3
super-majority on e	$2q_t(1-3q_t)(1-q_t)+3q_t^3$	1
super-majority on w or s	$2(1-3q_t)q_t^2$	1
disagreement	$1-2q_t+5q_t^2-q_t^3$	u_{t+1}

This sets up the indifference equation and a recursive system, similarly to the unanimity case above. We can also compute the probability of agreement at $t \leq T$ to be $4\left[(1-3q_t)(3q_t^2-2q_t^3)+3q_t^4\right]$ (the corresponding probability for $T+1$ is $\frac{1}{108}$).

(iii) Majority

Fix any $t \leq T$, and suppose that there was no agreement in $t-1$. Given symmetry, consider player N playing message n or any other message, say, e. For each case, we summarize all possible events and their likelihoods, together with the corresponding continuation payoffs:

- N chooses n.

outcome	likelihood	continuation payoff
unanimity (on n)	q_t^3	3
super-majority on n	$3\left(q_t^2-q_t^3\right)$	3
super-majority not on n	$3(1-3q_t)q_t^2$	1
majority on n	$9q_t^3+6q_t^2(1-3q_t)+3q_t(1-3q_t)^2$	3
majority not on n	$6\left[q_t^3+q_t^2(1-3q_t)+q_t(1-3q_t)^2\right]$	1
disagreement	$1-9q_t+36q_t^2-49q_t^3$	u_{t+1}

- N chooses e.

outcome	likelihood	continuation payoff
unanimity (on e)	$q_t^2(1-3q_t)$	1
super-majority on n	q_t^3	3
super-majority on e	$2q_t(1-3q_t)(1-q_t)+3q_t^3$	1
super-majority on w or s	$2(1-3q_t)q_t^2$	1
majority on n	$2q_t^2(1-q_t)$	3
majority on e	$1-7q_t+22q_t^2-22q_t^3$	1
majority on w or s	$2q_t(1-3q_t+2q_t^2)$	1
disagreement	$3q_t-13q_t^2+19q_t^3$	u_{t+1}

This sets up the indifference equation and a recursive system. We can also compute the probability of agreement at $t \leq T$ to be $4q_t\left(3-18q_t+49q_t^2-51q_t^3\right)$.

In the following table, we report some key features of the symmetric equilibrium above, for different definitions of an agreement and communication lengths. Given the payoffs used the experimental design ($k_1 = 1$ and $k_2 = 3$), we simulate for each game (i) the probability of coordination in the underlying game (as in (1) above and its counterparts in equilibria with other agreement forms) and (ii) the probability with which each player announces his favorite message/action in the first period of communication. In the table below, each row gives these probabilities calculated from the three equilibria for the game with pre-communication length T.

	Unanimity		Super-majority		Majority	
T	Coord prob	Mix prob	Coord prob	Mix prob	Coord prob	Mix prob
1	0.018	0.502	0.133	0.589	0.576	0.774
2	0.027	0.505	0.228	0.627	0.663	0.942
3	0.036	0.507	0.302	0.662	0.667	0.997
4	0.045	0.509	0.359	0.694	0.667	0.999
5	0.053	0.512	0.404	0.723	0.667	1.000

A symmetric equilibrium with partial/interim agreements Suppose that $T = 2$. As in the experiments, $k_1 = 1$ and $k_2 = 3$. We establish the following symmetric mixed strategy equilibrium:

- $t = 1$

  Each player $I \in \{N, E, S, W\}$ plays each $j \in \{n, e, s, w\}$, $j \neq i$, with probability q and i with probability $1 - 3q$.

- $t = 2$

  (1) If there was super-majority or unanimity in $t = 1$, each I plays the corresponding message with probability 1.

  (2) If there was majority and message i was played in $t = 1$, each I plays message i with probability $1 - 2x$ and each of the other two previously played messages with probability x.

  (3) If there was majority and message i was not played in $t = 1$, each I plays each of the three previously played messages with probability $\frac{1}{3}$.

  (4) If there was tied-majority and message i was played in $t = 1$, each I plays message i with probability $1 - y$ and the other previously played message with probability y.

(5) If there was tied-majority and message i was not played in $t = 1$, each I plays each of the two previously played messages with equal probability;

(6) if there was complete disagreement in $t = 1$, each I plays message i with probability $1 - 3z$ and each of the other three messages with probability z.

- underlying game

  If there was super-majority or unanimity in $t = 2$, each I plays the corresponding pure-strategy Nash equilibrium; otherwise, each I plays the symmetric mixed-strategy Nash equilibrium (yielding each player a payoff of $\frac{1}{72}$).[2]

In order to establish this equilibrium, let us first go through each continuation game at $t = 2$ (numbered as above). We compute the mixing probabilities and continuation payoffs that support subgame perfectness.

(1) The specified continuation strategies are clearly optimal.

(2) Given symmetry, without loss of generality, consider player N and suppose that the messages played in the previous period are n, e and s. Let u_x refer to the player's expected continuation payoff in this case.

If he chooses message n, his expected payoff amounts to

$$u_x = 3 \times \underbrace{\frac{x^2}{3}}_{\text{unanimity on } n} + 3 \times \underbrace{\frac{2x}{3}}_{\text{super-majority on } n} + \underbrace{\frac{2x(1-2x)}{3}}_{\text{super-majority on } e \text{ or } s} + \frac{1}{72} \times \underbrace{\left(1 - \frac{4x}{3} + x^2\right)}_{\text{otherwise}}$$

If he chooses e, the expected payoff is

$$u_x = \underbrace{\frac{x\,(1-2x)}{3}}_{\text{unanimity on } e} + 3 \times \underbrace{\frac{x^2}{3}}_{\text{super-majority on } n} + \underbrace{\frac{1-x}{3}}_{\text{super-majority on } e} + \underbrace{\frac{x(1-2x)}{3}}_{\text{super-majority on } s} + \frac{1}{72} \times \underbrace{\left(\frac{2}{3} - \frac{x}{3} + x^2\right)}_{\text{otherwise}}.$$

Thus, we obtain $x = 0.141717$ and $u_x = 0.38276$.

(3) Consider player N, and suppose that the messages played in the previous period are e, s and w. Let u'_x refer to the expected continuation payoff in this case.

If he chooses e, then we have

$$u'_x = \underbrace{x^2(1-2x)}_{\text{unanimity on } e} + \underbrace{2\left[x\,(1-2x)\,(1-x) + x^3\right]}_{\text{super-majority on } e} + \underbrace{2x^2\,(1-2x)}_{\text{super-majority on } s \text{ or } w} + \frac{1}{72} \times \underbrace{\left(1 - 2x + 3x^2\right)}_{\text{otherwise}}.$$

Substituting for x calculated above, we obtain that $u'_x = 0.23397$.

[2] Any observed deviation in period 2 is punished by continuation play of the pure strategy Nash equilibrium of the underlying game in which each player plays his favorite action for sure.

(4) Consider player N, and suppose that the messages played in the previous period are n and e. Let u_y refer to the expected continuation payoff in this case.

If he chooses message n, we have

$$u_y = 3 \times \underbrace{\frac{y}{4}}_{\text{unanimity on } n} + 3 \times \underbrace{\left(\frac{y}{2} + \frac{1-y}{4}\right)}_{\text{super-majority on } n} + \underbrace{\frac{1-y}{4}}_{\text{super-majority on } e} + \frac{1}{72} \times \underbrace{\frac{2-y}{4}}_{\text{otherwise}} \tag{2}$$

If he chooses e, the expected payoff is

$$u_y = \underbrace{\frac{1-y}{4}}_{\text{unanimity on } e} + 3 \times \underbrace{\frac{y}{4}}_{\text{super-majority on } n} + \underbrace{\left(\frac{1-y}{2} + \frac{y}{4}\right)}_{\text{super-majority on } e} + \frac{1}{72} \times \underbrace{\frac{1+y}{4}}_{\text{otherwise}} \tag{3}$$

However, (2) can be rewritten as $\frac{145}{144} + \frac{359}{288}y$, which is strictly larger than 1 for any $y \in [0,1]$. Thus, we obtain that $y = 0$ and $u_y = 1.00694$.

(5) Consider player N, and suppose that the messages played in the previous period are e and w. Let u'_y refer to the expected continuation payoff in this case.

If he chooses e, then

$$u'_y = \underbrace{\frac{y\,(1-y)}{2}}_{\text{unanimity on } e} + \underbrace{\frac{1-y+y^2}{2}}_{\text{super-majority on } e} + \underbrace{\frac{y(1-y)}{2}}_{\text{super-majority on } w} + \frac{1}{72} \times \underbrace{\frac{1-y+y^2}{2}}_{\text{otherwise}}.$$

Given $y = 0$, we obtain $u'_y = 0.50694$.

(6) Consider player N. Let u'_z refer to the expected continuation payoff in this case.

If he chooses message, then

$$u_z = 3z^3 + 9(z^2 - z^3) + 3z^2(1-3z) + \frac{1}{72}\left[1 - z^2(6-11z)\right]$$

If he chooses any of the other messages, say e, then

$$u_z = z^2(1-3z) + 3z^3 + \left[2z^2(1-3z) + 2z(1-z)(1-3z) + 3z^3\right] + \frac{1}{72}\left[1 - z(2-5z+z^2)\right].$$

We therefore obtain $z = 0.13691$ and $u_z = 0.19915$.

Next, let us consider each player's incentives in $t = 1$, given the continuation payoffs computed above. First, suppose that player N plays message n. We summarize all the possible events and their likelihoods in $t = 1$ as well as the corresponding continuation payoffs in the first of two tables below. Second, suppose that player N plays any other action, say, e. The second table below summarizes all the possible events, their likelihoods and continuation payoffs.

A simulation exercise from these figures demonstrates that there exists a unique $q \in \left(0, \frac{1}{3}\right)$ that solves the indifference condition and it amounts to $q = 0.122713$. The equilibrium payoff to each player is 0.495797.

- N chooses n.

outcome in $t = 1$	likelihood	continuation payoff
unanimity (on n)	q^3	3
super-majority on n	$3(q^2 - q^3)$	3
super-majority not on n	$3q^2(1-3q)$	1
majority on n	$9q^3 + 6q^2(1-3q) + 3q(1-3q)^2$	u_x
majority on e	$2q^3 + 2q^2(1-3q) + 2q(1-3q)^2$	u_x
majority on s	$2q^3 + 2q^2(1-3q) + 2q(1-3q)^2$	u_x
majority on w	$2q^3 + 2q^2(1-3q) + 2q(1-3q)^2$	u_x
tied-majority (on n)	$3[q^3 + 2q^2(1-3q)]$	u_y
complete disagreement	$2q^3 + 3q^2(1-3q) + (1-3q)^3$	u_z

- N chooses e.

outcome in $t = 1$	likelihood	continuation payoff
unanimity (on e)	$q^2(1-3q)$	1
super-majority on n	q^3	3
super-majority on e	$3q^3 + 4q^2(1-3q) + 2q(1-3q)^2$	1
super-majority on s	$q^2(1-3q)$	1
super-majority on w	$q^2(1-3q)$	1
majority on n	$2q^2(1-q)$	u_x
majority on e and n played by no-one	$2q^3 + 3q^2(1-3q) + (1-3q)^3$	u'_x
majority on e but n played by someone	$2q(1-2q)^2 + 4q^3$	u_x
majority on s and n played by no-one	$q(1-3q)^2 + q^2(1-3q) + q^3$	u'_x
majority on s but n played by someone	$q^3 + 2q^2(1-3q)$	u_x
majority on w and n played by no-one	$q(1-3q)^2 + q^2(1-3q) + q^3$	u'_x
majority on w but n played by someone	$q^3 + 2q^2(1-3q)$	u_x
tied-majority, not including n	$2q^3 + 2q^2(1-3q) + 2q(1-3q)^2$	u_y
tied-majority, including n	$2q^3 + q^2(1-3q)$	u'_y
complete disagreement	$3q^3 + q(1-3q)(1-q)$	u_z

I.2 Incomplete networks

Star and Kite The following construction is for the Star network. It is straightforward to extend it to the Kite network. Also, suppose that $T = 3$ (the games with $T > 3$ can be similarly handled). Consider the following strategies. Beliefs are Bayesian whenever possible.

- $t = 1$

  The hub, player E, mixes among the four messages with arbitrary probabilities. Each $J \neq E$ plays message j with probability p, each $k \neq j, e$ with probability q and message e with probability r (such that $p + 2q + r = 1$).

- $t = 2$ and $t = 3$

  If in $t = 1$ the other three players all played the same message (an "agreement") then, in both $t = 2$ and $t = 3$, E announces that message; otherwise, E announces two (arbitrary) different messages in $t = 2$ and $t = 3$. Each $J \neq E$ makes arbitrary announcements in $t = 2$ and $t = 3$.

- underlying game

  - If there was an agreement in $t = 1$ and he played as above in $t = 2, 3$, E plays the corresponding action with probability 1; if there was no agreement in $t = 1$ but he deviated from above by playing the same message, i, in $t = 2, 3$, E plays every $j \neq i$ each with probability $\frac{1}{3}$; otherwise, E plays e with probability 1.
  - If E announced the same message, i, in $t = 2, 3$ and he himself played i in $t = 1$, each $J \neq E$ plays i with probability 1;

    If E announced the same message, i, in $t = 2, 3$ but he himself did not play i in $t = 1$ and $i \neq j$, each $J \neq E$ plays j with probability 1;

    If E announced the same message, i, in $t = 2, 3$ but he himself did not play i in $t = 1$ and $i = j$, each $J \neq E$ plays e with probability 1;

    Otherwise, each $J \neq E$ plays j with probability 1.

To establish that the strategies constitute an equilibrium, note first that, in equilibrium, the indifference condition of each $J \neq E$ is given by

$$k_2 q^2 = k_1 pq = k_1 r^2$$

where the first term is the expected payoff from playing own favorite message, the second is the expected payoff from playing one of two other messages except for e and the final is the expected payoff from playing message e. It is straightforward to solve for the three probabilities:

$$p = \frac{k_2}{2k_1 + \sqrt{k_1 k_2} + k_2}, \ q = \frac{k_1}{2k_1 + \sqrt{k_1 k_2} + k_2}, \ r = \frac{\sqrt{k_1 k_2}}{2k_1 + \sqrt{k_1 k_2} + k_2}.$$

Since $k_2 > k_1$, this implies that $p > r > q$. Moreover, the probability of coordination on e (which is equal to r^3) is greater than that on any other action (equal to pq^2). It is straightforward to check that deviations are not profitable for E under any off-the-equilibrium beliefs.

Line network Slight modification to the strategies constructed for the Star (Kite) network above will deliver an analogous equilibrium for the Line network. Consider the following strategies. Beliefs are Bayesian whenever possible.

- $t = 1$

  Players E and W, mix among the four messages with arbitrary probabilities. Each $J \in \{N, S\}$ plays message j with probability p, each of e and w with probability q and the remaining message with probability r (such that $p + 2q + r = 1$).

- $t = 2$

  Player E (W) plays the message played by N (S) in $t = 1$. Players N and S play arbitrarily.

- $t = 3$

  Player E (W) plays the message that he played in $t = 2$ if W (E) played the same message in $t = 2$; otherwise, he plays a different message. Players N and S play arbitrarily.

- underlying game

  - If both he and player W (E) played the same message in $t = 2$ and $t = 3$ and that message was played by N (S) in $t = 1$, player E (W) plays the corresponding action for sure;

    If both he and player W (E) played the same message in $t = 2$ and $t = 3$ but that message was not played by N (S) in $t = 1$, E (W) plays the message of N (S) in $t = 1$ for sure;

    Otherwise, he plays e (w) for sure.

– If E (W) plays the same message in $t = 2$ and $t = 3$ and that message is the message that he himself played in $t = 1$, N (S) plays the corresponding action for sure;

  If E (W) plays the same message in $t = 2$ and $t = 3$ but that message is not what he himself played in $t = 1$, N (S) plays an action that corresponds to neither his message in $t = 1$ nor the message of E (W) in $t = 2, 3$ for sure;

  Otherwise, he plays n (s) for sure.

To compute equilibrium mixing probabilities at $t = 1$, consider N. His indifference condition is:

$$k_2 r = k_1 q = k_1 p,$$

which implies that $p = q = \frac{3}{10}$ and $r = \frac{1}{10}$. Clearly, the probability of coordination on action e or w is higher than that on n or s.

Online Appendix II

Sample instructions: kite network with T = 2

This is an experiment in the economics of decision-making. A research foundation has provided funds for conducting this research. Your earnings will depend partly on your decisions and partly on the decisions of the other participants in the experiments. If you follow the instructions and make careful decisions, you may earn a considerable amount of money.

At this point, check the name of the computer you are using as it appears on the top of the monitor. At the end of the experiment, you should use your computer name to claim your earnings. At this time, you will receive £5 as a participation fee (simply for showing up on time). Details of how you will make decisions will be provided below.

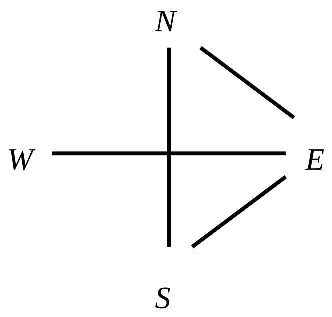
During the experiment we will speak in terms of experimental tokens instead of pounds. Your earnings will be calculated in terms of tokens and then exchanged at the end of the experiment into pounds at the following rate:

2 Tokens = 1 Pound

In this experiment, you will participate in 20 independent and identical (of the same form) rounds, each divided into two stages: a communication stage, which consists of 2 decision-turns, and an action stage, which consists of a single decision-turn. In each round you will be assigned to a position in a four-person network. In each decision-turn of a communication stage, you will be able to communicate with the other participants to whom you are connected in the network. That is, you will be able to send a message to the connected participants and receive messages from them.

Before the first round, you will be randomly assigned to one of the four network positions labeled *N*, *W*, *S*, or *E*. One fourth of the participants in the room will be designated as type-*N* participants, one fourth as type-*W* participants, one fourth as type-*S* participants and one fourth as type-*E* participants. Your type (*N*, *W*, *S*, or *E*) depends solely upon chance and will remain constant in all rounds throughout the experiment.

When you are asked to send your first message, the network and your type will be displayed at the top left hand side of the screen (see Attachment 1). It is also illustrated in the diagram below. A line segment between any two types indicates that the two types are connected and that they can communicate with each other: each can send a message to the other and receive a message from the other.



Note that in the network used in this experiment, type-*E* participants can communicate with all the other types (*N*, *W*, and *S*) and type-*W* participants can communicate only with type-*E*, while type-*N* participants can communicate with type-*E* and type-*S*, and type-*S* participants can communicate with type-*E* and type-*N*.

A decision round

Next, we will describe in detail the process that will be repeated in all 20 rounds. Each round starts by having the computer randomly form four-person groups by selecting one participant of type-*N*, one of type-*W*, one of type-*S* and one of type-*E*, per group.

The groups formed in each round depend solely upon chance and are independent of the groups formed in any of the other rounds. That is, in any group each participant of type-*N* is equally likely to be chosen for that group, and similarly with participants of type-*W*, type-*S* and type-*E*. Groups are formed by the computer.

Each round in a group consists of two stages: first, communication stage, and second, action stage. Your final earnings will depend only on what you choose and what others in your group choose in the action stage. Four actions, *n*, *w*, *s* and *e*, are available in the action stage. The communication stage that precedes the action stage involves each participant sending messages. Four messages are available in the communication stage, and they shall be labeled by the same letters, *n*, *w*, *s* and *e*, as the actions available in the action stage. A message may indicate your intended action in the subsequent action stage. However, you do not have to follow your message when it comes to making an action choice. We now describe each of these two stages in more detail.

<u>A communication stage</u>

The communication stage itself consists of two decision-turns. At the beginning of the first decision-turn, you will be asked to choose a message – *n*, *w*, *s* or *e*. You will see four boxes, each labeled with a possible message, at the bottom left hand side of the screen. When you are ready to make your decision, simply use the mouse to click on one of them. You will then see a small pop-up window asking you to confirm your decision (see Attachment 2).

Once everyone in your group has confirmed a decision, type-*E* participant in your group will receive the messages chosen by all the other types (type-*N*, type-*W*, and type-*S*) and type-*W* participant in your group will receive only the message chosen by type-*E*, while type-*N* participant in your group will receive the messages chosen by type-*E* and type-*S*, and type-*S* participants in your group will receive the messages chosen by type-*E* and type-*N*. For example, if you are type-*N* participant, you will be informed of which message each of type-*E* and type-*S* participants has chosen. This information is displayed at the middle right hand side of the screen (see Attachment 1). This completes the first of two decision-turns in the communication stage of this round.

This process will be repeated in the second decision-turn of the communication stage. Note again that when everyone in your group has made a decision in each decision-turn, your chosen message will be sent to each type participant in your group to whom you are connected. Likewise, you will receive the messages chosen by all the other type participants to whom you are connected.

<u>An action stage</u>

When the communication stage ends, each participant in your group will be asked to choose one action out of the four possible actions, *n*, *w*, *s*, or *e*, without knowing the action selected by each other. You will see four boxes, each labeled with a possible action, at the bottom left hand side of the screen (see Attachment 3). When you are ready to make your decision, simply use the mouse to click on one of them. This will end the action stage. When the action stage ends, the computer will inform everyone the choices of actions made by all the participants in your group and the earnings (see Attachment 4).

After you observe the results of the first round, the second round will start the computer randomly forming new groups of four participants. The process will be repeated until all the 20 independent and identical rounds are completed. At the end of the last round, you will be informed the experiment has ended.

<u>Earnings</u>

Your earnings in each round are determined solely by the action you choose and the actions the other participants in your group choose in the action stage. The messages you and other type participants have chosen in the preceding communication stage are irrelevant to earnings.

- If all the participants in your group choose action *n*, type-*N* participant in your group will receive 3 tokens and each of the other types (type-*W*, type-*S*, and type-*E*) in your group will receive 1 token.
- If all the participants in your group choose action *w*, type-*W* participant in your group will receive 3 tokens and each of the other types (type-*N*, type-*S*, and type-*E*) in your group will receive 1 token.
- If all the participants in your group choose action *s*, type-*S* participant in your group will receive 3 tokens and each of the other types (type-*N*, type-*W*, and type-*E*) in your group will receive 1 token.
- If all the participants in your group choose action *e*, type-*E* participant in your group will receive 3 tokens and each of the other types (type-*N*, type-*W*, and type-*S*) in your group will receive 1 token.
- Otherwise, that is, if all the participants in your group do not choose a common action, every participant in your group will receive 0 token.

For example, if type-*S* participant chooses action *s* and all the other types choose action *n*, every participant will receive 0 token. This information on earnings is displayed at the top right hand side of the screens in both the communication stage and action stage (see Attachment 1 and 3).

Your final earnings in the experiment will be the sum of your earnings over the 20 rounds. At the end of the experiment, the tokens will be converted into money. You will receive your payment as you leave the experiment.

Rules

Please do not talk with anyone during the experiment. We ask everyone to remain silent until the end of the last round.

Your participation in the experiment and any information about your earnings will be kept strictly confidential. Your payments receipt is the only place in which your name is recorded.

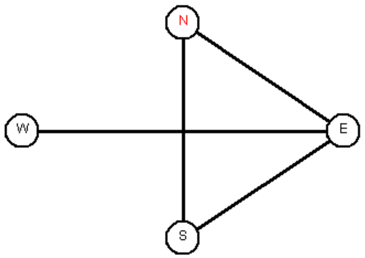
If there are no further questions, you are ready to start. An instructor will activate your program.

Attachment 1

Round

1 of 20

Stage 1 - Communication



You are a type- N participant

Payoffs in Stage 2

	N	E	S	W
All choose action n	3	1	1	1
All choose action e	1	3	1	1
All choose action s	1	1	3	1
All choose action w	1	1	1	3
Otherwise	0	0	0	0

Messages in Stage 1

Turn	N	E	S	W
1	s	s	e	?

Please send other participants connected to you a message which may indicate your intended action in Stage 2

n

w e

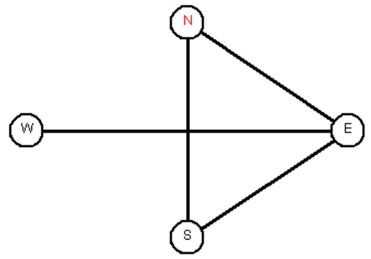
s

Attachment 2

Round

1 of 20

Stage 1 - Communication



You are a type- N participant

Payoffs in Stage 2

	N	E	S	W
All choose action n	3	1	1	1
All choose action e	1	3	1	1
All choose action s	1	1	3	1
All choose action w	1	1	1	3
Otherwise	0	0	0	0

Messages in Stage 1

Turn	N	E	S	W
1	s	s	e	?

Please send other participants connected to you a message which may indicate your intended action in Stage 2

Are you sure you wish to choose a message of n?

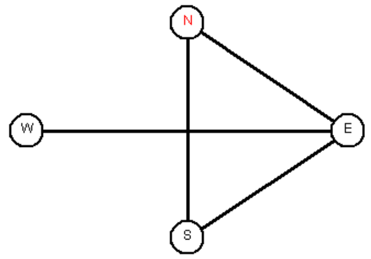
YES NO

<u>Attachment 3</u>

Round

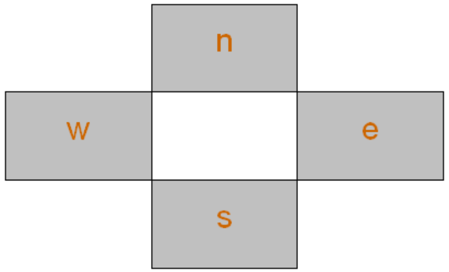
1 of 20

Stage 2 - Action



You are a type- N participant

Please choose your action



Payoffs in Stage 2

	N	E	S	W
All choose action n	3	1	1	1
All choose action e	1	3	1	1
All choose action s	1	1	3	1
All choose action w	1	1	1	3
Otherwise	0	0	0	0

Messages in Stage 1

Turn	N	E	S	W
1	s	s	e	?
2	n	e	n	?

Attachment 4

Round

1 of 20

You are a type-N participant. You chose the action n.

Action choices and payoffs of your group in this round are summarized below:

	N	E	S	W
Action	n	n	s	n
Payoff	0	0	0	0

Your total earnings so far are 0.

OK

Online Appendix III

III.1 First half vs. second half

Table 1-1A-1. Frequencies of coordination: 1st-half rounds

Session	Complete		Star		Kite		Line		No Communication
	T = 2	T = 5	T = 2	T = 5	T = 2	T = 5	T = 2	T = 5	
1	0.63	0.66	0.53	0.70	0.68	0.66	0.28	0.50	0.08
	(40)	(50)	(40)	(40)	(40)	(50)	(40)	(40)	(75)
2	0.80	0.75	0.45	0.58	0.40	0.68	0.33	0.53	0.07
	(40)	(40)	(40)	(40)	(40)	(40)	(40)	(40)	(60)
3	0.85	0.75	0.50	0.65	0.48	0.65	0.38	0.50	0.16
	(40)	(40)	(40)	(40)	(40)	(40)	(40)	(40)	(45)
All	0.76	0.72	0.49	0.64	0.52	0.66	0.33	0.51	0.09
	(120)	(130)	(120)	(120)	(120)	(130)	(120)	(120)	(180)

Table 1-1A-2. Frequencies of coordination: 2nd-half rounds

Session	Complete		Star		Kite		Line		No Communication
	T = 2	T = 5	T = 2	T = 5	T = 2	T = 5	T = 2	T = 5	
1	0.68	0.74	0.75	0.75	0.45	0.70	0.28	0.50	0.03
	(40)	(50)	(40)	(40)	(40)	(50)	(40)	(40)	(75)
2	0.70	0.88	0.63	0.55	0.28	0.68	0.30	0.68	0.05
	(40)	(40)	(40)	(40)	(40)	(40)	(40)	(40)	(60)
3	0.80	0.85	0.50	0.75	0.83	0.58	0.45	0.68	0.13
	(40)	(40)	(40)	(40)	(40)	(40)	(40)	(40)	(45)
All	0.73	0.82	0.63	0.68	0.52	0.65	0.34	0.62	0.06
	(120)	(130)	(120)	(120)	(120)	(130)	(120)	(120)	(180)

Table 2A-1. Frequencies of coordinated actions: 1st-half rounds

Network	T	Session	Action *n*	*e*	*s*	*w*	# of obs.
Complete	2	1	0.12	0.40	0.20	0.28	25
		2	0.34	0.22	0.22	0.22	32
		3	0.21	0.35	0.21	0.24	34
		All	0.23	0.32	0.21	0.24	91
	5	1	0.24	0.36	0.18	0.21	33
		2	0.20	0.23	0.27	0.30	30
		3	0.23	0.23	0.27	0.27	30
		All	0.23	0.28	0.24	0.26	93
Star	2	1	0.05	0.86	0.05	0.05	21
		2	0.17	0.67	0.11	0.06	18
		3	0.25	0.45	0.15	0.15	20
		All	0.15	0.66	0.10	0.08	59
	5	1	0.18	0.50	0.18	0.14	28
		2	0.13	0.57	0.17	0.13	23
		3	0.12	0.50	0.15	0.23	26
		All	0.14	0.52	0.17	0.17	77
Kite	2	1	0.19	0.56	0.15	0.11	27
		2	0.13	0.69	0.19	0.00	16
		3	0.26	0.42	0.16	0.16	19
		All	0.19	0.55	0.16	0.10	62
	5	1	0.18	0.27	0.21	0.33	33
		2	0.26	0.30	0.11	0.33	27
		3	0.12	0.35	0.31	0.23	26
		All	0.19	0.30	0.21	0.30	86
Line	2	1	0.36	0.18	0.18	0.27	11
		2	0.00	0.69	0.08	0.23	13
		3	0.00	0.20	0.00	0.80	15
		All	0.10	0.36	0.08	0.46	39
	5	1	0.25	0.35	0.15	0.25	20
		2	0.19	0.29	0.14	0.38	21
		3	0.20	0.35	0.10	0.35	20
		All	0.21	0.33	0.13	0.33	61
No Communication		1	1.00	0.00	0.00	0.00	6
		2	0.50	0.00	0.50	0.00	4
		3	0.86	0.14	0.00	0.00	7
		All	0.82	0.06	0.12	0.00	17

Table 2A-2. Frequencies of coordinated actions: 2nd-half rounds

Network	T	Session	Action *n*	*e*	*s*	*w*	# of obs.
Complete	2	1	0.26	0.26	0.26	0.22	27
		2	0.21	0.29	0.29	0.21	28
		3	0.22	0.22	0.22	0.34	32
		All	0.23	0.25	0.25	0.26	87
	5	1	0.24	0.19	0.30	0.27	37
		2	0.31	0.17	0.23	0.29	35
		3	0.24	0.35	0.24	0.18	34
		All	0.26	0.24	0.25	0.25	106
Star	2	1	0.13	0.70	0.07	0.10	30
		2	0.04	0.76	0.08	0.12	25
		3	0.15	0.45	0.10	0.30	20
		All	0.11	0.65	0.08	0.16	75
	5	1	0.20	0.40	0.20	0.20	30
		2	0.18	0.50	0.14	0.18	22
		3	0.10	0.73	0.03	0.13	30
		All	0.16	0.55	0.12	0.17	82
Kite	2	1	0.17	0.56	0.17	0.11	18
		2	0.00	0.91	0.00	0.09	11
		3	0.21	0.61	0.09	0.09	33
		All	0.16	0.65	0.10	0.10	62
	5	1	0.14	0.40	0.20	0.26	35
		2	0.22	0.41	0.26	0.11	27
		3	0.22	0.26	0.22	0.30	23
		All	0.19	0.36	0.22	0.22	85
Line	2	1	0.18	0.36	0.18	0.27	11
		2	0.08	0.75	0.00	0.17	12
		3	0.00	0.11	0.06	0.83	18
		All	0.07	0.37	0.07	0.49	41
	5	1	0.20	0.25	0.20	0.35	20
		2	0.22	0.22	0.30	0.26	27
		3	0.19	0.44	0.15	0.22	27
		All	0.20	0.31	0.22	0.27	74
No Communication		1	0.00	1.00	0.00	0.00	2
		2	0.00	0.00	1.00	0.00	3
		3	0.83	0.00	0.17	0.00	6
		All	0.45	0.18	0.36	0.00	11

III.2 Behavior in the Complete Network

Another noteworthy feature of Result 2 in Section 4 is the symmetry of coordinated outcomes in the Complete network. Given all four players are symmetric in this network, it is natural to adopt the symmetric equilibrium as a benchmark framework to approach our games with the Complete network. Table A3-1 presents the frequency of each message played by each subject in the first period of communication, together with the frequency of each action in the no-communication treatment.

- Table A3-1 about here -

In all reported treatments, all four players appear to randomize over the entire message set, each attaching the greatest weight on his own favorite message. As expected, the frequency of playing one's own favorite message is higher in treatments with communication than in the treatment without communication. However, there appears to be no significant difference in the reported frequencies in the Complete network under both time treatments. The frequencies of playing messages other than one's own favorite are fairly evenly distributed.

We next examine how the tendency of playing one's own favorite message/action changes along the play of the game in the Complete network. To do so, we focus on histories in which all four players chose distinct messages in the previous period (i.e. complete disagreement). Table A3-2 reports the frequency of playing one's own favorite message after complete disagreement, along with that of playing one's own favoriate message in the first period.

- Table A3-2 about here -

In the Complete network, there is a tendency that players are less likely to choose one's own favorite message in later periods. This pattern appears qualitatively consistent with the class of symmetric equilibria that we discuss in Online Appendix I.

Table A3-1. Behavior in the first period: complete network and no-communication treatments

Complete, T = 2		Message in $t = 1$			
		n	*e*	*s*	*w*
Type	*N*	0.69	0.10	0.10	0.11
	E	0.06	0.82	0.05	0.07
	S	0.11	0.11	0.67	0.12
	W	0.08	0.05	0.12	0.75

Complete, T = 5		Message in $t = 1$			
		n	*e*	*s*	*w*
Type	*N*	0.65	0.15	0.11	0.10
	E	0.10	0.78	0.05	0.07
	S	0.06	0.07	0.76	0.11
	W	0.10	0.10	0.12	0.68

No communication		Action			
		n	*e*	*s*	*w*
Type	*N*	0.50	0.19	0.18	0.13
	E	0.31	0.36	0.25	0.08
	S	0.30	0.18	0.41	0.12
	W	0.34	0.23	0.18	0.25

Table A3-2. Behavior in the first period and under disagreement in subsequent periods

			Time (t)					
		Type	1	2	3	4	5	6
No communication		All	0.38 (1440)	--	--	--	--	--
Complete	T = 2	All	0.73 (960)	0.69 (308)	0.64 (92)	--	--	--
	T = 5	All	0.72 (1040)	0.88 (324)	0.84 (264)	0.64 (152)	0.68 (60)	0.65 (20)

Note: A disagreement in the complete network means that none of four players chose a common message.

III.3 Individual-level analysis

Table 5A. Individual-level analysis: behavior of the hub

Network	T	Session	Subject ID	Type	Non-switching	Favorite
Star	2	1	1	E	0.95	0.68
			5	E	0.85	0.88
			9	E	0.85	0.53
			13	E	1.00	1.00
		2	1	E	1.00	0.25
			5	E	0.85	1.00
			9	E	0.80	1.00
			13	E	1.00	1.00
		3	1	E	1.00	0.25
			5	E	1.00	1.00
			9	E	0.90	0.44
			13	E	0.65	1.00
	5	1	1	E	0.85	0.65
			5	E	0.90	0.28
			9	E	0.80	0.56
			13	E	1.00	0.65
		2	1	E	0.85	0.88
			5	E	0.95	1.00
			9	E	0.75	0.53
			13	E	0.75	0.33
		3	1	E	0.75	0.87
			5	E	0.55	0.45
			9	E	0.45	0.45
			13	E	0.90	1.00
Kite	2	1	1	E	0.85	1.00
			5	E	0.85	0.41
			9	E	0.90	0.56
			13	E	0.80	0.94
		2	1	E	0.85	0.53
			5	E	1.00	1.00
			9	E	0.90	0.94
			13	E	0.70	1.00
		3	1	E	0.75	1.00
			5	E	0.55	1.00
			9	E	0.85	0.41
			13	E	0.80	0.88
	5	1	1	E	0.20	1.00
			5	E	0.45	0.89
			9	E	0.25	0.60
			13	E	0.45	0.11
			17	E	0.70	1.00
		2	1	E	0.55	1.00
			5	E	0.30	1.00
			9	E	0.75	0.87
			13	E	0.65	0.38
		3	1	E	0.45	0.44
			5	E	0.55	0.91
			9	E	0.35	1.00
			13	E	0.50	0.10

Table 5A continued

Line	2	1	1	E	0.90	0.94
			5	E	0.85	0.35
			9	E	0.90	0.33
			13	E	0.70	0.50
			3	W	0.65	0.23
			7	W	0.90	1.00
			11	W	0.60	0.67
			15	W	0.60	1.00
		2	1	E	0.60	1.00
			5	E	0.85	1.00
			9	E	0.75	0.53
			13	E	0.85	1.00
			3	W	0.35	0.71
			7	W	0.45	0.44
			11	W	0.60	0.83
			15	W	0.55	0.64
		3	1	E	0.75	0.07
			5	E	0.60	0.92
			9	E	0.65	0.38
			13	E	0.60	1.00
			3	W	0.70	0.86
			7	W	1.00	1.00
			11	W	0.95	1.00
			15	W	0.80	1.00
	5	1	1	E	0.25	1.00
			5	E	0.15	0.67
			9	E	0.25	0.40
			13	E	0.70	0.36
			3	W	1.00	1.00
			7	W	0.50	1.00
			11	W	0.40	0.75
			15	W	0.40	0.25
		2	1	E	0.70	0.36
			5	E	0.30	0.17
			9	E	0.25	1.00
			13	E	0.45	0.44
			3	W	0.50	0.50
			7	W	0.40	0.88
			11	W	0.50	0.60
			15	W	0.75	0.67
		3	1	E	0.65	0.69
			5	E	0.45	0.56
			9	E	0.50	0.80
			13	E	0.45	1.00
			3	W	0.55	0.55
			7	W	0.45	0.56
			11	W	0.50	0.50
			15	W	0.55	0.91

Table 6A. Individual-level analysis of behavior of the periphery

Network	T	Session	Subject ID	Type	Time (*t*) 2	3	4	5	6
Star	2	1	4	N	0.41 (17)	0.56 (9)	--	--	--
			8	N	0.13 (15)	0.69 (13)	--	--	--
			12	N	1.00 (18)	1.00 (2)	--	--	--
			16	N	0.06 (18)	0.69 (16)	--	--	--
			2	S	0.86 (14)	1.00 (5)	--	--	--
			6	S	0.10 (20)	0.78 (18)	--	--	--
			10	S	1.00 (5)	1.00 (2)	--	--	--
			14	S	0.29 (7)	0.00 (6)	--	--	--
			3	W	0.83(6)	1.00 (1)	--	--	--
			7	W	0.00 (2)	0.00 (2)	--	--	--
			11	W	1.00 (16)	1.00 (3)	--	--	--
			15	W	0.42 (19)	0.50 (14)	--	--	--
		2	4	N	0.33 (9)	0.40 (5)	--	--	--
			8	N	0.26 (19)	0.93 (14)	--	--	--
			12	N	0.10 (20)	0.12 (17)	--	--	--
			16	N	1.00 (18)	0.67 (3)	--	--	--
			2	S	0.44 (18)	0.45 (11)	--	--	--
			6	S	0.75 (4)	1.00 (1)	--	--	--
			10	S	0.38 (16)	0.73 (11)	--	--	--
			14	S	0.50 (14)	1.00 (8)	--	--	--
			3	W	0.13 (15)	0.73 (15)	--	--	--
			7	W	0.75 (12)	1.00 (1)	--	--	--
			11	W	0.29 (13)	0.64 (11)	--	--	--
			15	W	0.18 (17)	1.00 (12)	--	--	--
		3	4	N	0.17 (12)	0.00 (12)	--	--	--
			8	N	0.29 (17)	0.11 (1)	--	--	--
			12	N	0.20 (15)	0.50 (10)	--	--	--
			16	N	0.94 (18)	1.00 (1)	--	--	--
			2	S	0.78 (9)	1.00 (2)	--	--	--
			6	S	0.40 (15)	0.64 (11)	--	--	--
			10	S	0.22 (18)	1.00 (13)	--	--	--
			14	S	0.17 (18)	0.92 (13)	--	--	--
			3	W	1.00 (18)	1.00 (2)	--	--	--
			7	W	0.11 (19)	0.94 (16)	--	--	--
			11	W	0.32 (19)	0.67 (12)	--	--	--
			15	W	0.12 (17)	0.15 (13)	--	--	--

Table 6A continued

Star	5	1	4	N	0.08 (13)	0.00 (13)	0.07 (14)	0.00 (14)	1.00 (14)
			8	N	0.00 (14)	0.07 (15)	0.07 (15)	0.27 (15)	1.00 (11)
			12	N	0.00 (18)	0.00 (18)	0.00 (17)	0.00 (17)	0.88 (17)
			16	N	0.47 (17)	0.44 (9)	0.33 (6)	0.25 (4)	0.33 (3)
			2	S	0.40 (15)	0.18 (11)	0.44 (9)	1.00 (5)	-- (0)
			6	S	0.00 (18)	0.00 (18)	0.00 (17)	1.00 (17)	1.00 (1)
			10	S	0.41 (17)	0.45 (11)	0.43 (7)	0.33 (6)	0.25 (4)
			14	S	0.21 (14)	0.45 (11)	0.29 (7)	0.17 (6)	0.29 (7)
			3	W	1.00 (8)	1.00 (1)	1.00 (1)	0.00 (1)	0.00 (1)
			7	W	0.17 (12)	0.09 (11)	0.20 (10)	0.00 (7)	0.25 (8)
			11	W	0.60 (15)	0.38 (8)	0.00 (5)	0.50 (4)	0.00 (4)
			15	W	0.21 (19)	0.00 (14)	0.15 (13)	0.18 (11)	0.89 (9)
		2	4	N	0.00 (19)	0.00 (18)	0.00 (19)	0.82 (17)	1.00 (3)
			8	N	0.19 (16)	0.08 (13)	0.17 (12)	0.25 (12)	0.38 (8)
			12	N	0.00 (18)	0.00 (18)	0.22 (18)	0.86 (14)	0.50 (2)
			16	N	0.50 (17)	0.50 (9)	0.20 (6)	0.60 (4)	1.00 (3)
			2	S	0.56 (9)	0.60 (5)	0.33 (3)	1.00 (5)	-- (0)
			6	S	0.19 (16)	0.23 (13)	0.25 (8)	0.14 (7)	0.86 (7)
			10	S	0.05 (20)	0.16 (19)	0.44 (16)	0.89 (9)	0.50 (2)
			14	S	0.30 (20)	0.00 (15)	0.00 (15)	0.47 (15)	0.25 (8)
			3	W	0.50 (20)	0.25 (12)	0.33 (12)	0.10 (10)	1.00 (8)
			7	W	0.53 (17)	0.22 (9)	0.33 (9)	0.13 (8)	0.38 (8)
			11	W	1.00 (17)	1.00 (1)	-- (0)	1.00 (1)	-- (0)
			15	W	0.25 (20)	0.06 (16)	0.13 (15)	0.00 (13)	0.00 (14)
		3	4	N	0.13 (16)	0.06 (17)	0.13 (16)	0.07 (14)	0.93 (14)
			8	N	0.00 (20)	0.00 (20)	0.00 (20)	0.00 (19)	0.84 (19)
			12	N	0.13 (15)	0.00 (15)	0.07 (15)	0.73 (15)	0.80 (5)
			16	N	0.12 (17)	0.06 (18)	0.06 (17)	0.00 (17)	0.47 (15)
			2	S	0.35 (17)	0.27 (15)	0.64 (11)	0.80 (5)	1.00 (1)
			6	S	0.50 (10)	0.56 (9)	0.80 (5)	0.50 (2)	1.00 (5)
			10	S	0.07 (14)	0.07 (14)	0.08 (12)	0.82 (11)	0.75 (4)
			14	S	0.00 (18)	0.00 (18)	0.00 (17)	0.72 (18)	1.00 (6)
			3	W	0.44 (16)	0.23 (13)	0.18 (11)	0.55 (11)	0.80 (5)
			7	W	0.00 (18)	0.05 (20)	0.00 (18)	0.06 (18)	0.63 (16)
			11	W	0.11 (18)	0.18 (17)	0.21 (14)	0.36 (11)	0.44 (9)
			15	W	0.43 (14)	0.30 (10)	0.15 (13)	0.29 (14)	1.00 (11)

Table 6A continued

Kite	2	1	3	W	0.15 (13)	0.38 (13)	--	--	--
			7	W	0.35 (20)	0.64 (14)	--	--	--
			11	W	0.18 (17)	0.46 (13)	--	--	--
			15	W	0.00 (17)	1.00 (15)	--	--	--
		2	3	W	0.12 (17)	0.07 (15)	--	--	--
			7	W	0.06 (18)	0.82 (17)	--	--	--
			11	W	0.13 (16)	0.15 (13)	--	--	--
			15	W	0.40 (5)	0.67 (3)	--	--	--
		3	3	W	0.00 (18)	0.80 (15)	--	--	--
			7	W	0.22 (9)	0.64 (11)	--	--	--
			11	W	0.33 (6)	0.43 (7)	--	--	--
			15	W	0.24 (17)	0.92 (13)	--	--	--
	5	1	3	W	0.00 (13)	0.07 (15)	0.43 (14)	1.00 (9)	0.50 (2)
			7	W	0.31 (16)	0.15 (13)	0.00 (11)	0.44 (9)	0.50 (6)
			11	W	0.12 (17)	0.11 (18)	0.00 (19)	0.43 (14)	1.00 (8)
			15	W	0.00 (16)	0.11 (19)	0.13 (15)	0.73 (11)	1.00 (4)
			19	W	0.17 (18)	0.07 (15)	0.00 (13)	0.60 (10)	0.75 (4)
		2	3	W	0.22 (18)	0.13 (16)	0.07 (14)	0.23 (13)	0.93 (14)
			7	W	0.17 (18)	0.00 (14)	0.14 (14)	0.00 (13)	0.77 (13)
			11	W	0.36 (14)	0.00 (8)	0.56 (9)	0.57 (7)	0.57 (7)
			15	W	0.00 (20)	0.06 (18)	0.06 (17)	0.06 (17)	0.40 (15)
		3	3	W	0.29 (14)	0.18 (11)	0.00 (7)	0.17 (6)	0.67 (6)
			7	W	0.00 (17)	0.07 (14)	0.07 (14)	0.00 (10)	0.89 (9)
			11	W	0.00 (16)	0.18 (17)	0.14 (14)	1.00 (12)	1.00 (2)
			15	W	0.15 (13)	0.29 (14)	0.31 (16)	0.36 (14)	0.36 (14)

Table 6A continued

			4	N	0.07 (14)	0.17 (12)	--	--	--
			8	N	0.50 (16)	0.30 (10)	--	--	--
			12	N	0.94 (17)	1.00 (6)	--	--	--
			16	N	0.06 (17)	0.27 (11)	--	--	--
			2	S	0.47 (17)	1.00 (9)	--	--	--
			6	S	0.13 (15)	0.00 (12)	--	--	--
			10	S	0.60 (15)	0.71 (7)	--	--	--
			14	S	0.40 (15)	0.63 (8)	--	--	--
			4	N	0.33 (18)	0.67 (12)	--	--	--
			8	N	0.18 (17)	0.55 (11)	--	--	--
			12	N	0.27 (11)	0.57 (7)	--	--	--
	2		16	N	0.06 (16)	1.00 (9)	--	--	--
			2	S	0.00 (18)	0.67 (15)	--	--	--
			6	S	0.11 (19)	0.40 (15)	--	--	--
			10	S	0.69 (13)	0.50 (4)	--	--	--
			14	S	0.09 (11)	0.25 (8)	--	--	--
			4	N	0.18 (17)	0.67 (12)	--	--	--
			8	N	0.05 (20)	0.94 (16)	--	--	--
			12	N	0.00 (7)	1.00 (6)	--	--	--
			16	N	0.47 (19)	0.42 (12)	--	--	--
			2	S	0.47 (15)	1.00 (7)	--	--	--
			6	S	0.00 (16)	0.22 (9)	--	--	--
			10	S	0.00 (13)	0.63 (8)	--	--	--
Line			14	S	0.21 (14)	0.08 (12)	--	--	--
			4	N	0.11 (18)	0.00 (16)	0.35 (17)	0.83 (12)	0.80 (5)
			8	N	0.12 (17)	0.00 (13)	0.36 (11)	1.00 (8)	1.00 (3)
			12	N	0.17 (18)	0.00 (16)	0.07 (14)	0.42 (12)	0.43 (7)
		1	16	N	0.39 (18)	0.08 (13)	0.21 (14)	0.10 (10)	0.45 (11)
			2	S	0.00 (18)	0.00 (15)	0.07 (14)	0.18 (11)	0.89 (9)
			6	S	0.12 (17)	0.43 (14)	0.00 (9)	0.20 (10)	0.33 (9)
			10	S	0.41 (17)	0.36 (14)	0.40 (10)	0.80 (5)	1.00 (3)
			14	S	0.11 (18)	0.19 (16)	0.38 (13)	0.22 (9)	0.33 (6)
			4	N	0.35 (17)	0.27 (15)	0.25 (12)	0.38 (8)	0.20 (5)
			8	N	0.41 (17)	0.42 (12)	0.60 (10)	0.60 (5)	0.33 (3)
			12	N	0.57 (14)	0.56 (9)	0.25 (8)	0.67 (6)	0.75 (4)
	5	2	16	N	0.11 (18)	0.19 (16)	0.79 (14)	1.00 (6)	1.00 (2)
			2	S	0.15 (13)	0.40 (10)	0.00 (6)	0.00 (5)	0.25 (8)
			6	S	0.58 (19)	0.60 (10)	0.29 (7)	0.86 (7)	0.80 (5)
			10	S	0.32 (19)	0.36 (14)	0.63 (8)	1.00 (4)	0.00 (1)
			14	S	0.12 (17)	0.27 (15)	0.67 (12)	0.57 (7)	0.75 (4)
			4	N	0.41 (17)	0.44 (9)	0.25 (8)	0.43 (7)	0.71 (7)
			8	N	0.20 (20)	0.24 (17)	0.18 (17)	0.45 (11)	0.75 (8)
			12	N	0.00 (17)	0.29 (17)	0.42 (12)	1.00 (8)	1.00 (2)
		3	16	N	0.26 (19)	0.20 (15)	0.17 (12)	0.40 (10)	0.86 (7)
			2	S	0.06 (18)	0.00 (18)	0.06 (17)	0.06 (17)	0.94 (16)
			6	S	0.26 (19)	0.33 (15)	0.44 (9)	0.57 (7)	0.75 (4)
			10	S	0.00 (19)	0.22 (18)	0.92 (12)	1.00 (5)	1.00 (2)
			14	S	0.18 (17)	0.13 (15)	0.33 (15)	0.55 (11)	0.71 (7)