CHEAP, EASY, OR CONNECTED: THE CONDITIONS FOR CREATING GROUP COORDINATION

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ABSTRACT

In both legal and political settings there has been a push toward adopting institutions that encourage consensus. The key feature of these institutions is that they bring interested parties together to communicate with each other. Existing research about the success or failure of particular institutions is ambiguous. Therefore, we turn our attention to understanding the general conditions when consensus is achievable, and we test experimentally three crucial factors that affect a group's ability to achieve consensus: (1) the difficulty of the problem, (2) the costs of communication, and (3) the structure of communication. Using multiple experimental approaches, we find that difficult problems impede consensus, costs make consensus less likely (even relatively very small costs), and the structure of communication has significant effects and interacts with both problem difficulty and costs. In particular, the structure of communication can reduce the negative effect of costs and facilitate consensus. Together these results imply that consensus is only likely to

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occur if problems are easy, costs to communicate are low, or the communication structure helps overcome the other two problems. These findings can provide insight about the institutional designs that can be utilized to promote consensual outcomes.

I. INTRODUCTION

There has been a tremendous push in modern democracy to establish procedures that lead to more consensual lawmaking. One prominent example of this movement in modern democracy is negotiated rulemaking (or "regneg"), which is defined as "a consensus-based process in which a proposed rule is initially developed by a committee composed of representatives of all those interests that will be affected by the rule, including those interests represented by the rulemaking agency."[1] The Administrative Conference of the United States highlighted negotiated rulemaking as a method of lawmaking that could allow affected parties to have input in the legislative process.[2] The negotiated rulemaking procedure has been praised in many respects:

> This technique permits affected interests to retain greater control over the content of agency rules, while ensuring fairness and balance. It also permits agencies to obtain a more accurate perception of the costs and benefits of policy alternatives than can be obtained from digesting voluminous records of testimonial and documentary evidence presented in adversarial hearings.[3]

This quote implies the following about negotiated rulemaking:

(1) The agency itself has a built-in set of "fire-alarms" that prevent shirking;[4]

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1. CTR. FOR PUB. POLICY DISPUTE RESOLUTION, UNIV. OF TEX. SCH. OF LAW, TEXAS NEGOTIATED RULEMAKING DESKBOOK 11 (Pub. Res. Series No. 1, 1996), *available at* http://www.utexas.edu/law/centers/cppdr/resources/publications/Texas%20Negotiated%20Rulemaking%20Deskbook%20web.pdf.

2. *See* 5 U.S.C. § 561 (2006) ("The purpose of this subchapter is to establish a framework for the conduct of negotiated rulemaking . . . to encourage agencies to use the process when it enhances the informal rulemaking process.").

3. Henry H. Perritt, Jr., *Negotiated Rulemaking and Administrative Law*, 38 ADMIN. L. REV. 471, 471–72 (1986).

4. *See* Mathew D. McCubbins & Thomas Schwartz, *Congressional Oversight Overlooked: Police Patrols and Fire Alarms*, 28 AM. J. POL. SCI. 165, 166 (1984) (defining "fire-alarm oversight" as "establish[ing] a system of rules, procedures, and informal practices that enable individual citizens and organized interest groups to examine administrative decisions (sometimes in prospect), to charge executive agencies with violating congressional goals, and to seek remedies from agencies, courts, and Congress itself").

(2) Those affected by the policy are better off since legislation accounts for multiple points of view;

(3) Negotiated rulemaking strips away unnecessary information without removing that which is useful or relevant; and

(4) Agencies operating under these conditions can be put on autopilot to the point at which congressional intervention is all but unnecessary.[5]

At the core of these arguments is the notion of achieving consensus from communication. Those involved in negotiated rulemaking, as the name implies, must negotiate over the proper course of action to take.[6] The instinct underpinning negotiated rulemaking is that allowing the relevant parties to communicate will lead to both agreement among the actors and better decisions.[7] Some have argued that negotiated rulemaking is successful at achieving this outcome,[8] while others have argued that negotiated rulemaking is slow and thus infeasible as a lawmaking procedure.[9] Cary Coglianese, for example, argues that negotiated rulemaking does not reduce either the amount of time spent crafting legislation or the amount of litigation following a law's imposition.[10] Coglianese states, "Although this quest for consensus has held out the promise of a faster and less conflictual regulatory process, experience has

5. Mathew D. McCubbins, Roger C. Noll & Barry R. Weingast, *Administrative Procedures as Instruments of Political Control*, 3 J.L. ECON. & ORG. 243, 269-271 (1987) (using the FCC's broad regulation of the cable industry to demonstrate "how the administrative process keeps an agency in compliance with the preferences of political officials despite a vague mandate").

6. *See* Thomas C. Beierle, *Discussing the Rules: Electronic Rulemaking and Democratic Deliberation* 9 (Res. for the Future, Discussion Paper No. 03-22, 2003), *available at* http://www.rff.org/rff/ Documents/RFF-DP-03-2.pdf (demonstrating how administrative agencies have attempted to use electronic rulemaking to encourage greater public participation and to shift "participants from individual opinion to group choices and plans of action").

7. USDA, AGRIC. MKTG. SERV., WHAT IS NEGOTIATED RULEMAKING? 3, *available at* http://www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELPRDC5089434 (last visited Apr. 21, 2013).

8. *See* Philip J. Harter, *Assessing the Assessors: The Actual Performance of Negotiated Rulemaking*, 9 N.Y.U. ENVTL. L.J. 32, 33 (2000) ("[P]articipants in negotiated rulemaking have found a range of positive values in the process and that, when implemented in appropriate situations, it has been remarkably successful in fulfilling its promise.").

9. *See, e.g.*, Cary Coglianese, *Assessing Consensus: The Promise and Performance of Negotiated Rulemaking*, 46 DUKE L.J. 1255, 1335 (1997) ("[N]egotiated rulemaking has not lived up to its promising potential to save regulatory time or prevent litigation."); Jerry L. Mashaw, *Small Things Like Reasons Are Put in a Jar: Reason and Legitimacy in the Administrative State*, 70 FORDHAM L. REV. 17, 23 (2001) ("The insinuation of stake holder negotiation into administrative procedures is often viewed as a corruption of the administrative process. Agency use of advisory committees or 'regulatory negotiation' is surrounded by a host of constraints to ensure that the agency remains firmly in control of the ultimate regulatory product. Moreover, none of these devices reduces the agency's obligation to explain its decision in instrumentally rational terms.") (footnotes omitted).

10. Coglianese, *supra* note 9, at 1335.

so far shown otherwise."[11] Negotiated rulemaking establishes a process for communication among interested parties, but it remains unclear whether, or under what conditions, communication can lead to consensual outcomes. Therefore, in this Article we focus on the following question: Under what conditions can communication lead to consensus?

To shed light on communication and consensus, we present the results of two different experiments that focus on the conditions under which groups of people can solve consensus problems. Although there are a huge number of factors we could examine, we have chosen to focus on three factors particularly important to legal and political settings: (1) the costs of participations or communication; (2) the difficulty of the problem the group must solve; and (3) the structure of communication among decisionmakers (that is, who talks to whom, and how communication gets passed throughout the group). Our results suggest that consensus is most likely when groups face relatively easy problems or when they can communicate cheaply. However, our results also indicate that the structure of communication (who talks to whom) can encourage consensus even when problems are difficult or communication is costly. We turn now to a brief discussion of the three factors we study experimentally and then to a description of the experimental design and results.

II. DIFFICULT PROBLEMS, COSTLY COMMUNICATION, AND COMMUNICATION STRUCTURE

In settings in which consensus is a desirable outcome, three factors can affect whether a group will achieve the outcome: (1) the difficulty of the task facing the group,[12] (2) the cost of communicating or taking an action,[13] and (3) the structure of communication (who talks to whom).[14] In this section we briefly discuss each factor and explain why it might affect the likelihood of successful consensus.

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11. *Id.*

12. This has been considered in our prior research. *See* Cheryl Boudreau et al., *Making Talk Cheap (and Problems Easy): How Legal and Political Institutions Can Facilitate Consensus*, 7 J. EMPIRICAL LEGAL STUD. 868, 869 (2010) "[W]hen problems are difficult, and communication is most needed, it will be least likely to occur."). This Article draws heavily from the concepts discussed there. *See id.*

13. *See id.* ("[W]hen communication is costless, group members can achieve a consensus about the correct solution to a problem. However, when there is even a small cost (relative to the potential benefit) associated with sending information and/or listening, groups are much less likely to reach a consensus.").

14. *See id.* ("[L]egal and political institutions can facilitate consensus by making communication cheap and problems easy.").

In both of our experimental approaches (described in more detail later) communication is sparse—basically a simple dichotomous choice that all subjects in the experiment make.[15] All subjects are connected to at least one other subject, and they all have the same goal. The connections between subjects allow their stated preference to be conveyed to either everyone else in the group or some subset of all the subjects. The costs associated with the conveyance of these choices can be varied within the experiment.[16] Thus, the settings we focus on are a parsimonious framework for understanding how idealized communication can affect the ability of a group to achieve consensus. In neither experiment do we consider situations in which players lack an incentive to achieve consensus, although we know this may exist in legal and political settings. Rather, we focus on the conditions that affect consensus when there is an incentive for all individuals to agree.[17] Our results demonstrate that simply having an incentive to agree is insufficient to guarantee a consensus outcome.

A. PROBLEM DIFFICULTY

The difficulty of the problem that confronts a group will affect its ability to solve a consensus problem.[18] Two common ways problems can become more difficult are by reducing the number of solutions (the classic needle-in-the-haystack problem),[19] or by making the problem one in which

15. There are many decisions made in legal situations in which the choice space is binary. *See, e.g.*, Mashaw, *supra* note 9, at 30 (discussing the Social Security Administration dealing with hard-edge rules for disability benefits—that is, you are disabled or you are not).

16. The costs of communication can be borne by both "speakers" and "listeners" in this experiment. It may be similarly difficult for speakers in certain situations to push information through networks.

17. Political actors often do not have an incentive to reach agreement. For instance, the use of dilatory tactics exemplifies such instances. In the U.S. Congress, there are many examples of both times that political actors have an incentive to agree and have an incentive to disagree. The incentive for agreement within parties is highlighted in the works of Gary Cox and Mathew McCubbins, in which they develop and test a theory about how members of the majority party often manage to reach agreement among themselves about public policy. *See generally* GARY W. COX & MATHEW D. MCCUBBINS, LEGISLATIVE LEVIATHAN: PARTY GOVERNMENT IN THE HOUSE (2d ed., Cambridge Univ. Press 2007) (1993); GARY W. COX & MATHEW D. MCCUBBINS, SETTING THE AGENDA: RESPONSIBLE PARTY GOVERNMENT IN THE U.S. HOUSE OF REPRESENTATIVES (2005). At the same time, there are often times when there are incentives for disagreement between the two political parties in the U.S. Congress. The use of the filibuster in the U.S. Senate represents perhaps the most obvious manifestation of incentives not to reach agreement. For a review of the history and uses of the filibuster, see generally GREGORY KOGER, FILIBUSTERING: A POLITICAL HISTORY OF OBSTRUCTION IN THE HOUSE AND SENATE (2010).

18. Boudreau et al., *supra* note 12, at 868 ("We also find that difficult problems significantly reduce group members' willingness to communicate with one another and, therefore, hinder their ability to reach a consensus.").

19. *See* Daniel P. Enemark et al., Does More Connectivity Help Groups to Solve Social

fewer people in the population either know the correct answer or have a strategy for finding it (that is, can a person tell the difference between the needle and more hay).[20] Both types of problem difficulty occur in legal and political situations. For example, there a great many ways and places to store radioactive waste, and a regulatory body has to identify the best solutions; however, there may be very few individuals who are competent to adjudicate if a proposed solution is actually a good one. If it is difficult to identify the correct answer, it will be harder to achieve consensus than for a task in which the answers are relatively easy and widely understood.[21] In addition to directly manipulating the difficulty of a problem, one way to indirectly affect the difficulty of finding the correct solution is to change the decision rule by which groups decide an answer to a problem.[22] In political and legal settings, the decision rules often require either unanimity or majority for a decision to be reached.[23] In our experiments we directly manipulate both the difficulty of the underlying problem (how many people know the answer) and the decision rule to understand how these factors affect group consensus.

B. COSTS TO COMMUNICATE OR TAKE AN ACTION

Costs to communicate can significantly impede both communication and the likelihood a group achieves consensus on the right answer.[24]

Problems? 5 (unpublished manuscript) (Proceedings of the ACM Conference on Elec. Commerce, June 2011), *available at* http://polisci2.ucsd.edu/denemark/papers/enemark_ec_2011.pdf (demonstrating that reductions in the number of solutions can severely impede a group's ability to resolve a coordination problem).

20. *See generally* SCOTT E. PAGE, THE DIFFERENCE: HOW THE POWER OF DIVERSITY CREATES BETTER GROUPS, FIRMS, SCHOOLS, AND SOCIETIES (2007) (acknowledging that problem difficulty can affect solutions and arguing that diversity in groups is useful, because the diversity of individuals makes it more likely that either someone will know the correct answer or have a strategy to find the correct answer).

21. We assume here that the solutions to the problems do not have differential payoffs to the actors. Actors share a common preference in identifying and agreeing on a solution, regardless of which one it is. If actors also disagree about which solutions should be adopted (or have a different ranking of their benefits and costs), then the consensus problem will be made more difficult because of conflict between individuals.

22. *See generally* Matthew J. Gabel & Charles R. Shipan, *A Social Choice Approach to Expert Consensus Panels*, 23 J. HEALTH ECON. 543 (2004). Prior works have shown experimentally that in decentralized coordination game, the addition of conflict between individuals makes coordination significantly more difficult. *See generally* Mathew D. McCubbins, Ramamohan Paturi & Nicholas Weller, *Connected Coordination: Network Structure and Group Coordination*, 37 AM. POL. RES. 899.

23. *See, e.g.*, CAL. CONST. art. 1, § 16 (requiring unanimous jury verdicts in criminal trials, but only three-fourths majority jury verdicts in civil trials).

24. *See generally* Boudreau et al., *supra* note 12 (presenting experiments that take into account the costs of communicating and its effects on consensus).

Essentially, as it becomes more costly to acquire information, fewer people will choose to listen, which thereby induces fewer people to speak.[25] The result of this process is that costs substantially eliminate communication. An action's costliness can affect coordination or consensus. For example, it may be costly to change one's mind about the right answer to a question (that is, if a defendant is guilty or how to dispose of radioactive waste), or it could be that achieving consensus requires us to all take the same action (that is, multiple agencies must agree on how to implement a policy and implementation is costly). In either situation, the cost can impede coordination or consensus because if achieving consensus requires that some actors pay a cost, each actor would prefer that the others pay the cost. In this environment a successful outcome may be less likely because the guaranteed cost of taking an action exceeds the expected benefit of coordination. In essence, a coordination / consensus problem with costly actions contains elements of both coordination and cooperation and represents a common political and legal scenario.[26]

C. STRUCTURE OF COMMUNICATION

In a group of decentralized actors there are many different ways to model the structure of communication—that is, who talks to whom. Prior work in this vein has demonstrated that costs to communicate can impede coordination;[27] having a group leader can improve coordination[28] and the presence of focal points can encourage coordination.[29] We model the communication environment using a network.[30] In the network model a

25. *Id.* at 871 ("[E]ven small costs to communicate reduce the likelihood that groups reach a consensus by making group members less willing to send information and listen to one another about the correct solutions to various problems.").

26. *See id.* at 868–69 (describing various legal scenarios in which even minor communication costs can prevent a consensus from being reached).

27. *See id.* at 878–85.

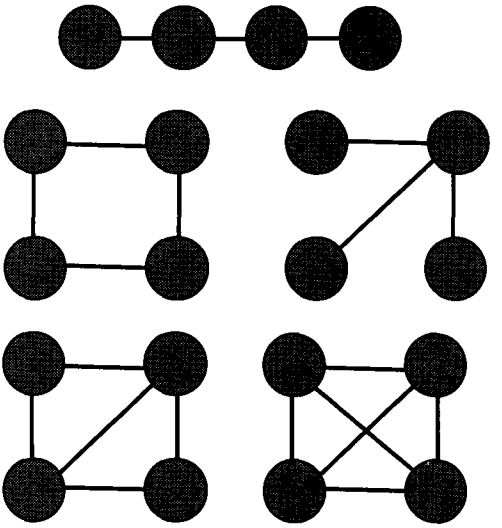
28. Rick K. Wilson & Carl M. Rhodes, *Leadership and Credibility in* N-*Person Coordination Games*, 41 J. CONFLICT RESOL. 767, 789 (1997) ("[L]eadership is important for resolving coordination problems. Leaders can serve as a focal point, helping followers choose one equilibrium from among several.").

29. *See generally* THOMAS C. SCHELLING, THE STRATEGY OF CONFLICT (1960) (concluding that "focal points" could be used to solve coordination games by allowing players to use obvious elements to come to one equilibrium).

30. We are not the first to use a network to model communication structure. *See generally* Antoni Calvó-Armengol, *Bargaining Power in Communication Networks*, 41 MATHEMATICAL SOC. SCI. 69 (2001) (studying how placing players in a network communication affects their bargaining power); Syngjoo Choi et al., *Network Architecture, Salience, and Coordination*, 73 GAMES AND ECON. BEHAV. 76 (2011) (utilizing asymmetric networks to study their effects on strategic delay and strategic commitment).

node is an individual / actor and a link represents communication or information between them. Using a network approach we can model an arbitrary pattern of information among nodes in a network. An example of some of the different communication structures that can exist among four actors is shown in figure 1. In our experiments, a link is undirected and implies symmetric information (both nodes see each other) along that link, but in theory, links could be directed (that is, information would be asymmetric) so that only one node could observe the other node, which would increase the number of possible communication structures. [31] It is clear that even with only a small number of nodes and bilateral undirected links there are many possible communication structures.

FIGURE 1. Possible Information Structures with Four Actors



III. TESTING THE EFFECTS OF PROBLEM DIFFICULTY AND COSTS TO COMMUNICATE ON CONSENSUS

All of our experiments on consensus in this Article involve several features: multiple decisionmakers; a state of the world that individuals need

31. The number of possible structures explodes if either of two things happen: (1) links are directed / asymmetric between nodes; or (2) positions in the network are not equivalent—that is in a line is the structure simply the connections or also which actors occupy a node. We opt for a simpler approach in this Article.

to determine; the opportunity to communicate information about one's beliefs about the state of the world; the opportunity to receive information about others' beliefs; and a great incentive for individuals and groups to reach a consensus. Despite sharing these similarities, our experiments differ in the communication structure that connects individuals, the task facing subjects, and the structure of incentives.

In the first experimental design, subjects are tasked with deciding the correct answer to math problems drawn from an SAT II, level-two math test.[32] We provide two possible answers for each question, one is correct and the other is incorrect. Subjects have sixty seconds to answer each math problem. They earn one dollar if their final answer is correct, they lose one dollar if their final answer is incorrect, and they neither earn nor lose money if they do not answer the problem. If the group achieves consensus, each individual makes an additional ten dollars. Consensus requires a correct answer by either a majority or unanimity (depending on the condition) of the subjects. This payment structure creates a common interest among all subjects to reach a consensus about the correct answer. The use of math problems allows us to focus on the core element of this experiment—the difficulty of the problem—and its relationship with successful consensus.

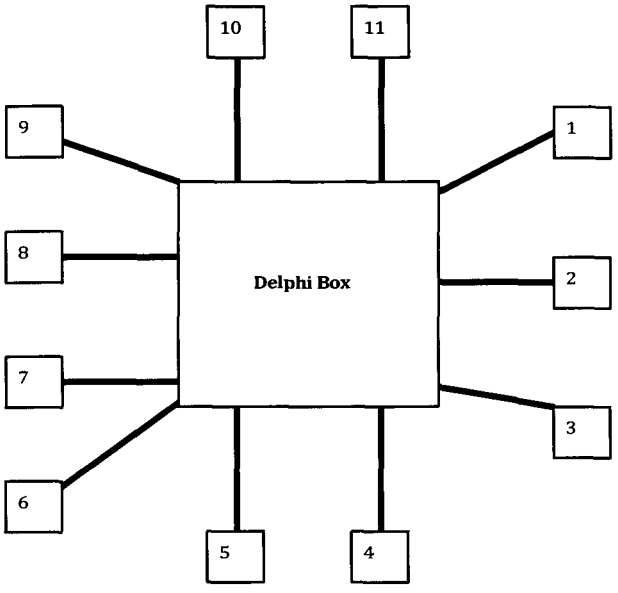
Subjects have the opportunity to exchange information during the experiment. In the experiment, we break the information process into two steps: sending information and receiving information. After subjects see the math question and the two possible answers, they have an opportunity to choose if they want to send a recommended answer about the problem to the other subjects. They also choose simultaneously if they would like to receive any recommended answers to the math problem. After subjects make these two decisions, the experimenters aggregate the number of subjects, if any, who suggest answer A or B, and then distribute this information to the subjects that chose to receive information. Subjects who chose to receive information will receive a signal that tells them the number of subjects who recommended each answer. This communication set up is analogous to the Delphi method and is represented by figure 2 below.[33] The figure demonstrates that we can model this structure of

32. Math problems are ideal because we can easily observe whether or not subjects converge to the correct consensus. In addition, subjects are unlikely to have ideological attachments to the answer that might make them unwilling to learn from others. For a longer discussion of why math problems are useful in such experiments, see generally Cheryl Boudreau, *Closing the Gap: When Do Cues Eliminate Differences Between Sophisticated and Unsophisticated Citizens?*, 71 J. POL. 964 (2009).

33. The Delphi method is one way to implement the model Morris DeGroot proposed for how a group could achieve consensus. *See* Morris H. DeGroot, *Reaching a Consensus*, 69 J. AM. STAT. ASS'N

connections between individuals as a network in which each node can connect to the central node ("Delphi box") at a cost. The core function of this Delphi box is to assure subject anonymity and to provide information about the other subjects' choices.[34]

FIGURE 2. Delphi Mechanism



We do not provide any information in our standard experiment about the characteristics of those who suggested answers because we do not want to affect what people know about the group or individuals, as that is not the

118, 120 (1974) (discussing a model that assumes "that there is no possibility of learning whether the opinion of one individual is closer to the truth than that of another."). The Delphi method has been used in government and business applications as a way to facilitate consensus among decisionmakers. The Delphi method has been implemented in a number of different ways, but generally, the technique involves experts answering survey questions, a central person aggregating the experts' answers and distributing the aggregated responses to the experts, and then experts again answering all or a subset of the survey questions. *See* Gene Rowe & George Wright, *The Delphi Technique as a Forecasting Tool: Issues and Analysis*, 15 INT'L J. FORECASTING 353, 353–55 (1999) (describing and reviewing the Delphi method). This process may then be repeated for some number of iterations, depending on the actual Delphi method utilized. *See id.*

34. For more about the Delphi method see generally Rowe & Wright, *supra* note 33 (reviewing and critiquing empirical studies of the effectiveness of the Delphi technique); HAROLD SACKMAN, RAND, DELPHI ASSESSMENT: EXPERT OPINION, FORECASTING, AND GROUP PROCESS (1974), *available at* http://www.rand.org/content/dam/rand/pubs/reports/2006/R1283.pdf (detailing the origination of and providing a critical analysis of the Delphi technique).

focus of the experiment. The significant bonus for consensus creates conditions of trust among subjects—it encourages only those who know the correct answer to provide information, and they should only suggest the correct answer because there is no benefit from deceiving subjects in this experiment.[35] After subjects receive the signal about recommended answers they must decide how to answer the math question. In the experiment, subjects do not receive any feedback after each problem about whether they answered a question correctly or if the group achieved the bonus. We design the experiment in this fashion to reduce the opportunity for subjects to learn about the others in the group. We also utilize dividers between subjects and all actions taking during the experiment are done anonymously to reduce learning within the experiment. We make each question as close as possible to a one-shot trial, as in the model. All of the protocols are read aloud to subjects to ensure common knowledge and subjects are quizzed on the various instructions throughout the experiment.

A. EFFECTS OF PROBLEM DIFFICULTY AND COSTS TO COMMUNICATE ON CONSENSUS

Costs to communicate significantly reduce the likelihood of groups achieving consensus.[36] This effect occurs for two reasons. First, if speaking is costly, fewer subjects will choose to do so because they may not believe their choice to speak will lead the group to achieve coordination; therefore they would pay the cost without receiving a benefit. Second, if listening is costly, subjects are less likely to listen. This implies that it is less useful for subjects to suggest an answer because no one is listening so the speech has no value. These results suggest that consensus may not be easy to achieve if communication is costly.

In the tables below, we examine the proportion of times that groups of eight subjects were able to achieve consensus on the correct answer to a math problem, based on the difficulty level of the problem. These results combine a variety of different costs for communication, but in all of these

35. *See* ARTHUR LUPIA & MATHEW D. MCCUBBINS, THE DEMOCRATIC DILEMMA: CAN CITIZENS LEARN WHAT THEY NEED TO KNOW? 184 (1998) ("Specifically, we find that a person's willingness to follow a speaker's advice depends strongly and regularly on that person's perceptions of the speaker's knowledge and trustworthiness.") (emphasis omitted); Vincent P. Crawford & Joel Sobel, *Strategic Information Transmission*, 50 ECONOMETRICA 1431, 1432 (1982) (arguing that a condition of mutual welfare between subjects creates an "optimal compromise" in which a sender of information will only do so in a way to encourage the receiver to respond favorably).

36. *See generally* Boudreau et al., *supra* note 12 (considering the difficulty in achieving consensus when there are costs to communicating).

trials it was possible for subjects to communicate with one another. We measured difficulty in a separate set of experiments in which we gave the math problems to randomly selected undergraduate students and paid them to solve the problems, for which they earned one dollar for a right answer. Table 1 combines the various communication conditions: free, cost to speak, cost to listen, and cost to speak and listen. It is clear that there is a considerable effect of the difficulty of a problem on the likelihood a group reaches consensus on the correct solution. For the easiest problems, groups almost always reach consensus, but the proportion steadily declines as the problem difficulty increases, until consensus almost never occurs. Therefore, even if there is a significant advantage to achieving consensus and communication is possible, groups may fail to do so if problems are difficult.

TABLE 1. Effect of Problem Difficulty on Consensus

Problem difficulty (percent of students answering correctly in pretest)	Hardest (6–15%)	Hard (16–36%)	Easier (37–56%)	Easiest (57–90%)
Successful consensus	2/104 (1.9%)	4/42 (9.5%)	25/68 (36.7%)	43/74 (58.1%)

We also expect that majority rule will lead to an increase in the probability that a group achieves consensus, compared to unanimity, because only five subjects must answer correctly instead of all eight. We test these predictions in tables 2 and 3, in which we examine how changing from unanimity to majority affects both communication and the ability to achieve consensus. The results in table 2 demonstrate that majority rule does not lead more subjects to send or receive information in the experiment. However, as shown in table 3, we find that majority rule is associated with a positive, significant increase in the probability that a group achieves consensus. These two results suggest that this greater success in achieving consensus is because fewer people must agree under majority rule and not because individuals are more likely to communicate. The results in table 3 indicate that both cost to receive and cost to send and receive are associated with a lower probability of achieving consensus, as we demonstrated in prior work.[37] The cost parameter is insignificant, suggesting that increasing cost does not decrease the probability of

37. *Id.*

consensus; the implication of this is that even a small cost has the same impact on achieving consensus as a large cost.[38] In addition, the results in both table 2 and table 3 show that easier problems are associated with both more communication and a higher probability of achieving consensus. Together, these results demonstrate that changing the decision rule may lead to greater consensus, but it does not engender greater communication in the process.

TABLE 2. Majority Rule Does Not Increase Communication

...	*DV: Sending information*	*DV: Receiving information*
Majority rule for consensus	0.87 (0.96)	0.32 (1.33)
Individual SAT math score	0.012 (0.003)**	0.002 (0.002)
GPA	-0.41 (0.47)	0.007 (0.35)
Group average SAT math score	-0.01 (0.02)	-0.005 (0.03)
Cost to send/receive information	-0.41 (0.41)	-0.95 (0.53)
Ease of problem	0.02 (0.008)**	-0.01 (0.006)
Constant	-3.00 (15.4)	1.94 (20.1)
N	372	372

Note: *= significant at 0.05 level; ** = significant at 0.01 level
Analysis includes only trials conducted in the cost to send and receive condition with eight subjects. Costs to send and receive information were ten cents, twenty-five cents, one dollar, and two dollars. Estimation done via a multilevel model with separate intercept for each experimental group.

38. *Id.* at 878.

TABLE 3. Majority Rule and Easier Problems Facilitate Consensus

...	*DV: Consensus*
Cost for taking an action, either speaking or receiving	-0.31 (0.63)
Pay to send condition, receive for free	-0.48 (0.77)
Pay to receive condition, send for free	-3.15 (0.94)**
Pay to send and receive condition	-2.98 (0.91)**
Group's average SAT math score	0.042 (0.01)**
Group's average GPA	-0.07 (1.91)
Ease of problem	0.10 (0.02)**
Majority rule	3.77 (1.44)**
Constant	-29.69 (10.8)*
N	258
Number of groups	25
Random Effect Parameter	
Group effect	0.84 (0.56)
LR test versus standard logistic regression (chi2)	0.97

IV. COMMUNICATION STRUCTURE AND COSTLY COORDINATION

In a separate set of experiments, we have studied how the structure of communication, modeled as a network, affects group consensus. These experiments model the network explicitly by treating individuals as nodes. A link between two nodes allows those nodes, or individuals, to communicate during the experiment. The task facing subjects in these experiments is deceptively simple—they must choose a color for their node that either makes them the same or different than all of their neighbors (depending on the experiment). If every node in the network successfully solves their local problem, then the entire group earns a payoff. If nodes are not connected, those nodes cannot observe each other, and thus do not have any information about the network other than the number of nodes.

Subjects were recruited from large public and private universities via email and flyers throughout campus. Interested subjects were then emailed

to sign up for an experimental session.[39] On the day of the experiment, we chose sixteen of the people who showed up to participate. The sixteen subjects were escorted to a computer lab where they sat at computer terminal with partitions between them to ensure they could not observe each other's behavior. We read instructions aloud to all the subjects to describe the game and ensure they understood the game's rules. We also quizzed the subjects any time we changed the experimental treatment of the game to ensure they understood the changes. Subjects were always given two colors to choose from during a trial, but the colors varied for each trial and for each subject. This was done to make the development of a focal color difficult. Subjects had three minutes to successfully solve the coordination task. Once the session began, subjects could make choices at any time. Choices were immediately visible to those with whom they share an edge. This makes the game dynamic and asynchronous, not a stage or single-shot game. If the trial was solved successfully each subject earned one dollar; however, if choosing a color was costly, the costs were subtracted from the earnings for that session. If trial was unsuccessful and the actions were costly, subjects simply lost money for each move.

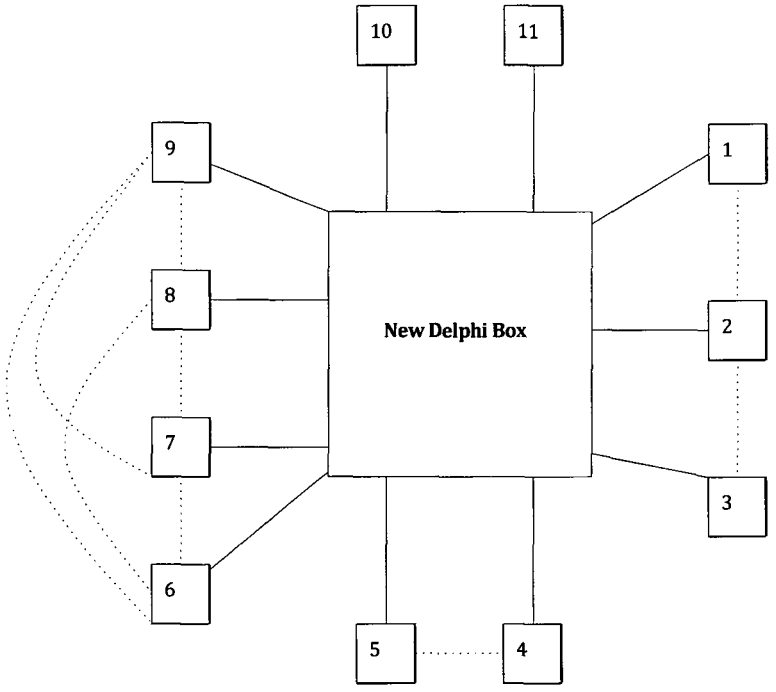
This experimental framework begins with a basic consensus game in which all actors try to take the same action. We then modify this by adding a cost that is imposed each time an actor chooses a color (similar to communicating about a proposed correct solution to a problem). The addition of costs creates an element of potential conflict between the individuals in the game, which is common in legal and political situations. Imposing costs changes the consensus game as illustrated in the following two scenarios. First, consider the situation in which no one has taken an action. If taking an action is costly, players will only pay the cost to take an initial action if they believe that the group can solve the coordination problem (which requires all players to pay at least an initial cost to take an action). If players believe the group cannot reach a solution, then they will not pay the cost to make an initial choice. If the initial costly choice leads to consensus, then no one has an incentive to deviate. Second, consider the situation in which the initial costly choice does not lead to consensus. Then, at least some players must pay an additional cost to take another action for consensus to occur. In this scenario each player would prefer if the other player(s) paid the cost to change color. However, if everyone waits for someone else to act, then the group will not achieve consensus.

39. The email was sent from one of the researchers to undergraduates at students from public and private universities in California. The email informed them of an opportunity to take part in an experiment and to earn money in the process. Further information is on file with the authors.

The most important point is that the simple addition of costs infuses the basic consensus game with an element of conflict regarding who will pay the costs to change color.

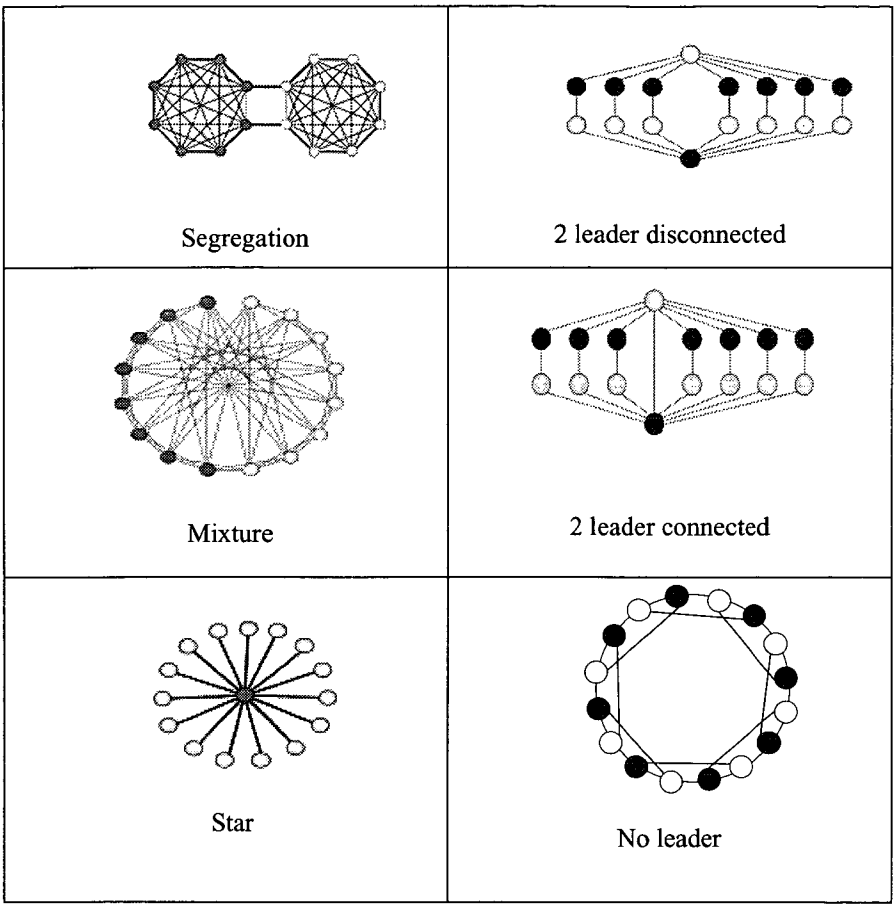
In figure 3 we present the modified version of the Delphi mechanism that functions in these experiments. Every actor is connected to the computer server (which acts as the Delphi mechanism) to maintain the anonymity of subjects and to let subjects know how much time remains in a particular trial. In addition, subjects have direct connections to others in the network which comprise the communication structure in the experiment. These connections are displayed in figure 4.[40]

FIGURE 3. Delphi Mechanism Modified so Subjects Can Directly Observe Others' Actions



40. The networks used in this set of experiments are displayed in figure 4. The networks differ in both the total number and structure of communication to allow us to study how both these factors can influence consensus.

FIGURE 4. Networks Used in Experiments



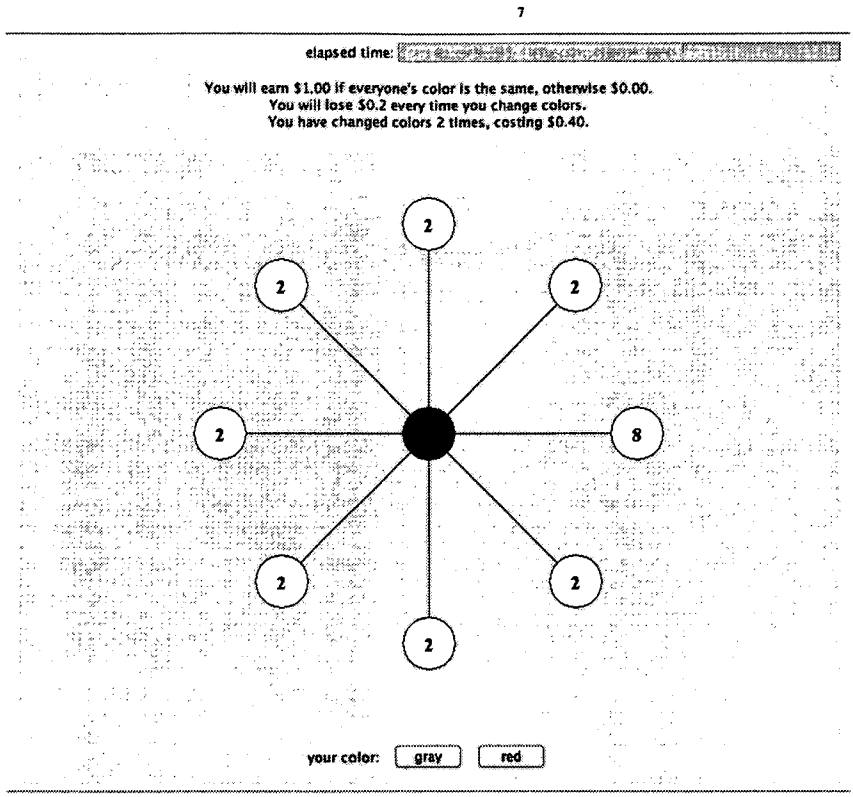
During the actual experiment, subjects know the following information, which is displayed in the sample screen shot in figure 5 below:

Number and Degree of Neighbors. Subjects can observe the other nodes to which they are connected and the color of those nodes at all times. They also know how many connections each neighbor has, which is displayed in the center of the node.

Time Elapsed. A bar displays how long until the session expires.

Cost to Move. We implement a cost for each choice a player makes, including his first choice. The cost per choice is displayed on the screen.

FIGURE 5. Interface Used During Network Consensus Experiments



In addition, subjects can determine if the trial was solved successfully because, if successful, the trial will end before the time elapsed bar runs out. They do not know the structure of the entire network at any point during these experiments. We utilize both within and between subject designs. During each experimental session (consisting of thirty to fifty trials), there are different costs to take an action. This allows us to observe, within a single group, how changes in costs affect coordination. At the same time, to achieve enough observations, we pool results from experiments that involved different groups.

A. EFFECTS OF COMMUNICATION STRUCTURE ON COSTLY CONSENSUS

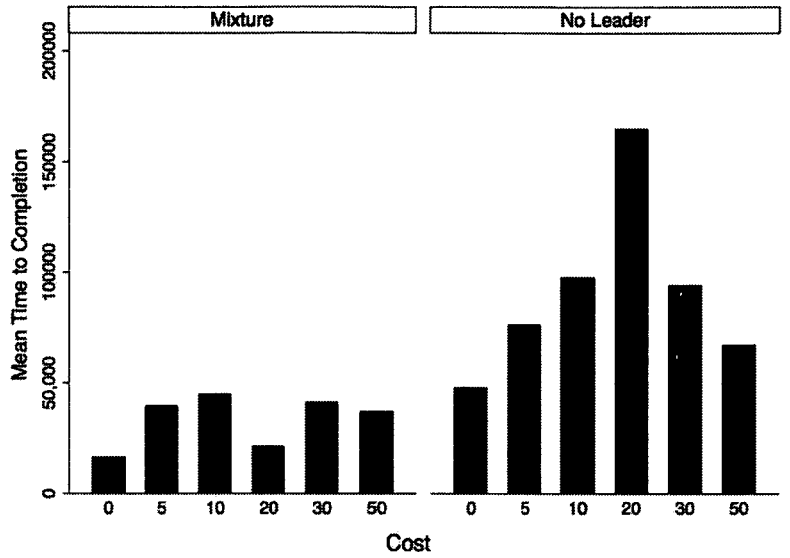
To study communication structure and costly coordination, we have subjects play a consensus game in which it is costly to choose a color. For instance, subjects might complete ten trials with no cost to move, twelve trials with a ten-cent cost, sixteen trials with a thirty-cent cost and sixteen

trials with a fifty-cent cost. The reason to group trials based on cost is to ensure that subjects fully understand the costs for each set of trials. We remind and quiz subjects before we change the cost to move. Given that the order of the costs may matter, we also vary the order of the trials between different groups; however, we always begin with the no-cost treatment to ensure that subjects believe the game is solvable and therefore attend to the coordination task to earn money. The addition of costs to a consensus game significantly increases the amount of time it takes for the group to solve the problem ($p < 0.01$, two-tailed test). Therefore, there is an overall main effect of costs on the time it takes for a group to reach agreement about how to solve this experimental task.

To examine the effect of communication structure on the time it takes to complete a costly consensus game, we focus on the mixture and no-leader networks, which feature no variance in degree. The mixture network has fifty-six edges and the leader network has only twenty-four. Consistent with this, the mixture network is completed faster than the no-leader network when we examine all the network trials across the various cost conditions (two-tailed t-test, $p < 0.01$). In figure 6 we display the average time to solve the consensus problem in the mixture and no-leader networks for each different cost level.[41] We can see that although costs increase the time to reach a solution in the mixture network, the increase is much less than it is in the no-leader network.[42] These results clearly suggest that even when it is very costly to take an action it is possible to create a structure of communication that facilitates consensus.

41. *See supra* Figure 4.
42. *See supra* Figure 4.

FIGURE 6. More Edges Reduce the Effect of Costs on Consensus



Note: Outcome is the average number of milliseconds to achieve coordination among all the trials in which taking an action was costly. Any failed trials are right-censored at 180,000 milliseconds.

The moderating effect of communication structure on the time to achieve consensus can provide guidance about the design of institutions, because it is through institutional design that we often build the structure of communication in legal and political situations. To put it another way, legal and political environments are often intentionally designed, which means that it may be possible to build a structure of communication that encourages agreement.

V. CONCLUSION

In a variety of legal settings there is a focus on creating consensus among affected parties. Scholars are divided on whether or not these attempts, such as in the case of negotiated rulemaking, will actually lead to greater agreement.[43] In our experiments, we demonstrate the conditions under which groups can, in fact, achieve consensus. Our experimental results conclude that achieving consensus is more likely when the underlying problem is relatively easy or when it is free (or very cheap) to take an action or communicate.[44] However, in settings in which communication is costly, our results indicate that the structure of communication can facilitate or defeat consensus. This last point implies that institutions that create communication between actors can be a valuable part of encouraging consensus, even when it is costly to communicate or take an action.

All our experiments discussed in this Article involve situations in which the actors have a common interest in solving the problem, even though they may not agree on how to solve it (that is, who should pay the costs to reach a solution); therefore, we have intentionally and explicitly stacked the deck toward finding that consensus is achievable. If individuals in a group do not have an incentive to agree (or have an incentive to delay a decision), then it will be more difficult to reach a consensus.[45]

These experimental results have important implications for both empirical research and the design of legal and political institutions. First, our results identify three important dimensions that can affect group consensus, and in so doing provide a path for future research about group decisionmaking. Additional experiments and observational research can help clarify and further refine the various ways that problem difficulty, costs to communicate, and communication structure work to either facilitate or impede the formation of a consensus. Our results demonstrate that each factor matters, but there is more work needed to fully understand how these factors affect outcomes. Second, our results can provide some guidance about how institutions can be designed to facilitate consensus.

43. *Compare* Harter, *supra* note 8, at 33 ("[P]articipants in negotiated rulemaking have found a range of positive values in the process and that, when implemented in appropriate situations, it has been remarkably successful in fulfilling its promise."), *with* Coglianese, *supra* note 9, at 1335 ("[N]egotiated rulemaking has not lived up to its promising potential to save regulatory time or prevent litigation.").

44. For further support of this proposition, see generally Boudreau et al., *supra* note 12.

45. Our prior research provides further communication experiments in which "group members have an incentive to reach a consensus about the correct solutions to various problems." *Id.* at 869.

Institutions have a particular role to play in creating the communication structure with which decisionmakers interact. This design structure, the structure of connections between decisionmakers, can go a long way to establishing the conditions for consensus. However, connections will not naturally emerge just by putting people into a room and having them make their cases; instead, a communication network needs to be established, one that reduces the adverse effects of costly communication and eases the burden of tough decisions.[46]

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46. Improved communication networks have potential to affect many legal and political institutions in which consensus in decisionmaking processes is crucial. As our former research indicates,

> In many legal, political, and social settings, people must reach a consensus before particular outcomes can be achieved. For example, a conviction in U.S. criminal cases requires jurors to reach a consensus about the guilt of the accused. In the United Nations, the five permanent members of the Security Council must reach a consensus to issue a resolution. In many legislatures, agencies, and lower courts, a consensus (or near consensus) is also necessary when making particular types of decisions. In all these settings, reaching a consensus is important not only because it is required for producing particular outcomes, but also because there are often significant costs associated with failing to reach a consensus. Indeed, a jury that fails to reach a consensus can result in a mistrial, Supreme Court justices who fail to reach a consensus can produce weak precedent, and legislators who fail to reach a consensus can face substantial political costs at election time.

Id. at 868–69.