The Micro-Dynamics of Network Leverage: Implications for Change Agents External to an Organization

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Abstract

Much of the impact of a policy depends on how it is implemented, especially as mediated by organizations such as schools, hospitals, or law enforcement agencies. Furthermore, implementation depends on each organization's capacity to absorb innovations based on its culture, routines, and leadership. Here we extend the concept of absorptive capacity to include the intra-organizational social *dynamics* that occur during the diffusion or implementation of an innovation. In particular, we attend to the potential for intra-organizational polarization along pre-existing lines. We then use agent based models to examine the interplay of intra-organizational social dynamics and the external change agent who seeks to direct the organization by introducing venues which contain information encouraging specific behaviors. We find that when organizational members are salient to one another, external change agents who attempt to direct organizations by introducing strongly oriented venues (e.g., professional development emphasizing specific practices) may unintentionally accentuate existing cleavages in the organizational network, inhibiting full implementation of the immediate policy as well as reducing organizational capacity to implement future innovations. Thus the external change agent should consider the short term interaction with the intra-organizational social dynamics as well as the organization's longer term absorptive capacity.

Keywords: Agent-based Model, Network Leverage, Influence, Selection, External Change, Venues.

1. Introduction

Most public policies are implemented by organizations which develop expertise and allocate internal resources to deliver services or programs (DeCarolis & Deeds, 1999; Kilduff & Tsai, 2003; Werner, 2004; Kilduff et al., 2006; Scott, 2008; Weiss, Bloom and Brock, 2014). For example, educational policies are implemented by schools which change their instructional staff or curricular materials as teachers ultimately deliver instruction to students (Bidwell & Kasarda, 1985; DeCarolis & Deeds, 1999; Weiss, Bloom and Brock, 2014). Similarly, health policies are implemented by hospitals, insurers, and associations (Barley, 1990; Poon et al., 2004; Watt et al., 2005); welfare-to-work programs are implemented by states and program offices (Weiss, Bloom and Brock, 20914), and immigration policy is implemented through law enforcement agencies (Ridgley, 2008).

An organization's specific ability to implement a policy or innovation can be described in terms of its absorptive capacity, defined as "an ability to recognize the value of new information, assimilate it, and apply it to commercial ends." (page 128, Cohen and Levinthal, 1990). Absorptive capacity typically includes elements of the organization's communication with the external environment (such as mediated by leadership), existing expertise that relates to an innovation, and the character and distribution of expertise within the organization. But here we emphasize that each of these elements can be enacted and enhanced through intra-organizational networks. That is, formal leaders can more effectively guide the organization to new behaviors when they are well-established in the informal network as well (Moolenaar, Daly, and Sleegers, 2010; Moolenar and Sleegers, 2015; Hopkins et al., 2013). Similarly, expertise can be effectively cultivated and distributed when conveyed through informal networks. In fact, an organization's culture can be characterized partly in terms of its capacity to distribute relevant resources through networks (Frank et al., 2015).

In this study we emphasize that the networks through which absorptive capacity is manifest are themselves dynamic. Networks not only convey information and norms, but networks themselves are modified by diffusion of information and implementation processes (Xu & Frank, 2016). In this sense, an organization's capacity is partly a function of the resilience of its network to sustain information flows before, during, and after the diffusion of new information or practices within the organization. Thus we attend to the intra-organizational social dynamics that affect each member's response to an externally generated policy shock.

In an example of the social dynamics of absorptive capacity, Frank et al. (2013) found that the pressures and institutions associated with No Child Left behind (NCLB) contributed to polarization in instructional practices among teachers within schools. This occurred as teachers were initially affiliated with cohesive subgroups, or cliques, within schools that featured different orientations and receptivity to NCLB related practices. Under the pressure of NCLB some subgroups became more aligned with instructional practices affiliated with NCLB and others less so as they lacked expertise associated with and orientation to NCLB practices. Thus schools became more polarized; ironically, the national policy intended to equalize opportunity across children contributed to the unintended consequence of uneven instruction. Such unevenness can ultimately create organizational challenges of coordination and collaboration beyond the focuse of an intervention associated with NCLB (Woodward, 1965; Bidwell, 1965; Thompson, 1967), broadly contributing to inequitable opportunities for students within schools (Frank et al, forthcoming), as well as between schools which experienced differing levels of dysfunction (Frank et al., 2015).

In this study, our ultimate goal is to inform the action of change agents by revealing how the effects of their actions depend on the intra-organizational micro-dynamics of the organization they seek to change. In particular, we show how a forceful change agent can exacerbate pre-existing intra-organizational rift lines. This can polarize the organization, ultimately inhibiting the implementation of the change agent's intended policy.

In the next Section, we describe the general scenario we consider and then present hypotheses based on conventional thinking about change agents. We then develop agent-based models expressing the externally generated policy or incentive in terms of information to which organizational members are exposed and then explore the internal dynamics in terms of the salience of the organization to its members. After that, we experiment with our system in terms of the actions of external change agents seeking to direct the organization to particular behaviors.

2. Theoretical Framework

2.1 General Scenario

We consider a set of actors in an organization; each actor engages in certain behaviors, such that the behaviors or beliefs contribute to the organization outputs. The actors start with different behaviors but have common utility functions determining how they are influenced by network partners and how they choose network partners. Given this baseline we will show that polarization occurs when the organization is only moderately salient in the sense of actors being influenced by other members and exhibiting a preference for like-minded others.

Next, we consider agents external to the organization who seek to change the organizational outputs. For example, a change agent might seek to increase general endorsement of the teaching practices consistent with a particular educational policy. By definition, actors external to an organization cannot change organizational outputs by changing their own behaviors. Furthermore, we assume external agents cannot influence behavior through extensive direct interactions with members of the organization, which would effectively bring the external agent inside the organizational boundary (Williamson, 1981). Thus the external agents must create mechanisms for introducing information or influencing behaviors within the organization. We think of these as sustained shocks, or venues. For example, public school districts may try to influence teachers' practices by creating sustained professional development (Garet et al., 2001; Desimone et al., 2002), the AHA (American Hospital Association) may provide seminars and leadership development programs for hospitals to improve the implementation of health care reform (AHA, 2010), or lobbyists may provide venues for interaction among members of the US senate (Fiorina & Abrams, 2008). Through these venues external agents can expose organizational members to information intended to affect the behavior of the members of the organization.

Critically, members of the organization must choose to participate in the venue (attend to the event or visit the website) based on the attributes of the venue. In this sense the venues create social spaces which increase the probability that any two actors participating in the venue will interact (Feld, 1981). As such participants in the same venues have increased probability of sharing information or capacity to impose a norm on one another.

Our research question then concerns what happens when an external change agent introduces a venue containing information supporting a policy goal into the social dynamics of an organization? For what internal dynamics is the change agent able to direct the whole organization in the desired direction of the venue's orientation, and under what conditions do the micro social dynamics generate unintended consequences?

2.2 Hypotheses based on Conventional Beliefs of External Change Agents

Before we investigate how the internal social dynamics of organizations affect their systemic response to exogenous shocks, we consider conventional thinking about how to use exogenous shocks to shape an organization. To begin, there is high face validity for attempts to change

organizations by introducing shocks which have valences in the desired direction. For example, if one wants to teachers to teach in a different way one introduces professional development (the exogenous shock) that trains teachers in the desired practices (Garet et al., 2001; Desimone et al., 2002; Weiss, Bloom and Brock, 0214). The same holds for any form of professional development. Similarly, political parties hold rallies and create media events (the exogenous shocks) to push the electorate towards the beliefs of the party, with the party's ultimate goal of moving the electorate enough to gain political power (Heaney & Rojas, 2015). This approach to systemic change can be summarized in a baseline hypothesis:

H_1: Change agents can direct an organization to a desired policy goal by introducing a venue conveying information supporting that goal

Note that although external agents may intuitively seek to efficiently allocate their resources, the hypothesis is specified independent of the internal dynamics of the social system. Thus we have the corollary that the effect of an exogenous shock will be more dependent on the strength or valence of that shock than on the internal social dynamics of the system.

Our theoretical development suggests a second hypothesis inhering in the intra-organizational social dynamics. Absorptive capacity rightly attends to the capacity of the organization's existing internal structures to diffuse information and practices. But an organization's capacity to absorb an innovation also depends on the internal dynamics manifest during absorption; during implementation, networks, status, and the distribution of information are likely to change in ways that can support or impede an organization's capacity to absorb an external innovation. For example, teachers with specific expertise in whole language instruction may gain status if their school adopts a whole language pedagogy. If some resent that elevation because of personality conflicts with the specific teachers or the general differentiation of status, then the school may polarize during implementation (Glidewell et al., 1983; DePaulo et al., 1983). Such dynamic polarization would limit the extent of implementation beyond what inhered in the static characteristics of the school at the time of implementation. Thus our second hypothesis is:

H_2: The capacity of the change agent to direct the organization to a desired goal depends on the intra-organizational social *dynamics* which can contribute to polarization.

The key is that the intra-organizational social dynamics can affect how shocks are distributed throughout a system, ultimately affecting the systemic response to the shock (Frank & Fahrbach, 1999; Xu and Frank, 2016). Furthermore, the shock itself can accentuate extant patterns of interaction which then shapes how the system responds to that shock as well as its future capacity to distribute information. In the next Section we turn to more formal models of intra-organizational social dynamics so that we may explore how these dynamics affect systemic responses to exogenous shocks.

3. Models

In this section we illustrate the basic models we use for the agent-based simulations (Wilensky & Rand, 2015). The key point is that to study the organizational response we must examine how it emerges out of individual behavior. In particular, we consider how actors in the organization deliberately choose their behavior (influence process) and with whom they interact (selection process) to maximize utilities which reflect their desire to reduce transaction costs to access new information under different levels of the salience of the organization. We then initiate

our simulations with two subgroups with different behaviors (representing baseline differentiation within most organizations), and we experiment to learn which types of strategies (such as created by change agents) exert the most leverage on the organization given the intra-organizational social dynamics.

3.1 Theoretical Basis for the Model

Drawing on economic literature, policies are implemented by changing incentives for individuals or organizations (Schneider & Ingram, 1990; Gneezy et al., 2011), and thus changing the behavior of organizations as corporate actors or as a collective of individuals. Our assumption is that these changes in incentives induced by policy are usually complex and context specific, and thus they are not immediately comprehensible to all of the members within the organization (Williamson, 1981). For example, teachers are uncertain about the implications of incentives associated with the Common Core for their choices of curriculum and instructional practice (Coburn et al., 2016). With high uncertainty/complexity in the environment, there are high transaction costs/risk to access information. This increases organizational salience, as actors rely on their organizations/immediate subgroups to reduce the transaction cost/risk to access new information. Furthermore, actors will also align their behavior with their immediate subgroup members to maintain the organization/group membership which can be protective in uncertain conditions (Lin et al., 2001). In contrast, with low uncertainty/complexity in the environment, transaction cost/risk is relatively low, and the salience of the organization is low, actors will directly seek sources for new information regarding incentives of the policy, and change their behavior based on this new information (Figlio et al., 2011). Thus actors balance their networks between those who engage in similar behaviors and those who possess non-redundant information.

3.2 Formal Specification of the model

In this section, we formally define our agent based models. Specifically, there are three interdependent processes involved, namely information seeking, behavior change, and network change:

1. Actors will seek information from other actors to gain a better understanding of the incentives of the policy;

2. Actors will change their behaviors according to information they access, as well as the behaviors of those from whom they seek information;

3. Actors will change their network relations in order to access non-redundant information.

Information Seeking Process. Each actor has an information list, which consists of unique pieces of information they possess. Each piece of information makes a unique contribution to the actor's understanding of the incentives of the policy, which could be either consistent or inconsistent with the intended direction of the policy. In each round, each actor is considered as an ego who seeks information from those in their networks (alters), who will randomly provide one piece of information in their possession to the ego. If the information is new to the ego, then ego will add this piece of information to its own information list; if the information is redundant, then it will not go into ego's information list.

Influence Process. Each round, actors will choose their behavior according to their previous behavior, new information they receive, as well as the behaviors of their network members.

Specifically, we choose a variation of Friedkin and Johnsen's (1990) influence model and specify our model as (see Frank & Fahrbach, 1999):

$$y_{it} = (1-\alpha)y_{it-1}I_{it-1} + \alpha\frac{\sum w_{ijt-1}y_{jt-1}}{\sum w_{ijt-1}} \quad (1)$$

Where y_{it} represents the behavior of actor i at time t. y_{it-1} represents actor i's behavior at time t-1, and I_{it-1} represents the effect of information on behavior. We define positive information as information that is consistent with the policy intent; and we define negative information as the information that is inconsistent with the policy intent. The second term represents the mean behavior of actor i's network members at time t-1, where w_{ijt-1}=1 if actor j is a member of the network of i at time t-1, 0 otherwise.

Given this model, α represents the salience of the organization on the actor's changes in behaviors. For a high value of α egos respond strongly to the behaviors of their network members. This is above and beyond the information the ego obtained as a result of interacting with organization members – large α represents a normative effect of others in the organization. This normative effect can be due to ego's identification with others in the organization (Frank, 2009), because of a shared sense of fate (Portes and Sensenbrenner, 1993) or a sense of shared mission in the organization (Williamson, 1981). Consider teachers in the NCLB example, where uncertainty about the implications of NCLB for a given school could be high (Penuel et al., 2009). In this case the school as an organization creates a strong filter of the effect of outside institutions (Frank et al., 2013). Therefore, teachers are inclined to conform to the norms in their intra-organizational networks with whom they share a common fate, as well as local conditions.

When α is low, ego's behavior is primarily a function of ego's prior behavior (y_{it-1}) modified by new information (I) to which ego is exposed. Importantly, this information can be conveyed by members of the organization (see below) but in this capacity other members of the organization carry no more weight than any other in ego's network – the organization member is simply a vector for conveying the information independent of the organizational context. For example, when there is considerable turnover among school faculty, teachers loose allegiance to the school (Ingersoll, 2001; Bryk and Schneider, 2002). As a result they act more atomistically, responding to more to individual incentives conveyed through information provided by individuals within or outside the school.

Selection Process. Each round, agents decide with whom to establish a network tie, assuming an actor's out-degree is constant. In this case, the salience of the organization as represented by α is associated with the standard homophily term in a network model $|y_{it-1} - y_{jt-1}|$. That is, actors prefer to interact with others of similar behavior when they have a strong identification or affiliation with others in the organization. When they do not, they seek merely to interact with others who can instrumentally shorten their path lengths to potentially new information (Frank and Fahrbach, 1999). This reduction in path lengths is represented by (mp_{ijt-1} -1) which occurs as a result of an ego's choice of with whom to interact given ego's current network. For example, if the network distance between agent i and agent j is 3 (mp_{ij}=3), and network distance between agent i and agent k is 5 (mp_{ik}=5), then agent i will gain more utility by connecting to k instead of j, because k is more likely to have new information regarding the incentives of the policy for i.

$$U_{ijt}(mp_{ijt-1}, y_{it-1}, y_{jt-1}) = (1-\alpha)(mp_{ijt-1}) - \alpha\,|\,y_{it-1} - y_{jt-1}\,| \quad (2)$$

With high transaction costs to access information, the salience of organization α is high, and actors will prefer similar others to reduce the transaction costs/risks. When transaction costs/risks is low, the salience of organization α is low, and actors will prefer distant others who have potential for new information regarding the incentives of the policy. Here again if we consider the NCLB example, the uncertainty in the environment is high, so teachers will gain more utility by selecting like-minded others, as a result teachers are more likely to select others with similar teaching practices (Penuel et al., 2009). Combining with influence process above they eventually form subgroups with homogeneous practices within the subgroup and heterogeneous practices between subgroups.

After actors make initial selections, in each round they also decide whether they want to maintain the network ties they have made before. As actors are motivated to seek new information, we specify that when actors access redundant information from a network member, there is higher probability that the actor will re-evaluate and dissolve the network tie. This decision process is a function of how many consecutive times an actor is exposed to redundant information from the network member:

$$P_{ijt} = \lambda^{x} \qquad (3)$$

Where P_{ijt} is the probability that actor i will maintain the network tie with j at time t, λ is a constant between 0 and 1, and x is a integer between 0 and +∞, which indicates how many consecutive times actor i is exposed to redundant information from j. So if actor i accesses new information from j, x will be 0 and the probability that i will maintain a network tie with j at time t is 1. The first time actor i is exposed to redundant information from j, x will be 1 and the probability to maintain the tie at time t becomes λ. If actor i continues to be exposed to information from j, x will increase by 1 each time until the tie is discontinued or actor j provides new information to actor i. Note that even if the connection is discontinued, it may be resumed if α is high and actor i and j already share similar behaviors because of previous interactions.

The rates of influence – k. Note that in the influence process and selection process, we use the same parameter α to represent the salience of the organization that can affect both actors' influence and selection processes. However, the relative rates at which influence and selection occur can vary. For example, the rate of influence would be high relative to that of selection if actors may rapidly adopt the behaviors of those in their network but are slow to change network ties based on homophily. Therefore we express the rate of influence relative to that of selection as *k* ($0 \le k \le 1$), and incorporate k into the influence process in (1):

$$y_{it} = (1 - k\alpha) y_{it-1} I_{it-1} + k\alpha \frac{\sum w_{ijt-1} y_{jt-1}}{\sum w_{ijt-1}} \qquad (4)$$

Generally, when $k \rightarrow 0$ actors retain only their previous behaviors – influence occurs slowly relative to selection; as *k* increases the process of influence occurs faster relative to selection, and when $k \rightarrow 1$ influence occurs at the same rate as selection.[1] If *k* is small, then actors maintain balance by focusing more on selecting members who engage in similar behaviors than conforming in behavior to those of network members. Thus our models allow us to express the

[1] If selection does not occur and therefore the network does not change, the system converges to the same end point for $0<k<1$ (Frank and Fahrbach 1999).

system in terms of the interplay of between influence and selection using two parameters: salience of the organization (α) and the rate of influence relative to the rate of selection (k).

4. Simulation Methods

We then initiate our simulations with two subgroups with different behaviors (representing baseline differentiation within most organizations), and we experiment to learn which types of implementation strategies created by change agents exert the most structural leverage on the system. We also examine how effects of these strategies interact with the salience of the organization and the rates of influence relative to selection.

Our primary focus is on efforts of agents external to the organization to change the behavior of organization members or the organization as whole. Interpreting the change agent in our models, the external agent does not exert leverage on the organization by changing its own behavior or network. Instead, the external agent is limited to creating venues or events that express a particular orientation or behavior to which members of the organization can be attracted and exposed. For example, national policymakers might seek to introduce professional development programs into schools and districts. The providers of these programs do not enter the schools as full agents of the schools, seeking to establish network ties and change their own behaviors. Instead the sponsors seek to change behaviors by providing information or representing national norms, Furthermore, they provide opportunities for subsets of teachers to convene, become exposed to one another, and perhaps create new network ties (Spillane et al., 2012).

Given our discussion above, the choice for the external change agent concerns how strongly to express a position in the venue the agent creates. A strong position may represent the policy well, but may create unintended consequences in terms of network dynamics and ultimately the adoption rate in an organization. Therefore, the change agent must choose the venue with an eye toward the attendant network consequences as well as the direct intended consequences for behavior.

We express the position of the change agent in terms of the valence of the events the agent introduces into the system. We describe two types of venues, one containing information strongly supporting a policy which we call positive venues (the effects of negative venues can be understood by symmetric arguments concerning information that supports an alternative policy and behaviors), and the other containing an almost equal balance of positive and negative information supporting a policy.

4.1 Simulation Process

We perform agent based simulations in Netlogo 5.2.0 (Wilensky, 1999). Specifically, in each round: (i) Each actor randomly seeks one piece of information from each of his/her network members; (ii) Each actor decides whether to end the current tie and to start new tie based on the probability equation in [3]; (iii) If new ties are to be established, an actor calculates the utility of establishing a tie with each of other actor based on the selection equation [2]; (iv) Each actor then establishes ties with other actors with highest utilities, holding the out-degree (number of others identified as network ties) for each actor constant;[2] (v) As actors select with whom to form network ties, they are influenced by the new information they receive as well as the mean

[2] For example, if an actor is initialized with 3 out-going ties, then in each round it retains the number of out-going ties as 3.

behavior of their network members, and adjust their behaviors based on the influence model in [4]. Actors only update their behavior when they receive new information from their alters, otherwise actors will retain their prior behaviors. The information I is set to be 1.05 for positive information (consistent with policy effort) and 0.95 for the negative information (inconsistent with policy effort).
For each experiment described below we stop the simulation when (1) every actor obtains all pieces of information in the system, (2) or after 600 iterations.[3] We set λ to be 0.8, and we vary the uncertainty salience of the organization (α) from 0.3 to 1 by intervals of 0.05, and chose the relative rate of influence (*k)* to be 0.1 or 0.5. In each configuration we simulated 200 rounds, with a total of 200*15*2=6000 simulations.

4.2 Experiment Condition

4.2.1 Baseline Condition

In the baseline condition we initialize each network as follows: (1) we create two subgroups, each consists of 10 actors, one we called a positive group and one we called negative subgroup; (2) we create relatively dense networks within subgroups and sparse networks between subgroup, which results in a density of 0.2 and clustering-coefficient around 0.4; (3) behaviors within subgroups follow a normal distribution with standard deviation 1; for the positive subgroup the mean behavior is 12, and for the negative subgroup the mean behavior is 8; (4) for actors in the positive subgroup, each actor starts with 3 random pieces of positive information and 2 random pieces of negative information. While for actors in the negative subgroup, each actor has 2 random pieces of positive information and 3 random pieces of negative information. In this way information is set up to be aligned with the behavior of the actor. The unique pieces of information are randomly drawn from a total of 15 pieces of negative information and 15 pieces of positive information.

4.2.2 Effects of Venues Created by External Change Agents

We initiate each simulation with 30 rounds given the baseline dynamics established by equations [2] through [4]. We then introduce shocks as venues with a particular set of information whose sum we refer to as a valence. Aligning with our assumptions about external change agents, these venues do not have capacity to change their behaviors or network ties. Actors in the organization can select these venues to be part of their networks based on the selection process as in equation [2], and they can be influenced by venues based on the influence process as in equation [4]. The information contained in the positive valenced venue is 13, one within-group standard deviation higher than the initial mean behavior of the positive group. The positive valenced venue also contains 3 pieces of positive information that are new to the organization, representing the external information exerted by change agents that supports the policy goal.

The baseline behavior of the near-neutral venue is fixed at the mean behavior of all the actors in the system at time 30. The near-neutral venue also contains 10 equal pieces of positive information and negative information that are already in the system. We then move the venue slightly away from neutral by including 3 pieces of positive information that are new to the organization.

4.2.3 Key Outcome measures

[3] We stop at 600 iterations because in a baseline experiment where we start from random networks, in most simulations actors obtain all pieces of information in the system within 500 iterations.

We are interested in two outcome measures. The first measure is the probability of full information diffusion (Rogers, 2010). It is calculated as the percentage of the total simulations in which all actors obtain all pieces of information in the organization. This represents the extent to which actors have acquired all the information to evaluate the incentives of the policy. The second measure is the mean behavior of members of the organization. It is calculated as the mean behavior of the actors as simulation ends. This represents the extent to which actors have adopted behaviors consistent with the policy.

5. Results

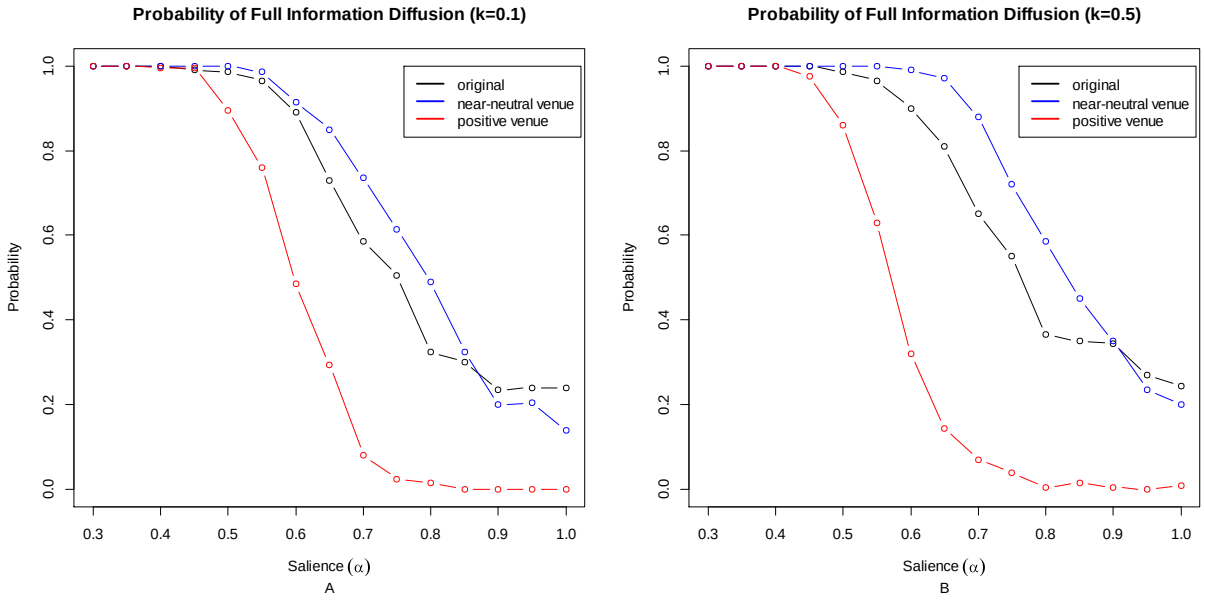

Figure 1. Simulations initiated with two subgroups for different rates of interpersonal influence (k). Probability of full information diffusion decreases with salience (α), with more dramatic decrease when a positive venue is introduced. (A) Probability of full information diffusion vs salience when rates of influence is low (k=0.1); (B) Probability of full information diffusion vs salience when rates of influence is high (k=0.5).

5.1 Diffusion of information

In Figure 1 the black lines represent conditions in which no external venues are introduced establishing a baseline against which to compare scenarios in which venues are introduced into the system. The baseline condition shows that the probability of full information diffusion (all the actors obtain all unique pieces of information in the system) decreases as organization salience (α) increases. For low values of α actors establish an integrated network of interaction with others of similar or different behaviors, thus allowing the diffusion of information across the organization. On the other hand, for high values of α the network becomes factionalized, inhibiting the diffusion of information between factions. These trends apply regardless of the relative rate of influence (k), although when influence is larger as on the right, the tendency for factions is mitigated for $.8 \leq \alpha \leq .9$ and therefore more information is diffused.

Turning to the effects of venues, as α increases, the red lines show a significantly sharper decrease (relative to baseline black) in the probability of full information diffusion when a positive venue is introduced (for α > .45), with the probability decreasing to near zero when α > .8. This is because the positive venue attracts actors of like behaviors (the yellow dots), accentuating their predispositions, and thereby distancing them from those of the initially opposite behavior. On the other hand, the system is more able to diffuse full information when a near-neutral venue is introduced (for α > .9 the equilibria for the near-neutral event are comparable to those for the baseline because the near-neutral event cannot compensate for the effects of homophily for extremely high organizational salience). Thus is because the near-neutral venue attracts actors of either orientation, providing opportunities for them to continue to exchange information and influence one another.

5.2 Change in Behavior

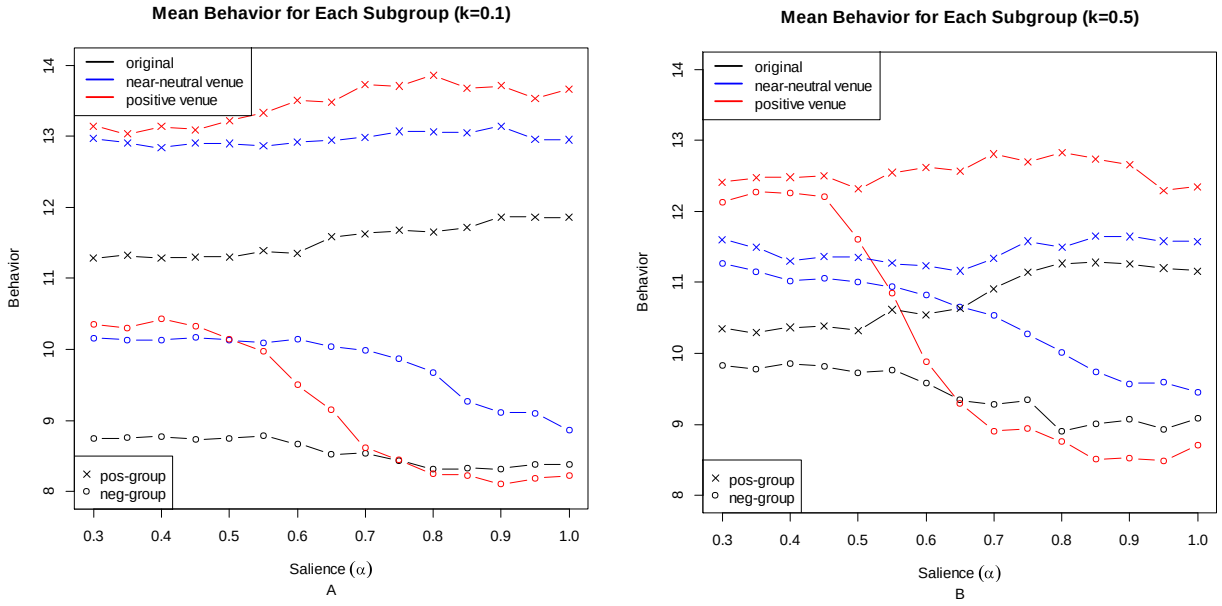

Figure 2. Simulations initiated with two subgroups for different rates of interpersonal influence (k). Divergence of behavior between subgroups increases with salience (α), more dramatic divergence emerges when a positive venue is introduced. (A) Mean behavior of each subgroup vs salience when rate of influence is low (k=0.1); (B) Mean behavior of each subgroup vs salience when rates of influence is high (k=0.5).

Figure 1 shows that the trends for diffusion are not dramatically altered when influence is presence (k=.5). But Figure 2 shows a more complex interaction between influence and the distribution of behavior between subgroups. In the baseline condition (represented by the black lines) the subgroups (x for the positive subgroup, o for the negative subgroup) maintain separation across values of α when influence is low (k=.1). But when influence is high (k=.5) the subgroups are more similar to each other for moderate levels of α. This is because members of different subgroups are able to influence one another and maintain similarity for low to moderate organizational salience (α<.5). It is only for high salience (α>.5) that actors are drawn to interactions within their subgroups to generate polarization in behavior.

The effects of the venues on behavior are shown with the colored lined in Figure 2. When influence is low, the pattern of separation between the subgroups for a near-neutral venue is similar to that for baseline, except all behaviors are moderately elevated because of the 3 pieces of positive information embedded in the near-neutral venue). The red lines show stronger separation and at lower values of α as members of the positive subgroup are attracted to the positive venue, and as a result become more extreme in their behaviors. This also creates a social distance between the positive and negative subgroups, and as a result there is little counterbalance to the normative pressures within the negative subgroup, making it more extreme.

When influence is stronger, as on the right, the subgroups maintain integration for low salience ($\alpha < .5$) in baseline and for positive or near-neutral venues. Thus influence can compensate for the tendency for homophily to drive subgroups apart provided salience is low to moderate. But the mitigating effects of influence on polarization is diminished for high salience (α alpha $> .5$) in which case polarization occurs regardless of the presence or strength of valence of a venue (although the separation between the subgroups is smaller across conditions for high influence than for low).

Across our results the effect of the event depends on the salience of the organization. When salience is low ($\alpha < .5$) an external change agent introducing a positive venue can shift the mean behavior of the organization without inducing polarization. On the other hand, when salience is high ($\alpha > .5$) a positive event accentuates polarization, ultimately inhibiting the diffusion of information and constraining the overall change in behavior (increases in the behavior of one subgroup are offset by decreases in the behavior of the other). Finally, the relative rate of influence (k) amplifies the distinction between high and low salience.

6. Discussion

Our context applies to the micro level action of the agent who seeks to change the behavior of an organization. This might apply to a national policymaker who seeks to influence schooling by changing the instructional practices of teachers (DeCarolis & Deeds, 1999; Porter et al., 2011; Weiss, Bloom and Brock, 2014). We make what we believe to be an authentic definition of an agent who truly external to the organization, and therefore must exert leverage by creating events (e.g., professional development) that will contain information supporting the intended change (Garet et al. 2001; Desimon et al., 2002). It is then incumbent upon the members of the organization to attend the event, absorb its information and distribute it throughout the organization. Given this context, our agent-based models reveal equilibria in terms of the distribution of information and attendant behaviors within the organization.

We start by assuming that there already exist at least modest divisions within the organization such as by formal departments or informal cliques (we discuss this in our assumptions checks below). Given the existence of these divisions, our dynamic analysis shows there is a tendency for polarization in the system when actors are able to influence one another or select others based on similarity of behavior. Thus it is these tendencies for polarization that the change agent encounters in trying to influence organizational behavior. In this sense our baseline finding adds a dynamic element to the literature on absorptive capacity which typically focuses on the ability of an organization's static structures to facilitate communication and coordination.

But our findings are more specific than just that internal dynamics matter. In particular, when social salience is high the change agent can more effectively influence the organization by

creating a near-neutral venue which will mitigate against the polarization of the organizational members. For example, if the employees of a school have a strong affiliation with the school then external change agents might paradoxically exert the most leverage by creating professional development that exhibits an even-handed, or near-neutral orientation to a particular set of teaching practices. In contrast, when social salience is low, change agents can more directly influence organizational members by creating a venue which strongly represents the orientation of the agent. This might obtain when the members of a school have weak affiliation with the school, such as when turnover rates are high (Ingersoll, 2001). Thus when the organization is weak the standard economic emphasis on changing incentives can change organizational behavior. The dependence of the optimal action of the change agent on the level of social salience confirms our second hypothesis, that the effect of the change agent is dependent of the internal social dynamics of the organization.

Our support for hypothesis 2 informs our assessment of hypothesis 1, that change agents can alter an organization by introducing a venue with an orientation in the desired direction. We now understand that how a change agent exerts leverage depends on the internal social dynamics of the organization. We emphasize that the actions of change agents are not merely sensitive to organizational network structure or the distribution of behavior, but to the internal dynamics which depend on the location of behavior in the network as well as the processes of influence and selection through which behaviors change and networks are modified. It is because of these dynamics that the effects of external change agents on an organization may go well beyond their intended actions.

Our second key result is that the process of implementation itself can change the intra-organizational dynamics. In particular, a change agent who introduces a strong venue into an organization may accentuate existing cleavages in the system. In the extreme, this can create polarization or factions, limiting the organization's capacity for coordination and to diffuse future innovations. Because changes in network structure have implications for the diffusion of any innovation, and because polarization may endure and be difficult to overcome, the effects of change agents may go extensively beyond their immediately intended goal.

Methodologically, we emphasize our parsimonious formalization of the internal dynamics of organizations (Chang & Harrington, 2006). Through the formalization we are able to express the dynamics of diffusion in terms of the processes of influence through and selection of network members. Thus although we recognize the formal organization as defining the broad conditions of diffusion, the action of the individual actors are derived from network dynamics of the individuals within organizations. The parsimony of our models is itself a theoretical contribution, as we describe the essential internal dynamics in terms of two parameters, organizational salience (α) and the rate of influence relative to that of selection (k). While no doubt other factors affect influence (level of expertise, trust, etc.) and selection (proximity), our models allow the theoretical exploration of two key elements of internal dynamics that affect consequences of the actions of agents external to the system.

7. Conclusion

The intent of any policy is to change experiences of end users. Much of that experience is shaped by action within organizational boundaries. But organizations are not monolithic. In particular, organizations typically feature formal divisions or subgroups in which informal interactions are concentrated. These subgroups define the lines of potential polarization when external shocks are introduced into the organization. Ignoring this potential can generate serious

unintended consequences that can undermine the immediate intent of action as well as the organization's capacity to learn, coordinate, and adapt to future innovations. Thus we urge change agents to attend to the network dynamics internal to the organizations responsible for implementing their innovations.

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