Simulating Symbolic Interaction[1]

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Abstract

We describe a program for simulating symbolic interaction. The program processes verbal inputs using empirically-based equations and a cybernetic theoretical model, while making reference to dictionaries of culture measurements. Results are verbal outputs suggesting what behaviors, emotions, attributions, and labelings will occur in the given situation. The program's structure is described by means of a pictographic algorithm. An illustrative application uses the program with its U.S.A. and German dictionaries to analyze some problems of role directives within multi-national corporations.

Pragmatic philosophers like Pierce (1960-66) and Mead (1936) developed theories of meaning imbued with logic and viewed symbolic interaction among humans in ways that we now call cybernetic (MacKinnon, 1994). Moreover, contemporary symbolic interactionists (e.g., McCall and Simmons, 1978; Stryker and Statham, 1985) see social process as reproducing a sociocultural system that provides a huge but researchable corpus of identities and actions. Thus symbolic interactionism focuses on people's efforts to experience logically connected meanings, views social interaction as a feedback process in which people try to control their own and others' experience, and studies how mental processes link sociocultural information with individuals' thought and actions. The potential for computerization is fairly evident when the field is described this way.

Indeed it turns out that simulation programs have emerged within the symbolic interactionist framework. For example, McPhail, Powers, and Tucker (1992) developed one of the most striking simulations in sociology -- a computer program that graphically shows movement, milling, and structural emergence in crowds. They achieved this success through a cybernetic model that has each separate individual trying to control his or her experience in order to maintain particular relationships to others, and the framing of this process is explicitly symbolic interactionist (McPhail, 1991).

This article deals with another computer program that simulates social relations from a symbolic interactionist perspective. The program displays verbal descriptions of what people might do in a given situation, of how they might respond emotionally to events, and of how they might attribute qualities or new identities to themselves and other participants in order to account for unexpected happenings. Begun two decades ago (Heise, 1978) as a complement to affect control theory (Heise, 1979; Smith-Lovin and Heise, 1988; MacKinnon, 1994), *Interact* achieves its results by employing multivariate non-linear mathematical equations that describe how events create impressions, by implementing a cybernetic model that represents people as maintaining cultural meanings through their actions and interpretations, and by incorporating large dictionaries that index cultural meanings (Heise and Lewis, 1988){2}. The program's results can be, and have been, tested in experimental and field studies (e.g., Wiggins and Heise, 1987; Smith-Lovin and Douglas, 1992).

We briefly discuss the equations, the dictionaries, and the cybernetic model in the following sections, then present a pictographic algorithm showing how simulations are structured. We offer an illustration of *Interact* simulations that focuses on a possible problem arising in multi-national corporations.

Equations

Various formulations of attitude balance that were developed in the 1950s and 1960s are mathematically transformable to an equation with the following structure (Heise, 1979).

$$E'_{A.Ego} = w_1 E_{A.Ego} + w_2 R E_{O.Ego}$$

$E_{.Ego}$ is an evaluation by the person (*Ego*) who is doing the psychological processing. *A* is the focal person (*Actor*) under observation. *R* is the relation -- positive or negative -- between *A* and another person or entity, *O*. The *w* are summation weights. The equation indicates that *Ego*'s new attitude toward *A* (indicated by a prime on the first evaluation) arises from *Ego*'s original attitude toward *A* and *A*'s observed relation with *O*. If *Ego* has a positive evaluation of *O* then

- *Ego* evaluates *A* more favorably if the relation between *A* and *O* is positive
- *Ego* evaluates *A* less favorably if the relation between *A* and *O* is negative.

However, if *Ego* has a negative evaluation of *O* then

- *Ego* evaluates *A* less favorably if the relation between *A* and *O* is positive
- *Ego* evaluates *A* more favorably if the relation between *A* and *O* is negative.

The relation *R* can be viewed as some behavior, *B*, that links *A* to *O*, and the relation can be quantified beyond ±1 in terms of *Ego*'s evaluation of the behavior (Gollob, 1968; 1974a; 1974b). Then the above equation becomes the following.

$$E'_{A.Ego} = w_1 E_{A.Ego} + w_2 E_{B.Ego} E_{O.Ego}$$

This non-linear equation reveals that the evaluative response to *A* depends on how good or how bad *A*'s behavior toward *O* is.

Notation is changed in affect control theory to allow for numerous complications. References to the constant processor, *Ego*, are dropped. Actor, behavior, and object are treated as the foci of the equation, with dimensions of affective response (like evaluation) identified in subscripts. The last equation would have the following form in affect control theory.

$$A'_E = w_1 A_E + w_2 B_E O_E$$

This equation deals with evaluation of the actor. In fact, there are three basic dimensions of affective response -- Evaluation, Potency, and Activity (Osgood 1962). Thus, assessing impressions of an actor as a result of an event requires two additional equations, one with *P* subscripts for predicting impressions of the actor's Potency, and another with *A* subscripts to predict impressions of the actor's Activity.

A long tradition of research has focused on estimating the weights in such equations and on seeing which additional terms improve accuracy of predictions (e.g., Gollob, 1968; Gollob and Rossman, 1973; Heise, 1969; 1970; 1979; Heise and Smith-Lovin, 1981; Britt and Heise, 1992; Smith-Lovin, 1979; 1987; Smith, Matsuno, and Umino, 1994). The above equation, implicit in attitude balance theories, turns out to be excessively simple as a representation of how people evaluatively respond to actors. For example, other kinds of balance enter besides that represented in the *BEOE*` ` interaction. An *AEBE* effect arises, meaning that actors are supposed to match the morality of their actions to their status; an *AEBEOE* effect means that judgments of an actor's relations to objects are more stringent for high-status actors. Some cross-dimensional interactions also contribute to the evaluation of an actor -- notably *BEOP* and *BPOE*, the combination of which corresponds to notions that an actor should be kind to the weak and oppose the powerful.

In fact, a reasonably complete specification of how impressions of an actor arise from events involves an equation with 13 terms to predict evaluations, plus two more equations to predict impressions of the actor's potency and activity. The equations are as follows, according to analyses of the 515 events studied by Heise and Smith-Lovin (1981).

$$A'_E = -.25 + .45 A_E + .42 B_E - .05 B_P - .09 B_A + .05 A_E B_E - .04 A_E B_P + .12 B_E O_E$$
$$- .06 B_E O_P - .05 B_P O_E + .06 B_P O_P + .02 A_E B_E O_E + .03 A_E B_P O_P$$

$$A'_P = -.14 + .59 A_P + .08 A_A - .08 B_E + .46 B_P + .05 A_P B_E - .07 A_P B_P - .03 A_A B_A$$
$$.02 B_E O_E - .02 B_E O_P + .03 B_P O_A + .01 A_E B_E O_E$$

$$A'_A = .08 + .06 A_E - .05 A_P + .65 A_A - .08 B_E + .10 B_P + .27 B_A - .05 A_A B_A - .02 A_P B_P O_A$$

Smith-Lovin (1987) elucidated the psychological meaning of various non-linear terms that appear in these equations.

Besides generating an impression of the actor, an event also creates impressions of the object person and of the behavior, and of the setting, too, if it is salient{3}. Additional equations, similar to those above, model these additional impression-formation processes. Altogether there are nine equations describing how an event creates impressions of the actor, the behavior, and the object in an event. This set of *impression-formation equations* constitutes the basic information that is included in *Interact* concerning how people experience events.

By interpreting the relation in attitude balance theories as a state-of-being verb instead of an action verb, we get another line of impression-formation research dealing with observations like "the doctor is angry." Studies have focused on states of being that can be represented by a modifier, *M*, for the person *P* -- e.g., "the angry doctor" (Averett and Heise, 1987; Heise and Thomas, 1989). Outcome impressions are predicted from pre-existing feelings about the person along with feelings about the modifying characteristic, as shown in the following equations.

$$P_E' = -.26 + .67\,M_E - .29M_P - .11M_A + .47P_E + .12M_EP_E$$

$$P_P' = -.18 - .15\,M_E + .76M_P + .06M_A + .56P_P + .07P_A$$

$$P_A' = .07 + .05\,M_E - .09M_P + .67M_A - .09P_P + .67P_A$$

These *amalgamation equations* constitute the basic information inserted into *Interact* concerning how people combine a person's identity with characteristics or states. This part of the model is used to combine status characteristics with identities and also to analyze emotions and the attribution of traits.

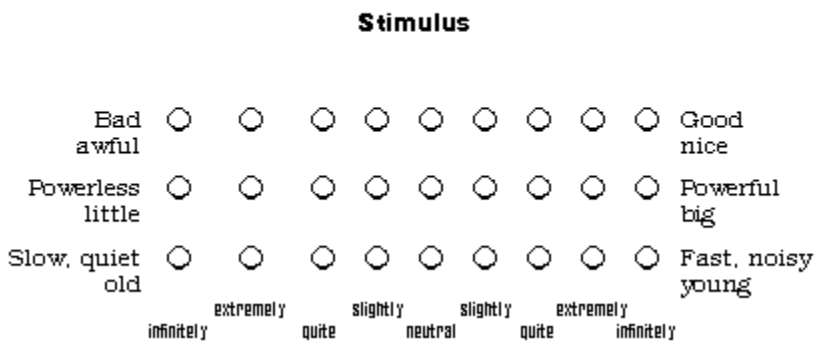
Dictionaries

Decades of research in more than 30 cultures world-wide revealed that every concept has a general affective meaning that can be assessed on the Evaluation, Potency, and Activity dimensions (Osgood, Suci, and Tannenbaum, 1957; Snyder and Osgood, 1969; Osgood, May, and Miron, 1975). The general affective meaning is a constant within a culture, though meanings vary across cultures and within subcultures. More recently,a number of studies have been done in several nations to index meanings that commonly arise in social interaction (Heise, 1975; MacKinnon, 1984; Schneider, 1990; Smith, Matsuno, and Umino, 1994).{4}

Each social-interaction dictionary includes role-identities, interpersonal behaviors, and person-modifiers such as emotions or traits. The American and Canadian dictionaries have approximately 800 identities and 550 behaviors; the smaller German and Japanese dictionaries have about half as many. The American dictionary has 495 modifiers, whereas the other dictionaries have about a fourth as many, focusing only on emotions. The American dictionary also contains 344 settings, ranging from an Adult Bookstore to a Zoo.

Measurements of concepts in the dictionaries were obtained on the Evaluation, Potency, and Activity dimensions by averaging ratings from approximately 30 male and 30 female students attending colleges in the U.S.A., Canada, Germany, or Japan. In English language studies, measurement scales were as shown in Figure 1.

Figure 1
Scales for measuring Evaluation, Potency, Activity



The neutral position on these scales is coded zero, the positions on the left are coded with negative numbers, and positions on the right are coded as positive numbers. Here, for example, is the U.S.A. entry for child.

Concept	Male ratings			Female ratings		
	E	P	A	E	P	A
child	1.42	-1.48	2.31	1.94	-1.10	2.52

Females rate a child as quite good, slightly powerless, and quite to extremely fast; males give similar but not identical ratings.

Culture dictionaries allow verbal definitions of situations and events to be translated into the quantitative variables that are used with equations. For example, suppose we analyze the event "The tired mother scolded her child." The U.S.A. dictionary provides the following male profiles for each of the key words in the event description.

tired	-0.44	-1.18	-1.76
mother	2.52	1.50	-0.13
scolds	-0.84	1.02	0.51
child	1.42	-1.48	2.31

We apply the amalgamation equations to get the profile for a tired mother.

1.00	-0.34	-1.22

Then impression-formation equations are applied to obtain the transient impression of a child who is scolded by his tired mother.

0.56	-1.55	1.51

This result along with the general profile for child can be turned into the profile for an emotion that the child feels, applying the amalgamation equations in a manner described later.

-0.23	-0.89	-0.48

The computer-implementation of the dictionaries also allows quantitative results of analyses to be translated back into verbal form. For example, we can find emotions that have a profile similar to the last EPA profile, and thereby come to the conclusion that a child who is being scolded by his tired mother would feel fearful or melancholy.

Aside from their use in simulations, the dictionaries can be used to explore cross-cultural variations and equivalences in meaning. Working with the German and American dictionaries, for example, we find that Germans see fathers (Vater) as less potent (1.36) than do Americans (2.14). For Americans, a nurse is a close affective equivalent of a German father.

Cybernetic Model

People accommodate to experiences, adjusting their understandings to fit what is happening, and they also actively create experiences that can be assimilated into understandings of what should be happening (Piaget, 1954). Definitions of situations link the two processes in symbolic interaction. A definition of the situation emerges from people's agendas, their perceptions of the setting, and on-going processes. Then people create events to confirm their definitions of a situation. Thereby they generate events that fit the situation.

Though working to validate meanings, participants can experience disconfirmation of meanings because they are working at cross-purposes or because of external disturbances. They then may reformulate their definitions of the situation in such a way that situational meanings fit the experiences that they are having.

The processes just described amount to a hierarchical control system. Agendas influence interpretations of settings, and settings influence definitions of situations, which settle what identities are assigned to each participant, the possible identities being considered in order of salience (Stryker, 1980). Participants create events in order to instantiate relevant meanings provided by their definitions of the situation. However, if experiential feedback intractably disconfirms meanings, then new identities are selected that fit the experiences. The new identities may require reinterpretation of the setting, and a new interpretation of the setting may require changing agendas.

Program *Interact* is concerned with the relations between experience and a definition of the situation. Each identity in a definition of the situation has an affective meaning, measured in terms of Evaluation, Potency, and Activity (EPA), defining how good, powerful, and active such a person is supposed to be. Participants construct events so as to create impressions of themselves and others that match the meanings of prevailing identities as much as possible. However, if events occur that disconfirm these identities, then the situation is redefined. Participants are comprehended in terms of new affective meanings that fit the impressions being generated by occurring events. This amounts to assigning new EPA profiles redefining how good, powerful, and active they are supposed to be, and the redefinitions may be accomplished either by selecting new identities or by amalgamating explanatory characteristics with current identities.

Emotions come into this process as a way of signifying how well impressions generated by events converge with the meanings of identities. Cybernetically, emotion is the perceivable manifestation of a comparator testing experience against identity. A person's emotional state combines with the person's identity, yielding an amalgamated impression that matches the transient impression of the person that has resulted from events. The emotion signals to self and others how well that person's confirmation process is going.

Simulations

An analyst using *Interact* provides a verbal definition of the situation and specifies a first event. *Interact* looks up words in cultural dictionaries, translating the verbal specifications to EPA profiles defining affective meanings. These EPA profiles then are substituted into the impression-formation equations, and the impressions created by the specified event are calculated. Schematically, this can be represented as follows.

Outcome impressions = *impression formation* (Event, Input impressions)

Input impressions are set equal to output impressions from a prior event, except in the case of the first event where input impressions are set equal to general meanings retrieved from the dictionary.

Emotions are computed according to the following schematic *emotion equation*, applied separately to the actor and the object in the event.

Event impression = *amalgamation* (Unknown emotion, Identity)

"Event impression" is the EPA profile for the participant that was computed via the impression-formation equations. "Identity" is the EPA profile representing the meaning of the person's identity. "Emotion" is an unknown EPA profile, entered into the amalgamation equations as a modifier. The equations are solved for the Emotion profile, and the program reports emotion words whose EPA profiles are similar to the computed profile.

An analyst can continue to specify events and observe consequent emotions as impressions continue to change. Alternatively, at any point in the sequence, the analyst can compute solutions to problems in which two elements of an actor-behavior-object event are specified, and *Interact* finds the third element that would maximally confirm all affective meanings. For example, the analyst can ask what behavior would optimally confirm the actor and object. Or the analyst can ask

what identity the actor should have so that the given behavior toward the given object causes least disconfirmation of meanings. The third element is obtained by a calculus solution shown schematically in the following *optimization equation*.

$$\frac{\delta(\text{Meanings} - \text{Impressions})^2}{\delta\,\text{Unknown meaning}} = 0$$

The "Impressions" in this formula are those that would result from the optimal event, and they are represented by substituting current impressions and the profile for the unknown element into the impression-formation equations. "Meanings" are the EPA profiles representing affectual meanings of the actor, the behavior, and the object, one of these profiles being the non-given "Unknown meaning." Disconfirmation is measured as the squared difference between the impressions and meanings. The disconfirmation measure is minimized by setting its derivative equal to zero and solving for the unknown meaning. *Interact* does the calculations defined by the complex non-linear equations and reports the resulting EPA profile . *Interact* also searches the culture dictionaries and displays identities or behaviors (whichever is appropriate) whose profiles are similar to the ideal profile.

Attribution of characteristics involves a further step. An unknown modifying characteristic has to amalgamate with the person's current identity, yielding the profile that gives maximum confirmation. This is shown schematically in the *attribution equation* below.

$$\text{Optimal profile} = \textit{amalgamation}\,(\text{Unknown characteristic, Identity})$$

The optimal profile is obtained as outlined in the previous paragraph. "Identity" is the EPA profile representing the meaning of the person's unmodified identity. The equation is solved for the EPA profile of the unknown characteristic. *Interact* reports the result, along with traits and status characteristics that have a similar profile.

Solutions to problems also can be computed while requiring that outcomes are as close as possible to a non-optimal condition defined by an emotion. In this case, the analyst specifies two elements of an actor-behavior-object event as givens and additionally specifies an emotional goal for the actor and/or the object person. *Interact* finds the third element that would come closest to producing the goal emotions. The following *emotion-specific optimization equation* shows the solution schematically.

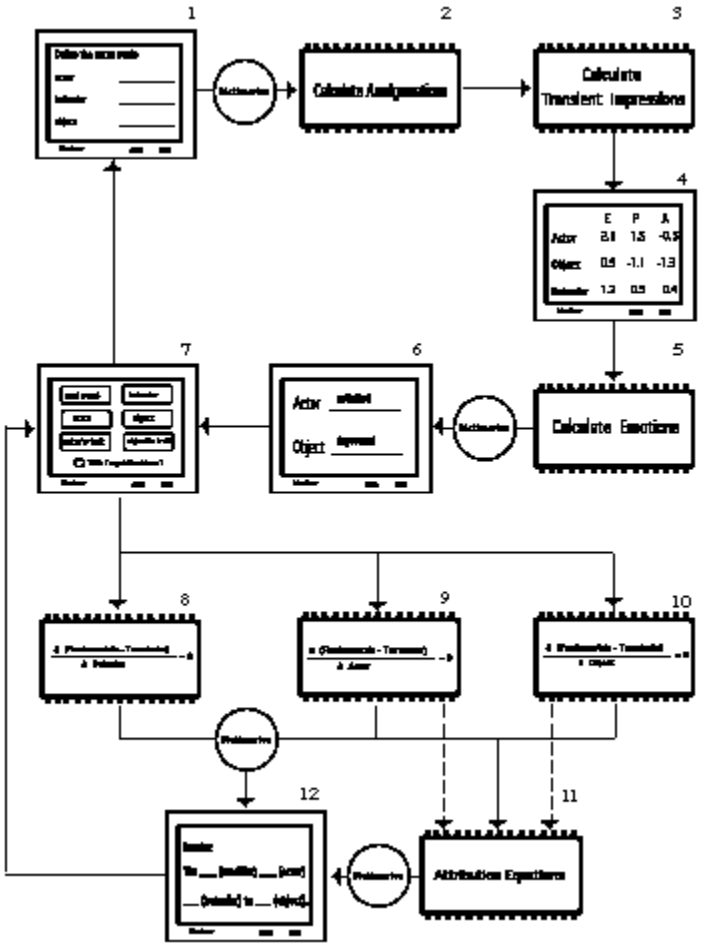
$$\frac{\delta(\text{Meanings} - \text{Impressions to get specific emotions})^2}{\delta\,\text{Unknown meaning}} = 0$$

"Impressions to get specific emotions" represents the impressions from an event that would give participants the specified emotions. The differential equation is solved to get the behavior (or an actor identity or an object identity) that comes closest to producing the desired emotions.

Algorithm

The current version of *Interact* is built from tens of thousands of lines of Pascal code. While much of the code deals with database management of the dictionaries and with input-output, the simulation of symbolic interaction itself requires several thousand lines of code. That is considerable complexity, but the general operations involved in the simulator can be described economically in terms of an algorithm. We present a pictographic algorithm of the symbolic interaction simulator in Figure 2.

Figure 2. An Algorithm for Simulating Symbolic Interaction.



Pictures of a computer monitor in Figure 2 symbolize input-output processes in analyses, and these correspond approximately to an interactant's posing of questions about a social scene and to answers that the person achieves by mental processing. Mathematical operations are shown schematically with an icon representing a computer chip; these pictures correspond to an interactant's mental processing of affective meanings, much of which occurs unconsciously and automatically. Arrows represent the programming that links screens to each other and to major kinds of computations. The arrow sequences correspond to methods by which interactants interpret situations and events. Boxes on arrows are points where culturally-defined dictionaries are searched to convert words to EPA profiles; circles on arrows are where EPA profiles are converted to words. The boxes and circles correspond to an interactant's recall of meanings and concepts from a culturally-influenced memory.

An analysis begins by defining the situation, indicating the identities and the modifying characteristics of participants in the scene and, optionally, the setting where participants are gathered. The analyst also specifies an event at this point, assigning one of the participants as actor, one as object, and indicating what behavior the actor directs toward the object. These verbal entries are symbolized in picture 1 of Figure 2. They are converted to EPA profiles as shown by the "Dictionaries" box on the arrow from picture 1 to picture 2.

A modifying characteristic has to be combined with a person's identity in order to determine what overall meaning the person is trying to maintain in the situation. (Our prior example of a "tired mother" illustrates the idea). EPA profiles for the identity and the modifier are looked up in the dictionary, then the amalgamation equations are used to combine the profiles into a single profile, as represented in picture 2. If no modifying characteristics were specified for a person, then the amalgamation routine merely passes on the EPA profile for the person's identity.

The specified event is processed by entering the behavior profile along with the profiles for actor and object into the impression-formation equations. The use of the equations is represented in picture 3. This computation results in a set of outcome EPA profiles representing transient impressions of each element in the event. These profiles are indicated in picture 4.

Emotion profiles are computed from the transient profile for a person along with the person's fundamental profile, via a special application of the amalgamation equations. This step is shown in picture 5. The result, an EPA profile for the emotion, is looked up in the dictionary in order to find emotion words with a similar profile, and these words are displayed, as shown in picture 6.

A variety of options become available at this point, as shown in picture 7.

If the prediction of emotions accompanying each event in a sequence is the focus of analyses, then the analyst can loop back to the input step shown in picture 1 and define the next event. Since transient impressions generated by the next event are computed from EPA profiles generated by prior events, emotions later in a sequence depend on events that occurred early in the sequence.

Alternatively, the analyst can compute theoretically ideal solutions to questions that may be asked in response to the last event. One such question is, What will the participants in the interaction do next? The answer is obtained by trying all possible actor-object combinations and solving the optimization equation for an unknown behavior with each combination, as shown in picture 8. The event that produces transient impressions closest to cultural meanings is the optimal event. That optimal event is reported by specifying its actor and object, and behaviors whose profiles are close to the computed profile, as signified in picture 12. The ideal event can be implemented in order to see what emotions it produces by looping back to the decision point in picture 7 and then to the input step in picture 1. Alternatively, the analyst can ask more questions.

Another question that can be asked in response to the last event is: What kind of person would behave that way toward the given object person? The answer to this question is obtained by solving the optimization equation for an unknown actor, as shown in picture 9. Identities whose EPA profiles are close to the computed profile are reported. After looping back to the decision step represented in picture 7, the actor can be re-identified on the basis of the ideal computation, or, alternatively, the analyst can ask more questions.

A third question that can be asked in response to the last event is: What kind of person would seek to be the object of such an action by the given actor? In this case, the optimization equation is solved for an unknown object, as shown in picture 10. The computed EPA profile is computed and matching identities are reported. After looping back to the decision point, the object person can be re-identified on the basis of this computation, or the analyst can ask more questions.

The profile for the ideal actor or object in the last event can be analyzed along with the person's original profile in order to discover modifying characteristics that explain the event. The two profiles are substituted into the attribution equation, which is then solved for the unknown characteristic, as shown in picture 11. This yields an EPA profile for a modifier that combines with the original identity to yield the ideal actor or object profile. Traits or moods fitting the modifier profile are reported, and then the analyst loops back to the decision point in picture 7.

Another set of possible questions follows from clicking the box labeled "with target emotions" in picture 7, though we do not represent the detailed processing. The analyst specifies a target emotion for the actor and/or the object, and then asks one of three questions. What behavior by the given actor toward the given object would come closest to producing the specified emotion(s)? Or, How would the actor have to be re-identified so that the given behavior on the given object produces the specified emotion(s)? Or, How would the object person have to be re-identified so that the given behavior by the given actor produces the specified

emotion(s)? The emotion-specific optimization equation is solved for behavior, actor, or object to get answers to these questions, and results are presented in the same manner as discussed above.

Example Application

Behaviors that fit role identities in one culture might not fit in another culture. Thus globally implemented organizational rules could lead to disconfirmation of identities when corporate offices operate in different cultures. Workers in foreign offices might be stressed and they might attempt to ameliorate their situation by redefining roles.

Suppose an official directive is distributed from an American corporation to all of its offices, including those in Germany. This hypothetical document deals with all aspects of hiring *ad hoc* advisors for special projects, including a section outlining how to guard against advisors who fail to contribute to organizational goals, or even subvert them.

Following the home office guidelines, a manager organizes a meeting with other colleagues and an advisor. The manager first tries to obtain as much information as possible by quizzing the advisor, and the advisor is properly informative. However, suppose the directive encourages uncertainty or even mistrust when adopting an advisor as a new team member, and consequently the manager leads a penetrating cross-examination of the new team member. Ultimately uncomfortable in this cross-examination, the advisor turns to gentle teasing and flattery to remove some of the pressure as he makes his points. The manager views the advisorŐs behavior as impertinent, and following company guidelines, the manager bluntly directs the advisor to be more professional.

For illustrative *Interact* analyses, we reduce this scenario to the following events.

- The manager quizzes the advisor.
- The advisor informs the manager.
- The manager cross-examines the advisor.
- The advisor cajoles the manager.
- The manager reprimands the advisor.

Having to cross-examine and reprimand an advisor might not be the most desirable actions in organizational situations, but such acts arise in interpersonal conflicts that American managers have to deal with (Selznick, 1957; Lobel, 1991; Grover, 1993a). Of course, in other cultures -- notably Japan (Smith, Matsuno, and Umino,1994) -- harmony rather than conflict is the dominating principle in business interactions.

EPA profiles for the identities and behaviors in the illustrative sequence are shown in Table 1, drawing on male data from the U.S.A. and from Germany. Table 2 reports some results of American and German *Interact* simulations after each of the manager's efforts to be true to the company directive regarding advisors. The table shows the manager's action in column one, then results produced by that action in the U.S. and results produced in Germany. *D* is a measure of the total disconfirmation of meanings produced by the action. *Emotion* is the affective state the manager experiences while engaging in the action. *Re-identification* is the ideal EPA profile for someone engaging in that action toward an advisor.

Table 1
EPA profiles for scenario identities and behaviors

U.S.A.				Germany			
Concept	**E**	**P**	**A**	**Concept**	**E**	**P**	**A**
manager	0.6	1.3	0.1	Manager	-0.3	1.6	1.7
advisor	1.0	1.3	-0.7	Berater	1.3	0.8	-0.5
quiz	0.5	1.0	0.3	ausfragen	-1.4	0.2	0.2
inform	1.2	1.1	-0.1	informieren	1.5	0.5	-0.1
cross-examine	-0.4	1.8	1.1	ins Kreuzverhör nehmen	-2.5	1.4	1.8
cajole	-0.6	0.1	0.9	beschwätzen	-1.7	0.3	1.7
reprimand	-0.1	1.4	-0.3	tadeln	-1.8	0.5	0.5

For each act, *D* values are higher in the German simulation than in the U.S. simulation. This shows that the prescribed behaviors generally are less confirming of meanings for Germans than for Americans. The *D* values indicate how strange the interaction seems for participants at each stage, and the values suggest that a moderate sense of irregularity is experienced in both cultures by the end of the interaction, but more so for the Germans than for the Americans.

Table 2
Results of American and German Simulations

Manager's action	U.S.A.					Germany				
	D	Emotion	Re-identification			D	Emotion	Re-identification		
quiz	1.7	none to charmed	0.2	0.6	0.5	3.7	grollen resentful	-1.7	0.2	0.2
cross-examine	6.3	angry	-0.7	1.4	1.1	9.7	unbefriedigt dissatisfied	-2.4	1.2	1.7
reprimand	8.9	none to angry	-0.3	1.2	-0.1	10.7	angstlich anxious	-1.9	0.5	0.5

The predicted emotions accompanying each behavior are mild in the U.S. The manager feels emotionally neutral while quizzing the advisor, with "charmed" being a feeling he might recognize, if any. Similarly, he is emotionally neutral while reprimanding, though slightly in the direction of angry. He feels anger while cross-examining, but quantitative output in *Interact* indicates the feeling still would not be very intense. Anyway, anger is an emotion that is appropriate in some business situations (Sutton, 1991)

In Germany, though, strong emotions accompany the events -- resentful while quizzing, dissatisfied while cross-examining, anxious while reprimanding{5}. Particularly the latter seems inappropriate for a manager in a work situation, so he would have to mask the display of his feelings. A German manager might have to engage in emotion work (Hochschild, 1983; Ashfoth and Humphrey,1993), besides his instrumental duties, when following corporate rules imported from the U.S.

Comparing the re-identification profiles to the original EPA profile for a manager allows us to assess the pressure to change the meaning of the manager role, or to adopt a different role entirely. For the American manager, there is relatively little pressure on the role. Computing the sum of the squared differences between

the original role and the ideal role, over the three EPA dimensions, we get a pressure index of 0.81 while the U.S. manager quizzes the advisor, of 2.70 while cross-examining him, and of 0.83 while reprimanding him. The same index indicates much more pressure to change roles in Germany: 8.11 while quizzing, 5.78 while cross-examining, 6.15 while reprimanding.

Indeed, the German manager might actually shift roles to be more comfortable with his task. The ideal role is critic (Kritiker) while quizzing. That role switch would be within business norms, though it creates potential role-conflict with other roles (Kahn et al., 1964, House, 1972), which could be a source of distress (Grover, 1993b). In the case of reprimanding, the ideal role is wrong-doer (MissetŠter), which is not a reasonable role to take in the business setting under consideration. However, the role of critic once again is not too far off, so the manager could make do with being a critic. However, in Germany the ideal role for cross-examining an advisor is he-man (Macho) or mugger (StrassenrŠuber). These are not possible business roles, and there are no business roles close to the ideal. So either the manager will flip completely out of the business frame (e.g., acting the he-man), or he will be tempted to change the meaning of manager so that it fosters such negative activity as cross-examining valued advisors.

We implemented the ideal behavior for the advisor after the manager reprimanded him, and continued implementing ideal behaviors of each participant after being acted on by the other, to examine what would happen if constrained interaction is followed by an opportunity for self-affirming action. Results are shown in Table 3.

Table 3
Outcomes of restorative behavior sequences

	U.S.A MANAGER			
EVENT	EMOTION	REIDENTIFICATION		PROFILE
advisor explains something to	apprehensive	1.7	-1.8	0.1
manager honors	awe-struck	1.6	1.3	0.1
advisor consoles	awe-struck	1.7	-1.4	0.2
manager congratulates	moved	1.6	1.4	0.5
advisor explains something to	awe-struck	1.7	-1.3	0.3
	GERMAN MANAGER			
EVENT	EMOTION	REIDENTIFICATION		PROFILE
advisor judges	embarrassed	-0.8	-1.0	-0.2
manager challenges	sorrowful	-0.7	1.3	1.5
advisor thanks	remorseful	2.0	-1.7	0.0
manager contradicts	reverent	-0.4	1.2	1.5
advisor suggests	reverent	2.2	-1.4	0.2

The restorative sequence allows both interactants to behave according to their own cultural understanding of advisors and managers, and the interactants rapidly remove the pressure on their identities. Through his actions, the American manager re-establishes himself as a positively evaluated role-identity. The German manager removes the extremely bad evaluation of himself that results from the prescribed behavior sequence and returns to the barely negative evaluation that represents a German manager.

Evaluation of the Simulations

The simulations suggest that prescribed behaviors that are acceptable for an American manager might have disruptive effect in the German culture. This is not invariably true, though. For example, additional simulations showed that emotions and re-identifications in American and German simulations are very similar in a sequence where the manager first corrects his advisor, the advisor then instructs the manager, the manager then criticizes the advisor. Simulations with *Interact* can help locate cross-cultural differences that would lead to undesirable sequences of action and also can identify sequences of action that operate similarly across cultures.

Role-identities have such a strong structuring effect on the situation that interactants in both cultures restored themselves quickly as soon as they were free to choose behavior that fits their culturally-defined corporate identity. Thus, computer simulations suggest that role-identities offer constant resistive force to corporate behavior prescriptions in the sense that activity goes back to its culturally-natural mode as soon as prescriptions are not in force. The finding fits theories that advance the integration of processional *and* structural processes into symbolic interactionism (Collins, 1981; McCall and Simmons, 1966; Stryker, 1980; 1987; Stryker and Statham, 1985)

The simulations reported here raise warnings against making global behavior prescriptions without due reflection. Attempts to standardize corporate activity cross-nationally carry a high risk, not only of failing, but of being counter-productive. Corporate behavior-prescriptions should be tested within relevant cultures before they are implemented globally. Computer simulations with *Interact* may turn out to be the most economical and least disruptive way to do such testing.

Discussion

Interact has been evolving for twenty years and has grown into a huge program with numerous subroutines to perform intricate calculations, to manage cross-cultural databases, and to provide friendly input and output. To cut through the complexity of *Interact* we actually constructed a HyperCard formulation that mimicked *Interact's* major functions, and on the basis of work with this miniaturization we developed the pictographic algorithm shown in Figure 2. In essence, we created a qualitative model (Heise & Durig, 1992) of the original program, and this HyperCard formulation led us to view the components of the program abstractly and to see the underlying coherence in the program's various components. In fact, maximizing the logical coherence of the model introduced a discrepancy between the model and the contemporary version of *Interact.* An *Interact* analysis currently begins by identifying participants and letting the program derive an ideal event; only then can an externally-defined event be introduced. In contrast, the model starts off with identification of participants *and* specification of an event. The latter approach permits a simpler algorithm and is more likely to correspond to the desires of an analyst, so we will restructure *Interact* in accordance with the model in a future version (while still offering construction of an ideal event on the first round as an option).

Our illustrative application of *Interact* focused on organizational processes that have been of concern in the literature on role management, role conflict, and emotions in business settings (Selznick, 1957; Kahn et al, 1964; Hochschild, 1983; Grover, 1993b). The simulation program proved to be a sensitive instrument capable of addressing these concerns and of locating subtle differences between two Western cultures.

Symbolic interactionism has a reputation for being a "soft" area of sociology, devoted largely to *ad hoc* observations and rhetoric. Even if the reputation is deserved to some degree, the programs that are emerging in symbolic interactionism reveal that the field has a rigorous core that invites mathematization, computerization, and construction of large databases to archive cultures. What's more, symbolic interactionist programs can be applied to practical problems in a way that testifies to the field's origins in the philosophy of pragmatism.

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1. Conflict of interest between DRH's roles as Special Issue editor and co-author was averted by submitting this paper to Editor Patrick Doreian, who reviewed it as a regular submission to the *Journal of Mathematical Sociology*.
2. A reviewer, puzzled about the way we use simulations, requested a clearer statement of the purpose of *Interact* simulations. The paramount purpose is to deal with Affect Control Theory's overwhelming demands for information processing, as recounted in Heise's Preface to *Interact*'s documentation (Heise and Lewis, 1988):

   > Electronic hand calculators had come on the market a couple of years before [1973], and I bought one and worked through the equations for a social situation involving two people. It took days, and I wasn't sure my calculations were correct. I translated numerical results into words by scanning lists of numbers visually, and I wasn't certain if I was selecting the right words to fit the numbers.
   >
   > Results seemed promising, but were they right? I'd never know unless I wrote a computer program to do the calculations and to search the dictionaries automatically. So I wrote the program.

3. We do not mention settings throughout this article in order to simplify the exposition. However, an event can be specified as an actor engaging in a behavior toward an object within a setting. When a setting is explicitly part of the event, then the setting influences impressions generated by the event, and the event changes impressions of the setting. Smith-Lovin (1979; 1987b) developed equations that incorporate setting effects and that predict setting impressions. The U.S.A. dictionary contains affective meanings for several hundred settings, and *Interact* can incorporate these settings into analyses.
4. There is an additional dictionary from Ireland. Because of its lack of modifiers and its small sample size, it does not allow precise simulations. It is, however, particularly interesting because of the unusual affective meanings of government identities in Northern IrelandŐs culture.
5. The German meaning of ängstlich; (-2.3 -1.2 -0.3) is much more negative than the American meaning of anxious (0.17 -0.10 1.26), though anxious is the correct translation suggested in German-English dictionaries and also back-translates successfully. Matching EPA profiles across cultures, ängstlich; is

affectively equivalent to feeling betrayed, insane or incompetent.

URL: http://php.indiana.edu/~heise/SimSI.html