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Network knowledge and the use of power

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ABSTRACT

Complementing recent work on the effects of power on network perceptions, we offer a theory specifying how knowledge of network structures and exchange processes differentially affect the use of power by advantaged and disadvantaged positions. We argue that under certain conditions, network knowledge is beneficial to occupants of low-power positions, but not to occupants of high-power positions. Any low-power actor can benefit from having superior information, but if all low-power actors have equally sound knowledge, then all are worse off—a type of social trap. We tested these arguments by manipulating power and the availability of information on network structure and exchange processes in an experimental exchange network setting. The results were supportive.

Previously we developed and tested a theory that explained how power affects the accuracy of perceptions of who is tied to whom in social networks (Simpson et al., forthcoming). Our experimental investigations found that those lower in power had more accurate perceptions than their higher power counterparts. The present research turns that work on its head by asking the following: How does knowledge of the network's morphology affect the ways that one uses power? For instance, in exchange networks where the goal is to maximize the resources that one extracts from others, it may seem obvious that having superior knowledge of structural and processual details should be beneficial regardless of one's position. A closer look suggests that this may not always be the case. Specifically, we suggest that network knowledge can pose a social trap for occupants of low-power positions: Although it is *individually* advantageous for a low-power actor to have more accurate knowledge about ties between others in the network, it is collectively disadvantageous since increased perceptual accuracy among *all* low-power actors enhances the advantage of high-power actors. We will proceed by laying out our theoretical rationale and then test the argument against the results of a new experiment.

1. Background and theory

Power, in our theoretical argument, refers to the potential of an actor in a network position to obtain favorable outcomes in social exchanges as a result of asymmetric dependence or control of valued resources (Emerson, 1972; Thibaut and Kelley, 1959). We situate our study in the context of exchange networks, i.e., social networks in which the ties between nodes represent opportunities for profitable exchanges. Decades of research have resulted in a deep understanding of power processes in exchange networks (see Molm and Cook, 1995; Willer, 1999).

We define *network knowledge* as the level of accurate information an individual possesses about (i) the pattern of social ties in a network and (ii) the activities transpiring within those ties. Differences in network knowledge may stem from a range of sources, including differences in perceptual acuity or availability of information (Casciaro, 1998; Krackhardt, 1990; Simpson et al., forthcoming). A complementary line of research (Simpson and Borch, 2005; Simpson et al., forthcoming) showed that power is negatively related to network perception. Given the strong empirical support for the argument that those low in power have more accurate perceptions of social ties, the question thus becomes: Does more accurate knowledge of the network benefit those low in power? Although a number of scholars have answered this question affirmatively, the arguments outlined in the section to follow will offer a more nuanced understanding of how network knowledge affects ongoing power processes.

1.1. From knowledge to power

Previous work has suggested that accurate knowledge of the network provides a basis of power (Krackhardt, 1990; Pfeffer, 1981). For instance, Krackhardt (1990) found that, net of location in a formal organizational hierarchy and informal network position, actors who had more accurate perceptions of the informal advice network were considered by others to be more powerful. Although such findings are suggestive, as Krackhardt (1990:358) himself noted, use of these reputational measures "assumes that the raters know who is powerful and that they are willing to tell the

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researchers honestly what they know." Furthermore, in these prior studies, data were collected in a natural setting at a single point in time. As a result, the observed relationship between network perception and reputational power may have been the spurious effect of a third variable such as being "closer to the action." One of the aims of the present research is to rule out such extraneous factors. The more central purpose, however, is to extend research outlined in Simpson et al. (forthcoming) to show that the relationship between network knowledge and power is not as direct as suggested previously.

Prior research focused on the consequences of more accurate network knowledge for individuals and, not surprisingly, concluded that it is always beneficial. This individualistic orientation overlooks the fact that power relations are embedded in social structures, and that knowledge of the network may have differential impact depending upon one's location in the structure. The argument that we outline below shows that more accurate network knowledge actually has a predictable negative impact on the collective outcomes of low-power actors. That is, we argue that knowledge of the network structure creates a *social trap* (Komorita and Parks, 1996; Platt, 1973) for low-power actors whereby short-term individual gains generate long-term collective losses.

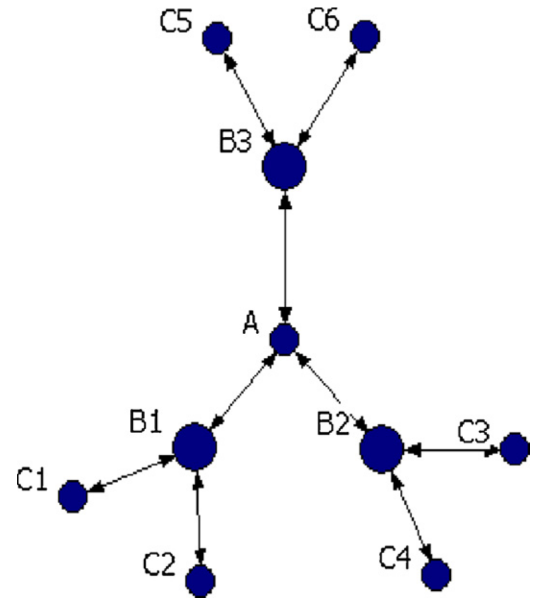

Fig. 1. 10-Actor exchange network. Node size corresponds with positional power.

1.2. How network knowledge creates a social trap

Who is more highly *motivated* to collect information about others' ties, and who *benefits* most from collecting information about those ties, are distinct questions. Here we propose that, although low-power actors potentially have more to gain from accurate knowledge than high-power actors, network knowledge also may create social traps for low-power actors. That is, although it is individually advantageous for a low-power actor to acquire knowledge pertaining to network ties, it is potentially disadvantageous when there are multiple low-power actors—a condition that virtually always exists in networks where power is structurally determined.

As argued elsewhere (Simpson and Borch, 2005), the low-power actor's greater dependence on information about network ties stems from the fact that his/her outcomes are typically more dependent on the activities of other low-power actors seeking exchange with the same high-power partner. That is, low-power actors must compete with structurally similar others for access to resources. If one low-power actor is more attuned than others to relationships that connect her competitors to potential exchange partners, then she will be more likely to maximize her outcomes than one who lacks such knowledge.

To illustrate, consider the 10-actor exchange network in Fig. 1, where each tie represents an opportunity for a profitable exchange. Following most exchange research, assume that each actor is limited to a single exchange with at most one other actor. Under these conditions, the A and C positions are at a great disadvantage because each of them risks being excluded from exchanges when the Bs opt for other partners, whereas the Bs always have willing partners available. How might knowledge of network ties and activities affect exchange outcomes under these conditions? Consider Actor A who is centrally located but low in power. A would benefit from accurate information regarding which Cs make better or worse offers to the Bs. This information would allow A to focus the bulk of her activity on the B that receives the least favorable offers in its B-C relations. In general, the low-power actor who accurately perceives exchange activities and ties beyond her immediate neighbors can be expected to be included in more exchanges and, as a result, gain more profits. On the other hand, the failure to acquire and respond to information about competitors increases the risk that a low-power actor will be excluded from exchange or included in a lower-profit exchange.

It follows that low-power actors with more knowledge of the structure of the network, their positions within it, and the ongoing activities of others will be included in more exchanges and therefore be less subject to the exercise of power than their structurally equivalent but less knowledgeable counterparts. Note that the prediction is not that knowledge countervails structural power, but that the *use* of power will be mitigated.

All else being equal, more frequent inclusion in exchanges results in greater resource accumulations. However, if all low-power actors have full knowledge of the network and what other actors are doing, then all should respond quickly and appropriately to one another's activities and none will have an advantage over the others. In fact, the situation would become maximally competitive, characterized by fierce bidding wars and declining profits among low-power actors. It follows that, when all low-power actors have relatively high (and equal) knowledge, the social trap is sprung and all low-power actors will experience disadvantages even beyond those stemming from their structural position.

As noted earlier, only high-power actors have exclusive exchange alternatives, making them less dependent on information about ties beyond those immediate adjacencies. In the paradigm case of a strong power network, actors in high-power positions need do nothing more than give their assent to a series of increasingly profitable offers emanating from those in low-power positions (Willer and Skvoretz, 1997). In contrast, actors in low-power positions are confronted with more decision points and more opportunities to strategize. Thus, the impact of increased knowledge on exchange outcomes is likely to be greater for low-power positions than for high-power positions. Given the predicted social trap effect, this leads us to expect that greater network knowledge will heighten the profit disparity between low-power and high-power actors.[1]

To summarize, the foregoing argument is largely consistent with statements made in previous work asserting that accurate network knowledge results in power advantages (Krackhardt, 1990), but with important qualifications. First, network knowledge is

[1] If low-power actors were able to collude, then they could use network knowledge to improve their outcomes. Our purpose here is not to study coalition-formation. Thus, the experimental setting prohibits coalitions or other explicit coordination mechanisms. We take up this issue in the conclusion.

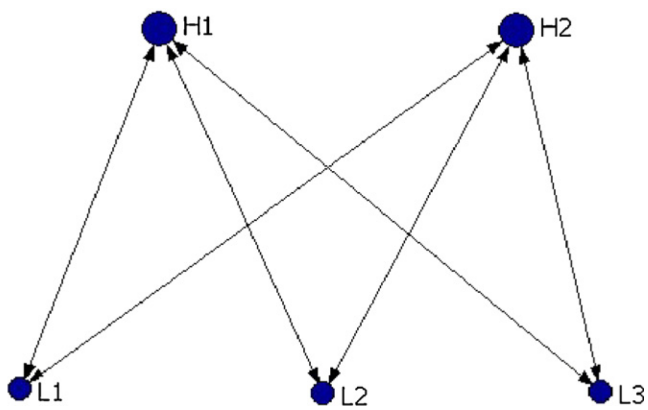

Fig. 2. 5-Actor exchange network. Node size corresponds with positional power.

expected to be more beneficial to individual low-power actors than to high-power actors. Second, we expect the advantages of network knowledge to accrue mainly to low-power actors whose competitors lack similar knowledge. This is because network knowledge presents an embedded social trap.

2. Method

Addressing the effects of network knowledge on power processes required a setting in which information on power relations and exchange processes were controllable. As noted earlier, the dynamics of power relations are well-understood in exchange networks, and so we investigated the relationship between knowledge and power in a commonly used experimental social exchange setting.

We recruited participants from the general student population using the opportunity to earn money as an incentive. Upon arrival at the laboratory, each participant was escorted to an isolated computer terminal where he or she completed a self-paced tutorial on using the computer to make offers, accept and reject others' offers, and complete exchanges. The tutorial further explained that while each person would be able to view his or her exchange partners during the bargaining rounds, they may or may not be able to view the exchange activities of others in the network. Thereafter, participants completed several practice sessions, always involving a network that differed from the test network.

Bargaining processes were managed using exchange network software that allowed us to control the nature and the amount of information available to any given participant. This permitted us to manipulate our primary independent variable: the level of information each position-occupant had about who was tied to whom, and the ongoing bargaining and exchange activity in the network.

Groups were randomly assigned to experimental conditions and, within groups, each participant was randomly assigned to one of the positions in the five-person network shown in Fig. 2. This network has two high-power (H) positions, each connected to the three low-power (L) positions. Each position was limited to one exchange per round across a series of 20 rounds, each lasting 2.5 min or until both H actors had completed exchanges. After the rounds were completed, participants were paid based on their exchange profits (an average of $20) and dismissed.

Potential exchange partners negotiated the division of a 24-point resource pool, a procedure used in numerous studies since the 1970s (Molm and Cook, 1995). If agreement was reached, points were allocated accordingly and converted into money at the end of the experiment. A participant who was excluded from exchange in a given round received no points for that round. Unequal outcomes per exchange indicate the use of power. In Fig. 2 structure, the 1-exchange rule necessarily excluded one L position in each round. We thus expected "bidding wars" to ensue among occupants of low-power positions attempting to avoid exclusion. Previous work showed that such networks generate inequalities favoring H positions (e.g., Simpson and Macy, 2004; Thye et al., 1997; Willer and Skvoretz, 1997), even in the absence of information about others' ties.

Table 1
Experimental design.

	Information to L positions		
	Full	Limited	Mixed
Information to H positions			
Full	Condition 1	Condition 2	Condition 3
Limited	Condition 4	–	–

In addition to structural power, we manipulated whether each participant was given full or limited network information. During bargaining rounds, subjects' computer screens in the *full information condition* displayed the entire network, including all negotiations and exchange agreements. In the *limited information condition*, this information was provided only for participants' own ties. Full vs. limited information for high-power positions was partially crossed with whether occupants of low-power positions were given full, limited, or mixed information. In the mixed information sessions, participants in position L_1 were given full information, while those in L_2 and L_3 were given limited information.[2] Participants in the full information condition thus had fuller knowledge of network ties and exchanges than participants in the limited information condition. Table 1 summarizes the four conditions.

2.1. Hypotheses

The argument outlined above generates several hypotheses. First, full information for L_1 and limited information for L_2 and L_3 should render L_1 less vulnerable to exclusion than L_2 and L_3.

Hypothesis 1. In the mixed information condition (Condition 3), L_1 will be included in more exchanges than either L_2 or L_3.

Next, a consequence of the social trap argument is that greater knowledge across low-power positions leads to greater inequalities between high- and low-power actors. Because profits to partners in any given exchange are zero-sum, we use the mean difference between the profits of high- and low-power positions as a measure of inequality and power-exercise. For brevity, let D_i indicate the mean difference between the profits of high- and low-power positions in Condition *i*. Then:

Hypothesis 2. $D_1 > D_2$.

or in words, the inequality between high and low power positions will be greater in Condition 1 where L positions have full network knowledge than in Condition 2 where they have limited network knowledge. Taken together, the first two hypotheses capture the argument that network knowledge poses a social trap for those low in power.

Finally, we argued that the magnitude of network knowledge effects differ for high vs. low power positions. That is, relative to the case where both high and low power positions have full information (Condition 1), limiting information to high power positions

[2] As shown in Table 1, this design does not contain the "mixed" information condition for occupants of high-power positions. Nor does the design fully cross the two levels of the independent variable for high power actors (full information vs. limited information) with the three levels for low-power actors. The omitted conditions were unnecessary for a full test of the hypotheses.

Table 2
Exclusions and profits for low-power positions.[a]

Condition (N)	Inclusions	Profits		
		Rounds 15–20[b]	All rounds	Total
(1) Full info H; full info L (14)	12.68 (.62)	7.75 (2.71)	5.95 (1.08)	118.91 (21.55)
(2) Full info H; limited info L (18)	12.77 (.69)	10.93 (.95)	7.13 (.68)	142.59 (13.68)
(3) Full info H; mixed info L, disadvantaged L (18)	11.58 (1.80)	10.00 (1.56)	6.32 (1.33)	126.31 (26.64)
(3) Full info H; mixed info. L, advantaged L (18)	14.12 (3.60)	10.21 (1.47)	7.38 (2.27)	147.56 (45.32)
(4) Limited info H; full info L (16)	12.69 (.73)	9.11 (2.81)	6.56 (1.10)	131.24 (22.06)

Notes:
[a] Displayed values are aggregated across like positions under like conditions. Standard deviations appear in parentheses.
[b] "Rounds 15–20" column includes means only for completed exchanges. "All Rounds" column means include results for exclusions (profit = 0).

(Condition 4) causes less of a decrement in inequality than limiting information to occupants of low-power positions (Condition 2). The full hypothesis would be $(D_1 - D_4) < (D_1 - D_2)$. However, because both sides of the inequality are expressed in relation to Condition 1, it may be simplified:

Hypothesis 3. $D_4 > D_2$.

3. Results

A total of 330 participants took part in 66 five-person experimental sessions. Table 2 shows descriptive statistics for the L positions' exchange profits and inclusions in successful exchanges, broken down by condition. Hypothesis 1 states that, in Condition 3 with mixed information, the occupant of the low-power position with full information will be included in more exchanges than those in low-power positions with limited information. The results supported this prediction. The low-power participant with greater network knowledge was included in an exchange an average of 14.12 out of 20 rounds, compared to 11.58 exchanges for low-power subjects lacking such knowledge ($t_{(34)} = 2.67$, $p \leq 01$, one-tailed). Although all low-power participants in Condition 3 earned similar amounts when they were included in exchange (10.21 for the more knowledgeable, 10.00 for the less knowledgeable), the fact that the information advantaged low-power actors completed 22% more exchanges than their disadvantaged counterparts resulted in higher earnings, 147.56 vs. 126.31, respectively ($t_{(34)} = 1.72$, $p \leq .05$, one-tailed). These results support the contention that advantages in network knowledge benefit low-power actors, thus establishing an incentive for any given low-power actor to improve his or her knowledge of the network.

Hypothesis 2 derives from the social trap argument that heightened network knowledge for *all* low-power actors results in worse outcomes for all. We test this by comparing the L positions' profits under full information (Condition 1) to their profits under limited information (Condition 2). Because high and low-power exchange partners' profits are zero-sum, lower profits for L means greater H–L inequality—i.e., greater *D* values. We first consider exchanges completed in the last five rounds where payoffs approach equilibrium. Low-power subjects in the full information condition earned substantially less than counterparts in the limited information condition: 7.75 vs. 10.93 ($t_{(30)} = 4.65$, $p \leq .001$). This same result holds when we look across all twenty rounds and include zero-payoffs resulting from exclusions: Low-power subjects in the full information condition earned significantly less per-round than occupants of low-power positions in the limited information condition: 5.95 vs. 7.13 ($t_{(30)} = 3.79$, $p \leq .001$). Thus, regardless of how we parse the data, low-power positions fared significantly worse when they had greater knowledge about others' ties and exchanges. Taken together, the results for Hypotheses 1 and 2 support our contention that heightened knowledge of the network creates a social trap for those low in power.

Hypothesis 3 suggests that the impact of full network knowledge should be greater for L positions than for H positions. As noted earlier, this entails comparing Conditions 2 and 4 to Condition 1. As a result, we can simplify and compare Condition 2 with Condition 4 directly. Again we used lower payoffs to low-power participants as our measure of greater inequality. According to the hypothesis, low-power participants in Condition 4 will earn less than those in Condition 2. The results displayed in Table 2 show that, in Rounds 15–20, occupants of low-power positions in Condition 2 (low-power limited information) earned an average of 10.93 points per round compared to occupants of low-power positions in Condition 4 (high-power limited information), who earned an average of 9.11 ($t_{(32)} = 2.60$, $p \leq .01$, one-tailed). We observed similar, though somewhat weaker, effects when looking across all twenty rounds and including zero-payoffs resulting from exclusions: 7.13 vs. 6.56 ($t_{(32)} = 1.82$, $p \leq .05$, one-tailed). Thus, these results support Hypothesis 3 and the more general point that network knowledge poses a social trap only for occupants of low-power positions.

4. Discussion

Our research investigated how knowledge of network structures and exchange processes affects power differentially for structurally advantaged and disadvantaged positions. This parallels our research on the effects of power on network perceptions which showed that low-power actors had more accurate perceptions of the network and, by extension, greater network knowledge (Simpson et al., forthcoming). Here we argued that under certain conditions network knowledge is beneficial to occupants of low-power positions, but not to occupants of high-power positions. However, the beneficial effects of network knowledge for low-power actors are contingent on avoiding a social trap: Any low-power actor can benefit from having superior information, but if all low-power actors have equally sound knowledge, then all are worse off. We verified these arguments in a setting that manipulated power and the availability of information on network structure and exchange processes. The results strongly supported the social trap argument for low-power actors. That is, while knowledge about others' exchanges benefited any given low-power actor, when occupants of all low-power positions had this additional information, they were all worse off. As predicted, the effects of having more information were much weaker for high-power actors.

Our research design did not provide occupants of low-power positions with any explicit coordination mechanism, e.g., to form coalitions or otherwise to collude. However, neither were they prevented from coordinating their actions, such as by sending similar offers to common exchange partners in order to halt counterproductive bidding wars. If such coordinated behaviors had emerged, it is reasonable to expect that it would have been in the condition where low-power actors had fuller information about each others' social ties. In that case the results would have been precisely the opposite of what we found. That is, low-power actors would have

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gained *more* when they had access to each others' ties and could therefore coordinate their actions accordingly.

The fact that we did not observe coordination effects is consistent with our argument linking greater network knowledge to worse outcomes for low-power actors. At the same time, more accurate information among low-power actors may provide both the motivation and the opportunity to form coalitions if explicit power-balancing mechanisms are permitted. Future work might extend the research presented here to address how network knowledge among disadvantaged actors interacts with the possibility of explicit coalitions to impact power processes. Similarly, given our finding that allowing all low-power actors access to more network information benefits those higher in power, future research might address the conditions under which high-power actors are motivated to ensure that their disadvantaged counterparts have accurate network knowledge.

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