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Social Network Hierarchy and Rational Group Decision Making: An Experimental Study of the Conjunction Fallacy

Sean Richey[*] and Sarah Brosnan[†]

Abstract

We test the influence of social hierarchy in political discussion with an experiment. We examine whether hierarchy is detrimental to group decision-making by using Tversky and Kahneman's (1983) logic question which tests the conjunction fallacy. We seek to determine whether the beneficial impact of group decision-making holds in hierarchical groups. To do so, we randomly assigned 176 participants to zero-history groups of five discussants. Two thirds of these groups had one member randomly assigned to be the group's leader, while the remaining groups had no leader. We find that groups with leaders conform to their leader's beliefs. If the leader was able to answer correctly the conjunction fallacy question, then group members are also more likely to resolve the conjunction fallacy. In groups where the leader was incorrect, group members are more likely to incorrectly answer. Thus, group decision making is benefited by hierarchy when the leader is correct, but harmed when the group leader is incorrect.

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What role does social hierarchy play in group decision-making? Many scholars see great potential for group discussion to benefit decision-making (e.g., Druckman 2004, Lupia and McCubbins 2000, Mutz 2002). There is a significant body of literature that details the positive impact of social networking in many areas, the overall finding being that advice from opinion leaders helps the average person make better choices (Bennet, Flickinger, and Rhine 2000; Berelson, Lazarfeld, and McPhee 1954; Conover, Searing, and Crewe 2002; Gastil and Dillard 1999; Huckfeldt, Sprague, and Levine 2000; Katz and Lazarfeld 1955; Lazarfeld, Berelson, and Gaudet 1944; Levine 2005; Neuman 1986; Price, Cappella, and Nir 2002). In particular, public deliberation is potentially helpful to most citizens, because they often know little about politics (see Ackerman and Fiskin 2004, Barabas 2004, Bartels 1996, 2005, Delli Carpini and Keeter 1996), and low-information rationality in decision making is common (Popkin 1991). Many researchers posit that group discussion can realistically achieve the deliberative ideal if opinion leaders share their knowledge with people who are uninformed–who can in turn spread that knowledge to others, thereby giving rise to "multiplier effects" (Huckfeldt 2001).

This formulation has the potential to explain much about why democracy works and how it can be improved. However, discussion is often bound by intuitionalized group hierarchies that are not tested in current research. Our research manipulates social hierarchy in discussion groups to provide data to

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test theories of human social interaction in a way that was not previously possible. Random assignment in controlled experimental conditions will ensure that there is no selection bias, which plagues much research on social interaction.

How beneficial is deliberation in groups that do not have group equality? In particular, groups that have subservience to social superiors may have deleterious effects on the goal of bringing about better decisions through group discussion. Obedience to hierarchical superiors will limit one's ability to engage in open, frank discussions that stimulate better decision-making processes. Considering the impact of group hierarchy, we must scrutinize whether group discussion can help people make wise decisions because we do not know to what the extent group discussion is beneficial in groups with a pervasive social hierarchy. Discussion in groups with social hierarchies may lead to blind acceptance of the beliefs of a superior–or, at the very least, an unwillingness to engage in debate with him or her.

We know that everyday social interactions greatly influence behavior (Klofstad 2007; McClurg 2006; Mutz and Mondak 2006), and it is often beneficial for decision-making. For example, Eveland and Hively (2009) show that discussion frequency, network size, and some types of network heterogeneity increase political knowledge. And Gastil and Dillard (1999) show that open discussion with disagreeing others increases public opinion quality. But prior research does not test subservience to hierarchical elites as a source of similarity in networks. The role of hierarchy is particularly worrisome since the goals of one's social superiors may very well differ from one's

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own. For example, Ryan (2010) finds that discussion with opinion leaders does educate, but the impact of partisanship in the network is a greater influence than knowledge. Simply put, we do not know whether the opinion leader is biasing the information being given, or that the person assuming the leadership role is the most knowledgeable about the issue at hand.

Our aim is to test the hypothesis that group discussion can help people make wise decisions in groups with clear social hierarchies. We test the influence of discussion with social superiors with an experiment in groups with differences in social hierarchies. Specifically, we posit that deferring to hierarchical superiors limits the ability to have the open frank discussions that are at the core of group decision-making. We test this in groups with randomly-selected leaders. We use Tversky and Kahneman's (1983) logic question which stimulates the conjunction fallacy, to test whether hierarchy is detrimental to group decision-making. Previous research shows that group decision-making helps solve the conjunction fallacy, as participants are able to answer logic questions more rationally when placed in a group that discusses it than they do when answering alone. We seek to test whether this beneficial impact of group decision-making holds in hierarchical groups. To do so, we randomly assigned 176 participants to zero-history groups of five discussants. Two-thirds of these groups had one member randomly assigned to be the group's leader, while the remaining groups were in a control condition with no leader. We find that groups with leaders conform to their leader's beliefs. If the leader was able to answer correctly the conjunction fallacy question, group members are more likely to follow that belief and

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resolves the conjunction fallacy. In groups where the leader was incorrect, group members are also more likely to follow that incorrect belief. Thus, group decision making is benefited by hierarchy when the leader is correct, but harmed when the group leader is incorrect.

The Beneficial Impact of Group Decision-making

It is often suggested that exposure to multiple sources of information increases the quantity of one's knowledge, and improves the quality of one's decision-making (Lazarsfeld, Berelson, and Gaudet 1944). For example, Page (2007) shows that combining bits of information garnered in individual conversations–some of which may overlap from one conversation to another–may yield a result which is greater than the sum of its parts. Grofman, Owen, and Feld (1983) show with formal modeling that, although group-think is a potential problem, more often than not, group decision-making leads to superior outcomes because one person's mistakes are corrected by the group. For example, researchers infer the influence of social networks by finding that similarity of vote choice between more and less knowledgeable discussants is greater than one would predict based on other known determinants of vote choice. The higher homogeneity shows the impact of the network. The great contribution of this body of literature is that it lays aside the traditional sociological perspective that posited the absence of persuasive discussion as being due to cognitive dissonance and conformity pressures (e.g., Festinger 1957). Nir (2005), for example, shows that most types of network heterogene-

ity will not harm the willingness to participate and actually stimulates more considered opinions about politics. People do influence each other's political beliefs and actions through discussion, and this has been shown in many countries (Ikeda and Huckfeldt 2001; Huckfeldt, Ikeda, and Pappi 2005).

Druckman (2004) makes an important contribution by showing that mistakes are common when individuals make decisions solely. For example, given simple problems, most people can be easily manipulated in predictable ways, such as risk aversion (Kahneman and Tversky 1979). Druckman (2004) shows that the irrational framing effects found by Tversky and Kahneman (1981)—which critics of deliberative democracy often point to—are not present when people are allowed to discuss their choices freely. He finds that discussion promotes rational choices. Additionally, Lupia and McCubbins (2000) show through experiments the power of discussion in helping people correctly predict coin toss results that they have never seen, implying that people can make the correct choice through discussion. If people discuss their options, they are far less likely to fall into common intellectual traps. In particular, if people with different stores of information communicate with one another, these irrational biases all but disappear. It is important, then, not to base research on atomistic views of political animals. By incorporating social networking into research on rationality, we can more realistically model decision-making, which is often done with input from others (Mendelberg 2005).

Power in Group Decision-making

However, the positive impact of group discussion may be valid only in the absence of power differentials among discussants. While it is generally agreed that evenly distributed discussion and deliberation improve decision making, there is currently an important theoretical debate on power differentials in deliberation. Many critiques of deliberative democracy (sometimes called discourse theory) argue that power will almost always be unevenly distributed in discussion (such as critiques of Habermas in Foucault 2002). This is a crucial potential flaw in this theory that has been explicated by both Feminist and Post-structuralist critiques of deliberative democracy (see Cohen and Arato 1992). Even though discourse theorists try to eliminate some of the raw power differentials by having structured norms of equality and mutual respect, the underlying problem of power differences between discussants in these formal settings remains (see Ackerman and Fishkin (2004) for more on some specific procedures).

To given an example, when men and women debate, it is possible that men will gain acquiescence from women by "winning" the debate, which may seem to be a fair way to resolve conflict (Frazer 1992). If, however, the men win the debate and gain the outcome they desire due to social customs that promote male hierarchical dominance, then this is not a fair process and decision-making by group discussion merely tricks women into submission (Frazer 1992). Critically, these power inequities may create sub-optimal group decisions. Yet, there have been no formal, empirical testing of

these critiques with clearly articulated hypotheses in controlled experimental conditions. Furthermore, these critiques may not go far enough as they do not take seriously the cultural differences that may lead to differential influences of hierarchy across different cultures.

We know that groups commonly have leaders, and, thus, this aspect of groups should be incorporated into research on group decision-making. Blind obedience to a social superior may lead to similarity of opinion, but it does not necessarily demonstrate that a meaningful group discussion has taken place, or that the influence of the social superior has served to educate the lower-status discussant, a crucial component of the theory (see Cooke 2000). Simply put, we do not know the influence of this omitted variable. Due to the unmeasured influence of hierarchy on deliberations, the positive influence of social networks on decision-making may be less common than previous literature suggests. Reformers who promote political deliberation and discussion should consider the impact of social hierarchy.

While past research provides evidence of the benefits of group decision-making, much of it does not examine other common social forces in group discussion, such as the relative power of the discussants. Thus, additional experiments are needed to test other influences in group decision-making, such as social hierarchy. Including this variable of social hierarchy will greatly inform our understanding of social decision-making.

The Conjunction Fallacy

To test whether or not groups can make a correct decision, we will use a commonly-used logic question from cognitive psychology, on the conjunction fallacy. It is derived from Tversky and Kahneman (1983). In their experiment, subjects were asked to read the following and rank which choice is more probable:

> Linda is 31 years old, single, outspoken, and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and also participated in anti-nuclear demonstrations. Which is more probable?
>
> A. Linda is a bank teller.
>
> B. Linda is a bank teller and is active in the feminist movement.

The original Tversky and Kahneman (1983) experiment (subsequently replicated across many samples) shows that over 80% of subjects incorrectly chose sequence B, since Linda resembles an active feminist more than she resembles a bank teller. However, sequence A is superior to B, because sequence A is included in B. B (Linda is a bank teller and is active in the feminist movement) is just A (Linda is a bank teller) with an additional condition (is active in the feminist movement). Thus, this question tests the conjunction fallacy that is formally defined as, for all A and B, P(B&A) <=

P(A). Since the probability that A and B are simultaneously true is always less than or equal to the probability that A is true, sequence B cannot be more likely than sequence A. The common explanation for this fallacy is that the participant is influenced by the representativeness heuristic. The details given about Linda's college days makes Linda resemble the representative heuristics of feminists more than bank teller, so subjects are primed to reach an irrational conclusion.

This logic question was chosen to test group decision-making for three important reasons. First, there is an objectively correct answer. Other possible topics such as public policy debates will not allow us to examine the role of the group leader in providing incorrect information, as it would be difficult to find an a priori correct answer for these policy decisions, unless they are artificial replications of these cognitive fallacies, such as alternative questions from Tversky and Kahneman. Additionally, the conjunction fallacy plagues decision-making in a variety of important real-world situations. Gaining data on its spread in public-discussion is valuable. Finally, previous research on group decision-making has used Tversky and Kahneman questions allowing us to compare our results to these previous studies (e.g., Druckman 2004).

Experimental Procedures

To investigate the role of hierarchy in group decision-making, we conducted an experiment on a convenience sample of 176 undergraduates at a large public research university in the southeastern United States. Participants

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were given \$10 to participate. Participants first answered a questionnaire that contained demographic information, and a conjunction fallacy question from Tversky and Kahneman (1983) that was described above (Linda is a bank teller...), after which they handed in their questionnaire. Importantly, the pre-experiment questionnaire allows us to know whether the participant is influenced by their group, because we know how they answered the logic question before discussion. We will also know whether the individual answer differs from the group answer. Following this, participants were randomly assigned to small discussion groups of five participants.

To test the influence of hierarchy in discussion networks, the groups were divided into three experimental conditions. In the condition 1, a randomly selected member was chosen to be the group leader from amongst the set who had answered the question correctly the first time. The leader was appointed by the experimenter telling the group that this person was their leader. The leaders were told to explain their logic for answering the question to the group. In condition 2, the leader was chosen from amongst the set that had answered the question incorrectly the first time. The leader was appointed in the same way and again was told to explain their logic to their group. In the control condition (3), each group had no assigned leader (no leader condition) and answered the question after twenty minutes of discussion.

Correct Leader Condition: The experimenter will select a member of the discussion group to be the group leader. The group was instructed that this person is the group's leader. The group leader was randomly chosen from the subset that correctly answered the logic question in a pre-test questionnaire.

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Incorrect Leader Condition: The experimenter will select a member of the discussion group to be the group leader. The group is informed as in condition one. The group leader was randomly chosen from the subset that incorrectly answered the logic question in a pre-test questionnaire

Control Condition: A control condition in which no leader assigned and the group is expressly told not to choose a leader.

They were then told to discuss the same logic question with members of their group, and answer it again after 20 minutes of discussion. They were told that if they answer it correctly the second time, they will receive $10. They were also informed that they could answer differently from their first answer or from their group, if they believed that the group was wrong. This incentive structure accurately matches decision-making, where following one's social group may or may not lead to optimal outcomes for each individual member. The group leaders were told to explain their logic to the group orally. For the condition without a leader (Condition 3), discussion proceeded with no leader. After twenty minutes of discussion, the participants were given the final questionnaire and instructed to write the answer that they believe the group thinks-termed "group answer", and then also write a separate second answer of their opinion as to the correct answer after group discussion-termed "second individual answer". The participants also answered an open-ended question on why they chose their answer. This allowed us to track the influence of hierarchy, by tracking the spread of correct and incorrect influence on decision-making.

Hypotheses

Our aim is to investigate the role of group discussion on decision-making. We hypothesize that group discussion will impact decision-making. Specifically we predict that a leader with good information (correct leader condition) will increase the frequency of correct responses as compared to the control condition. The incorrect leader condition will decrease the frequency of correct responses as compared to the control condition. This will show that hierarchy has an influence on group decision-making.

Data and Methods

The sample was selected from a mandatory introductory course in American politics, and thus matched the demographics of the university closely. It was 70% female, with an average age of 19. Racially, it was 13% Asian, 52% black, 23% white, and 9% other race. It contained students from 32 majors. This diverse sample provides an excellent understanding of decision making among diverse groups of people, as are present in real world situations. We randomly assigned each participant to discussion groups of five people. These participants were selected to come from different classes, and each was asked if they knew any other members. All participants reported having no familiarity with their group members, so these are so-called zero-history groups, which are commonly used in research on group decision-making (for example, see Gastil, Black, and Moscovitz 2008).

Variable codings

The dependent variable is coded 1 if they answer the logic question correctly, and zero if not. Again, the question was:

> Linda is 31 years old, single, outspoken, and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and also participated in anti-nuclear demonstrations. Which is more probable?
>
> A. Linda is a bank teller.
>
> B. Linda is a bank teller and is active in the feminist movement.

The distribution of answers is 25% answered it correctly, and 75% incorrectly. Additionally, we use the answers from the pre-test questionnaire, which was answered before group discussion, to determine how discussion changes the participant's answer. This variable of *Change* is coded 1 if the participants answered the question correctly after group decision, but had answered it incorrectly previously, it is coded zero, if there was no change between the answers, and -1 if the participant had answered it correctly in the pre-test and then changed to an incorrect answer. The distribution of this change is in Figure 1.

[Figure 1 around here.]

The key independent variables were indicator variables for each condition. We also measured how long the group deliberated for, as some groups

did not discuss it for the full 20 minutes. We expect that longer deliberation will increase correct answers. We use the first answer as a control for how the participant's cognitive abilities react to the conjunction fallacy. We also control for being male, Asian, Black and Other Race, income (in $5000 brackets), and age. We measure education by being a psychology major, because some of these students may have had exposure to the conjunction fallacy in psychology courses. The summary statistics for these data are listed in Table 1.

[Table 1 around here.]

Methods

For the dichotomous dependent variable, we use a probit regression model. The data on discussants are clustered by each participant's group. Probit egression models require observations to be independent, but here the nested data structure violates this assumption. To account for this nesting, we use robust standard errors in the vote similarity models below (see Woodbridge 2002, 482).

Results

We hypothesized that the leaders would have influence over their group, affecting decision making. In particular, we predicted that participants in groups whose leaders had good information should show better performance

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than the control group, and that those in groups with leaders with bad information should show the worst performance of all three groups. These predictions were supported by these data (see Figure 1). In the control group (with no leader), the percent who answered correctly after discussion increased by 34% percentage points. This shows that group decision-making in the absence of a leader is superior to individual decision-making. Nonetheless, individuals in the correct leader condition increased their percentage correctly answered after discussion by 52%, which is a significantly greater increase than the control condition, as we had hypothesized (p = .000). Finally, information alone is not sufficient to solve the problem; individuals in the incorrect leader condition did answer more correctly after the discussion, but the increase was only 18%, far less than the control condition (p = .001). It is interesting that discussion is beneficial in all treatments, however clearly it is much less beneficial when a leader is using incorrect logic.

[Figure 2 around here.]

In Table 2, the results of a probit regression model for determinants of a correct answer are shown. We see again that being in the correct leader condition leads to greater likelihood of answering correctly, while having an incorrect leader lowered this likelihood when compared to the control group. Additionally, we see that in model 2, the even when controlling for the participant's first answer—which has a strong significant impact—the treatment effects hold. We also find that the longer the groups deliberated also had a positive impact on decision-making, as expected. The other variables do not

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have significant effects.

[Table 2 around here.]

Conclusion

The results show that social hierarchy is an important factor in group discussion. Richerson and Boyd (2004) show that interpersonal communication is crucial to understand human accomplishment, but we find that communication is moderated by group hierarchy. As hierarchy is common in many groups, it is troubling for democratic theory that hierarchical discussion creates sub-optimal performance, because informed autonomous choice free from coercion is foundational for democracy (Habermas 1984). When discussion is not based on getting knowledge but deference to leaders, the effect of hierarchy will only be positive if the leader is correct.

This research suggests that we should escape the easy generalizations commonly made about the public's ability to use deliberation to make better decisions. Improving democratic practices is crucial for advanced industrial nations (Putnam 2007). Gaining knowledge about the impact of power relations in social interaction may allow insights that facilitate better policies on deliberative forums. If the impact of unequal power in discussion networks within deliberative public forums is known, this knowledge can result in effective public discussion. By determining the impact of cultural values toward power in society, it will tell us how to provide an environment that is conducive to successfully using deliberation. For example, policy-makers

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and activists can sponsor deliberative opportunities with more emphasis on actively ensuring that equal power in the discussion is given to all participants.

These results also suggest that in cultures where hierarchical influence is profound, the influence of hierarchy will decrease the amount of educative discussion. The clear, strong results found in this study confirm the limits of Huckfeldt's (2001) theory of social network diffusion of political expertise. Political discussion is not necessarily free from coercion in all cultures. This is one way in which citizens can lose their ability to use political discussion to improve their understanding of politics. These results suggest that just as with formal deliberation, people need equality to meaningfully engage in informal discussion as a way of exchanging political information.

Future research into the role of social networks in opinion formation should carefully examine the role of hierarchy. It is possible that hierarchical influences limit comprehension from political discussion in other cultures as well, perhaps even in the United States. For example, India has long history of social hierarchy, and an interesting extension of this research would be to analyze if this impact also happens in countries with these more salient social hierarchies. An additional concern with hierarchical societies is that many will self-silence their opinions and choose not to initiate discussions about politics.

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Table 1: Summary statistics

Variable	Mean	Std. Dev.	Min	Max	N
Change	0.347	0.555	-1	1	
Correct second answer	0.597	0.492	0	1	176
Correct leader	0.347	0.477	0	1	176
Incorrect leader	0.369	0.484	0	1	176
Discussion time	10.426	5.263	2	20	176
Correct first answer	0.25	0.434	0	1	176
Asian	0.131	0.338	0	1	176
Black	0.523	0.501	0	1	176
Other	0.085	0.28	0	1	176
Age	19.052	1.783	18	30	173
Male	0.307	0.462	0	1	176
Income	1.28	1.037	0	9	175
Psychology major	0.08	0.271	0	1	176

Table 2: Determinants of Answering Correctly

Variable	Republican	(S. E.)	Democratic	(S. E.)
Correct leader	0.500+	(0.271)	0.545*	(0.279)
Incorrect leader	−0.443+	(0.267)	−0.517+	(0.278)
Discussion time	0.044*	(0.021)	0.039+	(0.022)
Correct first answer			1.056***	(0.272)
Asian	−0.301	(0.339)	−0.171	(0.350)
Black	0.138	(0.243)	0.269	(0.256)
Other	−0.050	(0.396)	0.012	(0.404)
Age	−0.062	(0.061)	−0.085	(0.068)
Male	−0.077	(0.223)	−0.084	(0.232)
Income	0.049	(0.105)	0.030	(0.114)
Psychology major	−0.082	(0.365)	0.196	(0.374)
Intercept	0.930	(1.157)	2.169	(1.325)
Number of cases	172		172	
-2 Log likelihood	18.94		35.63	

Note: Cells represent unstandardized coefficients and standard errors of probit regression models for determinants of the respondent answering correctly after group discussion. Standard errors are clustered on discussion group. +p<.10 *p<.05 **p<.01
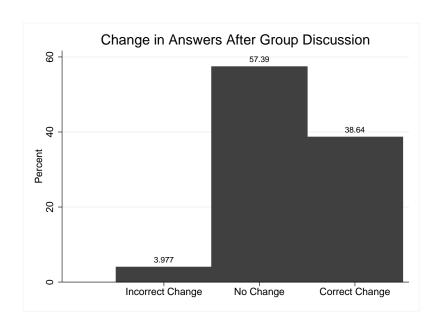
Figure 1: This graph shows average change in answering the conjunction fallacy question after group discussion.
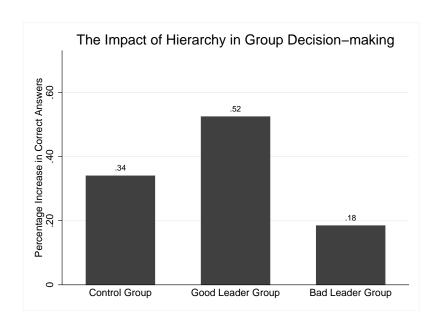
Figure 2: This graph shows average improvement in answering the conjunction fallacy question after group discussion across the three experimental conditions. The difference between the experimental conditions and the control group is statistically significant at the .05 level for both conditions.