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Modeling Generic Structures and Patterns in Social Psychology

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ABSTRACT

System dynamics has been enriched from many disciplines. This paper describes our effort to discover generic structures in the field of social psychology. Social psychologists have accumulated a body of empirical studies and theories that are reproducible and apply to a variety of social situations. Our task was to start modeling a few pivotal dynamic effects found in the social psychology literature. We present models of the dynamics of an important social process, namely, the "self-fulfilling prophecy." The structure underlying this process is associated with the drifting goals archetype. Next we model the dynamic effects of contact between groups. Finally, we develop a set of models that represent a key process in social psychology, namely the "fundamental attribution error." We hope that the approach to modeling generic structures in social psychology will enrich future system dynamics models by including relevant biases and distortions in perception discovered by social psychologists.

Key words: Social-psychology, social generic-structures, self-fulfilling prophecies, attribution-errors, intergroup contact.

INTRODUCTION

System dynamicists emphasize looking for generic structures underlying problem behaviors. Over the years, system dynamic modelers have discovered generic structures, such as archetypes, which are associated with the areas of management (Senge, 1990), organization theory (Sastry, 1998), and environmental problems (Meadows, 1989), among others. The field of psychology may contribute to the thinking of system dynamicists who might be confronted with modeling a problem that is dominated by a significant social process. In the field of system dynamics most psychologists who have made contributions to the discipline have contributed to the application of cognitive psychology to the empirical and theoretical study of mental models (e.g., see Doyle, 1997; Doyle and Ford, 1998, 1999). Although there have been some discussions about the relationship between psychology and the system dynamics discipline (e.g., Levine 1983, 2000), there has been little modeling of psychological processes to date, and therefore there has not been much of an opportunity to discover new generic structures that may not correspond to those already known from other fields.

This paper is a first attempt to discover, model, and describe those generic structures underlying key processes in the discipline of social psychology. This work is also an extension of previous efforts by Kao et al. (1998) to develop and use simple SD models to teach social psychology. Indeed, there have been a few system dynamics models of social psychological experiments, such as the Zimbardo prisoner experiment (Low, 1978) and the Milgram shock experiments (Richmond, 1980). In the Milgram obedience experiment (Milgram, 1963, 1965), the subjects, who thought they were part of a study to see the relationship between punishment and learning, were instructed to shock the "learner," when learner made a mistake. Although the victim looked like they were in extreme pain when shocked, actually the victim or learner was part of the experimental team and received no shocks at all. Moreover, the experimental subject had to progressively increase the shock voltage (ranging from 15 volts to 450 volts) if the learner continued to make mistakes. If the subject hesitated, the experimenter would pressure the subject by insisting that he or she continue in the experiment. The majority of the subjects (65%) continued to increase the voltage throughout the entire experiment. The subjects wanted to please the experimenter, who represented authority, and at the same time, they were disturbed because they thought they were hurting an innocent person. This conflict was represented in the model as two loops that dealt (1) with giving in to the pressure of the experimenter and (2) feeling the guilt of harming an innocent stranger.

The goal of the present paper is to describe a few common structures we have discovered that might give social psychologists a deeper theoretical understanding of well-established empirical findings. In addition, by starting to model social processes in depth, we hope that some of the work in social psychology might help to augment the set of tools used by system dynamicists.

Let us begin by defining social psychology. Social psychology is the scientific field that attempts to understand the nature and causes of individual behavior and thought in social situations (Baron and Byrne, 2000). From a system dynamics perspective, many of the problems in organizations and in other domains involve emotional and cognitive

components. System dynamicists have resisted many of the assumptions of pure rational choice theory that assumes having total informational resources in setting policies and making decisions. Many of the empirical findings of social psychology would concur with the system dynamicist's rejection of those assumptions. There have been many studies which show that people in general distort, discount, and filter out information, especially if it does not conform to preconceived beliefs (see Meyers, 2000). Also, social psychologists have found numerous problems in human selective memory, judgment, and decision-making ability that could lead to problem behaviors. For example, Holmberg and Holmes (1994) found in a repeated measurement study of newlywed couples that most initially reported being happy. A follow-up study conducted on the same couples two years later asked them how they felt currently about their marriage and asked them to recall how they felt about their marriage as newlyweds. The results showed that those whose marriages had disintegrated claimed that things had not gone well from the beginning. Indeed, Holmberg and Holmes say, "Such biases can lead to a dangerous downward spiral. The worse your current view of your partner is, the worse your memories are, which only further confirms your negative attitudes."

This type of "revisional memory" has been found in a number of studies (e.g., McFarland and Ross, 1985). Such a process might be very important to include in a model. For example, currently there is interest in understanding the dynamics of ethnic conflict. In modeling the escalation of anger and violent actions, one potential negative loop that could decrease the escalation process might be related to the fact that in the past, the two groups had gotten along very well, perhaps cooperated with each other in dealing with crucial problems, or perhaps fought together on the same side to defeat a common enemy. The "old comrade/friendship loop" might not mitigate the escalation structures if people on both sides revise the past to match present conditions. Including a revisional memory component process in a model of ethnic conflict would be realistic and insightful.

Before going on, it is interesting to comment that the revisional memory process is somewhat the opposite of a generic structure that is known and used by system dynamicists. The revisional memory structure is associated with a weighting of recent affairs as being more important than past affairs. The sticky/slippery perception process (see Richmond, 2001) is a process where the past is weighted more than present conditions. In the Zimbardo, Stanford Prisoner Experiment, students participated in a role playing simulation, in which they were either assigned to play the role of a prisoner or a prison guard. This was an experiment that was scheduled to be run over a continuous series of days, but had to be terminated prematurely for ethical reasons. Initially, the "guards" were very aggressive and hostile towards the "prisoners." The prisoners reacted to the guard hostility by generating a high level of resistance to the guards. At a later point in time, the guards become much less hostile to the prisoners, yet the prisoners remained highly resistant, even when conditions changed. The past dominated the current situation. In the revisional memory case, there is an active process of substituting current beliefs and attitudes for the past.

SOCIAL PSYCHOLOGY REVISITED

The social psychological perspective, as we have indicated, is focused on actual human abilities and processes in the social context. For forty or fifty years, social psychology as a field has accumulated a wealth of empirical research. Much of the studies have been true experiments. A number of theories have emerged in the field, such as attribution theory (e.g. see Kelley, 1972, Kelly and Michela, 1980), which aids in understanding the reasons behind others' behavior, and social learning theory, which helps us to understand how we acquire new information, behaviors, or attitudes from other people. Yet, these theories are usually stated only in verbal form. We feel that the time has come for going to the next step, modeling the dynamics of those processes that are well established in the literature.

Limitations

Thus far, we have been very positive about the potential for modeling social psychological processes, to enhance both the field of social psychology and the discipline of system dynamics. However, we have encountered several problems and constraints in our efforts to find and model generic structures in this area. First, many of the concepts presented in texts and in the literature are couched in static terms. For example, social psychologists study what is known as the "availability heuristic", which is a rule of thumb that assesses the likelihood of a phenomenon in terms of the ease with which examples can be recalled in memory. News and information about shark attacks prime us to think that shark attacks are more likely than actual base rate statistics. Normally, textbooks on social psychology will present the availability heuristic as a bias or constraint on thinking rather than putting it in a dynamic framework. There is little or no thought given to the possibility that one can change the tendency to over- or underestimate the risk involved in a particular action or situation over time.

From a system dynamics view, many of these static cognitive biases can be useful in modeling dynamic problems. They make the model more realistic by helping to specify human biases in perceptions, judgments, and reactions. As a minimum, these static biases can be included in SD models as either initial values of the levels or as parameters that describe individual differences among individuals or groups. On the other hand, these cognitive biases can be integrated into dynamic models as constraints or as parameters. For example, Riley (2001), working with wildlife managers, modeled the interface between the dynamics of the bear population in New York State and the response of landowners who may potentially come in contact with those bears. Incidents between bears and people are in fact quite rare, but every time there was an incident, as reported by the media, landowners in particular would put pressure on governmental land managers to either move the bears elsewhere or to get rid of them by increasing the number of hunting licenses. The farmers and other landowners perceived the likelihood of an encounter with a bear as being much higher than the actual risk involved, i.e., they unconsciously used the availability heuristic. However, in this case, Riley used this to capture the reason for the pressure on the managers. It becomes part of the dynamics of

the management problem. Finally, we might add that, in designing policies to solve the management problem, we might want to change the perceptions of the likelihood of human/bear encounters. Design policies that might lessen the effect of the availability heuristic move us to a dynamic perspective.

Experimental Rigor versus External Validity

Social psychologists have performed numerous studies using rigorous experimental methods. From a causal point of view, there are advantages to manipulating specific variables and keeping many other processes constant in an experimental setup. On the other hand, there is the problem of generalization, which in this context is called "external validity." In the real world, any particular problem is embedded in many processes. The advantage of the system dynamics simulation methodology is that a model can represent a number of loop processes simultaneously, which is closer to what happens in the real world. On the other hand, social psychological experiments go in the direction of isolating processes, and perhaps that is the reason that the field of social psychology has stayed primarily in the academic setting, rarely venturing out into the real world.

ADVANTAGES OF MODELING BASIC SOCIAL PROCESSES

Social Generic Structures: Augmenting the System Dynamicist's Toolbox

We believe that potentially most of the findings about cognitive biases and social processes studied in isolation may be externally valid. However, in any real situation, those social structures may not dominate the dynamics. We are suggesting that, if we were to model a social process in isolation, we might consider the model and its loop structure as a generic template, or "molecule," to be embellished and integrated into a larger, more realistic model of a dynamic problem. What, then, does the system dynamics community gain from focusing on structures found in social psychology? In general, it would supplement our knowledge of "classical" archetypes (Senge, 1990, Kim and Anderson, 1998) and other common patterns of behavior and structure in organizational settings (Sastry, 1998). Again, as we have indicated, social psychology can contribute to our thinking about the influence of emotional, nonrational reactions, decisions, and policies, as well as capture some of the cognitive biases that may play a leading role in dynamics of the problem.

EXAMPLES OF SOCIAL PSYCHOLOGICAL MOLECULES

When we first started this project, we initially believed that we were looking for social archetypes. However, we have come to the conclusion that it may not be appropriate to use the term " archetype" for the social processes under study. First, not all of these processes focus on a problem. Second, we would subscribe to Lane and Smart's (1996) suggestion that one consider archetypes as a special case of a generic structure in which the solution to the problem frequently is associated with counterintuitive actions. We feel comfortable in calling the patterns associated with social phenomena "social molecules."

They capture the dynamics of small bits of social processes, gleamed from replications of numerous social psychological studies. In this section we will present three of the models we have created up to date. From a cybernetic perspective, some of the models are more interesting than others. All of them seemed to qualitatively match what patterns of behavior existed in the literature. Currently, we are submitting them to more rigorous tests, as suggested by Forrester and Senge (1980).

We deliberately tried to formulate extremely simple models. One thing we should say about modeling social phenomena is we have found even small models to be informative, insightful, and interesting in themselves. We would concur with Richardson (2000) who feels very strongly that much can be learned from initially working with small, manageable, and insightful models. It is also noteworthy that each of these models can be extended and embellished quite easily, almost too easily. At this stage, we want to remain simple.

Self-fulfilling Prophecy

The first model deals with a well-established social process, namely, the self-fulfilling prophecy. To provide a background on the self-fulfilling prophecy, we will begin with the notion of a schema. Just as system dynamicists use the idea of mental model, cognitive social psychologists frequently work with a somewhat similar construct, the schema. Briefly, a schema is a mental framework that centers around a specific theme that helps people to organize social information. Schemas, once formed, may exert powerful influences on what the person notices, remembers, and how he or she may relate to others. In a social context, a person's schemas can affect the behavior of others. One possible effect of a person's schema is the self-fulfilling prophecy, in which social perceptions, even when wrong, can strongly influence the behavior of people who are targets of such perceptions. To give an example, Rosenthal and Jacobson (1968) examined the possibility that teachers' schemas about minority students in the San Francisco area were causing them to treat minority students differently with respect to time and effort (and in other ways) than majority students. As a result of this differential treatment, minority students might fall behind academically.

As system dynamicists, we recognize that in this school context, the effects of teachers' schemas provide the motivation for a familiar pattern seen in other contexts, namely, the success to the successful archetype. However, we are going to focus on the perceptions and goals of a teacher only with respect to one population, namely, in the context of minority students. What we plan to do is to describe two models that capture the essential idea of the self-fulfilling prophecy. Although the models are in the context of a school setting, the concept of self-fulfilling prophecy goes back into the history of social science. For example, in economics, during the depression in the United States in the 1930s, people circulated rumors that the banks would fail. This generated major runs on the banks, which in turn caused many sound banks to fail. Also, there is an active interest in studying the role of self-fulfilling prophecies in macroeconomics (see, e.g., Farmer, 1999).

To continue putting this social phenomenon in a school context, let's look at the Rosenthal and Jacobson field experiment in more detail. The team of researchers went to a school in the San Francisco area and administered IQ tests to the entire student body. Then they told the teachers that some of the students (picked randomly) in his or her class were brilliant, i.e., had scored high on the IQ test, and should be blossoming in the near future. Nothing was said about such high scores in the control group. Eight months later, the IQ tests were administered again for all students. The "bloomer group" showed greater gains than those who were not designated as bloomers. Further analysis indicated that the teachers had spent more time on their bloomer students than the rest of the class, which is the mechanism accounting for the gains in performance. In other contexts, where studies had been done on lower income schools, lower teacher expectations for minority students may decrease students' confidence in themselves, which in turn generates lower grades for those students.

Modeling the Self-fulfilling Prophecy

From the description of the social phenomenon, basically teachers may come in with some previous expectations about their students' ability to perform. In the first model, we are assuming that the teacher's expectations are fixed, and indeed some social psychologists talk about a "perseverance effect" that makes it difficult to change one's schema even in the face of contradictions and information contrary to one's beliefs.

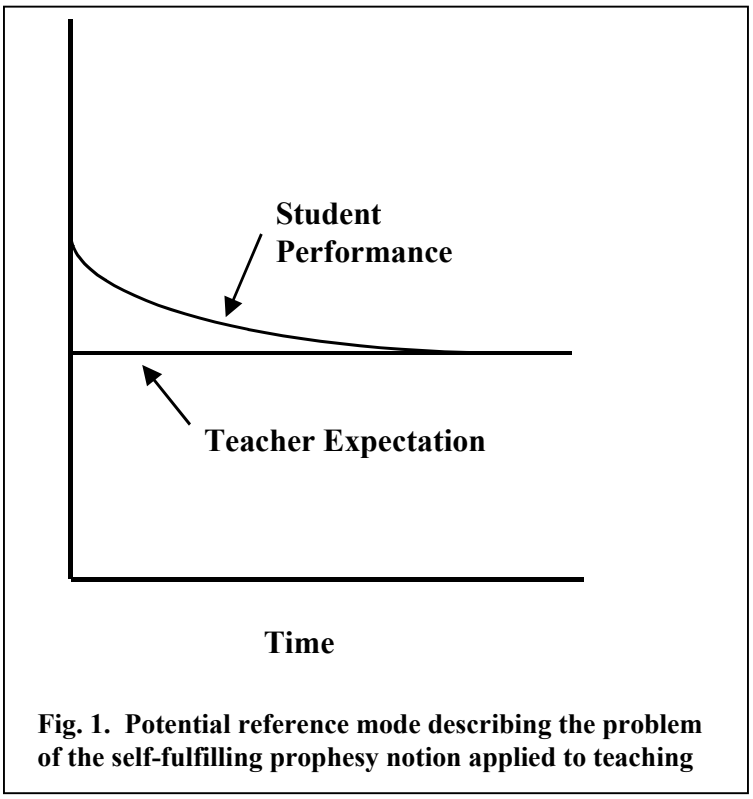


Fig. 1. Potential reference mode describing the problem of the self-fulfilling prophesy notion applied to teaching

Model 1: Behavioral reference mode for self-fulfilling prophecy. It was difficult to find explicit time series data to work with in this case. The Rosenthal and Jacobson study just measured performance at two time points. One contribution system dynamics may make is to provide a theoretical rationale to measure key variables over a number of time points, if possible. This would be expensive and difficult, but it certainly would be worth the costs in time and money. In any event, if initially, the teacher's expected performance were low, and students were initially above the teacher's expected performance, the students would merge towards the low value over time, perhaps displaying a logarithmic pattern. This reference mode is drawn in Figure 1.

Structural characteristics of the self-fulfilling prophecy, Model 1. From the description of the phenomenon and from our best guess of the temporal behavior, our first dynamic hypothesis is as simple as one can get, namely, a single negative loop process accounts for the self-fulfilling prophecy. The dynamic hypothesis and the stock and flow diagram of the model can be seen in Figure 2. For system dynamicists this is not very insightful or particularly interesting. However, it does represent a simple model for some very important social problem behavior.

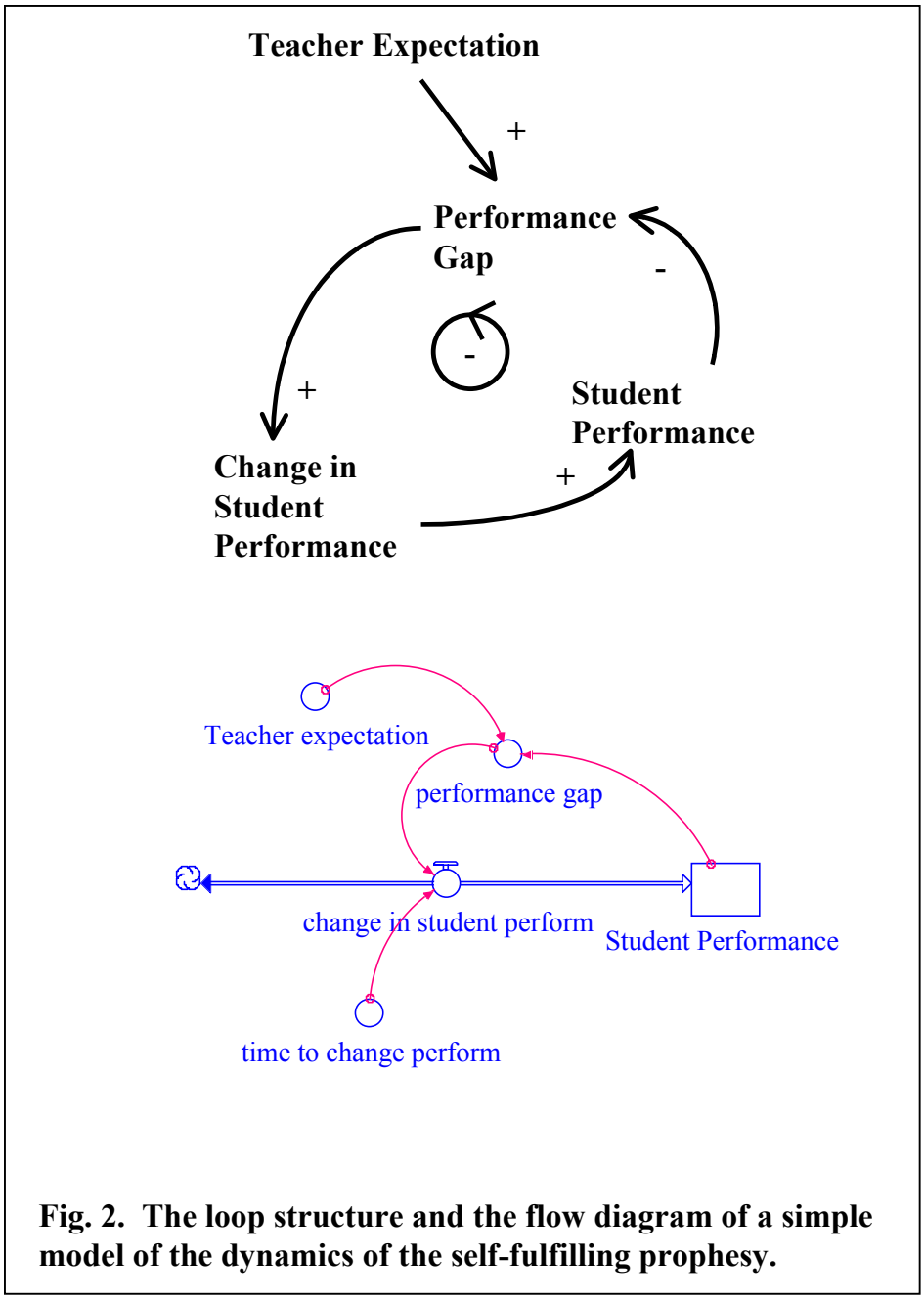


Fig. 2. The loop structure and the flow diagram of a simple model of the dynamics of the self-fulfilling prophesy.

Output from Model 1. The output of the model is found in Figure 3. In this run student performance was set initially to be above the level of the teacher expectations. Students gradually lowered their performance to meet the teacher's expectation level.

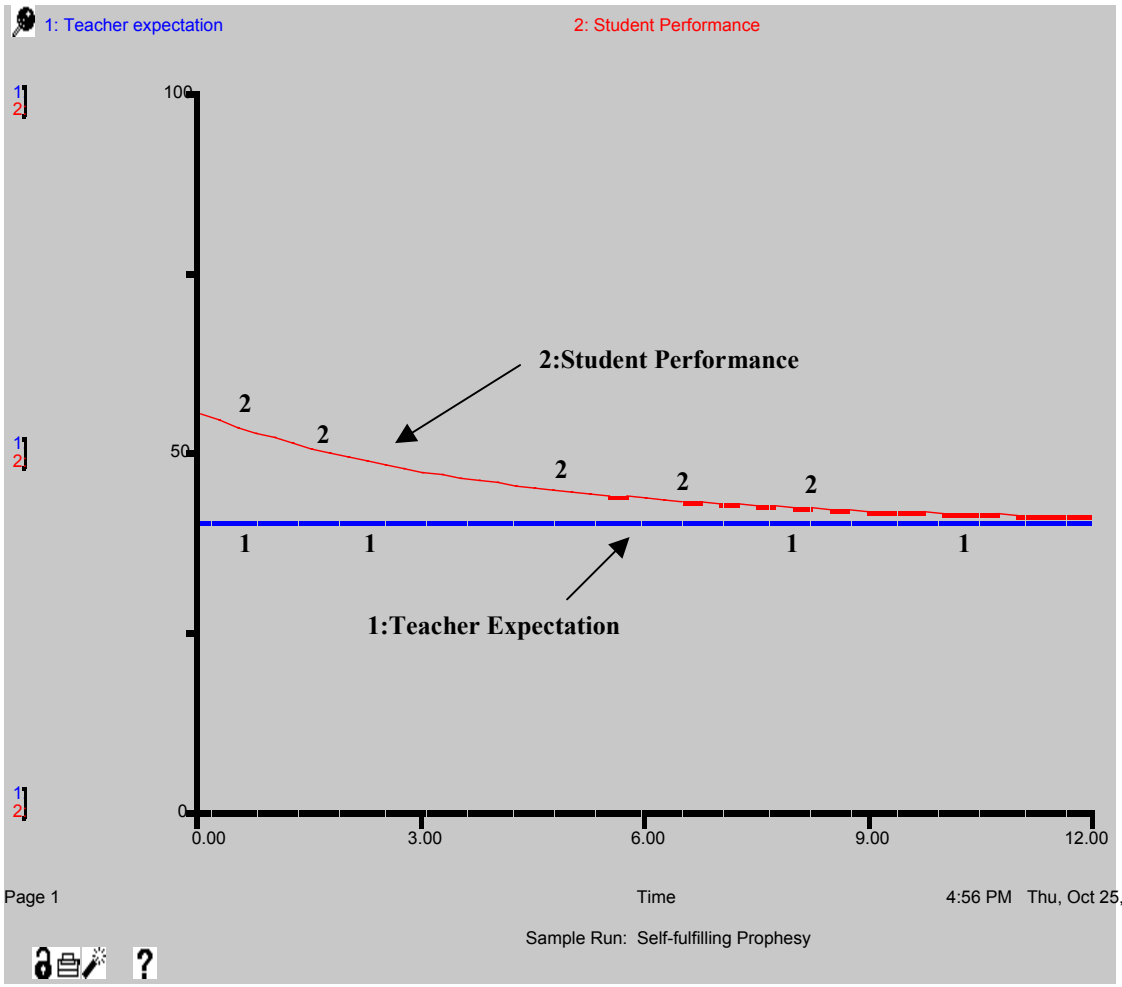


Fig. 3. Output of the simple model of the dynamics of self-fulfilling Prophesy.

Model II: Introduction. As we have indicated there are many static processes that might be useful to know when building traditional system dynamics models. In the situation where the self-fulfilling prophecy is relevant, such as in the context of an educational setting, it might be reasonable to assume that the teacher's expectation is not immutable, even though the perseverance effect might be operating in varying degrees, depending on the teacher. We assumed that the teacher watches student performance and is influenced by it over time. This leads to what we call the "reciprocal self-fulfilling prophecy" model, where the student is influenced by the manifestation of the teacher's expectations and the teacher, in turn, is influenced by the student's level of performance.

Model 2: <u>Behavioral reference mode for reciprocal self-fulfilling prophecy</u>. The double influence model of the self-fulfilling prophecy phenomenon may generate a similar logarithmic response by the teacher to the performance of the students. We have not found time series data that gives a detailed description of the time trajectory in the literature. Clauset and Gaynor (1992) discuss the fact that some teachers may pay much more attention to their students's performance than external standards.

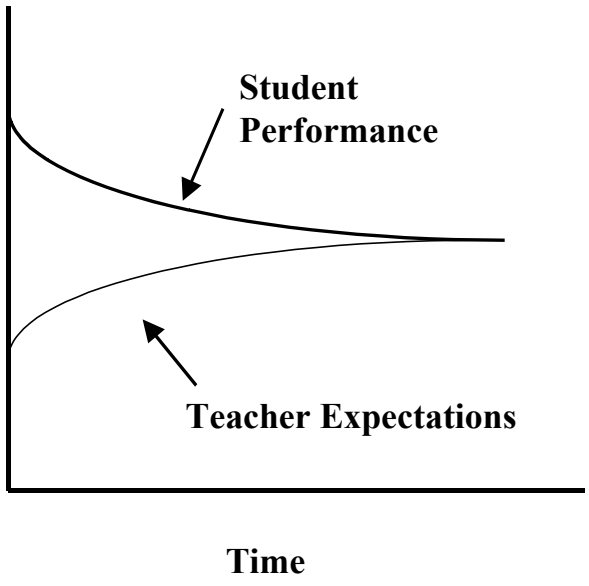


Fig. 4. Possible behavior-over-time-graph when teacher responds to the performance of his or her students.

Figure 4 shows our hypothesized behavior-over-time graph for this situation. We would guess that students begin to lower their performance in response to the "negative" signals given by the teacher. On the other hand, the teacher notes that the students are doing better than she or he expected and begins to raise performance expectations a bit over time.

<u>Hypothesized Loop structure, Model 2</u>. We have assumed that the response of the teacher is generally the same as the response of the students. Thus, in Figure 5, we have added a second negative loop, loop #2, to the structural map. In addition, note that when the teacher begins to follow performance, a new, positive loop, loop #3, comes into existence.

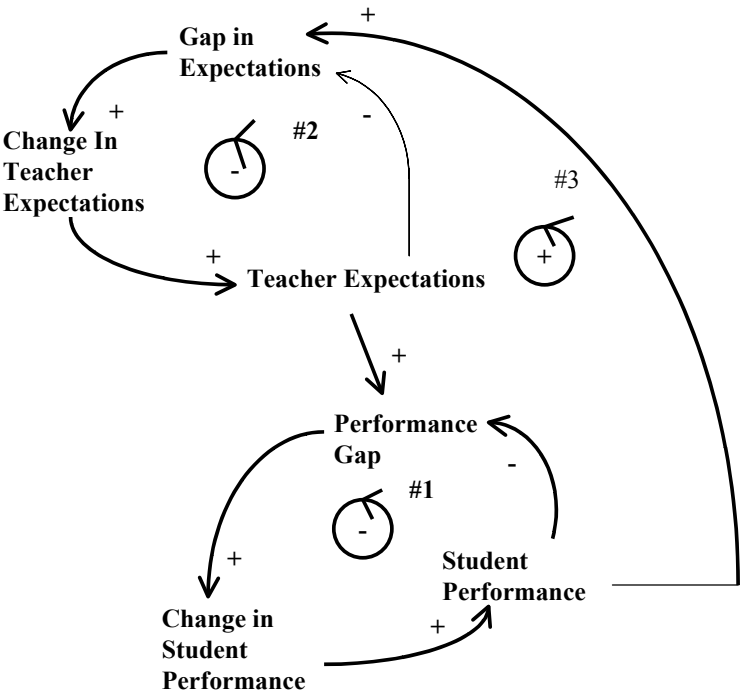


Fig. 5. Loop structure for the reciprocal self-fulfilling prophesy Model.

Have we seen this generic structure before in the system dynamics literature? We can find this structure featured in two separate sources. First, substantively, this structure played a dominant role in modeling classroom dynamics (Clauset and Gaynor, 1980, 1982, 1992; Levine, Van Sell, and Rubin, 1992; Roberts, 1978). In some actual situations, in low income schools, teachers appear to use student performance as the basis of working with the students to decrease the performance gap instead of using some external set of standards for all their students.

A second place in the SD literature where one can find this loop structure is in the description of existing archetypes, namely, drifting goals. One might want to consider this as an example of the drifting goals, although there is no explicit, extra, delay between the *performance gap* and the *change in performance* variable. Also, in this present version, when we assume that the teacher is paying attention directly to *student* **p***erformance*, a third, positive loop, which has never been mentioned or associated with the drifting goal archetype, is introduced.

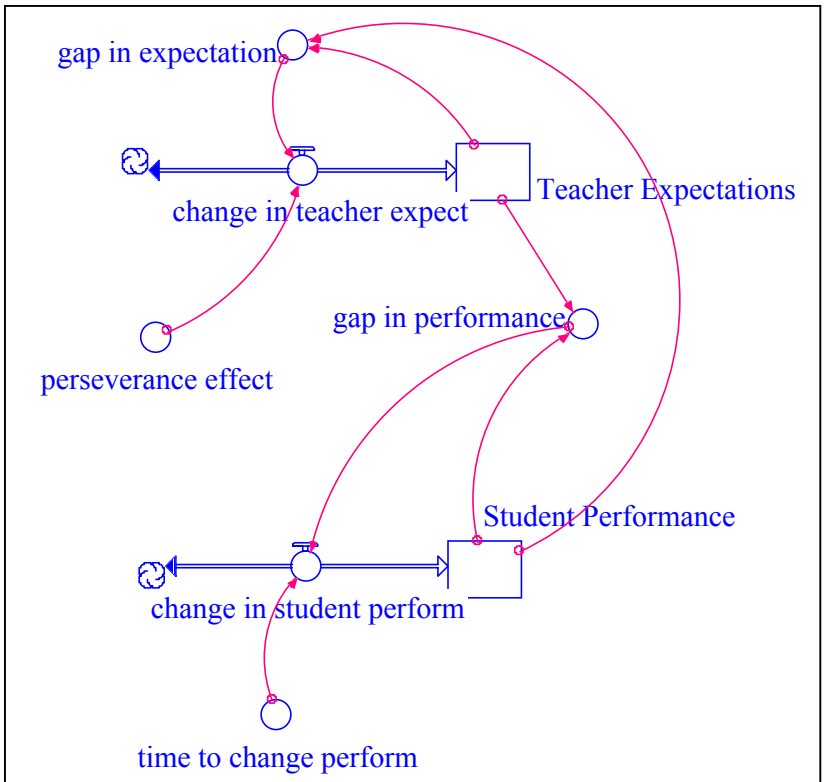


Fig. 6. The flow diagram for the reciprocal self-fulfilling Prophesy.

Stock and Flow View for Model 2. It might be instructive to see the stock and flow chart found in Figure 6. We note that the perseverance effect was explicitly represented as an individual difference parameter, the *perseverance effect*. Time is absorbed into this parameter, which has units of fraction per month. Thus, we recognize the potential for this static social psychological effect by dealing with it as an exogenous parameter

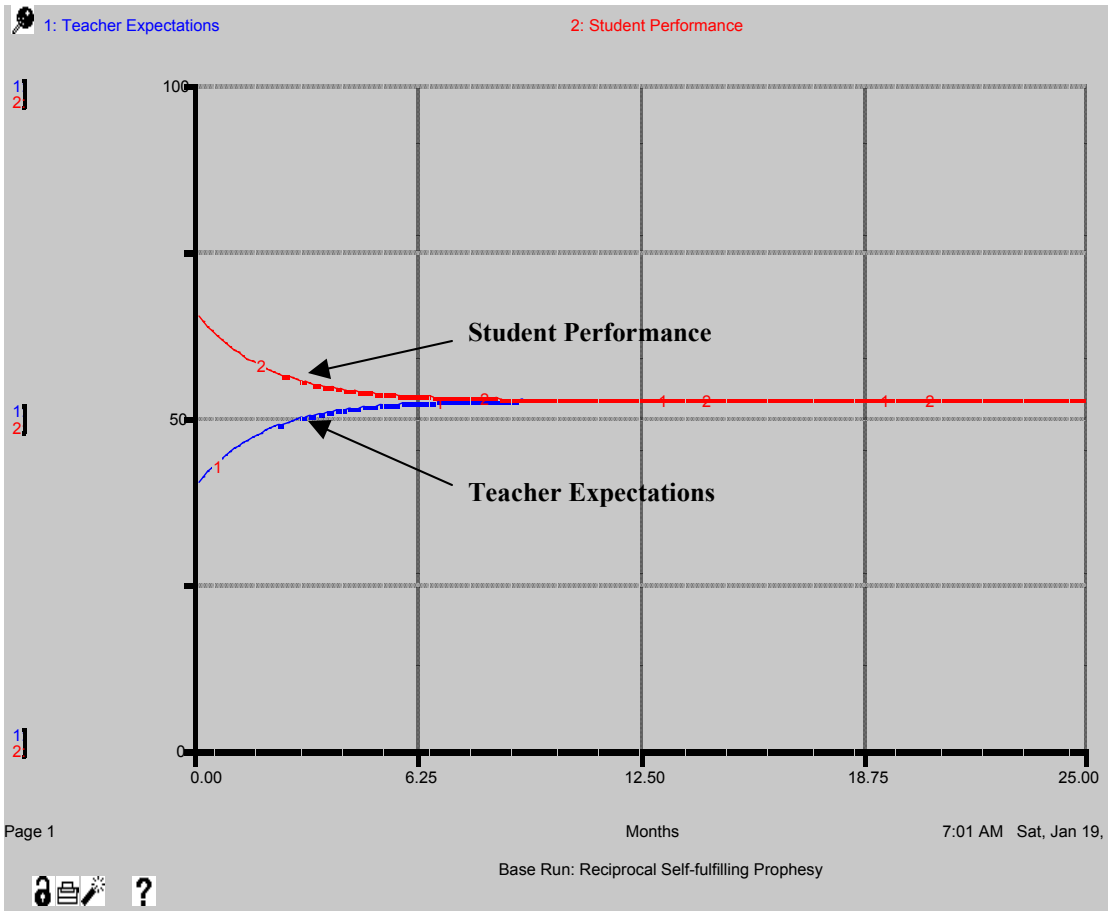
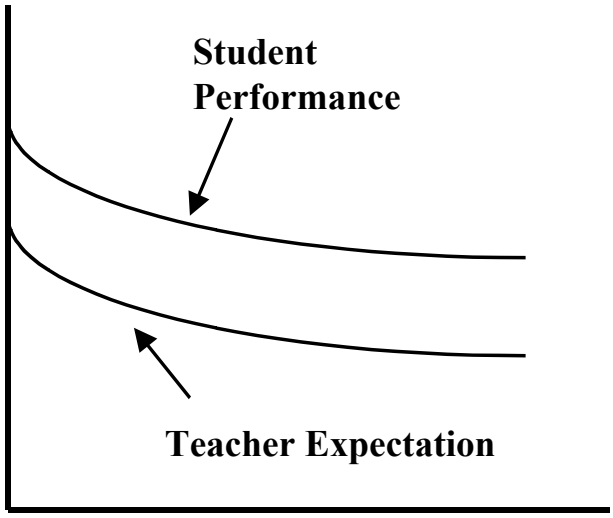


Fig.7. Results of the baseline simulation run for the reciprocal self-fulfilling prophesy model.

Figure 7 shows the output of the simulation. In this run, the students' initial performance level is above the teacher's expectations. This leads to a drop in performance, but because the teacher is influenced by performance, his or her expectations increase to match the performance. Eventually they come into equilibrium at a much lower student performance level than would be the case if the teacher had started with expectations set at a high level. Technically we note that, because we failed to put an extra delay in loop #1, the model is incapable of displaying oscillatory behavior, unlike Dowling and MacDonald's (1995) version of drifting goals. Thus, there are a few differences in the structural characteristics of both situations. However, in general, the drifting goals archetype does fit the situation where both the students and the teacher are influenced by each other's behavior.



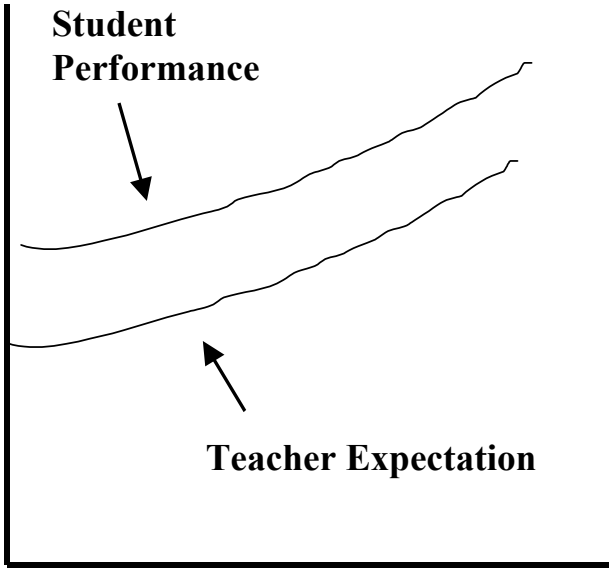


Fig. 8 Alternative patterns of behavior for drifting goals.

Other Patterns.

In concluding this discussion of the two models that deal with the social psychological process of the self-fulfilling prophecy, we should note that the literature on eroding goals,

when discussing behavioral patterns that are associated with this archetype, sometimes shows a different pattern from that found in Figure 7. In particular, Lane and Smart (1996) and Kim and Anderson (1998) show other patterns. Two alternative behavior patterns, as seen in Figure 8, shows the expectation and student performance going either up or down in tandem. This is a very different pattern than was generated by the present reciprocal model (see Figure 7).

This certainly is an intriguing idea. It might look like the pattern depicted in Figure 8b, where the two curves move with each other in the positive direction. However, we feel that the structure that underlies drifting goals, namely, two negative loops, cannot directly generate the patterns found in Figure 8. Those patterns also do not represent the notion of the self-fulfilling prophecy as well. Nevertheless, it is interesting and plausible behavior. The model might have to be modified to take into consideration the direction of the first derivative. For example, we might hypothesize that the students are also paying attention a positive change in the teacher's expectations. When they see that the teacher expects more out of them, they may respond by raising their performance, perhaps by raising their own internal goals. A model that incorporates (1) derivative control and (2) a perceptual delay in monitoring the speed and direction of the teacher's expectations might lead to fruitful insights in the future. However, again the loop structure will deviate from the simple structures associated with the drifting goals archetype.

Models Describing the Extended Contact Hypothesis

A second example of modeling basic and fundamental social psychology processes deals with the area of intergroup prejudice and conflict that might possibly be ameliorated by providing settings where the two groups can come in contact for periods of time, perhaps working together on a common task. This body of literature has policy implications in urban planning, for example, where subdivisions can be designed to include homes of varying price. Social psychologists asked the question whether contact itself could lower intergroup prejudice. There is some evidence that prejudice will decrease over time as a function of contact (Schwartzwald, Amir, & Crain, 1992). One would imagine that there are many other processes, however, that may come in to nullify the positive effects of contact. Recently, social psychologists have become somewhat pessimistic about the reliability of these results. However, they have not completely dropped the idea that contact plays a role in decreasing prejudice. Currently, they are accumulating a large amount of evidence to show that if contact leads to friendship between members of two groups, then members who have made friends with others have a much more positive feeling about the other group. Moreover, even knowing that someone in your group has made friends with members of the other group can lower your degree of prejudice for the other group, even without contact. This is called the "extended contact hypothesis" (Pettigrew, 1997; Wright et. al., 1997).

Given that the current literature emphasizes the development of friendships between groups, we have designated the *Degree Of Friendship* as a principal stock in a model of the contact hypothesis. The first question to ask is whether changes in the *Degree Of*

Friendship are caused by the total, cumulative time spent with the other group or is it the actual process of being in contact with the other group that increases the *Degree Of Friendship*. The literature was not explicit on this distinction, which is very important for system dynamicists. In the model we decided that the process of contact itself increased degree of friendship, not the cumulative time.

Model 1: Simple Extended Contact Model

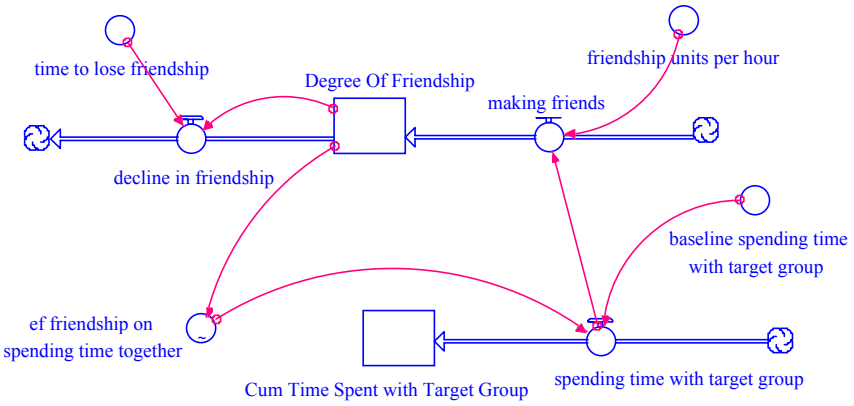


Fig. 9. The stock and flow diagram describing a simple representation of the extended contact hypothesis.

We shall start our description of the simple model of contact by viewing the stock and flow diagram found in Figure 9. First note that we have represented the mechanism of contact as a co-flow process. In addition, we hypothesize that as the *Degree Of Friendship* increases over time, people will want to spend more time with each other, hence the development and operation of a positive loop structure.

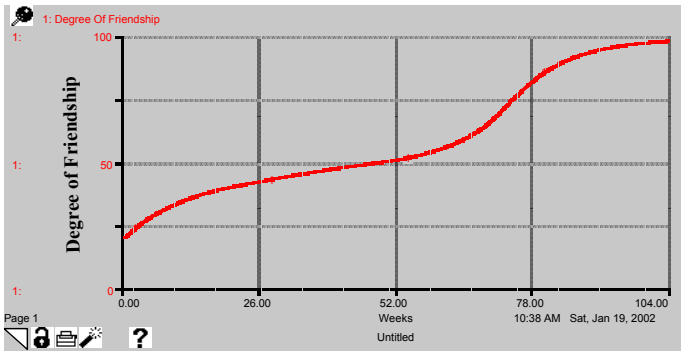


Fig. 10. The behavior of the simple extended contact hypothesis model over time.

The base output of this simple contact model is shown in Figure 10. Initially, *the Degree Of Friendship* shows a logarithmic pattern over time, until the positive loop kicks in. Then one observes an s-shaped curve for the rest of the time horizon, which is two years. Note also that, using this structure, the system can go into equilibrium.

Contact Burnout

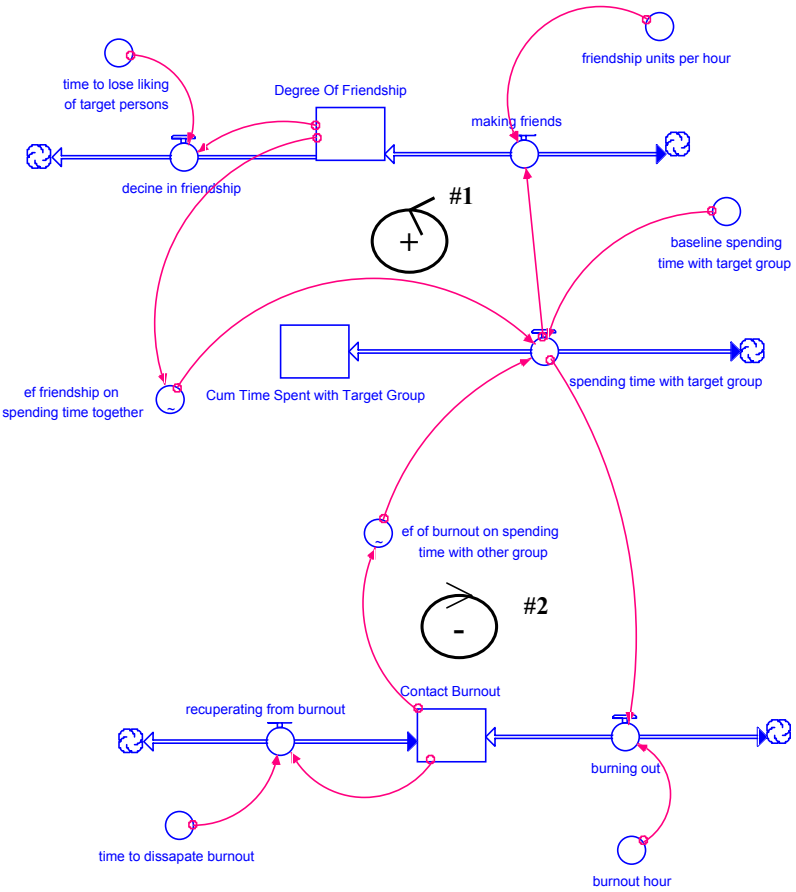


Fig. 11. The stock and flow structure of the effects of burnout on contact behavior: The fatigue variation.

This simple extended contact model displays rather complex behavior over time. However, one may find that "familiarization breeds contempt." Too much contact may inhibit the *Degree of Friendship*. We call this the "burnout effect", and have introduced another psychological stock, namely, a variable called "*Contact Burnout*," to capture the debilitating effects of contact over time. The main question we asked at this point was whether burnout directly affects contact behavior or does it directly affect the Degree Of Friendship. If contact burnout affects contact behavior, then we would consider burnout as inducing response fatigue. On the other hand, if burnout affects *Degree of Friendship*, then the decline in friendship is probably due to the aversive aspects of constantly being

with the other group. Figure 11 shows the stock and flow diagram of the fatigue model, where burnout builds up and then inhibits the rate variable, *making friends*. Thus we have augmented the original simple model of the extended contact hypothesis to include a negative loop process that provides a mechanism for limiting the *Degree of Friendship*.

We also note that, when creating the table function for the effect of burnout on *spending time with the other group*, we assumed that at first the degree of Contact *Burnout* had little or no effect on spending time with the other group. However, as the burnout variable became fairly high, the fatigue effect sharply cut down on *spending time with the other group*.

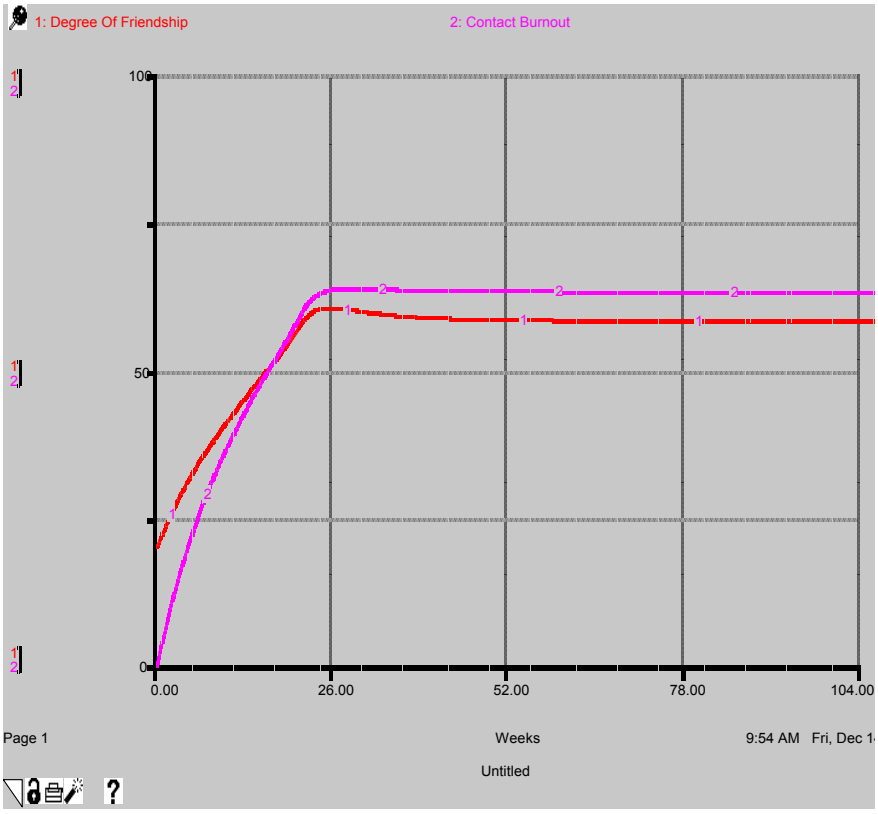


Fig. 12. The results of a base run of the fatigue model, whereContact Burnout directly affects contact behavior.

The results of a base simulation run indicate that the negative, fatigue loop had a very strong effect on inhibiting the growth of the *Degree of Friendship***.** Note also that the *Degree of Friendship* does show a little bit of overshoot and then comes to a new equilibrium point, at least with the parameter values used in this base run. In general there is the old pattern of initial logarithmic behavior, followed by a period of exponential growth that seems to be inhibited by the buildup of *Contact Burnout*.

As we discussed above, one of the major problems of attempting to find and model generic structures found in social psychology is that time series data may not exist. Change is usually measured at only two points in time. Thus, *Contact Burnout* might not directly affect the *Degree of Friendship* through the input side, through a fatigue effect, but because burnout itself is aversive. There are data to show that moods affect attitudes and being in a bad mood may increase the *loss in friendship* over time as *Contact Burnout* builds up

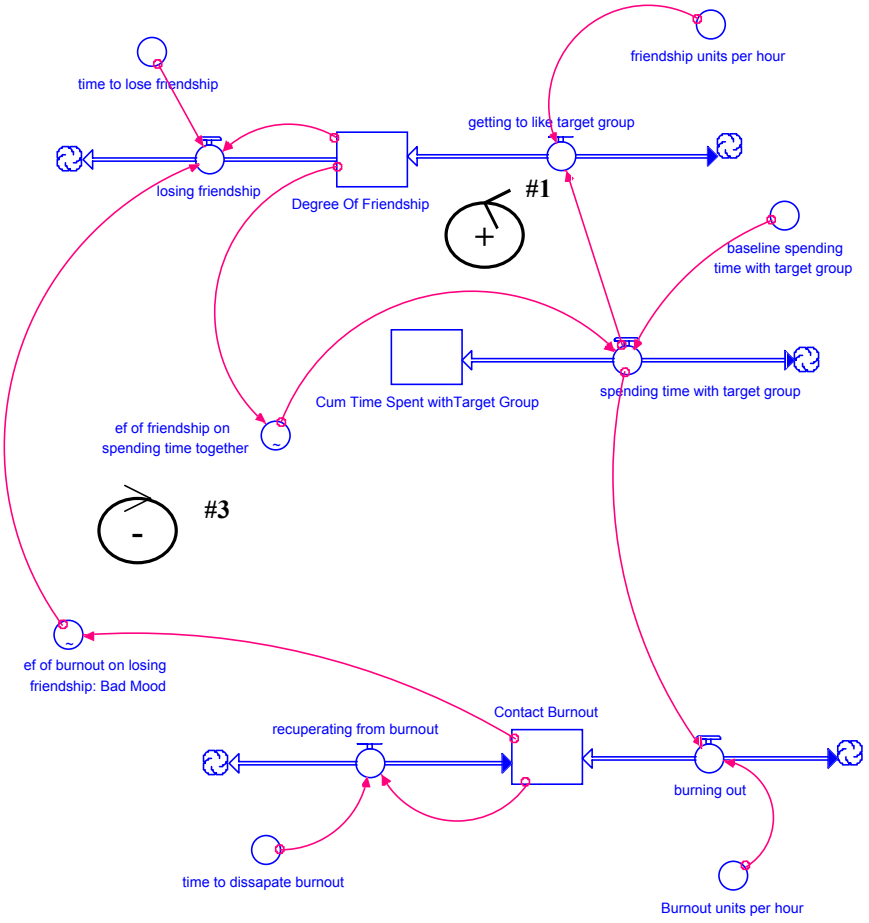


Fig. 13. The stock and flow structure of the effects of burnout on decreasing the Degree of Friendship: The mood variation

The stock and flow diagram of the extended contact hypothesis mood model is shown in Figure 13. Loop #3 inhibits the *Degree of Friendship* variable. This is a different mechanism from behavioral fatigue, associated with the previous model. The table function describing the effect of burnout on losing friendship was written in this base case to have no effect until mid level values of the stock. Then the effect of mood kicked in sharply. The maximum value of the multiplier was set around 3.0.

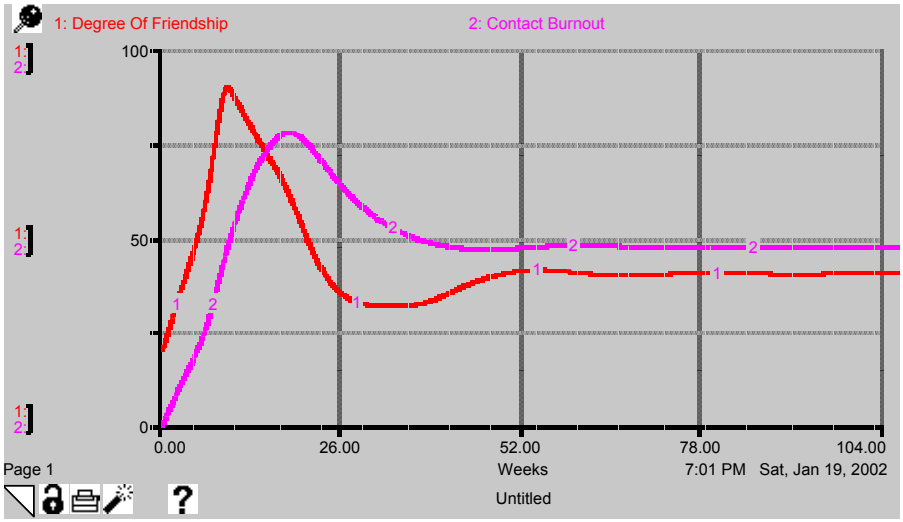


Fig. 14. Results of the base run for the contact mood Model.

Figure 14 represents the output of the model for the initial run. The rapid exponential increase is somewhat startling, compared to the previous fatigue model's trajectories. Note also the behavioral pattern of overshooting, collapsing, and partial recovering to a new asymptote. We have noted this behavior mode in several coflow models in the past (Levine & Nguyen, 2000). We would suggest future work in analytically deriving these oscillations.

Alternative parameter values. In subsequent sensitivity runs, we found that if the maximum value of the *ef of burnout on losing friendship* were set to be relatively low, say 1.6, then the trajectories look very much like the original base model in which we did not assume a burnout process operating.

Combining the two burnout effects. We have uncovered a large degree of uncertainty concerning whether fatigue or mood provides the fundamental mechanism for *Contact Burnout*. Of course it may be a combination of the two processes that operates here. It certain is plausible that both mechanisms are working simultaneously. We therefore extended the model to allow both processes to affect behavior. This variation of the model will be called the "combination model." It should also be pointed out that in the first case, Burnout had a direct impact on contact, per se. On the other hand, the second process had an effect on essentially the quality of friendship.

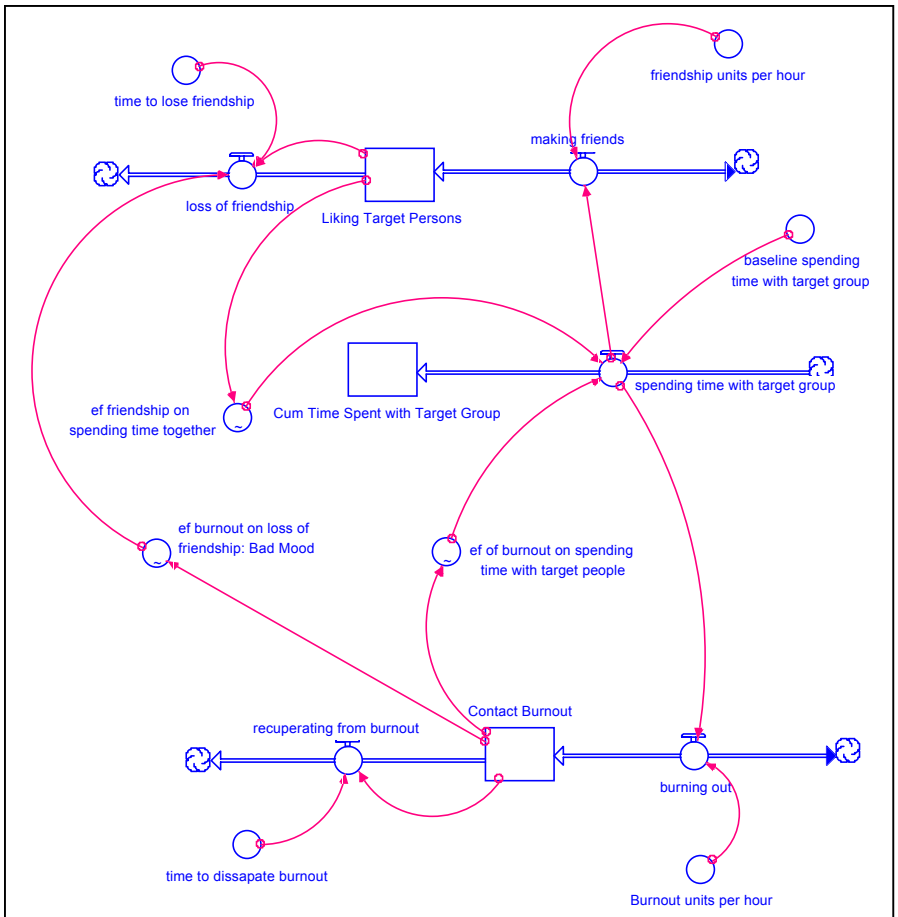


Fig. 15. The stock and flow structure of the effects of burnout on contact behavior: The combination variation.

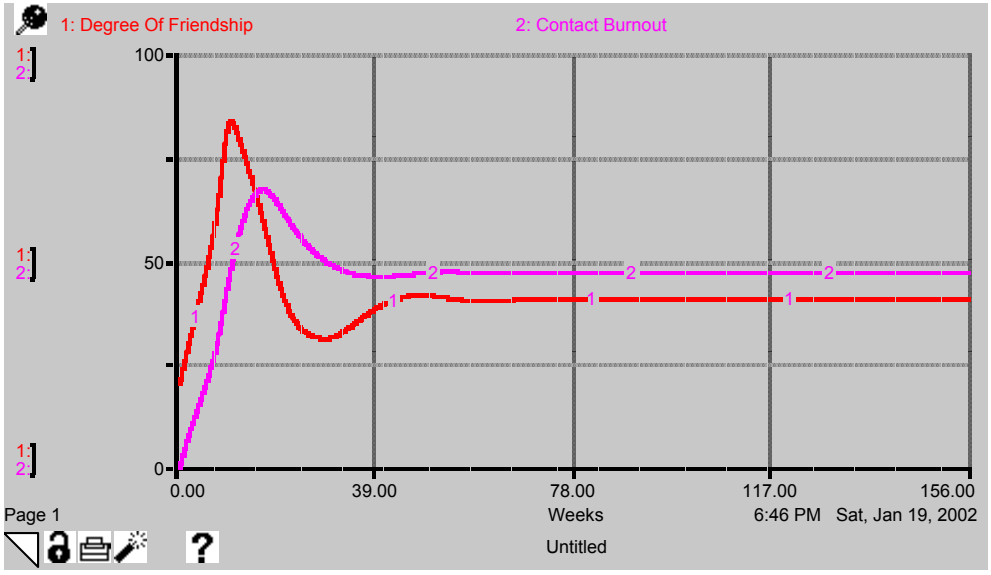


Fig. 16. Base run for model combining effects o fatigue and mood

The stock and flow diagram for the combination model of the extended contact hypothesis is presented in Figure 15, This time we have included the simultaneous operation of loops 1, 3, and 3. The output of the combined fatigue and mood model is shown in Figure 16. Given this parameterization, one can see that the growth, overshoot, and recovery to a new asymptote were sharper and quicker to happen over time.

Modeling the Fundamental Attribution Error

Introduction

Another pivotal process in social psychology deals with how people interpret the actions of others. The fundamental attribution error is quite interesting. The tendency to explain other's behavior patterns as a stable character trait even when objectively, one should be able to see that the behavior was caused by circumstances, is called the fundamental attribution error (Ross, 1977). In this situation, we have the observer and the person being observed, the target person. It is very true that sometimes people have internal, psychological characteristics that may affect their behavior. In the real world, the fundamental attribution error often has social consequences, like thinking that all alcoholics lack will power or that lower income people on welfare are all lazy. Those are internal, dispositional explanations of perceived behavior patterns. The community psychologist, William Ryan (1971, 1981, 1994) coined the term "blaming the victim" to describe the manifestation of the fundamental attribution error. In general, the fundamental attribution error is a bias towards explaining behavior patterns as caused by the biological, personal and moral attributes of the individual, rather than explaining behavior from more external sources, such as being exposed to violence, being discriminated against, and going to substandard schools. Ryan described the process whereby people who are victimized by the political and social system are blamed for their problems. Their personal characteristics are said to be the cause of their getting into trouble and not being able to cope adequately with their problems.

Repenning and Sterman (2000) recently utilized a form of the fundamental attribution error, which they called the "self-confirming attribution error" in a model that represents the dynamics of process improvement. Managers may attribute low throughput to inadequate worker effort, rather than understanding that low throughput may be due to deeper and less observable process problems. This leads to higher levels of production pressure and less emphasis and resources devoted to process improvement.

Research also finds that, when the observer makes errors or does not perform well, then usually the person will attribute poor performance to outside causes and conditions (McGuire and McGuire, 1986; White and Younger, 1988; Fiedler et al., 1991). In many respects, system dynamicists deal with structures that determine behavior. We call this an "internal approach" to causation, because we attribute the behavior observed to the internal loop structure underlying the system problem. We have to be a little careful here to point out that the term external and internal, as used by psychologists, may be used differently. Actually, in terms of explanation, SD's internal explanation corresponds most of the time to social psychologists external explanation. Frequently this means that

almost anyone in the system may act in the same manner, given the constraints imposed by the cybernetic loop structure. We also would like to point out the relationship between the self-fulfilling prophecy example and this process. The teacher may be attributing poor performance to laziness or stupidity of his or her students.

Introducing a dynamic perspective

In most cases, what we have found is that social psychologists treat this very powerful bias in a static manner. However, the degree of internal explanation can change over time. So, in developing a model of the dynamics of the fundamental attribution error, we are going to look at the role of consistency in changing the internal explanation of the observed behavior patterns.

Model variables

Let us start with the individual being observed. It may very well be that he or she does have some dispositional characteristics that explain behavior patterns in one situation or another. An example of such an internal, psychological disposition might be shyness. We can envision a variable that represents the degree that the persons' disposition affects their behavior patterns. This individual difference variable has theoretically been set to range from 0.0 to 100. It is called the 'target's actual strength of internal attribution." Low values imply that external causes can explain observed behavior patterns. High values imply that the target person's poor performance is low because of internal causes, such as low IQ or laziness, etc. A value of 50 means that about half the time the causes were internal and the other half external.

One of the main stocks of this model is the "*Perceived Internal Strength of Target by Observer*". This is the perceptual counterpart of the target's actual internal strength value. A second key process deals with the consistency of the target's behavior over time and situations. We assume that targets vary in their degree of consistency. Presumably, if internal strength is high, then the person will consistently show the characteristic behavior pattern in one setting after another, i.e., they will be very consistent. Low consistency indicates that outside circumstances and the system characteristics explain why performance, for example, can be good one time and fall down at other times.

Figure 17 shows the stock and flow representation of the model. A basic assumption is that most observers assume that the target's internal strength is very high, the fundamental attribution error, and that, if this is true, consistency should be high. Actually, the target person may have a low internal strength value and will eventual show that he or she varies considerably over time with respect to behavior.

Let us look at the structural characteristics of this model in a bit more detail. Actually, the model, from a system dynamics perspective, is not too interesting. There are only two negative loops that are coupled together by a single connection through the variable *time to change perceived internal strength*. This table functions assumes that, when the target person is very consistent over time, there is very little evidence that the target's

behavior is caused by circumstances, rather it is evidence for some permanent, highly immutable character trait that explains his or her behavior. On the other hand, when *Perceived Consistency* somehow gets low, then the adjustment time should be short. Thus, under these conditions, change in perceived internal strength occurs faster.

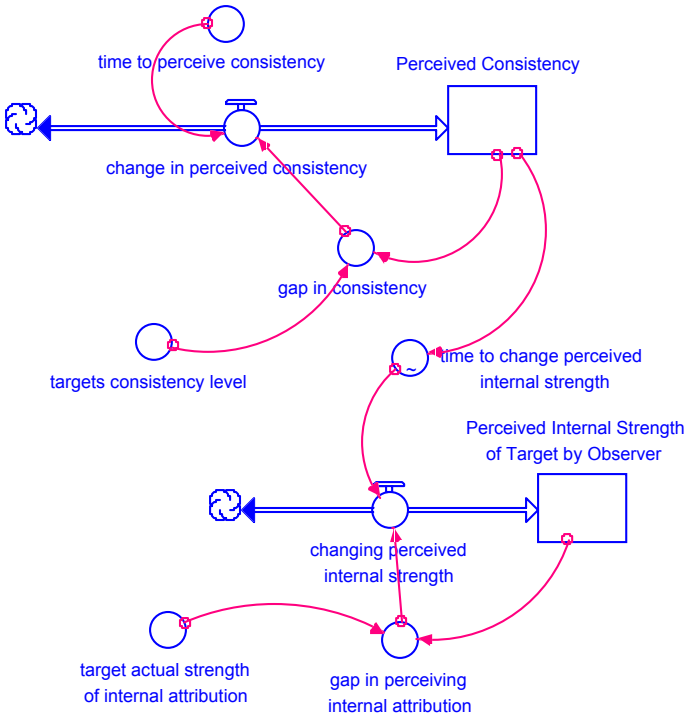


Fig. 17. The stock and flow diagram associated with modeling the dynamics of the fundamental attribution error.

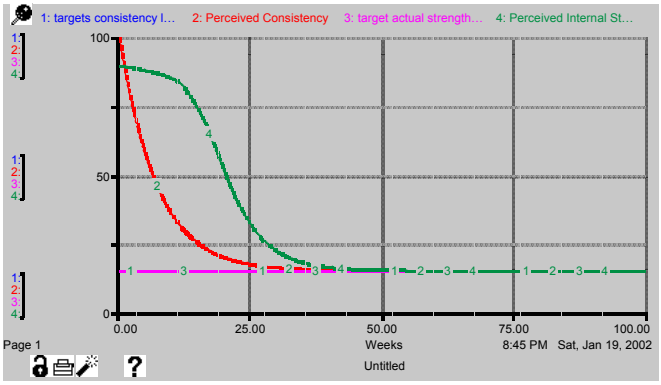


Fig. 18. The output of a model of the fundamental attribution Error.

The results of a simulation run are displayed in Figure 18. Initially we set the target's actual strength of internal attribution and the target's consistency level at a low value of 15 each. Thus the target actually was not consistent and mainly made mistakes and performed poorly primarily due to external causes. Figure 18 shows that at first, since *Perceived Consistency* is high there was not much change in perceived internal strength, until the observer changed his or her estimate of the target's consistency level. As the negative, stock adjustment process associated with *Perceived Consistency* move to realistic values, the Observer began to rapidly change his or her perceptions of the target's actual internal strength, which in this run, was very low, 15.

CONCLUSIONS AND COMMENTS ON SOCIAL PSYCHOLOGY

Advantages to Describing Common General Structures for the Field of Social Psychology

Thus far, we have been focusing on how these social generic structures might be integrated into the work of system dynamicists. On the other hand, it is always nice to see where system dynamics might prove extremely useful in bringing understanding and insight into a traditional social science discipline, like social psychology. Indeed, we think that a system dynamics approach to modeling empirically well-established social processes has some added value for the field of social psychology. First, it can lay things out so that the assumptions are clear and can be examined and assessed in more detail. Indeed, as we began to model these isolated social phenomena, we noted that we had to ask some hard questions about assumptions, which were not made explicit in the literature. Models help to raise questions about assumptions that would not have be asked without the modeling process. Along with making assumptions clearer, we suggest that SD modeling will make verbal theories more coherent and consistent. In addition, as we have indicated, traditionally, social psychologists focus on reliable static processes and sometimes fail to look into changes over time. Since the emphasis is on experimental manipulation, very little progress has been made to introduce cybernetic thinking about those social phenomena. System dynamics adds a cybernetic dimension to the study of those psychological processes.

Linkages. One of our observations about this field, as represented in textbooks on the topic, is that researchers specialize so much in their research that in general there is not much effort devoted to noting the linkages among research areas. Indeed, unlike physics and perhaps microeconomics, one could easily open a social psychology textbook to any chapter and randomly select further chapters without any difficulty in mastering the material. A system dynamic approach to finding common social molecules may tie up loosely fitting social phenomena through discovering those linkages. Accumulating these bits of social processes should be helpful in dealing with complexities of the real world by expanding and combining social molecules. Understanding attitude formation and change may be very useful in understanding conflict, aggression, and impression formation.

Further empirical research. Although we are looking for well established and thoroughly researched social phenomena, we feel that using system dynamics to model social processes can lead to identifying the need for further empirical research and indeed might provide a framework for future studies. In several cases we have found that, after developing a model of the social process, and running the model under conditions that match the contexts described in the literature, the literature did not contained extended time series data to look at, because researchers were only interested in demonstrating a change from the behavior before the intervention was given to the subject and after the intervention was given to the subject. The subtleties of the behavior-over- time graph were reduced to a straight line between two points for the experimental and the control group.

Many of these social processes are set in specific contexts. As part of our model analysis, we frequently pushed the model to see what would happen under other conditions and contexts. Although the output of the model seemed to be reasonable and consistent, we have found that there are typically no data in the literature to directly validate the model's trajectories. There appears to be massive gaps in the literature. The model points out rich areas of further research that can be done to study those social processes.

The social psychological literature provides a rich store of empirical data and interesting theories about social behavior. This paper is a first attempt to find dynamic aspects of this discipline and to model some of these processes. Hopefully, as we continue modeling, some of these generic structures should become useful for system dynamicists to incorporate some of these social processes into their models. Also, we would hope that social psychologists would move toward collecting time series data and paying more attention to behavior patterns over time. We can learn from each other.

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