Expertise and Bias in Political Communication Networks

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Citizens minimize information costs by obtaining political guidance from others who have already assumed the costs of acquiring and processing political information. A problem occurs because ideal informants, typically characterized by the joint presence of political expertise and shared viewpoints, are frequently unavailable or rare within the groups where individuals are located. Hence, individuals must often look beyond their own group boundaries to find such informants. The problem is that obtaining information from individuals located beyond their own groups produces additional costs. Moreover, the availability of ideal informants varies across groups and settings, with the potential to produce (1) context-dependent patterns of informant centrality, which in turn generate (2) varying levels of polarization among groups and (3) biases in favor of some groups at the expense of others. The article's analysis is based on a series of small-group experiments, with aggregate implications addressed using a simple agent-based model.

A primary obstacle to political participation lies in the individual costs of acquiring and processing political information (Wolfinger and Rosenstone 1980). One way for citizens to minimize these costs is to obtain political information from other well-informed individuals, thereby giving rise to networks of political communication. These networks, in turn, produce their own consequences, creating politically distinctive patterns of interdependence among citizens who communicate about politics. As a consequence, central issues in the analysis of political communication relate to the criteria for locating reliable sources of guidance, as well as the consequences of the resulting networks for the diffusion of information, patterns of influence, and the creation and mobilization of political bias (Schattschneider 1960).

Ideal informants are typically characterized by the joint presence of political expertise and shared preferences (Crawford and Sobel 1982; Downs 1957; Lupia and McCubbins 1998), but the supply of these individuals quite often varies across groups and settings (Miller 1956; Mutz and Mondak 2006). Moreover, looking for informants beyond an individual's own setting adds to information costs, thereby negating the efficiencies of social communication. Readily available informants—those located in the same families, churches, workplaces, and so on—provide the least costly sources of socially supplied information.

The problem is that many people find themselves in situations where their own political predispositions and needs for information are at variance with their local surroundings. The liberal Democrat raised in a conservative religious group may not locate politically compatible views at church social functions, and the political activist who is a committed bridge player may find the level of political expertise within his bridge group to be disappointing. In these and similar ways, individuals are often located within groups and settings unlikely to support the creation of communication networks that are both politically reliable and informative.

This article evaluates the consequences of group composition for the construction of communication

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networks. First, how important are expertise and shared preferences for network formation? Second, should we expect strategic individuals to invest resources in the creation of political networks that include expert informants with shared preferences? Finally, what are the implications for the centrality of participants within communication networks, levels of political polarization between groups, the diffusion of expertise, and patterns of bias in communication?

This article's analysis is based on small-group experiments involving two groups of seven participants who communicate with one another via networked computers. In a context of uncertainty regarding the positions of candidates, participants are rewarded with a cash incentive if the candidate closer to them wins the election. In arriving at a vote decision, participants may use three sources of information: free public information, private information with costs that vary across individuals, and information provided by other participants that also varies in cost.[1]

Experts, Bias, and Opinion Leaders

The earliest empirical studies of individual voting behavior, conducted by Lazarsfeld and his Columbia University colleagues (Berelson, Lazarsfeld, and McPhee 1954; Lazarsfeld, Berelson, and Gaudet 1948), revealed the importance of political communication among citizens. This led, in turn, to a focus on complex communication processes in which opinion leaders play a critical role, mediating both the flow and interpretation of information and creating opinion homogeneity within primary social groupings (Katz 1957; Katz and Lazarsfeld 1955). These opinion leaders are not generalists—those influential in politics may not be similarly influential in fashion or finance. To the contrary, the influence of opinion leaders lies in their own areas of interest and expertise. Thus, in view of the many individuals who were poorly informed in the 1948 election, Berelson, Lazarsfeld, and McPhee (1954) argue that interdependence enhances the civic capacity of democratic electorates.

Downs (1957, chap. 12) revisits the results of these early voting studies with a primary focus on the *consumers* of information, arguing that the utility of socially communicated information lies in its potential to minimize recipients' information costs. Rather than collecting and analyzing political information on their own, individuals might rely on information provided by well-informed associates. Because recipients run the risk of being misled or misinformed by biased information from informants holding divergent preferences, Downs stresses the importance of selecting expert informants with politically compatible viewpoints.

This potential for individuals to be misled has led to a burgeoning literature on the difficulties inherent when both the senders and the receivers of political signals are motivated by their own goals (Austen-Smith 1990; Austen-Smith and Feddersen 2009; Boudreau 2009; Crawford and Sobel 1982; Lupia and McCubbins 1998). In particular, the potential arises for "cheap talk"—situations in which individuals are free to send misleading signals without any penalty, and hence the sender is unable to assure the receiver that the message being sent is valid (Crawford 1998). Indeed, absent an institutional mechanism assuring the receiver that the sender's message can be trusted (Boudreau 2009), the potential for social communication to enhance collective outcomes is rendered problematic, and a "babbling equilibrium" (Lewis 1969) is generated in which no useful information is transmitted. As Crawford (1998) points out, however, not all talk is cheap talk. As the preferences of the sender and the receiver come into closer alignment, the incentive to mislead is increasingly diminished.

Hence, both the literature on opinion leadership, as well as the literature on strategic communication, point toward the political homogenization of social communication. The Columbia school suggests that the power of social influence produces homogeneity within primary groupings, while the political economy tradition points toward the difficulty of sending credible messages when preferences are heterogeneous. Moreover, literatures in social and political cognition point toward the personal discomfort that arises due to politically heterogeneous communication (Festinger 1957; Mutz 2006), with the potential to create self-selected patterns of association, conflict avoidance, self-censored political communication, and systematic biases in the recognition of politically divergent messages (Huckfeldt and Sprague 1995). The combined view thus portrays a world in which opinion heterogeneity within communication networks is personally disagreeable, potentially misleading, reduced by opinion leaders, and hence quite rare.[2]

[1] The experimental data for this article can be found at www.johnbarryryan.com.

[2] A cheap talk analysis implies that listeners might simply ignore messages from politically divergent sources, but a boundedly rational listener may take them into account (Crawford 2003), and a strategic voter may use these signals as confirmatory evidence (Calvert 1985).

The Costs of Communication

An implicit assumption underlying these conclusions is that social communication is free, with readily substitutable communication alternatives. That is, if you are a religiously conservative, politically liberal, pro-Keynesian voter, you should be able to locate, at little or no cost, a fellow traveler with similar preferences and beliefs from whom to extract useful political information and guidance. The problem with this view is that social communication is unlikely to be free if individuals wish to exercise strict control over the people who are included within their communication networks (Huckfeldt and Sprague 1995).

Observational studies confirm both that patterns of association tend to be clustered by shared preferences (Berelson, Lazarsfeld, and McPhee 1954) and that discussion is more likely to occur with associates judged to be politically expert (Huckfeldt 2001).[3] While seeming to support the capacity of individuals to control their own patterns of political communication, these studies also raise questions regarding the practical limits on the search for the perfect informant. First, the construction of communication networks is a two-way street, and it is less than obvious whether recipients select informants or informants select recipients. The individuals most likely to engage in political communication are those who are interested and informed—individuals who enjoy politics (Fiorina 1990). Hence, opinion leaders may be the instigators, and recipients may not be able to avoid the messages they send (Huckfeldt and Mendez 2008).

Second, the path of least resistance is to select an informant readily at hand. From a collective action standpoint, the costs of an extended search for like-minded associates are likely to swamp the expected benefits, once these benefits are down-weighted by the miniscule probability that improved information will be politically decisive in achieving a desired outcome. Equally important, politics is not the only criterion of choice in selecting associates, and thus relatively few individuals are likely to structure their associational lives around the optimization of political communication. Likewise, individuals often reside in multiple environments—home, sports club, place of worship, workplace—making it even more difficult to control the political mix of the people with whom they come into regular contact (Mutz and Mondak 2006).

[3]Efforts show that perceptions of expertise are little affected by disagreement but are subject to perceptual biases based on cultural traits such as gender (Mendez and Osborn 2010).

Finally, not only are distributions of preferences and expertise likely to vary across groups, but they are also likely to be imperfectly correlated. Hence, an individual might find herself in a group that is full of political experts but lacking in like-minded individuals, or among fellow travelers lacking even a shred of useful political knowledge. In this general context, some individuals seem particularly fortunate in being surrounded by expert individuals with compatible preferences, but this scenario produces its own problems. An expert surrounded by other experts may make a redundant contribution to the political sophistication of the group. That is, informants may be easily replaceable within environments where (1) their particular preferences dominate and (2) collective levels of expertise are quite high. Hence, the environmental constraints surrounding the choice of political informants carry implications for the centrality of even highly expert informants within communication networks.

In short, while individuals reduce their information costs by relying on politically expert associates with shared political preferences, the proximate supply of these informants is finite. Thus, individuals face a series of implicit choices and trade-offs—whether it makes sense to pay the costs of looking beyond their own groups to find ideal informants, the relative virtues of expert informants versus fellow travelers, and more. Indeed, communication networks are created at the intersection between associational preferences and the supply of potential informants (Huckfeldt 1983; Huckfeldt and Sprague 1995). These intersections, in turn, affect the dissemination of information, the creation of consensus and polarization among groups, and the political bias introduced through communication. These issues, in turn, pose a series of important observational challenges.

The Experimental Framework

The analysis is based on an experimental framework designed to address the issues identified above. In the words of Smith (1982), our goal is not to construct a "nomothetic" experiment aimed at establishing laws of behavior, but rather a "heuristic or exploratory" experiment aimed at incorporating several theoretical traditions within the same analysis. Such an analysis would be impossible absent an experiment, and even an experimental analysis makes it difficult to address all the issues identified. For example, our design creates a counterfactual world in which network formation responds almost entirely to the choices of those motivated to receive messages, not to those who are motivated to send them.[4]

The study includes several central design features. First, all individuals have an incentive to vote correctly, and information is central to their capacity to do so. Second, private information costs are experimentally manipulated. Some individuals have high costs and strong disincentives to invest, while others can invest at little or no cost. Third, free communication with other participants is restricted to the members of a participant's own immediate group, and communication beyond the group is costly. Fourth, the distributions of information costs and preferences are experimentally manipulated within groups and across experimental sessions to assess the consequences of environmental constraints on network formation and communication.

Our analytic framework is designed to combine the advantages of small-group dynamics with network representations of communication in the context of an experimental design. The experimental setting is based on a mock election with two "candidates" who are not real human subjects but are represented as positions on a one-dimensional policy space. The preference space varies from 1 to 7, where each participant has an integer position that remains constant across the rounds in an experimental session. In contrast, the candidate positions are represented on the same scale, but they are reset at each round.

The participant's goal is to elect the "candidate" closer to her own position, and she is rewarded with a cash incentive if the closer candidate wins the election at that round. The exact positions of the candidates are unknown to the voters, thereby creating an incentive to obtain information. Privately obtained information incurs costs that are varied randomly across participants. In order to minimize costs, individual participants have an opportunity to obtain free information from other participants, as well as to employ free public information. Costs and preferences are applied randomly within groups, and hence they are orthogonal to one another.

Not only are individual preferences and information costs randomly assigned, but the distributions of preferences and information costs within groups are also manipulated experimentally. We conducted a total of 12 sessions, three in each of the four experimental conditions or *contexts*. Fourteen subjects participated in each of the 12 sessions.[5] All sessions were identical in terms of the aggregate distribution of preferences (or ideal points) and information costs among the 14 voters. Two subjects were assigned to each of the integer points from one to seven such that there were two subjects with ideal point one, two subjects with ideal point two, and so on. In terms of information costs, each session had four low-cost voters who paid nothing for information, four medium-cost voters who paid 5 ECUs for a piece of information, and six high-cost voters who paid 25 ECUs for each piece of information.

The four contexts differ in terms of how the preferences and information costs are distributed between two groups of seven subjects. In sessions where information costs are identical between the groups, two subjects pay nothing for information, two subjects pay 5 ECUs, and three subjects pay 25 ECUs within each group. When costs are distributed asymmetrically, one subject pays 5 ECUs for each piece of information in the high-cost group, and six subjects pay 25 ECUs. In the low-cost group, four subjects pay nothing, and three subjects pay 5 ECUs.

In sessions where preferences are distributed identically within groups, one subject in each group holds each of the positions from 1 through 7. When preferences are distributed asymmetrically: two subjects in the first (or right-leaning) group are at position 7; two subjects are at position 6; two subjects at position 5; and one subject at position 4. In the second (or left-leaning) group: two subjects are at position 1; two subjects are at position 2; two subjects are at position 3; and one subject is at position 4.

Three experimental sessions are assigned to each of four distributional contexts. In the *first context*, information costs and preferences are distributed asymmetrically. The first group has right-leaning preferences and high information costs. The second group has left-leaning preferences and low information costs. In the *second context*, information costs are distributed identically within groups, but preferences are distributed asymmetrically. The first group has right-leaning preferences, and the second has left-leaning preferences. In the *third context*, preferences are distributed identically within the groups, but information costs are distributed asymmetrically. The first group has high information costs, and the second has low information costs. In the *fourth baseline context*, costs and preferences are symmetric between groups.

[4]This is, in fact, a conservative counterfactual. Targeting by opinion leaders serves to *increase* the heterogeneity of communication (Huckfeldt and Mendez 2008).

[5]The experiments were run at UC Davis, and the subjects were paid student volunteers. The experiment was programmed using z-Tree (Fischbacher 2007). Each session lasted approximately one hour. Subjects were paid a $5 show-up fee plus additional earnings denoted in Experimental Currency Units (ECUs) during the experiment and converted to real dollars at an exchange rate of 100 ECUs = $1. The average earning was $14.40 including the show-up fee: 90% of the earnings fell in the range of $11 to $17.

TABLE 1 Experimental Design

	Distribution of Preferences between Groups 1 and 2	
	Asymmetric	**Symmetric**
Distribution of Information Costs between Groups 1 and 2		
Asymmetric	Context 1: AI-AP	Context 3: AI-SP
	Group 1: (4, 5, 5, 6, 6, 7, 7)	Group 1: (1, 2, 3, 4, 5, 6, 7)
	(*m*, *h*, *h*, *h*, *h*, *h*, *h*)	(*m*, *h*, *h*, *h*, *h*, *h*, *h*)
	Group 2: (1, 1, 2, 2, 3, 3, 4)	Group 2: (1, 2, 3, 4, 5, 6, 7)
	(*l*, *l*, *l*, *l*, *m*, *m*, *m*)	(*l*, *l*, *l*, *l*, *m*, *m*, *m*)
Symmetric	Context 2: SI-AP	Context 4: SI-SP
	Group 1: (4, 5, 5, 6, 6, 7, 7)	Group 1: (1, 2, 3, 4, 5, 6, 7)
	(*l*, *l*, *m*, *m*, *h*, *h*, *h*)	(*l*, *l*, *m*, *m*, *h*, *h*, *h*)
	Group 2: (1, 1, 2, 2, 3, 3, 4)	Group 2: (1, 2, 3, 4, 5, 6, 7)
	(*l*, *l*, *m*, *m*, *h*, *h*, *h*)	(*l*, *l*, *m*, *m*, *h*, *h*, *h*)

Note: In the acronyms associated with the contexts, A refers to Asymmetric, S, symmetric, I, information, and P, preference. For each group, the set of numbers shows the ideal-points distribution in the group and the set of symbols shows the information cost distribution, where *l* means low, *m*, medium, and *h*, high.

Table 1 summarizes the distribution of preferences and information costs within and between groups. Note that within each group, the distribution of preferences and information costs are random and independent of each other. Participants were identified by unique numbers ranging from 1 to 14. These numbers were confidential, thus maintaining anonymity. All interactions were made via networked computers based on the experimental procedures, and no other communications were allowed among the subjects during the experiment.

The Experimental Procedure

Before the experiment begins, participants are randomly assigned integer preferences, information costs, and group memberships that remain unchanged for the duration of the experiment. Additionally, all participants are informed that Candidate A's position is between 1 and 6, while Candidate B's position is between 2 and 7. Then, in each of the approximately 15 rounds per session, the following steps occur:

(1) Participants receive 100 ECUs, of which 50 ECUs can be spent on information.
(2) The two candidates' positions are drawn from the respective intervals.
(3) Participants may purchase information at their assigned cost. A single "piece" of information arrives in the form (a, b), where a and b are integer estimates of the candidate positions. With α and β as true positions, the signals a and b are randomly and independently drawn from uniform intervals $[\alpha - 3, \alpha + 3]$ and $[\beta - 3, \beta + 3]$. Participants are informed how signals are drawn, reflecting on average the true candidate positions. (Participants are not told that a signal of -2 or 9 for Candidate A and -1 or 10 for Candidate B are thus definitive.)
(4) After the subjects receive the information, they are asked to provide a prior judgment regarding each candidate's position. They are truthfully told that their judgments will not be communicated to other participants.
(5) After being shown all other participants' preferences, group memberships, and information purchases, each participant is provided an opportunity to request information from two others. If an informant belongs to their own group, the information is free. If the informant belongs to the opposite group, the participant pays 10 ECUs. Potential informants are not required to comply with the request, and they are told that they need not provide the same information to all requestors. Participants almost always agree to provide information, consisting of a single message with their estimates regarding each candidate's position.
(6) After communication is completed, participants are provided a summary of all the information they have received, and they vote for one of the candidates.
(7) The outcome of the election is revealed to the voters. If the winning candidate's position is closer

to a voter than the losing candidate's position, the voter earns 50 extra ECUs. If the winning candidate's position is farther away from the voter's position than the losing candidate's position, 50 ECUs are subtracted from the voter's account. If candidates are equally distant from the voter or if the election ends in a tie, the voter neither gains nor loses. Thus, whether participants gain or lose ECUs is only indirectly related to the quality of their own judgments—they can, for example, fail to vote for the candidate closer to them and still benefit if that candidate wins. A voter could thus earn as much as 150 ECUs in a round, but only if she did not purchase any information. The minimum payoff is 0 ECUs—when a voter spends 50 ECUs on purchasing information and her candidate loses the election.

(8) Participants are informed of their net earnings, which accumulate across rounds.

(9) Candidate positions are reset, and participants proceed to the next round. At the end of the experiment, subjects are paid the show-up fee plus their total earnings in cash (100 ECUs = $1).

Participants thus have three potential sources of information on which to base their votes. First, the public information that the two candidates' positions are drawn from different intervals could potentially help a voter in the absence of other forms of information, and this information should be particularly helpful to voters with more extreme positions. Second, voters are allowed to purchase unbiased but noisy information on candidates' true positions. Third, each participant has an opportunity to request information from two other participants—information that is noisy and potentially biased. They not only depend on the reliability of information that serves as the basis for *the informants'* judgments, but also on the ability and willingness of the informant to compile and provide the information in an unbiased manner.

Do participants understand the experiment? We pretested the experiment to make experimental procedures comprehensible, and before every session we provided instructions followed by a practice period (see the online appendix). Finally, we carefully monitored the experiment, and it became clear that the participants understood the experimental procedures.

The proximate consequences of the experimental manipulations meet our expectations. First, participants with higher costs obtain less private information. Twelve percent of the low-cost (or no cost) individuals make fewer than two information purchases, compared to 28% of the medium-cost individuals and 70% of the high-cost individuals. Second, out-group information costs constitute a formidable barrier to communication. Participants received, on average, 1.88 information requests per round: 1.49 requests from their own group and .39 requests from the opposite group. Third, Part A of Table 2 shows that participants' prior judgments are more likely to reflect the candidates' true positions accurately when they are based on more information. Hence, expertise is defined in terms of political skills and knowledge that are enhanced by information. Expertise is measured in terms of the consumption of information—the socially visible indicator available to other subjects for use in evaluating the expertise of potential informants. Finally, as Parts B and C of Table 2 show, informants are more likely to communicate biased information when their preferences diverge from the preferences of the recipient—the strength of the relationship between the informant's message and the informant's prior is less likely to be compromised when the informant and the recipient share preferences.

These first-order consequences set the stage for a recurrent trade-off confronting subjects as they select informants. An expert informant's true assessment more accurately reflects the candidates' actual positions, but when the positions of the subject and the informant diverge, informants are more likely to send biased messages. Hence, in the trade-off between expert informants and informants with shared preferences, subjects expose themselves to biased information if they choose in favor of expertise. This trade-off is central to our argument, with important consequences both for the flow of information as well as for the mobilization of bias.

Contextual Contingencies Operating on Political Centrality

What makes experts influential? Some arguments are influential because they are inherently compelling, based on sound logic and judgment. Others are influential because they are confirmatory and supportive, reinforcing viewpoints an individual has encountered in the past. The former model portrays a communication process that addresses the details and nuances of complex issues, but abundant evidence suggests that few are equipped to participate in such a process (Delli Carpini and Keeter 1996). Moreover, discussion with experts is not a substitute for individual expertise (Jackman and Sniderman 2006; Ryan 2011), and individuals may be skeptical, even of

TABLE 2 Expertise, Priors, and Biased Messages

A. Prior judgments regarding candidates' positions by information purchased, candidates' true positions, and their interaction. Standard errors are adjusted for clustering on subject.

	Candidate A		Candidate B	
	Coef.	**T-Value**	**Coef.**	**T-Value**
Amount of Information Subject Purchased	−0.47	−7.41	−0.94	−12.03
Candidate's True Position	0.25	5.82	0.20	5.17
Amount of Information * True Position	0.16	11.15	0.18	13.16
Constant	2.45	13.08	3.98	17.97
N =	1,736		1,736	
R^2, S.E. of estimate =	.36, 1.43		.35, 1.42	

B. Informant messages by prior judgments and distance between dyad members. OLS with standard errors adjusted for clustering on subject.

	Coefficient	T-Value
Initial Estimate	0.92	31.62
Distance between Dyad Members	0.54	8.31
Estimate * Distance	−0.14	−8.40
Constant	0.28	2.42
N	5,328	
R^2, M.S.E.	44, 1.44	

C. Predicted informant messages based on estimates in Part B.

	Informant's Initial Estimate of Candidate's Position						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Distance between Dyad Members							
0	1.20	2.12	3.05	3.97	4.89	5.82	6.74
1	1.60	2.39	3.18	3.96	4.75	5.54	6.33
2	2.01	2.66	3.31	3.96	4.61	5.26	5.91
3	2.41	2.92	3.44	3.95	4.47	4.98	5.50
4	2.81	3.19	3.57	3.95	4.32	4.70	5.08
5	3.22	3.46	3.70	3.94	4.18	4.42	4.67
6	3.62	3.73	3.83	3.94	4.04	4.15	4.25

information taken from highly credible sources (Ahn, Huckfeldt, and Ryan 2010; Taber and Lodge 2006).

As a consequence, influence has less to do with the intrinsic qualities of the message or the messenger and more to do with patterns of support for the message (Huckfeldt, Johnson, and Sprague 2004). In this context, individuals are more likely to be influential to the extent that (1) they discuss politics frequently, thereby filling the conversational air waves with messages supporting their favored positions, (2) they are positioned within networks to guarantee maximal exposure of their views to others, and (3) the messages they send are confirmed by other messages obtained by a recipient. Hence, the role of opinion leaders is seen relative to the centrality of their locations within political communication networks.

In the analyses that follow, a subject's centrality is defined both in terms of the frequency with which other participants select her as an informant, as well as her own distance from other participants relative to the established communication links in the network. As we will see, the achievement of centrality may not only be due to a subject's own actions and intent. Not only does centrality depend on her own expertise, but also on the expertise of others within the larger context.

Table 3 Centrality and Expertise

A. Information requests received by subjects from in-groups and out-groups, by group and individual characteristics. T-values in parentheses.

	In-Group Requests	Out-Group Requests
Amount of Information Subject Purchased	0.09 (0.98)	0.05 (0.66)
Information Subject Purchased Minus Mean Information Purchased in Group	0.62 (6.56)	0.08 (1.36)
Mean Information Cost in Group	0.01 (1.38)	−0.02 (−3.84)
Absolute Difference between Subject's Preference and Mean Preference in Group	0.01 (0.27)	−0.04 (−2.24)
Constant	1.13 (3.77)	0.70 (3.42)
N	1736	1736
Subjects	168	168
R^2	.42	.09
S.E. of Estimate	1.04	.60

B. Logged betweenness by group and individual information costs, with controls for information purchased and extremity of preference.

	Coefficient	T-Value
Low-Cost Subject	1.183	3.86
Medium-Cost Subject	0.769	2.51
Extreme Preference	−0.109	−0.88
Asymmetric Cost	0.712	2.6
Asymmetric Preference	−0.185	−0.53
Low-Cost * Asymmetric Cost	−1.189	−2.72
Medium-Cost * Asymmetric Cost	−0.677	−1.56
Extreme * Asymmetric Preference	0.060	0.34
Constant	1.139	3.77
N	168	
Subjects	168	
R^2	0.10	
S.E. of Estimate	1.16	

C. Predicted Betweenness

	Information Cost		
	0	5	25
Asymmetric Cost	5.035	5.556	5.066
Symmetric Cost	8.118	5.364	2.486

Note: The 84 subjects in low- and high-cost groups participated in sessions where the information costs were asymmetrically distributed between the groups. The 84 subjects in medium-cost groups attended sessions where the information costs were symmetrically distributed between the groups.

Who Receives the Most Requests for Information?

What are the characteristics and locations of the individuals who receive the most requests for information? In the language of social networks, this points to a measure of "degree centrality"—individuals are more central to their own groups and to the opposite groups when they receive more requests from the in-group and out-group, respectively (Freeman 1970). Part A of Table 3 regresses out-group and in-group requests for information received by an individual on several explanatory variables—the amount of information purchased by the subject, the difference between the amount of information purchased by the subject and the mean amount purchased by the relevant group, the mean information cost in the group, and the absolute difference between individual preference and the mean preference in the group.

Several factors stand out as being particularly important. First, centrality within a participant's own group (the "in-group") is enhanced by the individual's information purchases relative to the mean level of purchases in the group. An abundance of experts creates a situation in which even relatively expert informants are less likely to become particularly central. Second, out-group centrality is diminished by the mean information cost in the out-group. Not only is it more difficult for the high-cost individuals in these out-groups to obtain information on their own, but they also have fewer remaining resources to obtain information from another group. Hence, they realize the double penalty of both individual- and group-based incapacities. Finally, shared preferences do not appear to produce more in-group requests—the absolute difference between the subject's preference and the mean preference within the in-group produces a coefficient with a small t-value. Subjects do, however, receive somewhat more requests from the out-group if their preference lies closer to the mean preference in the out-group.

Nondirectional Centrality

An alternative conception of centrality is based on social proximity to the entire network, without regard to whether an individual is requesting or receiving information. Individuals score higher on a "betweenness" measure to the extent that they lie along more of the shortest routes (the geodesic paths) connecting other pairs of subjects. Hence, these individuals are central because they are more likely to be located on the connecting paths along which information is communicated most efficiently (Freeman 1979).

In the analysis of Part B of Table 3, all rounds for a particular subject in a particular session are combined in a single observation, and hence we undertake the analysis in terms of information costs that are constant across rounds.[6] As the expected betweenness values in Part C show, information costs are directly related to centrality when costs are distributed *symmetrically* between the groups—lower costs translate into higher levels of centrality. When costs are distributed *asymmetrically*, this relationship disappears. Why?

When information costs are distributed asymmetrically, there is an abundance of low-cost informants to choose from within one group, but none in the other group. Most communication occurs within groups, and hence no informant plays a particularly central role. In contrast, when costs are distributed symmetrically, each group has several low-cost individuals who are likely to serve as the primary informants for the other members within the group. In short, we see once again that centrality depends not only on the characteristics of individuals, but also on the particular configurations of the contexts within which these individuals are located.

What Are the Criteria That Individuals Use in Selecting Informants?

In this analysis, the focus shifts from the individuals being selected as informants to the individuals making the selection—whether or not participants request information from particular individuals. Hence, the analysis includes each possible dyad at every period of all the sessions, increasing the number of observations to 22,568 dyads.[7]

In the Table 4 logit model, we consider whether one subject requests information from another subject, as a function of several characteristics related to each subject in the potential dyad. A dyadic proximity measure indexes the absolute difference between the ideal points of the potential informants and requestors. In addition, several dummy variables are also included in the regression: (1) whether the potential informant and requestor belong to the same group; (2) whether the requestor pays the medium-information cost (5 ECUs); (3) whether the requestor pays the high-information cost (25 ECUs); and (4) the interaction between high-information costs for the requestor and shared group membership for the potential dyad.

Magnitudes of effects are addressed in Table 4B, where the predicted probability of a request is shown contingent on factors included in Table 4A. The distance between the ideal points of subjects and potential informants is important, but its effect is much less pronounced than the information levels of potential

[6]The model in Table 3B logs the dependent variable because it is positively skewed. For the values in Part C, we calculated the nonlogged betweenness prediction.

[7]A clustering procedure avoids underestimating standard errors for the model coefficients, where the clusters are the 168 subjects who participated in the experiment (Rogers 1993).

TABLE 4 Factors Affecting the Subjects' Selection of Informant

A. Whether subject chooses a potential informant. Standard errors are adjusted for clustering on subject. (Logit model.)

	Coef.	T-Value
Potential Informant's Information Level	0.48	11.47
Distance between subject and potential informant's ideal points	−0.16	−4.68
Subject and Potential Informant Are in Same Group	1.36	5.22
Subject Pays Medium Information Cost	0.33	1.41
Medium Information Cost * Same Group	−0.42	−1.24
Subject Pays High Information Cost	−0.70	−2.83
High Information Cost * Same Group	1.10	3.33
Constant	−3.38	−14.02
N (Potential Dyads)	22,5678	
Subjects	168	
χ^2, df, p	270.06, 7, .00	

B. Predicted probabilities of selection based on estimates in Part A.

			Potential Informant Information Level	
Subject Information Cost	**Distance between Subject/ Informant Ideal Points**	**Same Group?**	**Low (0)**	**High (4)**
low/medium	0	no	.05	.24
low/medium	0	yes	.11	.45
low/medium	6	no	.02	.11
low/medium	6	yes	.04	.24
high	0	no	.02	.10
high	0	yes	.17	.58
high	6	no	.01	.04
high	6	yes	.07	.35

informants. For example, the second and fourth rows of the table show that the potential informant's information purchases increase the probability from .11 to .45 and from .04 to .24—approximately four- and sixfold increases. In contrast, reducing the distances between ideal points increases the probability from .04 to .11 and from .24 to .45—approximately twofold increases. The table also shows a negative effect for out-group communication that is enhanced among high-information-cost subjects. (Recall that high-cost individuals cannot purchase social information from the out-group if they have already purchased two pieces of information during the round.) In short, participants appear to weigh expertise more heavily than shared preferences in selecting informants.

In summary, our experimental results establish the relative importance of the criteria that participants impose on informant selection, as well as the implications for the communication of bias and the centrality of political experts. We turn, now, to the aggregate implications.

Aggregate Consequences of Individual Choice Criteria

Micro motives play important roles in the formation of communication networks, but these networks also generate important macro consequences (Schelling 1978)—aggregate implications that arise as a consequence of individual-selection criteria. Interdependence holds the key to understanding the relationships between individuals and aggregates in this analysis. The aggregate is more than a simple summation of individuals, depending instead on the particular patterns of interdependence that exist among actors (Achen and Shively 1995).

In this context, the relative distributions of preferences and information within groups become particularly important for levels of communication between groups. We construct an agent-based model of network formation that extends the experimental results. Rather than two groups with seven subjects in each group, the model includes nine agents in each of four groups. Expanding the numbers of agents and groups makes it possible to consider higher levels of variance in group composition, as well as the attendant consequences for dominance, biased communication, and polarization among and between groups.

As Table 5 shows, agents are arranged in four quadrants, where each quadrant represents one of the four experimentally manipulated distributions of preferences and information. Within each quadrant, 36 agents are assigned to four groups. Four contextual distributions are thus established across the groups: (1) asymmetrical preferences and information, (2) asymmetrical preferences and symmetrical information, (3) symmetrical preferences and asymmetrical information, and (4) the baseline condition of symmetric preferences and information.

Symmetric Distributions. In symmetric distributions, each group's composition is identical with respect to the characteristic in question. Each agent within each group is randomly assigned a unique preference on a scale of 0 to 8, and distributions of information within groups approximate the marginal distribution of information among experimental subjects {0, 1, 1, 2, 2, 2, 3, 4, 4}. Thus, the distributions are symmetric across groups and random within groups.

Asymmetric Preferences. In two alternative contexts, preferences are assigned asymmetrically: {0, 0, 0, 0, 1, 1, 1, 1, 2}, {2, 2, 2, 3, 3, 3, 3, 4, 4}, {4, 4, 5, 5, 5, 5, 6, 6, 6}, {6, 7, 7, 7, 7, 8, 8, 8, 8}. While the aggregate distribution corresponds to the baseline, preferences are highly skewed across the groups.

Asymmetric Information. Similarly, information is also assigned asymmetrically in two contexts: {0, 0, 0, 0, 1, 1, 1, 1, 1}, {1, 1, 1, 2, 2, 2, 2, 2, 2}, {2, 2, 2, 2, 2, 2, 3, 3, 3}, {3, 4, 4, 4, 4, 4, 4, 4, 4}. As before, information is independent from preferences within groups, and the aggregate distribution corresponds to the baseline.

All agents select two other agents as informants, and each of the other 35 agents is assigned a probability of being selected that is proportional to the probability set by the logit model of Table 4. Hence, based on the empirical results, preference is given to agents in the same group with similar preferences and more information.

TABLE 5 Symmetrical and Asymmetrical Preference and Information Distributions across Groups for Agent-Based Model

A. Symmetrical preference distributions across groups

Group 1			Group 2		
0	1	2	0	1	2
3	4	5	3	4	5
6	7	8	6	7	8
Group 3			**Group 4**		
0	1	2	0	1	2
3	4	5	3	4	5
6	7	8	6	7	8

B. Asymmetrical preference distributions across groups

Group 1			Group 2		
0	0	0	2	2	2
0	1	1	3	3	3
1	1	2	3	4	4
Group 3			**Group 4**		
4	4	5	6	7	7
5	5	5	7	7	8
6	6	6	8	8	8

C. Symmetrical information distributions across groups

Group 1			Group 2		
0	1	1	0	1	1
2	2	2	2	2	2
3	4	4	3	4	4
Group 3			**Group 4**		
0	1	1	0	1	1
2	2	2	2	2	2
3	4	4	3	4	4

D. Asymmetrical information distributions across groups

Group 1			Group 2		
0	0	0	1	1	1
0	1	1	2	2	2
1	1	1	2	2	2
Group 3			**Group 4**		
2	2	2	3	4	4
2	2	2	4	4	4
3	3	3	4	4	4

In the first formulation, the agents are not restricted in their ability to acquire information through communication regardless of their own information level, thereby omitting the high-cost factors from the model. This is equivalent to assuming that all the agents have low and moderate information costs. (The online appendix provides a parallel analysis showing that the implications of omitting the high-cost individuals are not consequential.) The model is run for 100 iterations, for each contextual distribution, with each agent making two selections at each iteration. Hence, agents for a particular nine-agent group make a total of 1,800 selections.

Patterns of Communication among the Agents

Table 6 shows the proportion of requests directed from agents within groups on the rows to agents within groups on the columns. The main diagonals within *each* part of the table show that agents are likely to select informants within their own groups. As expected, little variation occurs along the diagonal entries in the baseline distribution of Part D—in-group selection probabilities vary from .761 to .776, and all the other selection probabilities vary within very tight bounds of .068 to .087. In short, when the expertise and preference distributions are symmetric within the groups, all agents face the same selection task using the same criteria.

In Part B of the table, when information is distributed symmetrically but preferences are distributed asymmetrically, the values in the main diagonal are even larger, varying from .803 to .863. In this instance, there is even less likelihood that an agent would reach beyond the group for an informant. Every group has the same information distribution, but preferences are highly clustered. Hence, it is a particularly straightforward task for agents to select an expert informant with a compatible preference. Part B does, however, show slight but systematic variation in the out-group selection probabilities across out-groups. As the preferences of the out-group grow more distant from the in-group, the corresponding selection probabilities grow smaller.

In contrast, Parts A and C display significant variation in the size of the in-group selection probabilities. In Part A, where preferences and information levels are both distributed asymmetrically, the in-group selection probability increases from .742 to .937 as the level of information within the group increases. The agents in group 1 confront a challenging task—they are located in a low-information group with distinctive preferences. If they choose informants in group 4 to maximize expertise, they pay the price of selecting an informant with highly divergent preferences. Alternatively, if they make informant selections that maximize shared preferences by choosing an in-group agent from group 1, they select from among the least expert agents.

In Part C, with preferences distributed symmetrically across groups but expertise levels distributed asymmetrically, agents confront a choice that is in some ways easier. All agents in every group are able to find an expert informant in group 4 with preferences that approximate their own. Not surprisingly, the in-group selection probability for group 4 is relatively high, .902. The agents in group 1—the group with the lowest information level—demonstrate the lowest in-group selection probability in the table, .583. And they show a correspondingly high probability (.235) of selecting an informant from the politically expert fourth group.

Finally, it is important to emphasize that these selection probabilities are all based on the Table 4A model. Hence, the differences are not based on idiosyncratic individual-level traits of the agents, but rather on differences in the contextually imbedded sets of choices they confront.

Dynamical Implications of Contextual Variation

Contextual variations in the distributions of preferences and expertise produce dynamic consequences for information flows, with advantages and disadvantages for particular groups. Each of the four sets of group-based selection proportions can be treated as a transition matrix for a fixed arbitrary unit of time, providing the probability that information from groups on the columns will be communicated to groups on the rows (each row thus sums to unity). We treat this as a Markov process, and the transition matrix is defined as C, where

c_{ij} = the probability that someone from group i will obtain information from group j at any particular opportunity.

At some initial time point before a particular subject is a topic for communication, information is held individually but not communicated. As initial conditions, we treat information sources as being distributed proportionally across the four groups {.25, .25, .25, .25}. Hence, we define:

g_{jt} = a four-column row vector with the cumulative proportions of information in the population taken from groups 1 through 4 at time t.[8]

[8]Selection probabilities are assumed to be constant in time, and the experimentally generated selection probabilities support this

TABLE 6 Agent-Based Simulations of Cross-Group Communication for Low- and Medium-Cost Subjects: Group Transition Rates with Implied Equilibria

	Source of Information				
	Group 1	**Group 2**	**Group 3**	**Group 4**	**Σ**
A. Distributions: asymmetrical preferences, asymmetrical information					
Source of Request					
Group 1	0.742	0.068	0.077	0.113	1.00
Group 2	0.027	0.763	0.077	0.132	1.00
Group 3	0.008	0.048	0.812	0.132	1.00
Group 4	0	0.019	0.043	0.937	1.00
Equilibrium	0.017	0.102	0.205	0.676	
B. Distributions: asymmetrical preferences, symmetrical information					
Source of Request					
Group 1	0.852	0.074	0.048	0.026	1.00
Group 2	0.078	0.818	0.064	0.041	1.00
Group 3	0.049	0.083	0.803	0.064	1.00
Group 4	0.032	0.037	0.068	0.863	1.00
Equilibrium	0.266	0.263	0.232	0.238	
C. Distributions: symmetrical preferences, asymmetrical information					
Source of Request					
Group 1	0.583	0.073	0.109	0.235	1.00
Group 2	0.027	0.697	0.081	0.194	1.00
Group 3	0.019	0.046	0.766	0.168	1.00
Group 4	0.016	0.037	0.045	0.902	1.00
Equilibrium	0.041	0.119	0.186	0.654	
D. Distributions: symmetrical preferences, symmetrical information					
Source of Request					
Group 1	0.763	0.073	0.077	0.087	1.00
Group 2	0.085	0.772	0.075	0.068	1.00
Group 3	0.079	0.081	0.761	0.079	1.00
Group 4	0.081	0.071	0.073	0.776	1.00
Equilibrium	0.256	0.246	0.239	0.258	

The dominance of a politically expert group is based on the group members' increased access to information, but dominance is only realized through the communication process—and not simply realized but actually enhanced. While communication increases the volume of information available throughout a population, all information originates from a particular source, and as we have seen in Table 2, the information (with bias) is distinctive to its source.

assumption (see the online appendix). The equilibria are independent of initial conditions (Jackson 2008, chap. 8; Kemeny and Snell 1960).

This process produces an equilibrium distribution of information, g^* that is wholly a function of the transition probabilities, independent of the initial distribution of information. The only behavioral information needed to identify the equilibrium vector is the matrix of transition probabilities, and these equilibria are shown in the bottom row of each part of Table 6.

When information is distributed symmetrically across groups, the behavioral responses of the agents create communication networks with an egalitarian equilibrium vector for the population that is balanced across the groups. When information is distributed asymmetrically, the communication networks generate an equilibrium vector that *dramatically magnifies* the initial informational inequalities, and expert groups achieve informational hegemony.

How Accurate Is the Communicated Information?

Information and preference distributions affect group dominance relative to information flows, and hence they also create the potential for disparities in the quality of information communicated between groups. We examine message quality by once again using estimates obtained from the experimental setting and extending them based on an agent-based model. The Table 2A estimates are used to predict agent priors according to the amount of information they have purchased, the candidate's position, and their multiplicative interaction. Here we consider two candidate configurations: polarized candidates with candidate A positioned at 1 and candidate B at 7 and convergent candidates with candidate A at 3 and candidate B at 5.

We use these agent priors to estimate the message sent by informants to requestors, based on the model in Table 2B, where the message is defined in terms of the distance between the informant and the requestor, the informant's initial estimate, and an interaction. Using these estimates, the noise attached to messages communicated between agents is defined as:

$$noise = \sqrt{(message - prior)^2}$$

Agents receive information about the two candidates, based on calculated priors and messages for each. Our estimate of the noise received by a particular agent requestor from a particular agent informant is then the average of the noise estimates associated with each candidate.

These noise estimates allow us to investigate the quality of information communicated between groups, contingent on the four configurations of preference and information distributions described above. Biased communication between groups becomes particularly relevant when preferences are distributed asymmetrically across groups, and hence *we restrict ourselves to considering the two contexts with asymmetric preference distributions*. To estimate the quality of information sent between groups, we simply average the noise calculations for all messages received by each group, according to the group where the messages originate. For example, if the agents in group 1 made five requests to agents in group 4, we estimate the noise associated with each of the five requests and average these to obtain a final estimate of information quality sent by group 4 to group 1. The noise estimates for communication among low- and medium-cost agents are presented in Parts A and B of Table 7 for polarized candidates, positioned at 1 and 7, and in Parts C and D for convergent candidates, positioned at 3 and 5. (Similar results occur when the analysis includes high-cost subjects; see Table A2 in the online appendix.)

Polarized candidates clearly increase the noise communicated between groups. Within each table, however, it is also clear that the information and preference distributions produce strong effects on the accuracy of information transmitted between groups. For both symmetrical and asymmetrical information distributions, individuals receiving information from outside their own groups receive less accurate information compared to information originating within their own group. The volume of communication between groups is much higher when information is also distributed asymmetrically. Hence, the strongest aggregate effect depends on the joint presence of asymmetrical distributions for both information and preference.

Summary and Conclusion

Our analysis supports an expectation that individuals seek out expert informants with shared preferences, but this is only part of the story. Network formation occurs within a social context that introduces opportunities and constraints on patterns of association. Problems thus arise when the range of available options is constrained—when an individual's own preferences are rare, when the supply of experts is low, and especially when these two circumstances coincide. When forced to choose, experimental participants look primarily for expert informants, and only secondarily for informants with preferences similar to their own—a result that coincides with observational studies of network formation (Huckfeldt 2001).

We should not be surprised that experimental participants are hesitant to invest heavily in an extended search for the ideal political informants. Given sufficient time and resources, individuals might carry out extended searches for associates, but time and resources are typically scarce, and hence individuals often carry out truncated searches within the pool of readily available individuals, constrained as a matter of cost and convenience.[9] There are, of course, exceptions to this pattern—Internet dating services provide one example—but the exceptions are typically exceptional, and observational

[9]See the online appendix for an analysis of costs and benefits related to information search.

TABLE 7 Agent-Based Simulations of Noise in Cross-Group Communication, for Low- and Medium-Cost Subjects, in Contexts with Asymmetrically Distributed Preferences

	Source of Information			
	Group 1	**Group 2**	**Group 3**	**Group 4**
A. Polarized candidates with asymmetrical preferences and asymmetrical information				
Source of Request				
Group 1	0.19	0.55	1.29	2.6
Group 2	0.45	0.31	0.72	1.85
Group 3	0.77	0.58	0.38	0.95
Group 4	*	1.16	0.73	0.48
B. Polarized candidates with asymmetrical preferences and symmetrical information				
Source of Request				
Group 1	0.37	0.88	1.52	2.25
Group 2	0.84	0.4	0.86	1.53
Group 3	1.51	0.81	0.41	0.77
Group 4	2.21	1.52	0.78	0.38
C. Convergent candidates with asymmetrical preferences and asymmetrical information				
Source of Request				
Group 1	0.06	0.18	0.43	0.87
Group 2	0.15	0.1	0.24	0.62
Group 3	0.26	0.19	0.13	0.32
Group 4	*	0.39	0.24	0.16
D. Convergent candidates with asymmetrical preferences and symmetrical information				
Source of Request				
Group 1	0.12	0.29	0.51	0.75
Group 2	0.28	0.14	0.29	0.51
Group 3	0.5	0.27	0.14	0.26
Group 4	0.74	0.51	0.26	0.13

Note: * = insufficient information to calculate noise.

studies affirm the importance of availability in network construction (Huckfeldt and Sprague 1995).

Distributions of preferences and information levels within groups thus carry important implications for individuals, with important aggregate consequences as well (Achen and Shively 1995). First, group boundaries on communication redefine political expertise relative to particular settings, and centrality in the flow of information is thus affected by distributions of expertise. Second, when information is distributed asymmetrically across groups, the likelihood of communication between groups is enhanced, and the primacy of expertise over shared preferences as a selection criterion fosters heterogeneous streams of information.

The primacy of expertise is accelerated in the real world by the intrinsic nature of experts who invest in political information because they value being informed (Fiorina 1990). Many of the same experts also realize value in talking about politics, thus creating heterogeneous streams of information. It is not that people necessarily prefer the experience of diverse preferences. Rather, heterogeneous information is a by-product of the individuals who value information—both acquired and communicated—as an end in itself (Huckfeldt and Mendez 2008).

Correspondingly, the potential for polarized groups is greatest when information is distributed symmetrically and preferences are distributed asymmetrically across groups. In this context, the contextual distributions of preferences and expertise create self-contained camps of like-minded individuals who are readily able to locate politically astute informants with shared preferences.

Conversely, individuals are more likely to encounter divergent views and biased messages when expert informants with shared preferences are scarce—when information and preference distributions produce a disadvantage for their particular viewpoints, thereby creating a social dimension to the mobilization of political bias (Schattschneider 1960).

In these and other ways, particular patterns of interdependence among individual actors, fostered by contextual distributions of preferences and expertise, carry important consequences for aggregate realities. An important element of the solution to ecological fallacies, both theoretically and empirically, thus lies in a concentrated investment in understanding the nature of interdependence among individual citizens.

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Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's web site:

- Instructions to Participants
- High-Cost Subjects in the Agent-Based Model
- Incentives for Cross-Boundary Information Acquisition
- Patterns of Change across the Periods

Table A1: Agent-Based Simulations of Cross-Group Communication for All Subjects: Group Transition Rates with Implied Equilibria.
Table A3: Determining the Value of Private Information. Results from One Million Simulations by Candidate Positions and Private Information Signals.
Table A4: Replicating Table 2A with Data Split between Early and Late Periods. Prior Judgments Regarding Candidates' Positions by Information Purchased, Candidates' True Positions, and Their Interaction.
Table A5: Mean Number of In-Group and Out-Group Requests Subjects Received by Period.
Figure A1: Social Information Exchange over Time.