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Towards an Organizational Model of Attitude Change

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Abstract

Building on the growing literature that views organizations as complex adaptive systems, this paper proposes a general model to analyze the relationship between organizational context and attitudes. In particular, we focus on how the system of formal and informal communication channels that characterize an organization and the timing of information flows affect the dynamic process of attitude change. We also use a stylized version of the model to illustrate how the general framework is able to generate insights that are relevant to particular situations.

Keywords: social networks, influence, attitudes, alignment of attitudes, organizational design

> "I cannot imagine someone advancing a plausible argument that understanding the process of attitude change is unimportant to us—yet no body of organizational literature on attitude change exists." (emphasis original)
>
> Arthur P. Brief, in *Attitudes in and Around Organizations*, 1998, page 82.

1. Introduction

An extensive literature in the field of social psychology studies the relationship between individual attitudes and behavior (e.g., Fishbein and Ajzen, 1974; Ajzen and Fishbein, 1977; Ajzen, 1987, 1988; Pratkanis and Turner, 1994; Brief, 1998). Attitudes are summary evaluations of persons, objects, ideas, or activities along a dimension ranging from positive to negative. As Fishbein and Ajzen point out, "there is general agreement that a person's attitude towards some object constitutes a predisposition on his part to respond to the object in a consistently favorable or unfavorable manner" (1974, p. 59). Since attitudes are presumed to influence behavior, an important dimension of the problem of organizational design is to choose the organizational structures and procedures that best contribute to the alignment of individual attitudes and collective goals.

The relationship between the social context and the formation of attitudes has been extensively studied under a social information processing approach, following the important work by Salancik and Pfeffer (1978). This perspective builds on the fundamental idea that individuals adapt attitudes, behavior, and beliefs to their social context and to their own past and present behavior and situation. In particular, the social information processing model posits "the direct effect of the social environment, through the influence of social

information and pressures for conformity, on job attitudes" (Salancik and Pfeffer, 1978, p. 238).

In the same vein, we study the relationship between the characteristics of the organization and the dynamic process of attitude change. We do not study the impact of attitudes on behavior explicitly. Instead, we take as a starting point the idea that, at least under certain circumstances, attitudes determine behavior, and study the impact of organizational design on the dynamic process of attitude change. More specifically, we take the perspective of a top manager whose objective is to choose the organizational design that best contributes to align members' attitudes with his/her own initial attitude.[1]

This paper is inspired by a growing literature in organization science that views organizations as complex adaptive systems, i.e., systems where individual adaptive agents are linked together within interactive networks (e.g., Heydebrand, 1989; Burkhart, 1996; see Anderson, 1999, for a recent overview). As pointed out by Simon (1996), every aspect of a complex adaptive system—individuals, their attitudes, and the nature and strength of connections between them—can change over time as the system evolves. In this context, we analyze how the top manager is able to affect the evolution of attitudes, by influencing the *timing of information flows* and the *system of formal and informal communication channels* that characterize an organization.

We distinguish three *types of organizations*, according to their communication channels: the hierarchy, the network, and the hybrid organization. Hierarchies and networks have been characterized in many ways in the literature (e.g., Hummon and Fararo, 1995; Carley and Lin, 1997). In this paper, we use the words "hierarchy", "network" and "hybrid" in a very specific sense. We define hierarchy as a system in which the communication channels correspond to the links of authority that characterize the formal structure. The formal structure is composed of the set of positions in the organization, the way these positions are clustered, and the way the formal authority flows among them. In contrast, in the network, the communication channels corresponding to the formal links of authority are complemented by a complex system of informal relationships between organization members, so that all the members within the organization are linked. The hierarchy and the network correspond to two extreme cases. The hybrid organization is an intermediate structure, where some informal relationships exist and others do not.

Individual attitudes are related in a systematic way to a number of things, including beliefs, values, personality and past behavior. However, members' attitudes are also strongly affected by the attitudes of co-workers and other organization members with whom they interact through discussions, exchanges of information, etc. (e.g., Weiss and Nowicki, 1981; Griffin, 1983).

As Friedkin (1993) points out, the two components of social influence are *interpersonal visibility* and *salience*. Individual's i influence on individual j depends on j's knowledge of i's attitude. Obviously, invisible attitudes cannot be directly influential. Following Friedkin (1993, p. 863), we assume that j is more likely to know i's attitude, the more frequently i and j communicate with each other. Once j is aware of i's attitude, then i's influence on j depends on the salience or value of i's attitude for j. Irrelevant attitudes cannot directly influence j. In this particular, we assume that the salience of i's attitude for j depends on their relative hierarchical position.

This means that, by determining who communicates with whom, the organizational form may affect the process of attitude change within the organization. For example, in a network the top manager is able to exercise direct influence on subordinates in different levels of the organization; and the members' attitudes may reinforce each other. In contrast, in a hierarchy, the top manager contacts only his/her direct subordinates; and the possibility of mutual reinforcement of attitudes is lessened. These two scenarios are likely to have many different implications for top managers trying to change attitudes. However, it is not clear which of the two types of organizations better facilitates change.

The evolution of attitudes within the organization depends, not only on who communicates with whom and, therefore, who influences whom, but also on the *direction* of that influence. As Marsden (1981, p. 1214) points out, individuals may be influential in one of two ways. First, they may have the capability to influence others in the same direction. This is the usual conception of influence as persuasion. Second, they may influence others "negatively". In this case, the influenced individual becomes more likely to have an attitude contrary to that of the individual that exercises the influence. We say that there is *affinity* between two individuals when the fact that one of them has a given attitude induces the other to have the same attitude. In contrast, we say that there is *animosity* between two individuals when they influence each other in the opposite direction. This paper considers both the existence of affinity and animosity between peers. We characterize the way in which the type of relationship between peers affects the optimal organizational design.[2]

The evolution of attitudes within the organization also depends on the order in which individuals revise their attitudes. This, in turn, depends on the *timing of information flows*. By influencing who gets the new information first, top management may affect the order in which individuals revise their attitudes. As a consequence, attitudes do not necessarily change all at the same time. We consider two classes of dynamics of attitude change: the simultaneous dynamics and the sequential dynamics. In the simultaneous dynamics information flows quickly in the organization, so that all the individuals adjust their attitudes simultaneously. This scenario may be understood as corresponding to the situation where issues are discussed openly, with a high level of participation, so that everybody gets the same information at nearly the same time and attitudes change almost simultaneously. In the sequential dynamics information flows slowly, in a prespecified order, so that individuals adjust their attitudes sequentially. This scenario may represent the situation where issues are discussed with organization members according to a certain order. Two sequential dynamics are analyzed, corresponding to different prespecified orders: the top-down (TD) and the bottom-up (BU) sequential dynamics. In the TD, individuals at the top of the organization revise their attitudes first, followed by their direct subordinates, and so on, until the bottom of the organization is reached. We assume that the process does not start with the top manager because this individual is the change agent whose impact in the organization we want to study. In the BU, the process of revision of attitudes starts from the bottom of the organization and proceeds sequentially until the top of the organization is reached. Independently of the type of dynamics, the process is repeated until the configuration attains a fixed point under the specified dynamics.[3]

In addition, the evolution of attitudes in an organization depends on the *initial configuration of attitudes*. Two extreme initial configurations of attitudes appear to be particularly interesting: the isolated leader case and the conflicting attitudes case. The isolated leader case corresponds to the situation where an isolated leader tries to change the attitude of the rest of the organization, which is opposed to his/her own. The conflicting attitudes case corresponds to the situation where the organization is split into two equally important parts—one that has the same attitude as the top manager and one that has the opposite attitude. In both cases, the problem faced by the top manager is to choose the structures and procedures that best contribute to the alignment of the members' attitudes with his/her own initial attitude.

This paper is related to the literature on social networks (e.g., Katz, 1953; Hubbell, 1965; Marsden, 1981; Friedkin, 1993; Friedkin and Johnsen, 1990, 1997; Bueno de Mesquita and Stokman, 1994; see Stokman, 2001, for a recent overview). Recognizing that much of the real work in organizations happens despite the formal organization, this literature pays attention to the networks of relationships that individuals form while interacting. In particular, our paper is closely linked to the research stream developed by social psychologists and mathematicians that studies the relationship between the network of interpersonal influences and the content of individuals' opinions (e.g., French, 1956; DeGroot, 1974; Friedkin, 1986, 1990, 1991; Friedkin and Cook, 1990; Friedkin and Johnsen, 1990, 1997). These authors propose a formal model of social influence where individuals form their opinions in a complex interpersonal environment. In their model, interpersonal influences occur when individuals take into account the opinions of others in the formation of their own opinions on an issue. Individual opinions result from this endogenous process of opinion formation and a number of exogenous factors. The model describes how a network of interpersonal influences enters into a process of opinion formation, and how this opinion formation process results in either a stable pattern of disagreement or group consensus.

The analysis presented in this paper follows the saw paradigm. However, as discussed later, our model differs from the ones presented in the literature in some important dimensions. First, we explicitly assume that the top manager has some degree of choice over the pattern of interactions and the order by which individuals influence each other. In this context, we analyze how the top manager is able to affect the evolution of attitudes by influencing the timing of information flows and the system of formal and informal communication channels that characterize an organization. Assuming that the top manager's objective is to align members' attitudes with his/her own initial attitude, we discuss how the optimal choices depend on the initial configuration of attitudes. To accomplish this, we propose a model that allows for arbitrary initial configurations of attitudes, that are treated as independent of other exogenous variables. In contrast to our work, in the models mentioned above the initial configuration of attitudes is *uniquely* determined by the set of exogenous variables.

Second, while in the existing models the rule governing the change of opinions is typically linear, in ours the rule is highly nonlinear. This results from our emphasis on how, by influenting the organizational design, the top manager is able to align the members' attitudes with his/her own initial attitude. We say that two attitudes are aligned with each other if and

only if they have the same sign. To focus on the *sign* of attitudes, we use a binary model, i.e., a model where attitudes may be either positive or negative. This naturally implies a highly nonlinear dynamics.

In this paper, as in the above mentioned literature on the process of opinion formation, the structure of influences is assumed to be exogenous, reflecting the pattern of interactions among individuals. In contrast, Marsden (1981) proposes a model where influences may be exercised purposefully. Marsden assumes that individuals may influence each other strategically, in the pursuit of their individual goals. This author builds on the social exchange model proposed by Coleman (1972, 1973). The social exchange model is based on a simple conceptual framework consisting of actors and events, where actors vary in their control over and interest in events. Coleman shows how changes at the collective level result from exchange between actors of control over one event for control over other events. Coleman's model has been extended in several ways. For example, Stokman and Oosten (1994) apply the model to *indivisible* events in collective decision making. More in the vein of our paper, Marsden (1981) modifies and extends the model by introducing a process in which the interests expressed by actors may be influenced by those of other actors.

Marsden explicitly considers that individuals may influence each other strategically. However, his model does not incorporate a dynamic process of influence. In fact, he assumes that individuals influence each other only once, and does not study how the repeated interplay of the influence process leads to an equilibrium configuration of interests. In addition, Marsden's model differs from ours by assuming that the rule governing the change of opinions is linear.

While this paper focuses on attitude change, it is important to note that attitudes and beliefs are similar constructs. Beliefs can be defined as statements about relationships between objects, concepts and events. As a result, the model presented in this paper may also have some implications for cultural change.[4] Following Schein, we define culture as the "*basic assumptions* and *beliefs* that are shared by members of an organization, that operate unconsciously, and that define in a basic 'taken-for-granted' fashion an organization's view of itself and its environment" (1985, p. 6, emphasis original). For example, our analysis of the isolated leader case may capture important elements of the situation often faced by top-managers when initiating a cultural change process in their organizations. In fact, as mentioned by Kotter and Heskett (1992), effort towards major change is often initiated by leaders who "either came into their positions from outside their firms, came to their firms after an early career somewhere else, 'grew up' outside the core of their companies or were unconventional in some other way" (1992, p. 89). As a result, these leaders tend to bring with them perspectives, personal values and attitudes that are different from the ones that are dominant within their organizations.[5]

The remaining of the paper is organized as follows. Section 2 describes the conceptual framework used to analyze the impact of the timing of information flows and the system of formal and informal communication channels on the dynamic process of attitude change. Section 2.1 presents the model and Section 2.2 compares it to those presented in some related papers. Section 3 discusses the stylized version of the model studied in this paper. Section 3.1 describes the basic assumptions and Section 3.2 analyzes the results. Section 4 summarizes the main conclusions.

2. Conceptual Framework

2.1. The Model

The dynamic process of attitude change is modeled as follows. Consider an organization composed of N individuals. The attitude of each individual towards a given issue is assumed to be in one of two possible states: a positive attitude or a negative attitude. Attitudes are denoted by $s_i = \pm 1$, for $i = 1, 2, \ldots, N$. The state of this organization of N individuals at a given time t is described by the vector of attitudes

$$(s_1(t),\ s_2(t), \ldots, s_N(t)).$$

Attitudes evolve over time as individuals are influenced by other members of the organization. The attitude of an individual is affected by two types of things: his/her personal values, beliefs and personality, and the influence exercised by others over him/her. An individual's predispositions and the set of influences exercised on him/her may reinforce each other, if aligned, or have the opposite effect, if disaligned. In the latter case, the stronger influence prevails. Individual's i's ability to influence individual j depends on interpersonal visibility, i.e., on j's knowledge of i's attitude (e.g., Friedkin, 1993). Following Friedkin (1993, p. 863), we associate the idea of interpersonal visibility with the existence of communication channels between the two individuals. More specifically, we assume that individuals influence each other if and only if they communicate.

These ideas are formalized as follows. The interaction between pairs of individuals is described by a $N \times N$ matrix M, where each element M_{ij} describes the influence of individual i over individual j. The intensity of the influence of i over j is given by the absolute value of M_{ij}. A positive value of M_{ij} means that there is affinity between i and j, i.e., a given attitude of i tends to influence j's attitude in the same direction. Conversely, a negative value of M_{ij} means that there is animosity between i and j, i.e., a given attitude of i tends to influence j's attitude in the opposite direction. We assume that influences are reciprocal, in the sense that if i influences j, then j also influences i. Notice, however, that this assumption does not imply that the influence of i over j has the same intensity as the influence of j over i.

Consider a sequence of points in time, $t = 1, 2, 3, \ldots$. For a given set of attitudes at time t, the j-th attitude is updated at time $t + 1$ based on three factors: the attitudes of the other individuals at time t, the influence of each of them on j, and the strength of j's personal beliefs, values and personality. This last factor is represented by a variable α_j. The sign of this variable gives the attitude of j in the absence of interpersonal influence. Its magnitude allows us to compare the impact of j's personal beliefs, values and personality with the strength of the influence exercised by others over him/her.

The change of j-th attitude is assumed to occur according to the rule

$$s_j(t+1) = \operatorname{sign}\left[\sum_i M_{ij} s_i(t) + \alpha_j\right]. \tag{1}$$

Notice that s_j tends to align with the personal values α_j and with the attitudes of those who have a positive influence over $j(M_{ij} > 0)$. In addition, it tends to align negatively (or disalign) with the attitudes of those who have a negative influence over $j(M_{ij} < 0)$.[6]

The rule in Eq. (1) defines the way in which the attitude of a given individual changes. It describes how the attitude of an individual at time $t + 1$ is influenced by the attitudes of the other individuals at time t. We still have to specify whether the above equation applies to all individuals at the same time, or whether they update their attitudes according to a certain order. This is determined by the specific dynamics considered.[7]

Independently of the dynamics, the process of attitude change goes on until the configuration attains a fixed point under the specified dynamics. When such a fixed point is reached, the system is said to be in equilibrium. The idea is the following. At any moment in time, the system may or may not be in a stable situation. The system is in a stable situation when the attitude of *each* individual is aligned with the combined impact of his/her personal values and the influence exercised by others over him/her. The relevant issue, in this model, is to find whether the system converges to an equilibrium configuration or not, and to characterize such equilibrium.

Since the top manager's objective is to align members' attitudes with his/her own initial attitude, the optimal organizational design is the one that maximizes the number of individuals that share the top manager's initial attitude. Clearly, the ideal organizational structures and procedures are those where, as a result of the dynamic process of attitude change, the entire organization converts to the top manager's attitude. And the worst possible designs are those leading to a fixed point of the dynamics in which all individuals reach an attitude that is different from the one top-manager is trying to disseminate. Two intermediate situations may arise. First, the system may reach a fixed point in which some individuals have positive attitudes and others have negative attitudes. Clearly, the larger the number of individuals with the same attitude as the top-manager, the better. Second, the dynamics may not allow the system to find a stable configuration. We assume that the top manager is indifferent among all the situations where no equilibrium is reached.

This model should be seen as a laboratory that can be easily adapted to particular empirical contexts. The evolution of attitudes depends on factors such as the matrix of interactions, the nature of the dynamics, and the initial configuration of attitudes. For any given specification of the model, the evolution of attitudes can be analyzed. As an illustration of our general approach, we analyze, in Section 3, a stylized model of attitude change in organizations.

2.2. *Related Models*

In this section, we relate our model to the formal theory of social influence that studies how a network of interpersonal influences enters into the process of opinion formation (e.g., French, 1956; DeGroot, 1974; Friedkin, 1986, 1990, 1991; Friedkin and Cook, 1990; Friedkin and Johnsen, 1990, 1997). The objective is to understand the main differences between our model and the framework proposed in this literature.

In the framework proposed in the literature, the state of an organization of N individuals at a given time t is described by the vector of opinions

$$y(t) = (y_1(t), y_2(t), \ldots, y_N(t)).$$

The evolution of opinions is modeled as depending on two factors. First, on the individuals' original opinions $y(0)$, described as the $N \times 1$ vector

$$y(0) = XB,$$

where B is a $k \times 1$ vector of coefficients and X is a $N \times k$ matrix of exogenous variables.

Second, as in our model, the formation of opinions depends on social interactions, represented by $\sum_i M_{ij} y_i(t)$, where M is the $N \times N$ matrix of endogenous interpersonal influences.

The evolution of opinions is assumed to depend on these two variables in a linear way

$$y_j(t+1) = \gamma \left[\sum_i M_{ij} y_i(t) \right] + \beta y(0).$$

This equation is to be compared with our highly nonlinear expression in Eq. (1) .

The parameters of this model (γ, β, M, B and X) may be labelled by time period to allow for the possibility that they change over time. The number N of group members may also change over time. Obviously, our model has the same flexibility: we could also make, for example, α, M and N time-dependent. However, as Stockman (2001) points out, the existing models have been solved for fixed parameters' values.

Finally, it is important to notice that our model shares with this formal theory of social influence the three fundamental assumptions mentioned by Friedkin and Johnsen "(1) *Determinism*: There is an assumption that individuals' opinions are completely accounted for by a set of causal variables (...). (2) *Decomposability*: There is an analytical assumption that opinion formation process is decomposable into periods (that need not be of equal length) (...). (3) *Continuance*: (...) there is an assumption that the process of opinion formation continues unless all changes of opinion that might occur have made themselves out" (1990, pp. 195–196).

3. The Stylized Model

3.1. Assumptions

One of the main features of organizations is their formal structure (e.g., Mintzberg, 1983), characterized by the set of positions within the organization, the way these positions are clustered, and the way formal authority flows among them. We consider an organization with the following formal structure. Let $l = 1, 2, \ldots, k$ label the different levels of authority. In each level l there are, say, n_l individuals ordered as $i = 1, 2, \ldots, n_l$. Let $n_1 = 1$. Each individual is formally subordinated by an authority link to one individual in the next higher level $l - 1$ except, of course, when $l = 1$. Also, the i-th individual of level l is the direct superior of n_{il} individuals in the next lower level $l + 1$ except, once again, in the obvious case where $l = k$. Thus, $n_{l+1} = \sum_{i=1}^{n_l} n_{il}$ for all $l \geq 1$ and the total number of individuals

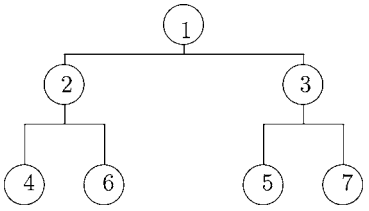

Figure 1. Formal structure.

in the organization is

$$N = 1 + \sum_{l=1}^{k-1} n_{l+1} = 1 + \sum_{l=1}^{k-1} \sum_{i=1}^{n_l} n_{il}.$$

For the sake of simplicity, we consider an organization composed of three levels ($k = 3$), where each individual in level 1 and 2 has two subordinates, meaning that $n_{il} = 2$ for $l = 1, 2$ and $i = 1, \ldots, n_l$. Such a formal structure is represented in figure 1. This is the simplest formal structure that captures the typical features of departments. In fact, this organization may be interpreted as consisting of one top manager and two multi-agent departments. Each department has two individuals and one manager. Both managers report to the top manager of the organization. The numbers have been distributed in such a way that it is possible to refer to the two departments as the odd department (the one including individuals 3, 5 and 7) and the even department. Let $s_i = \pm 1, i = 1, 2, \ldots, 7$, represent the attitude of each individual.

As already mentioned, individual i's ability to influence individual j depends, not only on his/her interpersonal visibility, but also on the salience of his/her attitude (e.g., Friedkin, 1993). We assume that the salience of i's attitude for j depends on their relative hierarchical position. More specifically, we consider that if i is subordinate of j, then $0 < M_{ij} < M_{ji}$.

In this setting, we consider three different organizations, according to their communication channels: the hierarchy, the network and a specific type of hybrid organization. In the *hierarchy*, the communication channels correspond to the formal links of authority. In particular, we define a matrix of influences M given by

$$M = \begin{bmatrix} 0 & u & u & 0 & 0 & 0 & 0 \\ d & 0 & 0 & u & 0 & u & 0 \\ d & 0 & 0 & 0 & u & 0 & u \\ 0 & d & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & d & 0 & 0 & 0 & 0 \\ 0 & d & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & d & 0 & 0 & 0 & 0 \end{bmatrix}$$

This matrix assumes that each individual influences its subordinates equally, with intensity $u > 0$. For instance, the influence of the top manager on managers 2 and 3 is expressed by $M_{12} = M_{13} = u$. It is also assumed that the subordinates influence their direct superiors with an intensity $d < u$. For example, the top manager is influenced by the two managers, but with less intensity. This is expressed by $M_{21} = M_{31} = d$, with $u > d > 0$.

Apart from the formal structure, an organization may be characterized by a complex system of informal communication channels (e.g., Krackhardt and Stern, 1988; Krackhardt and Hanson, 1993; Sanders et al., 1998). Through such informal channels, individuals bypass the formal authority system in order to communicate directly. We define the *network* as an organization where the communication channels corresponding to the formal links of authority are complemented by a complete system of informal communication. In particular, we define a matrix of influences M given by

$$M = \begin{bmatrix} 0 & u & u & u & u & u & u \\ d & 0 & e & u & u & u & u \\ d & e & 0 & u & u & u & u \\ d & d & d & 0 & e & e & e \\ d & d & d & e & 0 & e & e \\ d & d & d & e & e & 0 & e \\ d & d & d & e & e & e & 0 \end{bmatrix}$$

This matrix assumes that each individual influences all the individuals in lower levels equally, with intensity $u > 0$. For instance, the influence of the top manager on both managers 2 and 3 is the same as his/her influence on individuals in the lower level. This is expressed by $M_{12} = M_{13} = M_{14} = M_{15} = M_{16} = M_{17} = u$. It is also assumed that each individual influences all individuals in upper levels equally, with intensity $d > 0$ and $d < u$. Finally, since all relationships are considered, we include the influence among individuals within the same hierarchical level.

The notion of affinity and animosity are introduced in a very particular way. We assume that, whatever level is considered, the reciprocal influence between individuals in the same hierarchical level is denoted by e with $|e| < u$. We study both the situation where e is positive and the situation where e is negative. In the former case, there is affinity between peers; in the latter there is animosity.[8]

We also consider a specific type of hybrid organization, where there is only one type of informal relationship: direct peer contact. More specifically, we assume that the two managers communicate directly with each other and that peers working in the same department also communicate with each other. These links may be interpreted as corresponding to the existence of an executive committee, and of intradepartmental influence. In particular, we

define a matrix of influences M given by

$$M = \begin{bmatrix} 0 & u & u & 0 & 0 & 0 & 0 \\ d & 0 & e & u & 0 & u & 0 \\ d & e & 0 & 0 & u & 0 & u \\ 0 & d & 0 & 0 & 0 & e & 0 \\ 0 & 0 & d & 0 & 0 & 0 & e \\ 0 & d & 0 & e & 0 & 0 & 0 \\ 0 & 0 & d & 0 & e & 0 & 0 \end{bmatrix}$$

We consider the simultaneous dynamics, the TD sequential dynamics and the BU sequential dynamics. Under the TD dynamics, attitudes are revised starting from the top of the formal structure of the organization to the bottom, in repeated cycles until an equilibrium is reached. In particular, it is assumed that, in each cycle, the sequence of attitude change follows the numbering given to the members of the organization. Under the BU dynamics, attitudes are revised starting from the bottom of the formal structure of the organization to the top in repeated cycles until an equilibrium is reached. Here, in each cycle, the sequence of attitude change follows in decreasing order the numbering given to the members of the organization.

The different dynamics are implemented as follows. We assume that personal values and beliefs are relatively weak, so that influences play a relevant role. Obviously, if personal values and beliefs are relatively strong, individual attitudes do not change. More specifically, we assume that $\alpha_j = 0$, for all j.

Under the simultaneous dynamics, the total influence over individual j at time t is measured by

$$h_j(t) = \sum_{i=1}^{N} M_{ij} s_i(t).$$

If $h_j(t)$ is positive, the j-th individual will have a positive attitude at time $t + 1$; if $h_j(t)$ is negative, the j-th individual will have a negative attitude at time $t + 1$. In the simultaneous dynamics all the individuals revise their attitudes at the same time. Hence, at time $t + 1$

$$s_j(t + 1) = \text{sign } h_j(t).$$

A sufficient and necessary condition that characterizes the equilibrium configuration of attitudes at time t is given by $s_j(t)h_j(t) > 0$, for all j.

In the TD sequential dynamics, those in the top of the organization revise their attitudes first. Our objective, in this paper, is to analyze the problem faced by the top manager when choosing the organizational structures and procedures that facilitate the alignment of the members' attitudes with his/her own initial attitude. Therefore, it makes sense to assume that, in the TD dynamics, the first individual that revises his/her attitude is manager number two, not the top manager. The top manager will have a chance to revise his/her attitude only

after the whole organization has passed through this process. For an initial configuration $\{s_1(0), s_2(0), \ldots, s_7(0)\}$, this dynamics implies that the configuration of attitudes at any future time t is given as follows.

$$
\begin{array}{llllll}
\text{At } t = 1, & s_2(1) = \text{sign } h_2(0) & \text{and} & s_i(1) = s_i(0), & \forall i \neq 2 \\
\text{At } t = 2, & s_3(2) = \text{sign } h_3(1) & \text{and} & s_i(2) = s_i(1), & \forall i \neq 3 \\
\text{At } t = 3, & s_4(3) = \text{sign } h_4(2) & \text{and} & s_i(3) = s_i(2), & \forall i \neq 4 \\
\quad \vdots & & & & \\
\text{At } t = 6, & s_7(6) = \text{sign } h_7(5) & \text{and} & s_i(6) = s_i(5), & \forall i \neq 7 \\
\text{At } t = 7, & s_1(7) = \text{sign } h_1(6) & \text{and} & s_i(7) = s_i(6), & \forall i \neq 1 \\
\text{At } t = 8, & s_2(8) = \text{sign } h_2(7) & \text{and} & s_i(8) = s_i(7), & \forall i \neq 2 \\
\quad \vdots & & & &
\end{array}
$$

Equilibrium is reached at the first time t where $s_j(t)h_j(t) > 0$, for all j.

In the BU sequential dynamics, for a given initial configuration $\{s_1(0), s_2(0), \ldots, s_7(0)\}$, the configuration of attitudes at any future time t is given as follows.

$$
\begin{array}{llllll}
\text{At } t = 1, & s_7(1) = \text{sign } h_7(0) & \text{and} & s_i(1) = s_i(0), & \forall i \neq 7 \\
\text{At } t = 2, & s_6(2) = \text{sign } h_6(1) & \text{and} & s_i(2) = s_i(1), & \forall i \neq 6 \\
\text{At } t = 3, & s_5(3) = \text{sign } h_5(2) & \text{and} & s_i(3) = s_i(2), & \forall i \neq 5 \\
\quad \vdots & & & & \\
\text{At } t = 6, & s_2(6) = \text{sign } h_2(5) & \text{and} & s_i(6) = s_i(5), & \forall i \neq 2 \\
\text{At } t = 7, & s_1(7) = \text{sign } h_1(6) & \text{and} & s_i(7) = s_i(7), & \forall i \neq 1 \\
\text{At } t = 8, & s_7(8) = \text{sign } h_7(7) & \text{and} & s_i(8) = s_i(7), & \forall i \neq 7 \\
\quad \vdots & & & &
\end{array}
$$

As before, equilibrium is reached at the first time t such that $s_j(t)h_j(t) > 0$, for all i.

We still have to specify the two initial configurations of attitudes. The isolated leader case corresponds to the situation where the leader has an attitude which is different from the one that prevails in the organization. Without loss of generality, we consider $s_1 = +1$ and $s_i = -1$ for $i \neq 1$. In the conflicting attitudes case, the organization is split in two significant factions—one that has the same attitude as the top manager and one that has the opposite attitude. In particular, we assume that one department (the odd department) has the same attitude as the top manager and the other department (the even department) has the opposite attitude. This means that $s_i = +1$ for all odd i and $s_i = -1$ for i even.

In sum, in this paper we conduct a virtual experiment with a $3 \times 2 \times 2 \times 2$ design. We consider three types of organizations (hierarchies, networks and hybrid organizations); two directions of influence among peers (affinity and animosity); two timings of information flows (simultaneous and sequential change, the latter being either top-down or

Table 1. Virtual experiment $3 \times 2 \times 2 \times 2$.

Types of organizations (3)	Hierarchies, networks and hybrid
Directions of horizontal influence (2)	Affinity and animosity
Timings of information flows (2)	Simultaneous and sequential
Initial configuration of attitudes (2)	Isolated leader and conflicting attitudes

bottom-up); and two initial configuration of attitudes (the isolated leader case and the conflicting attitudes case). This experiment is described in Table 1.

3.2. Results

We are now in position to discuss the relationship between the organizational type and the dynamic process of attitude change, in the context of the stylized model presented in Section 3.1. For convenience, we first discuss the results for the affinity case, i.e., the case where peers influence each other in the same direction ($e > 0$), and then analyze the animosity case, i.e., the case where peers influence each other in the opposite direction ($e < 0$).

The results presented below are derived as follows. For each given initial configuration of attitudes, matrix M of interactions, direction of influences among peers, and initial configuration of attitudes, we iterate the specified dynamics until a fixed point is attained. In some cases, however, no fixed point is attained, meaning that there is no equilibrium configuration.

3.2.1. Affinity

Isolated Leader Case. The results for the isolated leader case in the presence of affinity are summarized in Table 2.

Table 2. Results for the isolated leader case in the presence of affinity.

	Dyn	$u < 2d - e$	$2d - e \leq u \leq 2d$	$2d < u < 2d + e$	$2d + e < u$
Hybrid	T-D	All (−)	All (−)	Init. Conf.	All (+)
	B-U	All (−)	All (−)	All (+)	All (+)
	Sim.	All (−)	All (−)	All (−)	No eq.
Hierarchy	T-D	All (−)	All (−)	All (+)	All (+)
	B-U	All (−)	All (−)	All (+)	All (+)
	Sim.	All (−)	All (−)	No equil.	No eq.
		$u < 4d - e$	$4d - e \leq u \leq 4d + e$		$4d + e < u$
Network	T-D	All (−)	All (−)		All (+)
	B-U	All (−)	All (−)		All (−)
	Sim.	All (−)	All (−)		All (−) $u < 3e$
					No eq. $u \geq 3e$

It follows from this table that a necessary condition for the leader to be able to change the prevalent attitudes within the organization is that the dynamics is sequential. Given our interpretation of the sequential dynamics, this result suggests that the degree of participation is a relevant ingredient in the process of attitude change.

The intuition for this result is the following. When the top manager has an attitude which is different from the attitude of all other members, it is easier for him/her to influence first the individuals in one level of the formal structure and then—possibly with the help of those individuals—to influence individuals in the other level. To illustrate this point, let us contrast the simultaneous dynamics and the top-down sequential dynamics. In the simultaneous dynamics, it is more difficult for the leader to change the attitudes of the individuals in level 3. In fact, when individuals 4, 6, 5 and 7 revise their attitudes, managers in level 2 have not yet revised their attitudes. The influence exercised by these managers makes it more difficult for the top manager to change the attitudes of the individuals in level 3. In contrast, in the top-down sequential dynamics, managers in level 2 revise—and possibly change—their attitudes before individuals in level 3. Therefore, when individuals 4, 6, 5 and 7 revise their attitudes, managers in level 2 may have already changed their attitudes, helping the top manager in changing the attitudes of individuals in level 3.

It also emerges from Table 2 that the hierarchy is the optimal organization because it maximizes the number of individuals who share the top manager's attitude for any given circumstance. To understand the intuition for this result, it is important to distinguish between informal relationships *including* the top manager and informal relationships *excluding* the top manager.

Consider first the informal relationships including the top manager. These relationships have two different effects. First, the larger the number of relationships, the stronger the influence of the organization as a whole on the top manager. Second, the larger the number of relationships, the stronger the direct influence of the top manager on the lowest level of the organization. These two effects seem to be contradictory. While the first effect apparently makes it more difficult for the initial attitude of the top manager to prevail in the organization, the second effect seems to have the opposite impact.

Interestingly, however, the second effect does not make it easier for the initial attitude of the top manager to prevail in the organization. To see why this is so, consider first a sequential dynamics. Clearly, in a sequential dynamics, either the top manager is able to change the attitude of the individuals in level 2, or it is not possible for the top manager's initial attitude to prevail in the organization. Furthermore, if the top manager is able to change the attitudes of the two managers, the attitude of individuals in level 3 will also change, independently of any additional links beyond the formal structure. Therefore, it is possible for the initial attitude of the top manager to prevail in the organization if and only if he is able to influence the attitudes of the two managers. This means that, for a sequential dynamics, the fact that the top manager is able to directly influence individuals in level 3 cannot help. Consider now the simultaneous dynamics. In this case, as opposed to what occurred in the previous case, all individuals within the organization revise their attitudes at the same time. There is no gradual convincing process as in the case of the sequential dynamics. Thus, even if the top manager has enough influence over individuals in level 2 to make their attitudes become positive, his/her own attitude will certainly become negative.

Table 3. Results for the conflicting attitudes case in the presence of affinity.

	Dynamics	$u \leq 2d - e$	$u > 2d - e$
Hybrid	Top-down	Init. conf.	All (+)
	Bottom-up	Init. conf.	All (+)
	Simult.	Init. conf.	All (+)
Hierarchy	Top-down	Init. conf.	All (+)
	Bottom-up	Init. conf.	All (+)
	Simult.	Init. conf.	All (+)
Network	Top-down	All (+)	All (+)
	Bottom-up	All (+)	All (+)
	Simult.	All (+)	All (+)

This justifies the no-equilibrium solution obtained in Table 2 for the hierarchy (for $u > 2d$). Any additional links of the top manager with individuals in level 3 simply reinforce this mechanism and, clearly, do not help the top manager in his/her original attempt.

Consider now the informal relationships which exclude the top manager. These relationships lead to the mutual reinforcement of the initial negative attitude of the members involved. Therefore, they can only make it more difficult for the top manager to influence the attitude profile in the organization.

Conflicting Attitudes Case. The results for the conflicting attitudes case in the presence of affinity are summarized in Table 3.

From this table, it follows that the ability of the top manager to impose his/her initial attitude does not depend on the dynamics under consideration. This result seems to suggest that the importance of the dynamics depends on the initial distribution of attitudes among the different levels of the organization. The idea is the following. In the conflicting attitudes case, as opposed to the isolated leader case, positive and negative attitudes are evenly distributed in levels 2 and 3. Thus, the degree of participation is a less-relevant ingredient in the process of attitude change.

It is also evident from Table 3 that the network is the optimal organization. The intuition is the following. In the conflicting attitudes case, the informal relationships that characterize the network help the top manager in imposing his/her initial attitude. In the hierarchy, there are clusters of individuals with a given attitude that do not interact with other clusters having the opposite attitude. They only interact with people having the same attitude. This makes attitude change more difficult. The informal relationships that characterize the network avoid this situation, allowing everybody to interact with everybody. Since half of the members in levels 2 and 3 have the same initial attitude as the top manager, his/her initial attitude prevails.

This result contrasts with that obtained for the isolated leader case. While in the isolated leader case the informal relationships between individuals in levels 2 and 3 lead to the reinforcement of the members' common negative attitudes, here the opposite effect is produced.

Table 4. Results for the isolated leader case in the presence of animosity.

	Dynamics	$u \leq 2d - e$	$2d - e < u < 2d + e$	$u > 2d + e$
Hybrid	Top-down	All (−)	Dissid. dept.	All (+)
	Bottom-up	All (−)	Dissid. dept.	All (+)
	Simult.	All (−)	All (−)	No equil.
		$u \leq 2d$	$u > 2d$	
Hierarchy	Top-down	All (−)	All (+)	
	Bottom-up	All (−)	All (+)	
	Simult.	All (−)	No eq.	
		$u \leq 4d - e$	$4d - e < u < 4d + e$	$u > 4d + e$
Network	Top-down	Init. Conf.	All (+)	All (+)
	Bottom-up	All (−)	All (+)	All (+)
	Simult.	All (−)	No equil.	No equil.

The interaction between individuals from different departments makes it easier for the top manager to impose his/her initial attitude.

3.2.2. Animosity

Isolated Leader Case. The results for the isolated leader case in the presence of animosity are summarized in Table 4.

From this table, it follows that, as in the affinity case, a necessary condition for the leader to be able to change the prevalent attitude within the organization is that the dynamics is sequential. Again, it is easier for an isolated leader to first influence the individuals in one level of the formal structure and then—possibly with the help of those individuals—to influence individuals in the other level.

It is also apparent from Table 4 that, as opposed to the affinity case, the network is the optimal organizational structure. The intuition is the following. Let us first compare the hierarchy and the hybrid organization. In contrast to the affinity case, where the informal links lead to the mutual reinforcement of the members' negative attitudes, here, because of animosity, the informal links between peers facilitate attitude change. Interestingly, the network amplifies this effect, because when an attitude becomes positive there is a chain-reaction impact on all the other members of the organization.

Conflicting Attitudes Case. The results for the conflicting attitudes case in the presence of animosity are summarized in Table 5.

It follows from this Table that it is easier for the top manager's initial attitude to prevail in the organization under the sequential dynamics than under the simultaneous dynamics. The intuition is the same as above.

In addition, the network is the optimal organization. This is so because, as in the affinity case, in both the hierarchy and the hybrid organization there are individuals in level 3 who

Table 5. Results for the conflicting attitudes case in the presence of animosity.

	Dynamics	$u \leq 2d$	$2d < u < 2d + e$	$u > 2d + e$
Hybrid	Top-down	Init. conf.	Init. conf.	All (+)
	Bottom-up	Init. conf.	Init. conf.	All (+)
	Simult.	Init. conf.	Init. conf.	All (+)
Hierarchy	Top-down	Init. conf.	All (+)	All (+)
	Bottom-up	Init. conf.	All (+)	All (+)
	Simult.	Init. conf.	No equil.	No equil.
Network	Top-down	All (+)	All (+)	All (+)
	Bottom-up	All (+)	All (+)	All (+)
	Simult.	All (+)	All (+)	All (+)

interact only with people having the same attitude. Since, by assumption, $u > e$, this makes it more difficult for the top manager to change the attitude of those individuals in level 3 who start with a negative attitude.

4. Conclusion

This paper presents a general framework to analyze how the system of formal and informal communication channels that characterize an organization and the timing of information flows affect the evolution of attitudes. The evolution of attitudes in an organization may depend on several factors, such as the initial configuration of attitudes, the network of influences, and the degree of participation. The framework proposed in this paper allows the analysis of the dynamic process of attitude change for any specific realization of these variables.

To illustrate how this approach is able to generate results about the impact of organizational design on attitudes, we analyze a stylized version of the model. In spite of relying on very specific assumptions, this particular version of the model provides some useful insights.

Our analysis shows that the organizational type affects the ability of the top-manager to influence the configuration of attitudes in the organization. For example, in the affinity case, we identify conditions under which the hierarchy is the optimal structure and conditions under which the network is the optimal structure. Furthermore, using our stylized model, we show that the optimal organizational type depends on the type of relationship among organization members. Consider the affinity case. Here, when the leader is isolated, informal relationships typically lead to the mutual reinforcement of the members' attitudes, making attitude change more difficult. As a result the hierarchy tends to be the optimal structure. In contrast, in the conflicting attitudes case, the informal relationships that characterize the network may facilitate attitude change. As a result, the network may be the optimal structure. However, even a small degree of animosity may change these results. In particular, when there is some animosity between peers, it may no longer be optimal for an isolated leader

to choose a hierarchy. Due to animosity, the informal relationships that characterize the network may facilitate change. This result shows that one cannot discuss the problem of organizational design without paying attention to the degree of affinity and animosity that characterizes the organization.

The analysis presented in this paper also indicates that the optimal organizational type depends on the intensity of the top-manager's influence. Consider, for example, our stylized model. In the isolated leader case, when the influence of the top-manager is low, the dissemination of the top-manager's original attitude is very difficult (or even impossible), independently of the organizational type. In this case, the organizational type only makes a difference when the influence of the top-manager is sufficiently high (Tables 2 and 4). In contrast, in the conflicting attitudes' case, the organizational type plays an important role, even when the top-manager's influence is low (Tables 3 and 5).

In addition, we show that, depending on the values of the other parameters, the equilibrium attitudes may be affected by the dynamics of attitude change. For example, in our stylized model, the sequential dynamics facilitates attitude change under both the affinity and the animosity cases. The top manager may make attitude change easier by decreasing the level of participation, so that issues are discussed within subgroups, in an order corresponding to the formal structure of authority. The reason is that it is easier for the top manager to first influence a group of individuals and then—possibly with the help of these individuals—to influence other individuals. The fact that the equilibrium attitudes may be affected by the dynamics of attitude change has an important implication for the social network literature: formal models of social networks should consider *both* simultaneous and sequential processes of influence.

All these results indicate that there is no one best organization design when a top manager is trying to change the attitude profile of an organization. The optimal organizational design may depend on the specific circumstances faced by the top manager, such as the initial configurations of attitudes and the type of relationship among peers. This is consistent with the ideas of contingency theorists (e.g., Lawrence and Lorsch, 1967), who argue that the right design for an organization depends on the situation.

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Notes

1. In real life organizations there are situations where diversity of attitudes is beneficial. By providing a general framework to analyze the evolution of attitudes, the model proposed in this paper is also capable of generating

useful insights about the conditions under which such diversity is produced. For simplicity of exposition, we focus on those situations where the objective of the top manager is to align the members' attitudes.

2. According to Heider (1958), a system is balanced whenever each individual agrees with liked persons and disagrees with disliked persons. Imbalance exists when an individual disagrees with a liked person or agrees with a disliked person. Imbalance creates a pressure to change in order to restore a state of balance. This suggests that there is affinity between two individuals when they like each other, and animosity when they dislike each other.
3. Most likely, no real organization is correctly described by any of these extreme specifications. In general, we would expect a combination of the simultaneous and the sequential dynamics, with some subgroups changing their attitudes simultaneously and others sequentially. However, since all the possible dynamics are combinations of the extreme cases, our discussion captures important features of the dynamics of attitude change in organizations.
4. We thank the editor for pointing out this analogy and its potential implications.
5. Kotter and Heskett (1992) offer an interesting description and analysis of major change processes that occured in several large organizations. Other important references on the topic of organizational change are Kanter et al. (1992) and Jick (1993).
6. Alternatively, we could model individual attitudes as continuous variables rather than as binary ones. Although such a representation of attitudes may seem more natural, it would significantly complicate the analysis. As we increase the number of attitudes each individual may assume, complexity increases exponentially. In our setting there are 2^N possible configurations of attitudes; with three different attitudes there would be 3^N possible configurations; and so on. With continuous attitudes, there would be an infinite number of configurations of attitudes to be compared. As already mentioned, our binary approach is justified by our focus on the alignment of attitudes.
7. By considering, not only the simultaneous dynamics but also the two sequential dynamics, our paper extends the existing formal models on the formation of opinions (e.g., Friedkin and Johnsen, 1990, 1997) in another direction. In spite of acknowledging the possibility that influences are exercised sequentially (e.g., Friedkin and Johnsen, 1990, p. 195, footnote 3), this literature focus on the simultaneous case.
8. These specifications can be generalized in two ways. First, any u and/or d could be negative. Second, different e's could have different signs. Obviously, the number of alternative scenarios is very large. For simplicity, we limit our analysis to the above mentioned cases.

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