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The Attitude-Behavior Linkage in Behavioral Cascades

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The assumption that individual behavior has an antecedent evaluative foundation is an important component of theories in sociology, psychology, political science, and economics. In its simplest form, the antecedent evaluation is a positive or negative attitude toward an object that may affect an individual's object-related behavior. This attitude may be influenced by the attitudes of other persons. The occurrence of such endogenous interpersonal influences, in which persons' attitudes are affected by other persons' attitudes, is among the basic postulates of social psychology. The present article advances work on the attitude-behavior linkage in behavioral cascades by jointly considering two theories: the theory of reasoned-planned action, which emphasizes the deliberative foundations of individuals' object-related behaviors, and social influence network theory, which emphasizes the group dynamics involved in the formation of individuals' attitudes.

He had in him all the attitudes of others, calling for a certain response; that was the "me" of that situation, and his response is the "I."

George Herbert Mead, 1934

INTRODUCTION

Explanations of behavioral cascades involved in collective action and social diffusion within large-scale groups have focused on a social psychological mechanism in which the probability of a group member adopting a behavior is affected by the adoption-behavior of other members of the group (Centola and Macy 2007; Granovetter 1978; Valente 1995; Watts and Dodds 2007). When individuals' attitudes are included in the explanation of a behavioral cascade, they are attitudes with direct effects on individuals' behaviors, i.e., an attitude-behavior linkage is specified. Unless strict mimicry of behavior is assumed, the behaviors of others that are posited to affect the behavior of a focal

individual may also be fundamentally based on attitudinal influences. The effect of significant others' behaviors may be based on individuals' perceptions of the attitudes of significant others about the behavior that the significant others have or have not adopted.

In the absence of information about the attitude of another person, a focal individual may impute a commensurate positive or negative attitude to a significant other who has adopted or not adopted a behavior and be influenced by the choice of that other person based on that imputation. For example, when Warren Buffett adds a stock to his portfolio of equity positions, others adopt his behavior based on the reasonable assumption that Buffett has a positive evaluation of the firm's prospects. However, given information about the attitude of another person, the behavior of that other person may not be salient in the focal individual's choice. This may occur in two ways. First, a focal individual for whom the behavior is a voluntary choice is unlikely to be influenced by the behavior of significant others who negatively evaluate the behavior based on their experience with it, or who have been compelled to adopt it contrary to their attitudes; in such a case, the focal individual's attitude about

the behavior is likely to be influenced by the negative attitudes of these significant others and, because the focal individual has a choice, the individual is unlikely to adopt the behavior. Second, a focal individual for whom the behavior is a voluntary choice is unlikely to be influenced by the behavior of significant others who positively evaluate the behavior but who have not had the opportunity or do not have the means to adopt it; in such a case, the focal individual's attitude about the behavior is likely to be influenced by the positive attitudes of these significant others and, because the individual has a choice, the individual is likely to adopt it. In short, a credible approach to the explanation of behavioral cascades may be based on an attitude-behavior linkage in which individuals' behaviors are directly affected by their attitudes that have been influenced by the attitudes of significant others. In this article, I develop an approach to behavioral cascades that is based strictly on individuals' attitudes.

The present article advances work on the attitude-behavior linkage in behavioral cascades via a joint consideration of two theories: the approach to the attitude-behavior linkage advanced by the theory of reasoned-planned action (Ajzen 1988; Ajzen and Fishbein 1980; Fishbein 1967; Fishbein and Ajzen 1974, 1975), and the approach to interpersonal influences on attitudes advanced by social influence network theory (Friedkin 1998, 1999; Friedkin and Cook 1990; Friedkin and Johnsen 1990, 1999, 2003). In tandem, the theories provide an explanation of the voluntary behaviors of individuals, the adoptions of courses of action by small groups, and the behavioral cascades of large-scale groups. The explanation of these phenomena is based on a discrete time social process of attitude change in which, at each point in time during the process, individuals' attitudes about an object are influenced by the attitudes of others about the object and manifested in their object-related behaviors.

Voiced and written words, and other symbolic gestures, are deeds with which an individual may express a detailed evaluative position on an issue, or a broad evaluative orientation toward an object. If the display of an attitude is defined as a form of behavior, then the attitude-behavior linkage involved in such display is problematic only in situations that foster a decoupling of persons' private and public attitudes. Displayed attitudes, opinions, judgments, and preferences are behaviors that allow various forms of symbolic interaction among persons, including interpersonal influences in which individuals' attitudes affect or are affected by other persons' attitudes. In the interpersonal settings in which displayed attitudes ubiquitously arise, the display of an attitude typically occurs jointly with displays of other persons' attitudes, and may trigger the latter. The extent to which explanations of individuals' responses attend to the endogenous interpersonal influences that are based on such displays is a classic touchstone in social psychology (Blumer 1969; Mead 1934). Newcomb writes (1951:34):

> Any observable behavior is not only a response (on the part of a subject) which is to be treated as a dependent variable; it is also a stimulus to be perceived by others with whom the subject interacts, and thus to be treated as an independent variable.

In the symbolic interaction tradition and in social network theory, an attention to endogenous interpersonal influences is not restricted to explanations of the individuals' independent responses, but more broadly encompasses the implications of such influences unfolding in a group of individuals, influences to which each member is subject. The implications of group dynamics include flows of interpersonal influence among group members and the formation of interpersonal agreements, including group consensus, on the definition of situations, positions on issues, and orientations toward objects of interest to group members.

As a matter of convenience, I employ the term *attitude* to refer to various forms of object evaluation (an opinion, judgment, or preference), and I employ the expression *attitude-behavior linkage* to refer to the mapping $\dot{y}_i^{(t)} \leftarrow y_i^{(t)}$ of an individual's time t attitude $y_i^{(t)}$ onto the individual's time t object-related behavior $\dot{y}_i^{(t)}$ (dot y). In turn, I draw on social influence network theory and treat the attitude

$y_i^{(t)}$ that is involved in this linkage as a *dynamic social construction* of individual i based on i's accord of interpersonal influence to others, i.e., an accord of particular weights to self and others' attitudes. Social influence network theory, extended to the account of individual behavior, is an approach in which an individual's object-related behavior is linked to an attitude that is an individual's *dynamic cognitive integration* of self and others' attitudes,

$$\dot{y}_i^{(t+1)} \leftarrow y_i^{(t+1)} = \left(1 - w_{ii}^{(t)}\right) \sum_{j=1}^{n} w_{ij}^{(t)} y_j^{(t)} + w_{ii}^{(t)} y_i^{(1)},$$

(1)

$t = 1, 2, \ldots$, where $w_{ij}^{(t)}$ is a nonnegative relative accorded weight, i.e., $0 \leq w_{ij}^{(t)} \leq 1$ for all i and j, and $\sum_{j}^{n} w_{ij}^{(t)} = 1$ for all i. In this social process, an individual's self-weight $w_{ii}^{(t)}$ governs the contribution of others' attitudes to the individual's attitude, and the individual's accorded weight to a particular other $w_{ij}^{(t)}$ ($i \neq j$) governs the contribution of the attitude of that other person j to the individual's attitude.

The above formalization draws on the large body of empirical work on the attitude-behavior linkage that has developed from the theory of reasoned-planned action to extend the scope of application of social influence network theory. Previous empirical assessments of social influence network theory have focused on small group dynamics. The theory has not been applied to investigations of individual-level behaviors (i.e., samples of individuals who have been drawn from different groups) or to investigations of behavioral cascades within large-scale groups. The application of the theory to such individual and collective phenomena is straightforward when the attitudes being formed by the mechanism described by social influence theory are linked with individuals' behaviors in manner that is consistent with the social psychological literature on the attitude-behavior linkage. This literature presents important conclusions about the conditions under which a strong attitude-behavior linkage arises.

THE ATTITUDE-BEHAVIOR LINKAGE

In the simplest of cases, the attitude-behavior linkage is the identity mapping in which an individual's behavior is the individual's *displayed* attitude, $\dot{y}_i^{(t+1)} = y_i^{(t+1)}$, e.g., a derogatory or admiring remark of some strength, on a scale of such remarks, about another person (group member, job candidate, office holder). In other simple cases, the linkage may involve a partial linear mapping of a quantitative attitude onto a quantitative behavior, e.g., $\dot{y}_i^{(t+1)} = \beta_0 + \beta_1 y_i^{(t+1)} + \beta_2 z_{i2}^{(t+1)} + \ldots$ in which the amount of funds that an individual allocates to an object (e.g., a person, institution, activity) is affected by the scale value of the individual's evaluation of the object, along with other variables (z_2, z_3, $\ldots$). It also may involve a simple threshold mapping of a quantitative attitude onto a binary behavior, e.g., the adoption or non-adoption of a practice $\dot{y}_i^{(t+1)} = 1$ if $y_i^{(t+1)} \geq T$ and $\dot{y}_i^{(t+1)} = 0$ if $y_i^{(t+1)} < T$, where T is a homogeneous threshold value, e.g., $T = 0$ or $T = 0.50$. In a modestly more complex case, the linkage may involve a mapping of a quantitative attitude onto the odds of manifesting a binary behavior, e.g., $\Pr\left(\dot{y}_i^{(t+1)} = 1\right) \Big/ \Pr\left(\dot{y}_i^{(t+1)} = 0\right) = \exp(\beta_0 + \beta_1 y_i^{(t+1)} + \beta_2 z_{i2}^{(t+1)} + \ldots)$. There are many possible mappings of attitudes onto behaviors that include mappings suitable to multidimensional attitudes and behaviors.

Meta-analyses of the available findings on the attitude-behavior linkage have served to highlight conditions that affect the strength of the linkage (Armitage and Conner 2001; Glasman and Albarracin 2006; Kim and Hunter 1993; Wallace et al. 2005; Webb and Sheeran 2006). The empirical issue of whether attitudes ubiquitously *precede* behavior appears settled, and so does the empirical issue of the existence of a reliable *linkage* of attitudes and behaviors. Bargh and his colleagues have shown that attitudes are instantaneously formed upon the presentation of objects (Bargh et al. 1992; Bargh and Ferguson 2000). Meta-analyses of the strength of the attitude-behavior linkage have addressed the

question, raised to prominence by Wicker (1969), on whether a reliable attitude-behavior linkage exists. The strength of the attitude-behavior linkage for voluntary behaviors is noteworthy and, in careful work that takes into account both measurement errors and scaling constraints, it is substantial. The literature on the linkage has grown large by addressing conditions that affect (moderate) the strength of the linkage. These advancements have contributed to an understanding of the properties of a strong linkage; three such properties have been emphasized.

Voluntary Behavior

The first property of a strong linkage is that it involves voluntary action. It is clear that individuals' attitudes will not be strongly linked to their behaviors when manifesting or refraining from the behaviors is inhibited or forced. Persons may or may not behave in ways that are consistent with their attitudes because of conditions that inhibit or disallow the behavior (e.g., constraints of income, age, or proscriptions) or because of conditions that encourage or coerce the behavior (e.g., pressures of compliance to authority, status obligations, or prescriptions). Research on the linkage has been advanced by focusing on special cases of behaviors that are credible homogeneous resultants of voluntary choice, and by including measures of individuals' level of discretionary control over their behavior.

Although a scope restriction to voluntary behaviors appears restrictive, there are many situations in which feasible optional or alternative behaviors exist under a particular set of constraints. A useful perspective on voluntary choice is involved in the operations-research approach to decision making (Hillier and Lieberman 1995). A feasible set of optional voluntary behaviors usually exists under a specific set of constraints. In operations-research problems, the selection of a particular option is determined by a constrained optimization of a criterion value. Here, in contrast, the choice is the "selection" of an object-related behavior by an individual, from a feasible set

of two or more behaviors, which is affected by an individual's attitude toward the object.

Compatible Constructs

The second property of a strong linkage is that it involves compatible constructs. A strong linkage between attitudes and behaviors occurs when the constructs are comparably general or specific. Fishbein and Ajzen's (1975) work established this principle early in the literature on the linkage, and the merits of the principle have now been firmly established. General attitudes are weak predictors of specific actions, but do predict behavioral tendencies in an aggregated domain of object-related behaviors on which the general attitude has a bearing. For instance, political liberalism-conservatism is a general attitude, which may be manifested as an effect on the distribution of a person's object-related behaviors (e.g., votes) across a number of objects (e.g., candidates and issues). Such an attitude may have a weak association with specific object-related behaviors, i.e., persons' votes on a particular candidate or issue. In contrast, *specific* attitudes are linked to the *specific* actions to which such attitudes refer. For instance, an evaluative attitude about a particular practice, such as partial-birth abortion, is a specific attitude that is likely to be manifested in specific object-related behavior, such as individual legislators' votes on the status of the practice. Fishbein and Ajzen emphasize four dimensions of specificity—action, target, context, and time (Ajzen and Fishbein 2005). A high level of specificity arises when: (1) the object of the attitude is specified as a particular object-related action or set of actions; (2) a particular target or a set of targets is specified as the object of the action; (3) a particular context or set of contexts is specified for the object-related action; and (4) a particular time or time-range is specified for the object-related action. Subsequent research indicates that the first two dimensions of specificity are more important than the latter two dimensions (Kim and Hunter 1993).

Deliberate Behavior

The third property of a strong linkage is that it is based on the formation of a behavioral intention: Attitudes are reliably manifested in behavior via the formation of an intention to manifest the behavior. This property of the linkage also was proposed by Fishbein and Ajzen (Fishbein 1967; Fishbein and Ajzen 1974), and measures of individuals' behavioral intentions have been incorporated in studies of the linkage. However, an attitude-behavior linkage is not restricted to deliberative action, in service of formulated goals, but may also arise with unreasoned and unplanned actions. Fazio and Towles-Schwen (1999) have outlined a more general approach in which the linkage may involve either deliberate or spontaneous action. Bargh and his colleagues have established a linkage between individuals' automatic spontaneous attitudes and subsequent behaviors (Bargh et al. 1992; Bargh and Ferguson 2000). It is as yet unclear whether the detected effects involved in such spontaneous linkages may be classed as strong attitude-behavior linkages, comparable to the linkages documented for deliberative actions that are mediated by the formation of behavioral intentions.

THE THEORY OF REASONED-PLANNED ACTION

The theory of reasoned-planned action has framed work on the attitude-behavior linkage since the theory's inception as a reformulation of Dulany's (1961) work on behavioral intentions (Fishbein 1967). A large number of studies have probed the theory's merits, and research related to the theory remains an active field (Ajzen and Fishbein 2005; Fishbein and Ajzen 2009). At the same time, as noted above, current research on the linkage has been broadened (e.g., in the line of work, referenced above, on the behavioral correlates of instantaneously formed attitudes), and current work on the linkage now includes prominent alternative approaches (e.g., Fazio and Towles-Schwen 1999). The sustained research activity, spanning decades, that revolves on the theory of reasoned-planned action, is a remarkable testament to the merits of Fishbein and Ajzen's

approach to the linkage. I focus my analysis on their theory because it has a suggestively close relationship with social influence network theory (Friedkin and Johnsen 2010).

The theory of planned action differs from its predecessor, the theory of reasoned action, with inclusion of an additional construct—an individual's level of discretionary control—that moderates the effect of behavioral intentions on behaviors. I will concentrate on the theory's realization for specific attitudes and behaviors. I put the treatment of general attitudes and behaviors aside, since I cannot thoroughly address such general linkages within the confines of this article. It may be noted, however, that if a general attitude and behavior are both measured in terms of multiple specific indicators pertaining to various manifestations of the attitude and behavior, then the approach to general attitudes and behavior may be constructed on the basis of the analysis of aggregated specific attitudes and behaviors.

Figure 1 presents a schematic diagram of the theory. In the theory of reasoned-planned action, the immediate antecedent of a specific voluntary deliberative behavior is a person's intention to engage in the behavior. In turn, the immediate antecedents of a behavioral intention are (a) a person's favorable or unfavorable attitude toward the behavior and (b) a person's subjective norm, that is, the person's perception of the extent to which significant others believe that the person should manifest the behavior. Each construct (the person's attitude and subjective norm) has a weight in determining the person's behavioral intention. In terms of the standard notation for the theory,

$$B \leftarrow I = w_1(A_B) + w_2(SN) \qquad (2)$$

where the behavior B of a person is a function of the behavioral intention I of the person, A_B is the person's attitude toward performing the behavior, SN is the person's subjective norm, and w_1 and w_2 are relative weights. A person's attitude toward the behavior is determined by his or her beliefs that the behavior will lead to particular outcomes and by his or her evaluations of those outcomes,

$$A_B = \sum_{k=1}^{K} b_k e_k, \qquad (3)$$

where b_k is the person's belief that the behavior will have outcome k and e_k is the person's evaluation of the outcome. A person's subjective norm is determined by his or her perceptions of the attitudes of others, and by his or her motivation to comply with the attitudes of these referents,

$$SN = \sum_{j=1}^{n} b_j m_j, \qquad (4)$$

where here b_j is the person's belief that referent j thinks that he or she should or should not adopt or discard the behavior and m_j is a person's motivation to comply with referent j. Thus, the key equation is:

$$B \leftarrow I = w_1 A_B + w_2 SN$$
$$= w_1 \sum_{k=1}^{K} b_k e_k + w_2 \sum_{j=1}^{n} b_j m_j \qquad (5)$$

Note that the influence of referents may modify an individual's behavioral intention, so that an intention may be formed that is *inconsistent* with an individual's attitude, even in the case of strictly voluntary deliberative behavior. Also note that an influence of referents on the individual's attitude toward the behavior is not specified. It is evident (Figure 1) that the antecedents of the A_B attitude construct do not include the attitudes of others and that the SN normative construct is treated as an external constraint.

Most of the research that has been conducted on the model takes the observed attitude of an individual as the measure of A_B and the individual's self-reported perception of the aggregate attitudes of others as the measure of SN. However, if the observed attitude of an individual has been influenced by the attitudes of others, then the observed attitude reflects such influences and the subjective norm is an internalized component of the individual's expressed attitude. Moreover, if the attitude of the individual has influenced the attitudes of the referents, then the subjective norm is an influenced resultant that incorporates the individual's personal preferences. It is not surprising that, controlling for individuals' observed attitudes, the findings on this model present mixed results for the effects of subjective norms, especially under the typically invoked simplifying assumption that w_1 and w_2 are homogenous values across individuals that may be estimated as regression coefficients.

I draw only on the empirical work related to the attitude-behavior linkage that has developed from the consideration of Fishbein and Ajzen's work. As indicated in the previous section, this work now includes a broader perspective on the linkage that relaxes Fishbein and Ajzen's emphasis on the formation of behavioral intentions. In the remainder of this section, I describe the standard measurement models for the types of attitudes that have been shown to be strongly linked to behaviors, within the measurement-model paradigm of the theory of reasoned-planned action. For completeness, I also include a description of the standard measures of behavioral intentions and subjective norms. However, I do not rely on these latter two measures.

Attitude and Behavior Constructs

The attitudes of the focal individual (and, by extension, the attitudes of his or her referents) are *attitudes toward the behavior* and referenced to a comparably specific measure of the object-related behavior. In applications of the theory of reasoned-planned action, an individual's attitude toward a specific behavior is conventionally measured with semantic differential indicators. For example,

> For me to walk on a treadmill for at least 30 minutes each day in the forthcoming month is:
>
>   harmful . . . . beneficial
>   pleasant . . . . unpleasant
>   good . . . . bad
>   worthless . . . . valuable
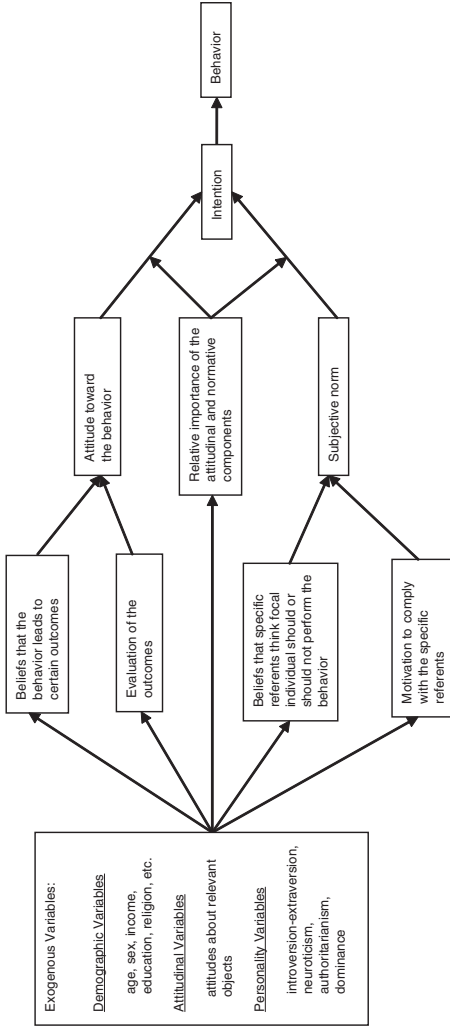>   enjoyable . . . . unenjoyable
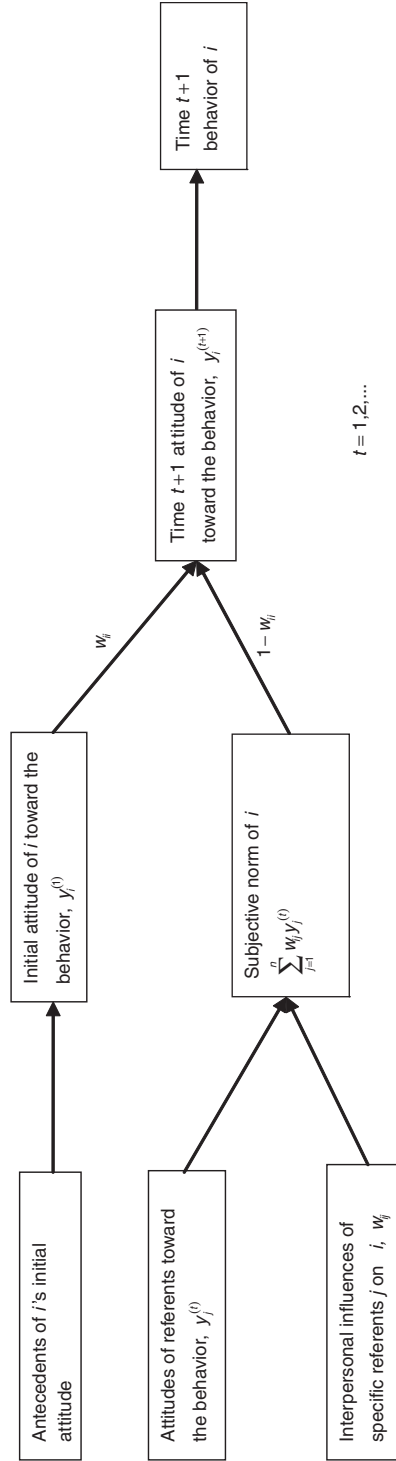
Figure 1. Theory of Reasoned Action

Figure 2. The Attitude-Behavior Linkage Extension of Social Influence Network Theory

Note: $0 \le w_{ij} \le 1$ for all i and j; $\sum_{j=1}^{n} w_{ij} = 1$ for all i.

Note that the four criteria of a specific attitude are incorporated in the measure—action, target, context, and time.

A semantic differential measure of attitudes is, of course, credible, and theoretically comports with sociological work on affect control (Heise 2002; Smith-Lovin and Heise 1988). Affect control theory draws on the work of Osgood, Suci, and Tannenbaum (1957) and is based on paired antonyms that are indicative of three dimensions—evaluation, potency, and activity—that Osgood et al. have observed as underlying dimensions of attitudes about a wide range of objects in different cultures. Good-bad is a standard indicator of the evaluative dimension; the other indicators presented in the above illustration might also be taken as items pertaining to the evaluative dimension. Object-related behavior also may reflect an individual's attitude on the potency of the object (strong vs. weak) and its activity (active vs. passive). A potential weakness in the measurement of the attitudinal foundations of a specific object-related behavior may arise when the measurement does not sufficiently attend to all three dimensions. In speculative discussions of the ubiquitous appearance of these dimensions in cross-cultural factor analyses of semantic differential items, it has been hypothesized that the dimensions have an evolutionary origin that served to optimally position individuals in a three-dimensional cognitive space with respect to their behavioral responses to objects encountered in their environment.

Specific attitude-behavior linkages may be based on attitudes that are not measured as positive-negative scale values. Issue-positions may take the form of specific opinions expressed as subjective probabilities, preferred resource allocations, or other quantifiable judgments that bear on a specific behavior. Such opinions, preferences, and judgments are also evaluative in a broad sense. A juror's vote may be based on an evaluation of the subjective probability of a defendant's guilt. The allocation of a particular amount of funds, at a particular time to a specific object (organization, person, task, or event), may be based on an evaluation that such an allocation is appropriate under specific circumstances.

Here, with such attitudes, the cognitive positions of individuals and their referents also are measured on the same scale.

Behavioral Intentions

The crux of the construct of a behavioral intention is the extent to which manifesting the behavior is a high priority personal goal for the individual. For example,

> I intend to walk on a treadmill for at least 30 minutes each day in the forthcoming month:
>   extremely unlikely . . . extremely likely
> I will try to walk on a treadmill for at least 30 minutes each day in the forthcoming month:
>   definitely true . . . . definitely false
> I will try to walk on a treadmill for at least 30 minutes each day in the forthcoming month:
>   strongly agree . . . . . . strongly disagree

Unfortunately, obtaining a declaration of intention, i.e., the individual's declaration to an agent (e.g., an investigator or therapist) that he or she "intends" and will "try" to manifest the behavior, may importantly alter the individual's situation with the introduction of an implicit social contract between the individual and agent who solicited the declaration. With such declarations, the perceived expectation of the agent is entangled with an individual's subjective norm; the agent becomes a referent.

Individuals who privately view manifesting or discarding a particular behavior as a high priority are more likely to manifest or discard it (or manifest actions in which they attempt to do so) in the future than are individuals who do not view such behavior and attempts as a high priority. The theory of reasoned-planned action postulates that behavioral intentions intervene and explain the attitude-behavior linkage. This postulate comports with the scope restriction of the theory to deliberative actions: reasoned-planned actions are based on the definition of goals. However, numerous specific behaviors are not resultants or realizations of individuals' deliberative intentions.

Moreover, the meta-analyses of findings on the attitude-behavior linkage are consistent with the conclusion that compatible measures of attitudes and behaviors may *suffice* to detect a strong attitude-behavior linkage. If persons' specific attitudes have important direct effects on specific voluntary object-related behaviors in the absence of goal-oriented behavioral intentions, then we may elaborate the explanation and prediction of such behaviors by concentrating on the antecedents of persons' attitudes without the construct of behavioral intentions.

Interpersonal Weights and Subjective Norms

In applications of the theory of reasoned-planned action, the contributions of referents are usually subsumed in a general measure of the subjective norm *SN*, based on such indicators as "Most people who are important to me think that ...", "It is expected of me that ...", and "The people in my life whose opinions I value would... ." The formalization, $SN = \sum_{j=1}^{n} b_j m_j$, but not such measures of *SN*, allows for a situation in which all referents are in disagreement. The formalization also allows for a situation in which *most* referents hold an attitude that differs from the attitude of a minority of referents who are more influential than the majority. The focal individual, who is confronted with such a majority-minority disagreement, may accord no weight to the majority's attitude and, given an opportunity to do so, report that "Most people who are important to me believe that I should walk on a treadmill for at least 30 minutes each day in the forthcoming month; however, my best friend believes that swimming is a superior exercise, and I was persuaded by my friend's position." The subjective norm construct is a cognitive integration of the attitudes of significant others based on the focal individual's "motivation to comply" with the perceived attitude of each significant other. In the formal framework of the theory, the construct is treated as a variable that may or may not strongly determine an individual's behavioral intention and, in turn, his or her behavior. The weights, w_1 and w_2, govern the relative contribution of A_B and *SN*.

In applications of the theory of reasoned-planned action, the contributions of the individual and interpersonal antecedents (w_1 and w_2) are usually estimated as homogenous regression coefficients when an empirical individual-level measure of these weights is unavailable. However, the theory specifies individual differences and calls for such an individual-level measure. Fishbein and Ajzen (1975:302-3) define the weights, w_1 and w_2, as proportional to the relative importance of the attitudinal and normative components in the prediction of behavioral intentions, which may "vary with the kind of behavior that is being predicted, with the conditions under which the behavior is to be performed, and with the person who is to perform the behavior." The importance of an individual-level measure of these weights is reinforced by social influence network theory. Based on the empirical work that has been conducted on social influence network theory, such individual differences are pronounced (Friedkin 1999; Friedkin and Johnsen 1999); in the small group settings that have been investigated, many individuals' are either intransigent or accommodative on an issue. Hence, *depending on the individual*, the anchorage on an initial (exogenously determined) position is often either nearly complete or absent, and depending on which circumstance obtains, an individual's observed attitude is often either a strict reflection of his or her uninfluenced inclination or a resultant of an interpersonal influence process. In social influence network theory, the "subjective norm" is a construct that is implicated in a mechanism of interpersonal influence, and it is formed via each individual's *accord* of some relative influence to his or her own and particular others' positions on an issue.

SOCIAL INFLUENCE NETWORK THEORY

Given a change in the state of a person at time *t* (during some unit of time) on one or more of the antecedent conditions of a specific

behavior, the time $t+1$ attitude and behavior of the person may be changed. However, the occurrence and stability of such changes depend on the system of causal effects. A behavioral intention may be unstable if it is inconsistent with its antecedent conditions. A change in the attitude of a sufficiently influential referent $j \neq i$ may trigger changes in the attitudes of other referents, and the attitude of the focal individual. A change in the attitude of the focal individual may trigger changes in the attitudes of referents. Such specification becomes theoretically crucial in analyses of how equilibrium behavior may change given a change in any of the antecedent conditions of the behavior.

The theoretical foundations of a dynamic analysis are now described, in tandem with the theoretical reformulation, consistent with social influence network theory, described in the introduction, Equation 1. Figure 2 presents a schematic diagram of the theory. In this reformulation, an individual's time $t+1$ behavior $\dot{y}_i^{(t+1)}$ is a *direct manifestation* of the individual's time $t+1$ attitude toward the behavior $y_i^{(t+1)}$,

$$\dot{y}_i^{(t+1)} \leftarrow y_i^{(t+1)}. \tag{6}$$

Equation 6 is the attitude-behavior linkage. In turn, the individual's time $t+1$ attitude is directly affected by the time t attitudes of n referents, including the time t attitude of the focal individual, and the focal individual's initial attitude,

$$y_i^{(t+1)} = \left(1 - w_{ii}^{(t)}\right) \sum_{j=1}^{n} w_{ij}^{(t)} y_j^{(t)} + w_{ii}^{(t)} y_i^{(1)}, \quad (7)$$

$t = 1, 2, \ldots,$ where $0 \leq w_{ij}^{(t)} \leq 1$ for all i and j, and $\sum_{j=1}^{n} w_{ij}^{(t)} = 1$ for all i. Equation 7 is the mechanism of attitude change specified by social influence network theory. Different measures of the accorded weights have been employed in the operationalization (measurement models) of social influence network theory. The theory is open with respect to the definition of these weights: see Friedkin and Johnsen (1999) and Friedkin (1999) for an approach based on individuals' self-reported distributions of weights, see Friedkin (1998, 2001) for an approach based on the contact network among members of a group, and see Kalkhoff, Friedkin, and Johnsen (2006) for an approach based on expectation states theory.

Henceforth, in the exposition, I drop the time t superscripts on the weights, which allow for their change, with the understanding that they may be added unless I explicitly invoke the constraint of fixed weights. The construct of behavioral intention also has been dropped, although it may be reinserted as a mediating construct. The construct of discretionary control over behavior is not employed, although it also may be introduced and employed as a construct.

An investigation of within-group dynamics is enabled when a set $G = \{i \mid 1 \leq i \leq n\}$ of n individuals includes all of the referents of each individual, the referents-of-the-referents, and so on, so that G is a closed set that does not exclude any person with a direct or indirect influence on the attitudes of the members of G on a specific issue, via the mechanism that is specified by social influence network theory. In such a group, the mechanism describes an *influence system*:

$$\dot{y}_1^{(t+1)} \leftarrow y_1^{(t+1)} = \left(1 - w_{11}\right) \sum_{j=1}^{n} w_{1j} y_j^{(t)} + w_{11} y_1^{(1)}$$

$$\dot{y}_2^{(t+1)} \leftarrow y_2^{(t+1)} = \left(1 - w_{22}\right) \sum_{j=1}^{n} w_{2j} y_j^{(t)} + w_{22} y_2^{(1)}$$

$$\tag{8}$$

$$\vdots$$

$$\dot{y}_n^{(t+1)} \leftarrow y_n^{(t+1)} = \left(1 - w_{nn}\right) \sum_{j=1}^{n} w_{nj} y_j^{(t)} + w_{nn} y_n^{(1)}$$

for $t = 1, 2, \ldots$. Collecting the weights involved in these n equations, the matrix realization of the *influence network* for the group is obtained,

$$\mathbf{W} = [w_{ij}] = \begin{bmatrix} w_{11} & w_{12} & \cdots & w_{1n} \\ w_{21} & w_{22} & \cdots & w_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ w_{n1} & w_{n2} & \cdots & w_{nn} \end{bmatrix}$$

Now let $\dot{\mathbf{y}}^{(t)} = [\dot{y}_i^{(t)}]$ be the $n \times 1$ vector of group members' behaviors, let $\mathbf{y}^{(t)} = [y_i^{(t)}]$ be the $n \times 1$ vector of group members' attitudes, and let

$$\mathbf{A} = [a_{ij}] = \begin{bmatrix} 1-w_{11} & 0 & \cdots & 0 \\ 0 & 1-w_{22} & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & 1-w_{nn} \end{bmatrix} \quad (9)$$

contain the complements of individuals' self-weights. The attitude and behavior change process within the group may now be expressed as a matrix equation,

$$\dot{\mathbf{y}}^{(t+1)} \leftarrow \mathbf{y}^{(t+1)} = \mathbf{A}\mathbf{W}\mathbf{y}^{(t)} + (\mathbf{I}-\mathbf{A})\mathbf{y}^{(1)}, \quad (10)$$

$t = 1, 2, \ldots$. The formal properties, empirical assessments, and applications of the attitude change system $\mathbf{y}^{(t+1)} = \mathbf{A}\mathbf{W}\mathbf{y}^{(t)} + (\mathbf{I}-\mathbf{A})\mathbf{y}^{(1)}$ have been reported in a number of publications (Friedkin 1998, 1999; Friedkin and Cook 1990; Friedkin and Johnsen 1990, 1999, 2003). With measures of $\mathbf{W}$ and $\mathbf{y}^{(1)}$, the mechanism generates predictions $\mathbf{y}^{(2)}, \mathbf{y}^{(3)}, \ldots$ for group members' evolving attitudes, including their equilibrium attitudes $\mathbf{y}^{(\infty)}$ if an equilibrium exists.[1] It can be shown that group members' equilibrium attitudes are weighted averages of the group members' initial attitudes,

$$\mathbf{y}^{(\infty)} = \mathbf{V}\mathbf{y}^{(1)} \quad (11)$$

where

$$\mathbf{V} = [v_{ij}]$$
$$= \lim_{t \to \infty} \left\{ (\mathbf{A}\mathbf{W})^t + \left[\sum_{k=0}^{t-1} (\mathbf{A}\mathbf{W})^k \right] (\mathbf{I}-\mathbf{A}) \right\} \quad (12)$$

assuming that this limit exists, since $0 \leq v_{ij} \leq 1$ for all i and j and $\sum_j v_{ij} = 1$ for all i.[2] The matrix $\mathbf{V}$ describes the total (direct and indirect) relative interpersonal influence of each group member j on each group member i, that is, $y_i^{(\infty)} = v_{i1}y_1^{(1)} + v_{i2}y_2^{(1)} + \ldots + v_{in}y_n^{(1)}$ for each i.

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[1] There are special cases of influence systems with no equilibrium, e.g., a dyad with $\mathbf{A} = \mathbf{I}$.

[2] For a nonsingular $\mathbf{I} - \mathbf{A}\mathbf{W}$, $\mathbf{V}$ may be directly obtained with $\mathbf{V} = (\mathbf{I} - \mathbf{A}\mathbf{W})^{-1} (\mathbf{I} - \mathbf{A})$. For $\mathbf{A} = \mathbf{I}$, $\mathbf{V} = \mathbf{W}^\infty = \mathbf{W}\mathbf{W}\ldots$. Equation 12 is the general case.

Depending on $\mathbf{W}$, a consensus attitude may be formed that, in a small group, may have direct bearing on a group's collective choice of a course of action. For example, if an accommodative executive committee is deliberating on how much to reduce the allocation of funds to a particular activity, based on the following matrix of accorded weights $\mathbf{W}$,

$$\mathbf{W} = \begin{bmatrix} 0 & 0.45 & 0.16 & 0.39 \\ 0.08 & 0 & 0.41 & 0.51 \\ 0.27 & 0.61 & 0 & 0.12 \\ 0.24 & 0.30 & 0.46 & 0 \end{bmatrix}$$

then

$$\mathbf{V} = \begin{bmatrix} 0.16 & 0.31 & 0.27 & 0.25 \\ 0.16 & 0.31 & 0.27 & 0.25 \\ 0.16 & 0.31 & 0.27 & 0.25 \\ 0.16 & 0.31 & 0.27 & 0.25 \end{bmatrix}$$

and if group members' enter into this discussion of the issue with the initial positions

$$\mathbf{y}^{(1)} = [0\% \quad 20\% \quad 8\% \quad 50\%]',$$

then an equilibrium consensus will emerge that is close to the 20 percent initial position of member 2

$$\mathbf{y}^{(\infty)} = [21.14\% \, 21.14\% \, 21.14\% \, 21.14\%]' = \mathbf{V}\mathbf{y}^{(1)}.$$

Based on the identity mapping, the behavioral decision of the group is simply $\dot{\mathbf{y}}^{(\infty)} = \mathbf{y}^{(\infty)}$, i.e., the emergent consensus that a 21.14 percent reduction of funding is appropriate. For the same vector of initial positions, a different consensus (or no consensus) may emerge with a different matrix of accorded weights $\mathbf{W}$. The outcome of the interpersonal influence process in the group depends on the group's social structure for a specific issue, where the social structure is defined by the group's matrix of accorded weights $\mathbf{W}$ *and* initial positions on the issue $\mathbf{y}^{(1)}$.

APPLICATION TO BEHAVIORAL CASCADES

The social diffusion of individual choices within *large-scale* groups, including emergent collective actions and behavioral cascades, based on this approach, has not been

previously developed or empirically investigated. However, the theoretical scope of social influence network theory includes attitude changes that arise from interpersonal influences within an influence network $\mathbf{W}$ of any size and any array of weights consistent with the formal specification of $\mathbf{W}$. The network may, for example, be one in which each member is directly influenced by small subsets of other members, who may or may not be linked by relations of interpersonal influence. A substantial literature has developed on large-scale social diffusion phenomena; Watts and Dodds (2007) provide a useful overview of this literature that includes investigations from both the social and physical sciences. Given the practical difficulties of collecting longitudinal data on these large-scale phenomena, many of the advancements have been theoretical investigations, in which models have been proposed and analyzed with simulations. Much of this work is premised on endogenous interpersonal influences unfolding in social networks, in which persons' behaviors are direct responses to the behaviors of other individuals. Threshold models prevail in this literature, according to which individuals adopt a behavior at time $t+1$ when a threshold proportion of their referents have adopted the behavior at time t. The attitude-behavior linkage is not directly attended to; however, attitude changes may underlie behavioral cascades.

I employ a simulation to illustrate the application of the theory to large-scale social diffusion phenomena. No substantive conclusion is drawn from this simulation other than the following: Social influence network theory, extended to an account of behavior, provides a credible new approach to the analysis of social diffusion within *large-scale* groups, including collective action and behavioral cascades, based on social psychological theory and empirical work on the micro-mechanism involved in formation of attitudes and behaviors.

The Analytical Framework

The simulation presented below describes the potential effects of interpersonal influences on attitudes and behaviors in a group with an initially normal distribution of attitudes on a specific behavior (e.g., adoption of a practice) and an unstructured influence network. I set the size of the group to $n = 1,000$. It could be smaller or orders of magnitude larger.

A vector of initial attitudes, $y_i^{(1)} \sim N(\mu, \sigma^2)$, for each i is obtained as a random draw of n values from the standard normal distribution. The obtained initial attitudes have minimum/maximum values $-3.07/3.30$ and mean/variance values $-0.03/1.01$. The initial vector of attitudes need not be theoretically centered on $\mu = 0$ with $\sigma^2 = 1$.

An unstructured connected network of relative *interpersonal* influences, described by an $n \times n$ matrix of row normalized values $\mathbf{C} = [c_{ij}]$, is obtained from a matrix of uniform random values $\mathbf{R} = [r_{ij}]$, each in the interval [0,1]. These values are set to 1 if $r_{ij} \geq 0.90$ and set to 0 if $r_{ij} < 0.90$. The main diagonal values r_{ii} are set to 0 for all i. The resulting $\mathbf{R}$ corresponds to a random (unstructured) network. It has a network density of 0.10 (it contains 10% of the possible $n^2 - n$ direct interpersonal influences) and is connected (every individual is connected to every other individual by a path of some length). The matrix $\mathbf{C}$ is obtained from $\mathbf{R}$ by dividing each random value by its row sum. Hence, $0 \leq c_{ij} \leq 1$ for all i and j, $c_{ii} = 0$ for all i, and $\sum_j c_{ij} = 1$ for all i. Connected sparse networks are characteristic of large-scale groups. The network that is employed here may be based on empirical measures or on an invoked model for the influence network with specified structural features and values. It is treated as a fixed structure, although this constraint also may be altered.

With two constructs $\mathbf{C}$ and $\mathbf{y}^{(1)}$ fixed, the analysis focuses on the implications of the construct $\mathbf{A}$ that describes the extent to which each individual is responsive, open or closed, to interpersonal influences. Recall that $0 \leq a_{ii}(=1-w_{ii}) \leq 1$; hence, if $a_{ii} = 0$, then individual i is completely unresponsive to interpersonal influence, and if $a_{ii} = 1$, then individual i is completely responsive to interpersonal influence and accords no weight his or her initial attitude. In this analysis, the specification of $\mathbf{A}$ governs the outcomes of the

influence system. Given $\mathbf{A}$ and $\mathbf{C}$, the influence network of the group is determined, i.e., $\mathbf{W} = \mathbf{AC} + \mathbf{I} - \mathbf{A}$. Given $\mathbf{A}$, $\mathbf{W}$ and $\mathbf{y}^{(1)}$, the predicted attitude changes of the population's members are determined $\mathbf{y}^{(t+1)} = \mathbf{AWy}^{(t)} + (\mathbf{I} - \mathbf{A})\mathbf{y}^{(1)}$ for $t = 1, 2, \dots$.

The predicted probabilities of manifesting the behavior are determined $\dot{\mathbf{y}}^{(t)}$ via the following mapping for the attitude-behavior linkage, $\Pr\left(\dot{y}_i^{(t)} = 1\right) = \left[1 + \exp\left(-y_i^{(t)}\right)\right]^{-1}$ for each i and each $t = 1, 2, \dots$. Here, the manifested behaviors of the individuals are Bernoulli responses. A Bernoulli response is stochastic: $\dot{y}_i^{(t)} = 1$ with $\Pr(\dot{y}_i^{(t)} = 1)$ and $\dot{y}_i^{(t)} = 0$ with probability $1 - \Pr(\dot{y}_i^{(t)} = 1)$. Hence, at each time t, each individual's observed behavior is generated *as if* the individual were randomly drawing his or her behavior from an extremely large (effectively infinite) set of 1's and 0's in which the proportion of 1's is the value $\Pr(\dot{y}_i^{(t)} = 1)$ and the proportion of 0's is the value $1 - \Pr(\dot{y}_i^{(t)} = 1)$. Under the assumptions of this realization, the prediction $\Pr(\dot{y}_i^{(t)} = 1)$ is the time t probability of the individual manifesting the behavior $\dot{y}_i^{(t)} = 1$ during the time period t based on the individual's time t attitude. The logistic function, $\Pr(\dot{y}_i^{(t)} = 1) = [1 + \exp(-y_i^{(t)})]^{-1}$, which maps an individual's attitude onto the probability of a specific behavior, may be replaced with a different function.

Note that there is no imposed assumption that an individual will maintain the behavior over time, $\dot{y}_i^{(t)} = 1$ or $\dot{y}_i^{(t)} = 0$, once having manifested it. This behavioral response specification may be altered or elaborated in various ways with auxiliary linkages that need not be fleshed out here. Also note that this specification of the attitude-behavior linkage is consistent with the ubiquitous employment of *threshold* models of social diffusion and collective action in which each individual is assumed to have a threshold T_i such that

$$\dot{y}_i^{(t)} = \begin{cases} 1 & \text{if } y_i^{(t)} \geq T_i \\ 0 & \text{if } y_i^{(t)} < T_i \end{cases}.$$

Hence, $\Pr(\dot{y}_i^{(t)} = 1 | y_i^{(t)}) = \Pr(y_i^{(t)} \geq T_i)$ and $\Pr(y_i^{(t)} \geq T_i) = [1 + \exp(-y_i^{(t)})]^{-1}$

under the assumption that the cumulative probability distribution of the thresholds is logistic.

A Minority Faction with Fixed Positive Attitudes

Figure 3 presents one realization of the above conditions. Five individuals, perhaps an alliance, located in the 99.5 percentile of the group's initial distribution of attitudes, commit to their extreme positive attitudes toward a particular behavior ($a_{ii} = 0$, $i = 1, 2, \dots, 5$) and seek to propagate their viewpoint via their interpersonal influences in a group consisting of 995 accommodative members. These five members' initial attitudes range from 2.74 to 3.30, and their corresponding probabilities of manifesting the behavior range from 0.94 to 0.96. Hence, they may be expected to regularly manifest the behavior unlike the average member of the group. The average member has a neutral attitude and 0.50 probability of manifesting the behavior at time 1. In a circumstance of an accommodative group, with 995 members each with no attachment to their positions ($a_{ii} = 1$, $i = 6, \dots, 1000$), an opportunity structure exists for a behavioral cascade in which the unreliable behavioral manifestations of the average member may be shifted toward the committed positions of the five.

Figure 3a presents the over time shift of the probability distributions with box plots of the influenced distributions. The time 1 box plot are the probabilities based on the group members' initial attitudes. Based on the influence system, there is a quick reduction of the variance of the probability distribution: The 995 members converge to a position that reflects their indifference $\Pr\left(\dot{y}_i^{(2)} = 1\right) \approx 0.50$ for $i = 6, \dots, 1000$, and the five members (with their fixed positions) now clearly appear as outliers in the distribution. Over time, the convergent mass is *slowly* drawn toward the position of the five. Figure 3b presents one realization of the behavioral responses of the group. At time 1, the proportion of $\dot{y}_i^{(1)} = 1$, i.e., $(1/n)\sum_{i=1}^{n}\dot{y}_i^{(1)}$

a

Probabilities of manifesting a behavior, by time period

b

One Bernoulli realization of the process, by time period

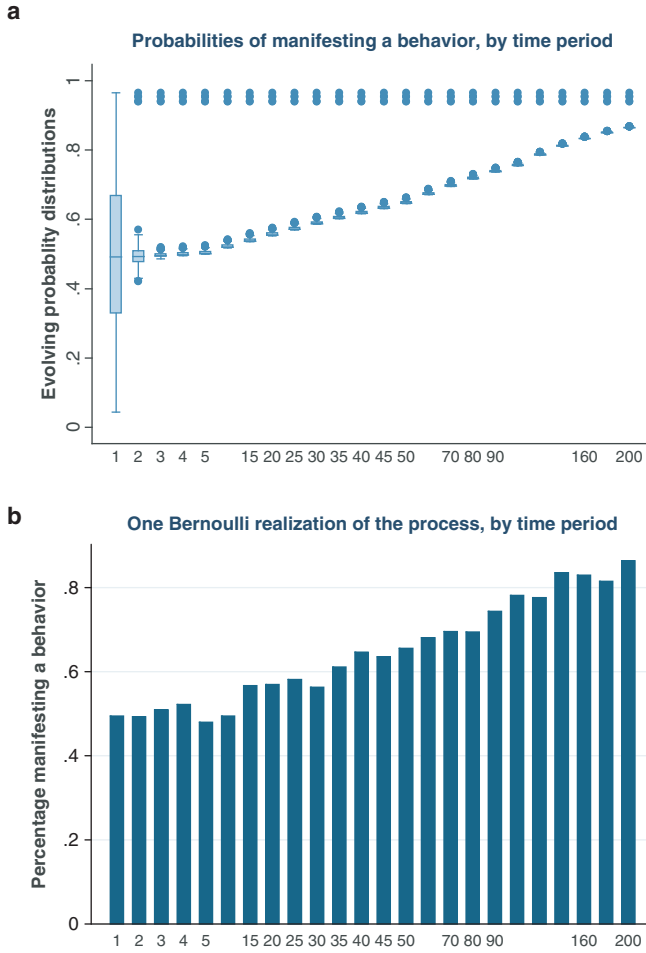

Figure 3. The Influence on Behavior of a Minority Faction with Extreme Fixed Positive Attitudes on a Behavior in an Otherwise Accomodative Group of 1,000 Members with Normally Distributed Initial Attitudes, Random Interpersonal Influences, and Bernoulli Behavioral Responses

is approximately 0.50. Over time, as the central tendency of the probability distribution (a distribution with near 0 variance) is shifted toward the position of the five, the proportion $(1/n) \sum_{i=1}^{n} \dot{y}_i^{(t)}$ approaches committed behavioral manifestations of the five.

Variations

Space does not permit a formal display of the implications of structural variations of the above circumstance, nor a consideration of different circumstances. I briefly and informally touch on some of these variations. First, as

a general property of the logistic framework, it cannot be assumed that manifesting a particular behavior at particular time implies a continued reliable (committed) manifestation of the behavior over time. If only first adoptions of a behavior are analyzed, then the proportion of group members' who have manifested the behavior at *some* time must cumulatively increase without any interpersonal influence. Even individuals with low non-zero probabilities of manifesting the behavior will contribute to the cumulative growth of "anytime" adoption, and individuals with an indifferent 0.50 probability of adoption (who manifest the behavior at time t and do not at time $t+1$

with equal probability) markedly contribute to the cumulative growth of "anytime" adoption of the behavior. Committed behavior has a different structural foundation. The illustration describes a circumstance in which commitment to the enactment of a behavior grows via interpersonal influence.

Various modifications of the social structure of the group will present dramatically different outcomes. Specifically, holding constant the conditions of the illustration, modifications of the responsiveness of the 995 members may generate different outcomes. If, for example, the five committed members in the 99.5th percentile of the distribution of initial attitudes (the positive tail) are opposed by five committed members in the .005th percentile of the distribution of initial attitudes (the negative tail), then the accommodative remaining mass of 990 members will be subject to a cross-pressure. The mass will converge to a consensual position of neutrality that, at each time t thereafter is manifested by no individual-level commitment to either opposing party—neither to the positive nor to negative committed five—and neither of these two parties will have a following that reliably adheres to their respective extreme positions on the behavior.

Moreover, if the mass of group members are *not* completely accommodative and, instead, have heterogeneous levels of responsiveness to interpersonal influence, then the effects of a single minority faction of committed members may be dramatically reduced. Suppose, for example, that responsiveness is negatively coupled with attitude strength as follows among the 995 members: $a_{ii} = 1 - \exp\left[-0.693 \exp\left[-\left|y_i^{(1)}\right|\right]\right]$, where the coefficient 0.693 serves to equate a neutral attitude $y_i^{(1)} = 0$ with $a_{ii} = 0.50$. The greater the individual's initial distance from a neutral position, the greater the weight that the individual places on his or her initial attitude during the influence process. The influence system will not generate a consensus among the mass. The central tendency of the time 1 box plot of Figure 3a will be only moderately shifted by the influence process and the variance of this initial distribution will only be modestly reduced.

The general model, Equation 1, which allows for changes in the influence network during the influence process, provides a framework for a large number of deterministic and statistical applications. The applications include ones with biased distributions of initial positions, and structured initial distributions with blocks of individuals who are in initial agreement. The attitude-behavior linkage may be based on attitudes that are subjective probabilities or opinions measured on other scales, and it may be extended straightforwardly to multidimensional attitudes and behaviors. The model may be enhanced with auxiliary functions that relate the values of the theoretical constructs or that specify antecedent conditions, which restructure the influence network.

DISCUSSION

The present article draws on a prominent tradition of research in social psychology on the attitude-behavior linkage to extend the scope of application of social influence theory. The key finding of research on the attitude-behavior linkage, which bears on the extension of social influence network theory to explanations of behaviors, is that such an extension must rest on comparably specific or general measures of attitudes and object-related behaviors. Absent such comparability, the predictive accuracy of an attitudinal explanation of the behavior is likely to suffer. Where attitudinal antecedents of individuals' adopting a specific practice are being examined, the proximate antecedent attitudes to the behavior are the attitudes of individuals about the specific practice and any specific alternatives. Where a general attitude about an object is being investigated, multiple indicators of object-related behaviors are called for. The clear signal from the considerable work that has been conducted on the attitude-behavior linkage is that the prediction of behavior will be weak without compatible measures.

A strong attitude-behavior linkage need not rest on individuals' formation of behavioral intentions. If a personal goal is formulated and accorded a high priority, then the presence of such a goal in the mind of an individual may importantly affect future behavior. However, recent work on the attitude-behavior linkage suggests that behavioral intentions may not be ubiquitously present as antecedents of object-related behavior, nor be a necessary condition of a strong attitude-behavior linkage. A strong attitude-behavior linkage may rest simply on attitude strength; the stronger the attitude, the more reliable its manifestation in particular object-related behaviors. Strong attitudes may have reliable behavioral manifestations in both planned (deliberate) and unplanned (spontaneous) behaviors.

Social influence network theory allows a seamless theoretical transition from the analysis of the decisions of individuals to the analysis of the decisions of small groups, and to the collective behavior of individuals in large-scale groups. When a small group of individuals is assembled to consider an object-related behavior, the members of the group may have differing initial object-related attitudes. When a consensual position on an issue emerges from the group members' discussion of the issue, such a position may be directly manifested as an object-related group-level decision and in the collective behavior of the group's members. From the theoretical perspective of social influence network theory, group decisions are based on the group members' initial positions on issues and on any modifications of these positions occurring during the discussion of the issues. Such modifications may or may not result in the formation of a group consensus; in either case, the emergent attitudes of the group's members are implicated in the collective decision of the group. The group decision is either a direct reflection of the consensus position or the outcome of a social choice procedure (vote) that is based on the individuals' initial or modified positions. In large-scale groups, the emergence of consensus via interpersonal influences is unlikely. However, such influences may importantly alter particular individuals' attitudes and behaviors, reduce the within-group variance of attitudes and behaviors, and shift the central tendency of the group's attitude and behavior distributions.

This article contributes a new approach to large-scale social diffusion phenomena in which the evolution of attitudes in a group is emphasized as the theoretical foundation of behavioral cascades and collective action. I acknowledge that persons' behaviors may directly or indirectly endogenously influence other persons' behaviors. As I pointed out in the introduction, interpersonal influences of others' attitudes are based on the visibility of *displayed* attitudes, which are a form of behavior. Moreover, individuals may sometimes mindlessly mimic others' behaviors. A strictly behavioral account, behaviors influencing behaviors, when it suffices to provide an accurate explanation of behaviors, is a more parsimonious theory than one which requires not only measures of behaviors, but also measures of attitudes. However, a strictly behavioral account may be theoretically superficial, and potentially misleading, when it does not attend to the antecedent evaluative bases of behavior. These cognitive foundations are a central feature of the symbolic interaction of individuals, and I take such interaction as a fundamental explanatory basis of individuals' separate and collective behaviors.

In models of behaviors influencing behaviors, individuals' evaluations are limited to their selections of significant others. However, individuals also discriminate among their significant others, according more or less weight to some referents than others, and are heterogeneously responsive to the attitudes of others. Treating influence on behaviors as a disease contagion, in which individuals automatically acquire (adopt) the behaviors of others, underestimates the cognitive filtering of others' behavioral and attitudinal states. A threshold assumption, which holds that a behavior is triggered given the occurrence of some minimal social pressure, does not address the problem, since in its typical application, the thresholds pertain to a minimum proportion of adopters among each individual's referents. If an

individual has 12 referents and a triggering threshold of 6 referent-adopters, then all 924 combinations of 6 of these 12 are *equivalent* minimum triggers of the behavior (which seems oddly indiscriminate). As more discrimination is added in a treatment of individuals as heterogeneous highly discriminating entities, we are ultimately led to a formalization in which (a) individuals' evaluative attitudes about other persons-as-objects, including themselves, importantly shape their accord of influence, and (b) individuals' attitudes (reasoned and spontaneous) are important antecedents of their manifested behaviors.

In short, in the present formal framework, global behavioral cascades appear as phenomena that arise in special, arguably unusual, circumstances. When individuals' attitudes importantly mediate the probabilities of manifesting a behavior, the observed behavior of individuals at particular times may be based on strong or weak commitments to the behavior. The individuals who are observing the behaviors of others, and familiar with those who are either enacting or not enacting the behavior, will place those behaviors in context, i.e., as indicative of others' more or less strong evaluative positions on the suitability of the behavior. When individuals' own evaluations of the behavior are importantly modified by the evaluations of others, a temporal structural change may occur in the probability of their enacting the behavior.

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