STATUS CHARACTERISTICS AND EXPECTATION STATES:

A PROCESS MODEL*

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I. Introduction.

In task groups generally it is found that power and prestige are unequally distributed; that various components of power and prestige (such as participation rates, influence, evaluations of contributions) are highly correlated; and that, once having emerged, power-prestige orders are quite stable, resisting change (Bales, et al., 1951; Bales, 1953; Bales and Slater, 1955; Harvey, 1953; Heinecke and Bales, 1953; Sherif, White and Harvey, 1955; Short and Strodtbeck, 1963; Strodtbeck, 1951; Strodtbeck, 1954; and Whyte, 1943). In those task groups in which there are prior status differences, differences, for example, in age, sex, occupation, or color, it is repeatedly found that differences in power and prestige correspond to differences in status (Caudill, 1958; Hurwitz, Zander, and Hymovich, 1953; Katz, Goldston, and Benjamin, 1958; Katz and Cohen, 1962; Mishler and Tropp, 1956; Strodtbeck and Menn, 1956; Strodtbeck, James, and Hawkins, 1957; Torrance, 1954; Zander and Cohen, 1955; and Ziller and Exline, 1958). Caudill, for example, found that in a series of sixty-three consecutive morning rounds in a small psychiatric hospital, the head administrator participated more than the chief resident, the chief resident more than other residents, the most passive resident more than the nursing supervisor, the nursing supervisor more than other nurses, and the ancillary personnel (social workers, occupational therapist) about as much as nurses (Caudill, 1958, Chapter 10). If the sixty-three sessions are divided into three equal periods, the same order persists stably in each period except that the position of the ancillary personnel fluctuates slightly.
Two facts are particularly interesting about the effects of prior status differences. First, whatever they are due to they are not due to direct, personal experience of other group members. For the same result is observed even if the group members have never previously met. Torrance, for example, instructed temporary B-26 crews, composed of a pilot, navigator, and gunner, who were not previously acquainted; to estimate the number of dots scattered on a card. (The card displayed a very large number of small dots haphazardly arranged.) The pilot, who was also air crew commander, had more influence on the decision than the navigator, who in turn had more influence than the gunner. The same result was obtained for three other tasks (Torrance, 1954). Second, prior status differences in the group correspond to the distribution of power and prestige even where they do not have any obvious or direct bearing on the group task. Often, of course, prior status differences, even in ad hoc settings, are of a kind that naturally affect interaction, as when highly prestigeful mental health specialists have more influence than less prestigeful specialists in a discussion of mental hygiene issues (Hurwitz, Zander, and Hymovich, 1953). But the effect is not always of so obvious a kind. One of Torrance's four tasks, for example, required his air crews to construct a joint story that would describe what was taking place in an ambiguous picture taken from a projective test. It is not self-evident that the pilot should have, either as a consequence of his training or of his predictable taskabilities, any projective story-telling skills; but even for this task the pilot influenced the final story more than the navigator, the navigator influenced it more than the gunner (Torrance, 1954). Thus it has been repeatedly found that
When task groups are differentiated with respect to some status characteristic external to the task situation, this differentiation determines the observed power and prestige order within the group, whether or not the members have previously known each other or the external characteristic is related to the group task.

In a previous paper (Berger, Cohen, and Zelditch, 1965) we have explained this result in the following way: (1) In a task situation, the observed distribution of power and prestige, for example the distribution of performance outputs, or of evaluations of task-contributions, can be regarded as a function of underlying beliefs about relative abilities to perform the task (Berger and Snell, 1961); if, for example, an actor, p, believes another actor, o, is better at the task than he himself is, and if he is committed to his group's success at the task, then he will defer to o's suggestions. (2) While such expectations can arise from direct experience of others, they can also be embodied in stereotyped beliefs about people who have particular states of a status-characteristic; if, for example, p is male and o is female, p may assume, even without knowing o personally, that he is better than o at whatever task they are to perform. (3) In situations in which p and o are to work together to accomplish a collective task, and in which they care about the successful outcome of the task, there will be some pressure on the actors to assign expectation states to each other; for example, p will want to know how seriously to take suggestions made by o. (4) If p and o differ in status, and there is no other basis for assigning expectations about performance except this difference, then beliefs embodied in the status-characteristic become a basis for assigning expectations. (5) Even if the task requires an ability that is not part of the stereotyped conceptions that p and o have of
each other, the status-characteristic will become significant in the situation because it has a halo effect; it tends to become diffuse, to generalize. (6) In either case, therefore, whether the task requires a wholly new ability or not, because the status-characteristic determines assignment of expectations, and expectations determine the observed distribution of power and prestige, we will find that the power-prestige order corresponds to the prior status differences.

This formulation is sufficient to account for results like those of Strodtbeck and Torrance, but it is applicable essentially to non-process experiments. In the present paper we propose to extend it, so that we are able to describe an action process through which, step-by-step, the status-characteristic determines the allocation of performance expectations. This extension is significant, first in that it provides a way of precisely testing some of the basic assertions in our formulation, second in that it is a model applicable in an important class of interactive settings. But it should be understood that the model is in no sense exhaustive, there are other interactive settings in which the effects of prior status differences are apparent, in which prior status differences in fact function in the way we have just claimed that they do, but in which the action process itself is different.

In Section II we summarize our previous formulation: there we define a diffuse status-characteristic, show how it comes to determine performance expectations in specific task situations, and, finally, show how performance expectations determine the observed distribution of power and prestige. In Section III the way in which we propose to extend this formulation is described.
In Section IV we formalize the model developed in Section III. This is followed by a technical appendix, in which questions of estimating and testing the model are considered.

II. Basic Concepts and Assumptions.

The idea of a diffuse status-characteristic has already been developed in Berger, Cohen, and Zelditch, 1965 and Zelditch, Cohen, and Berger, 1965. Here we only summarize the main features of the definition and emphasize those aspects of it that are particularly relevant to this paper.

It will be recalled that, first, characteristics like age, sex, ethnicity, or color, are symbolically rather than intrinsically significant. "Black" in itself means nothing; what is important about color is what it stands for in the minds of many people. Second, associated with status-characteristics are sets of fairly specific beliefs, such as "Negroes are musical." But third, such specific beliefs tend also to generalize to the actor as a whole, rather like a halo effect, so that one is able not only mathematically, or mechanically, or verbally; one is also simply "able" in a way that is quite general and indefinite. Fourth, states of a status-characteristic stand for evaluations of people as well as beliefs about them; these evaluations are also given to the specific and general beliefs associated with the characteristic.

We employ the following notation: D is used to refer to status-characteristic D to refer to its states. In this paper we talk of characteristics as having two states, so that x = a or b. For example: though occupation is a characteristic having many states, we arbitrarily lump some of these so that
we might have, say, white-collar and blue-collar occupations. C is used to refer to specific characteristics (such as mathematical, or mechanical ability) to its states \((x = a, b)\). States are differentially evaluated if one is positively and one negatively evaluated; for, limiting ourselves to two states, we have only two values as well. A set of states of specific characteristics is represented by \(Y_x\) (where again \(x = a, b\)). The generalized state that, like a halo effect, also comes to be associated with states of \(D\), is represented by \(GES_x\) (for general expectation state). We mean by a diffuse status-characteristic, then,

**Definition 2.1.** A characteristic \(D\) is a diffuse status-characteristic if and only if

1. the states of \(D\) are differentially evaluated, and
2. to each state, \(x\), of \(D\) there corresponds a distinct set \(\mathcal{S}_x\) of specifically associated evaluated states of characteristics, and
3. to each state, \(x\), of \(D\) there corresponds a distinct general expectation state, \(GES_x\), having the same evaluation as the state \(D_x\).

In this definition the term "specifically associated" refers to those states that are understood as a matter of socially accepted belief to be related to states of \(D\). If \(C_x\) is specifically associated with \(D_x\), then an actor \(p\) will attribute \(C_x\) to another, say \(o\), if told that \(o\) possesses state \(D_x\). For example, \(p\) may expect himself to be better at solving mathematical puzzles than \(o\) if \(p\) is male and \(o\) is female; in that case, in \(p\)'s eyes mathematical ability is associated with sex.

Note that a state and its value are carefully distinguished, since it
is possible to negatively evaluate the higher state of a characteristic. For example, high aggressiveness is sometimes negatively evaluated. And, of course, the high and low states of a specific characteristic may not be differentially evaluated at all. High ability to solve mathematical puzzles may be positively evaluated by some, not evaluated at all by others; not that it would be negatively evaluated, but rather it would have no evaluative significance.

Whether, for a particular actor in a particular situation, a given characteristic is a diffuse status-characteristic or not, is of course an empirical question. In each case in which our theory is to be applied we must first ask: does p differentially evaluate the states of D? Does he have specific beliefs about those who possess different states of D? Does he believe those who possess one state of D to be superior to those who have the other, simply because they possess state D? Social class, for example, is a diffuse status-characteristic in a community if the white-collar class is thought, ipso facto, to be more worthy, smarter, more moral, more industrious, more energetic, and in fact altogether superior in almost every way that counts in the community, to the blue-collar class.

If a diffuse status-characteristic embodies beliefs about actors that, in the absence of direct experience or personal knowledge of a particular actor, can stand in place of such experience, we naturally will want to ask in what situations such beliefs come to determine interaction. Four conditions appear to be important. Hereafter we will take these four conditions as defining what we mean when we use the expression 'the situation $S$.'

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1. The conditions we describe here are sufficient, but they do not necessarily exhaust the possible situations in which D becomes significant.
First, we will assume that there is a collective, valued task, T; that is, a task that requires p and o to act together in order to achieve some task-outcome, say $T_a$, that is more positively evaluated than some other outcome, $T_b$. P is therefore committed to "success" at the task and must take the behavior of o into account in achieving that success.

Second, we may think of the task as requiring an ability C, with states $C_a$ and $C_b$. We will say that C is instrumental to T, if one state of C increases the likelihood that p achieves one of the outcome states of T while the second state of C increases the likelihood that p achieves the second outcome state of T. If not instrumental, C is independent of T. We assume that if $C_a$ is instrumental to $T_a$, and $T_a$ is the positively valued outcome of T, then $C_a$ is the positively evaluated state of C, while $C_b$ is negatively evaluated.

Third, we assume that p has not assigned specific states of C to himself or o, nor has such an assignment been provided as an initial condition of situation $S$.

Fourth, we assume that p and o possess different states of a single status-characteristic D, so that D is a basis of discrimination between p and o in situation $S$.

In such a situation, we will say that the diffuse status-characteristic is activated if and only if the specifically associated sets of states $x$ and the general expectation state $GES_x$, that are associated in the actors' minds with $D_x$, are attributed by p to the actors in the situation. This is meant to formulate as exactly as we can the idea that the characteristic and the beliefs associated with the characteristic become significant to the actors and become part of a meaningful response that the actors have to each other. What we have, of course, is a situation in which there is some pressure to assign states of C to actors, that is to attribute expectation states
to them, but no basis for doing so. Since beliefs about states of D are capable of being viewed as "experience" which embodies knowledge about how actor will behave, D becomes a basis from which expectations can be inferred.

**Assumption 2.1. (Activation).** D is activated in task situation S if T is a differentially evaluated, collective task, and D is a basis of discrimination between p and o in S.

If D is activated in the situation S, and C is the characteristic instrumental to T in that situation, then either C has already been specifically associated with D or it has not. If it has, then assignment of states of C is immediate, since activation means that the characteristics allocated to D are attributed to actors. For example: Hurwitz, Zander, and Hymovich (1953), require mental health specialists to discuss a mental health problem. Some are "eminent specialists" in the field, while others are not. We can in this setting assume that the specific characteristic is already associated with states of the diffuse characteristic.

If it has not been specifically associated with states of D, C might be very similar to a characteristic that has. Or it might even be well-known to be irrelevant to D; that is, the social definition that forms part of p's beliefs about D might explicitly regard C as independent of, or dissociated from, D. But here we are particularly interested in the situation in which there has been no prior relation specified at all. A close parallel is Torrance's projective story task, in which officers and enlisted men combine to tell a story based on an ambiguous stimulus. In this case, even though C has not previously been associated with states of D, we shall believe that
the burden of proof will be on anyone to show that D is not relevant to C. Relevance here means that possession of the state of one characteristic is a basis for anticipating possession of a state of a second characteristic. Actors will want to know who is good and who poor at the task; if there are general expectation states associated with D, they will become relevant to C.

**Assumption 2.2. (Burden of Proof).** If C has not been previously associated with or dissociated from D, and D is activated in S, and D is the only basis for discriminating p and o, then D will become relevant to C in S.

It is, of course, natural to suppose that states of C when they are assigned, will be assigned to p and o so as to accord with their states of D and GES. We will call such an assignment balanced.

**Definition 2.2. (Balance).** Two relevant or associated states are balanced in S, if and only if they have the same evaluation.

And,

**Definition 2.3. (Balance).** A status structure is balanced in S, if and only if all its relevant or associated states are balanced.

For example, if p is a college senior and o is a high school freshman, then to attribute a positively evaluated ability to p and a negatively evaluated ability to o will be balanced. To attribute a negatively evaluated ability to p and a positively evaluated ability to o would be imbalanced.

**Assumption 2.3. (Assignment).** If p and o possess differentially evaluated states of D, and D is relevant to C in S, p will assign in S states of C to himself and o that are balanced with the states of D that he and o possess.

We have, now, a set of assumptions that will explain how states of C are attributed to p and o in the absence of any information in the experimental
situation itself that would be grounds for assigning expectations. Either D is already associated with C and conveys some information to p and o about who should do well and who poorly; or D is not already associated with C but the general expectation state associated with D is seen as relevant in the situation and conveys similar information. How will this affect the interaction that takes place?

Consider first a situation in which there is no D to distinguish actors at all, but we have a valued, collective task—say the Bales’ conference setting (1953). We may think of each actor as having certain opportunities to act, as when p is asked by o what he thinks about a given problem; if, given this opportunity, p seizes the chance to act, we may say that he makes a problem-solving attempt; if, on the other hand, p does not take the opportunity offered, but instead allows o an action-opportunity, then we may find that p praises, agrees with, or shows some kind of reaction to o’s behavior, which we will call a unit-evaluation ("unit", to distinguish evaluation of a particular act from the more general evaluations of states of characteristics); if p does make a problem-solving attempt, and then tries to have o change his own views in the direction of p’s suggestions, we can speak of an influence attempt, and if p succeeds we can speak of the exercise of influence. If we choose these as the selected features of interaction that are of most interest from the point of view of the present theory, the whole set of actions taken together can be called an observable power-prestige order.  

2A standardized experimental situation has been developed in which these concepts are operationalized. The situation is structured so that, for example, action opportunities, agreements and disagreements on unit acts, and
It will be recalled that certain uniformities in the distribution of power and prestige are regularly observed: first, they are almost always unequally distributed; second, each component is highly correlated with the other; third, differences in power-prestige are correlated with influence over the final decision (Bales et al., 1951; Bales, 1953; Strodtbeck, 1951; Strodtbeck, 1954). A parsimonious way of accounting for these facts is to regard the observable power-prestige order as a function of a hypothetical, underlying performance-expectation structure (Berger and Snell, 1961). If C is instrumental to task T, the expectations associated with the states C can be ordered as "high" and "low", where the high state is that which increases the likelihood that p achieves the positively evaluated outcome and the low state is that which increases the likelihood that p achieves the negatively evaluated outcome of T. And we have,

Assumption 2.4. (Basic Expectation Assumption). If C is instrumental to T and if specific performance expectations for C are attributed by p to himself and o in S, the observable power-prestige order in S will tend to be an increasing function of these attributed states. 

By the expression in Assumption 2.4, "will tend to be an increasing function of these attributed states," we mean that the rates of received action-opportunities, performance-outputs initiated, positive unit evaluations received, and successful influence attempts, will tend to be greater for the communicated unit evaluations can be controlled, and successful influence studied as dependent behavior. Thus, in general the different types of behavior associated with the power and prestige order of the task-oriented group can be studied while the remaining behavior types are experimentally controlled. This situation is related to the process model discussed in Section III and IV and will be referred to as the expectation action situation.
actor to whom the high state of C is attributed than the actor to whom the low state of C is attributed.

Note that, because they are all functions of the same underlying factor, all of the observable components of the power-prestige order will be correlated. That they will be differentiated, however, is a consequence of additional assumptions into which we need not venture far here, since they are for the moment outside the scope of our defined objectives. (See, however, Berger and Snell, 1961, and Section III of this paper.)

We have now the following explanation of the Strodtbeck-Torrance type of experiment: There are two possible situations, in one of which C has already been specifically associated with states of D, in the other of which it bears no prior relation to D.

In the first case, C is instrumental to the collective task, T, and one outcome of T is more valued than another. The experimental conditions are such as to activate D, and external diffuse status-characteristic, since actors have no previous personal knowledge of each other and there is no basis for discriminating one from another in the immediate task situation except D. By activating D, since C is already associated with it, actors are able to attribute performance-expectation states to themselves and others. The observed power-prestige order will be a function of the states they assign. If we assume that the high state of the performance characteristic is the positively evaluated state, and is the state associated with the positively evaluated state of D, conditions that appear usually to be satisfied, we will find that the distribution of observed power and prestige will tend to coincide
with the distribution of the diffuse status-characteristic.

An example of the first kind of situation we want to distinguish is reported by Zander and Cohen (1955), who formed "committees" of college students who were to discuss how to dispose of a gift to their school made by an anonymous donor. Into each committee Zander and Cohen introduced two students, one identified as a Dean and one as a freshman, though the two did not themselves know how they had been identified to the other students. Interviewed after brief discussions with their committees, Deans, more than the freshmen, reported that other students were attentive to and readily agreed with their ideas.

In the second case, in which no prior relation has been specified between D and C, we have as in the first case that C is instrumental to the collective task T, T is valued, but actors have no idea what state of C to attribute either to p or to o. D is activated because there is no basis other than the diffuse status-characteristic, either in the situation or from past knowledge of each other, to discriminate the "able" from the "unable" actors. Even though there is no reason to suppose that D is relevant to C, since they have not previously been socially defined in relation to each other, we believe the burden of proof is on the actors to show that D is not relevant (Assumption 2.2). This simply expresses the generalizing power of the GES states. If relevant, D becomes a basis for attributing states of C to actors. States of C will be assigned in such a way that they accord with, or are balanced with, states of D. Having attributed states of C to actors, the performance-expectations they hold for each other will determine the distribution of observable power and prestige. If the high state of C is the positively evaluated
state, then the distribution of power and prestige that is observed will tend to coincide with the distribution of the diffuse status-characteristic.

The clearest example of the second kind of situation is Torrance's projective discussion task (Torrance, 1954). It will be recalled that, among Torrance's four tasks, one called for air crews to construct a joint story about an ambiguous picture taken from a projective test. In both temporary and permanent air crews, the pilot had the greatest influence, the navigator was next, and the gunner had the least influence over the crew story. We argue that this result cannot be explained by supposing that "projective story telling" skills are associated, in the minds of the subjects, with air crew position or air force rank. The idea of a general expectation state and the burden of proof assumption alone can account for it.

This completes our first task, which was to construct a theory relating diffuse status characteristics to an observed power and prestige order and as a consequence to explain the results obtained by Strodbeck, Torrance, and others. The theory that we have constructed is deliberately formulated so as to exist independent of any particular process of attribution of performance expectations. That is, the theory presumes that attribution must always occur in an action setting of one kind or another but it does not specify that action setting. Hence, we envisage the possible investigation of a wide variety of settings and consequently possible construction of many process models. However, we have as our present objective the consideration in some detail of only one particular kind of action setting and we intend as our second main task to specify precisely in that setting one
process by which status characteristics determine performance expectations. This task we undertake in Section III.

III. Assignment of specific performance expectations.

In this section we shall construct a set of assumptions describing one action process through which specific performance expectations come to be attributed to actors. Definitions and assumptions from Section II will provide the initial status conditions of the situation. Given this initial status situation, we shall describe a specific task and interaction situation, in which the process of assignment takes place. Given these three sets of conditions, respecting status, task, and interaction, we will be able to describe exactly a sequence of actions that takes place in the defined situation, and show how, as a consequence of these actions a given actor, p, assigns the states of C to himself and others. We shall also show how, after the assignment of states to actors, the assignment of states itself can be seen as determining the further course of the action process.

A. Initial status situation

The first set of conditions that we must specify have to do with the status situation in which actors find themselves at the outset of the process. We will talk of only two actors, p and o. The situation is viewed from p's point of view, and there are two objects of his orientation in the situation: himself, p', and the other, o. We assume that the following conditions are given: (1) there is a valued collective
task, T, one state of which is positively evaluated by p and o, so that to achieve that state represents "success", while the other state is negatively evaluated, representing "failure"; (2) there is a specific performance characteristic, C, instrumental to T; (3) the states of C have not been previously attributed to p' and o, nor previously associated with states of status characteristic D; and (4) there is a diffuse status characteristic, D, with respect to which p and o are differentiated.

If these conditions are given, assumption 2.1 leads us to conclude that D will be activated, so that p will attribute to p' and o the GES associated with their states of D. Either p believes that he himself is generally superior and o generally inferior, or the reverse. And, although p will not know which state of C either he or o possesses, assumption 2.2 leads us to conclude that D will be relevant to C—that is, p will believe that possessing a given GES is not independent of possessing a given state of C.

We may conveniently represent this situation in the following way. Allow the sign "+' to represent any positive or high expectation (general or specific) and "-' any negative or low expectation; and allow 0 to represent an unformed expectation. Let any expectation state with respect to a given characteristic be represented by an ordered pair with expectations for self in first position and expectations for other in second position. Thus [++] means that p has high expectations for self, low for other, with respect to some specified characteristic. In order to distinguish general from specific expectations, enclose the former in braces \{\} and the
latter in [ ] brackets. Now: there are only two possible states in which
the process, from p's point of view, can start; for either p is superior
and o inferior, or the reverse; and expectations about C are not yet formed,
even though general expectations are relevant. The process must therefore
begin either in the state \( \begin{bmatrix} \gamma + \beta \end{bmatrix} [00] \) or \( \begin{bmatrix} \gamma - \beta \end{bmatrix} [00] \)--where general expectation
states are written first, and the specific performance characteristic is
that characteristic to which GES is relevant.

B. Task and interaction conditions

We will assume that in this initial status situation p is confronted
with an an n-step decision process, which in an experiment can be iden­
tified with n identical trials. At each decision step p and o must each
make a binary choice, say between the two alternatives A and B. The
decision, however, is a multi-stage decision: for, after making a preli­
minary selection of one of the two alternatives, actors are required to
exchange information about their choices and then to come to a final
decision. We envision a situation in which the process of exchanging
information about preliminary decisions is controlled by the experimenter,
so that, for example, we can manipulate subjects' beliefs that they agree
or disagree in their preliminary decision. Throughout we will restrict
ourselves to the special case in which p' and o are in continual disagreement.
At each decision step, finally, p is led to believe that there is one
"correct" and one "incorrect" alternative, but he is not provided with an
objective standard by which he can determine which alternative is correct.
P is assumed to believe (and in an experiment would have to be made to believe
by the experimenter's instructions) that only his final decision counts.
Further, the question of where his final decision comes from has been defined to him as being of minimal or no importance. In other words, p is primarily motivated to take that alternative which he thinks is correct, whether it is his own preliminary decision or the preliminary decision of o.\(^3\)

Now, given this sort of task, these interaction conditions, and the initial status situation, our problem is to describe a process by which the states of the specific performance characteristic C, and thus specific self-other performance expectations, come to be attributed by p to himself and o. The process will have two general features: (1) it will relate the actions of p at each decision step to his assignment of specific expectations to self and other, and (2) it will, conversely, relate attributed self-other expectations to the actions of p at each decision step. We also divide the task of constructing this process in two parts: for, first, we want to construct a set of action possibilities, which permit us to specify exactly every possible path from the starting to the terminal state of each decision step; second, we will want to assign probabilities to each event, hence each path, in this set of action possibilities.

For the sake of clarity of exposition and ease of expression we separate the discussion of these two parts, undertaking to define action possibilities in the next sections, Sections C and D, and assigning probabilities in Section E.

\(^3\)We distinguish a person-oriented situation, in which p wants to do well himself, from a task-oriented situation, in which p wants the best answer to a problem, regardless of source. Here we assume p is task-oriented.
C. Action possibilities

We have a situation in which p begins in one of two states, \[00\] or \[00\], depending upon his state of the characteristic D. The task and interaction conditions are so structured that on each step of the process, p must make a preliminary decision in which he is required to choose which of two alternatives (say A or B) is more likely to be the correct one. In the case that p has initially evaluated the alternatives, his choice, is determined by those evaluations and we have,

**Assumption 3.1.** At any stage of the process: if p positively evaluates one alternative and negatively evaluates the second, then p will select the first and reject the second.

But p must make a choice even if he has not initially evaluated the alternatives. If p has not initially evaluated alternatives, but is nevertheless required to make a choice, we assume that he will still come to evaluate positively the alternative he selects and evaluate negatively the alternative he rejects. We reason that the experimenter has defined the situation in such a way that p believes there is a correct answer. It is p's task to be correct. And when he selects an alternative, that alternative will be viewed by \(o\) and by the experimenter as the alternative p believes to be correct. Therefore, p will come to feel that he is responsible for making correct decisions, and will want to see the alternative he has chosen as in fact the correct one. Hence, if p has not evaluated alternatives before making his choice,
Assumption 3.2. At any stage of the process: if p required to accept one alternative as correct and reject the second as incorrect, then p will differentially evaluate alternatives.

The principal significance of 3.2. is that p is assumed to believe (and must be made by experimental instructions to actually believe) that he has discovered some plausible basis for choosing one alternative rather than another. He is not, for example, convinced that his choice is a "guess", that if he obtained the correct answer it was purely a matter of chance. In both cases we shall call the structure of the situation at this initial stage p's preliminary choice structure. A digraph representing the process at this initial stage is given in Figure 1.

![Figure 1](image)

Figure 1. P has positively evaluated and selected alternative A and negatively evaluated and rejected alternative B. Directed lines indicate evaluations, which can be positive (+) or negative (-). Directed braces indicate in this case, selection (+) or rejection (-). (In this and in all subsequent digraphs the labelling of A and B is arbitrary.)

Once the preliminary choice structure has been completed and p's decision made, p exchanges information with o and discovers, under the conditions we are imagining, that o's preliminary decision disagrees
with that of p. We shall call the situation where p and o have selected
different alternatives an act of disagreement and we reason that it can
only imply for p that he and o have assigned different evaluations to
the alternatives, and, therefore, that he and o had different prelimi-
nary choice structures.

Assumption 3.3. At any stage of the process: P associates an act of
disagreement between self and other with differences
in evaluations of alternatives by self and other.

Again the point that is important is that p does not just assume o
was guessing when he made his choice. Just as p himself is assumed to
positively evaluate the alternative he has selected and to negatively
evaluate the alternative he has rejected, so too we expect p to believe
that o was not guessing, that o in fact also positively evaluated the
alternative he selected and negatively evaluated the alternative he
rejected. Confronted with disagreement, therefore, p believes that o
has also evaluated the alternatives, but differently.

P's conception of the situation at this new stage of the decision
step is represented by the digraphs in Figure 2. Note that now we have
a self-other choice structure, a graph that contains both p's choices
and o's choices, as seen from p's point of view.
Figure 2a. P is given the information that o disagrees. The letter p' stands for p as an object of orientation to himself. (Note: Relations originating from p' represent p's perceptions of his own preliminary decision, which are now objects of orientation to p just as o's preliminary decision is.) P views himself, as well as o, as having selected and rejected certain alternatives.

Now p is forced to make a final decision. We conceive that there are probably two activities going on simultaneously, or possibly alternating with each other, at this stage. P probably is trying to decide which alternative is right and which wrong, A or B, and also who is right and who is wrong, p' or o. P might either decide about persons first, or about alternatives first; but he must in some way make a choice. At this stage of the process, of course, p's expectations about the specific performance characteristic do not provide any basis for choice. In fact, we will want to see how, as a consequence of making a final decision there is some impetus to assign states of C to p' and o.

If p is not able to decide who is right, he is still required to choose between the alternatives. Applying assumptions 3.1 and 3.2 to this stage we reason that p will come to differentially evaluate A and
B, and will select and reject them in accord with his evaluations. There are two possibilities. Either p continues to view his preliminary choice as correct, or p changes his evaluations of the alternatives and makes a selection that accords with o's preliminary decision. We will call these final decisions the observed response process and define:

**Definition 3.1.** P makes a P-response at any stage of the process if his final selection of an alternative is the same as his preliminary selection. P makes an O-response at any stage of the process if his final selection of an alternative is the same as o's preliminary selection.

Whichever alternative p finally chooses, we reason that the outcome of his choice is to assign unit evaluations to the persons, p' and o. (A unit evaluation is an evaluation of p' or o's performance on a given step of the process.) Further, his assignment of unit evaluations will coincide with the evaluations p has made of the alternatives. Thus, for example, if he makes a P-response then he will come to believe that "I was right and o was wrong". If he makes an O-response he will come to believe that "I was wrong and o was right".

In terms of the digraphs of p's self-other choice structure, this is equivalent to assuming that p will complete his self-other choice structure so that the digraph is balanced in the meaning of the term given by Cartwright and Harary (1956).

If p is able to decide who is right then we argue that p will evaluate the alternatives in accord with this decision and, applying assumption 3.1, that p will make a P or an O response which is consistent with these evaluations.
Thus, whether p first evaluates alternatives or first evaluates persons he will complete his choice structure in a balanced manner. Both possibilities are taken into account in the following assumption.

**Assumption 3.4.** At any stage of the process: If p assigns positive and negative evaluations to alternatives or to persons, he will complete his self-other choice structure in a balanced manner.

Two possible ways of arriving at a final complete and balanced structure are shown in Figures 3 and 4. Figure 3 is an example of the first process described in assumption 3.4, in which alternatives are evaluated, then persons; figure 4 is an example of the second process covered by assumption 3.4, in which persons are evaluated, then alternatives. (Note: Relations originating from p (rather than p'), in the center of the figure, represent p's actions in making his final decision.)

![Figure 3a. P makes a P-response, again selecting (and positively evaluating) alternative A and rejecting (and negatively evaluating) alternative B. Final choices are shown on the central vertical axis of the digraph.](image)

![Figure 3b. P completes the self-other choice structure in a balanced manner by evaluating p' positively and o negatively.](image)
Figure 4a. P decides that he is incorrect and o is correct, thus assigning positive and negative unit evaluations to p' and o.

Figure 4b. P completes the self-other choice structure in a balanced manner by selecting and positively evaluating o's preliminary choice and by rejecting and negatively evaluating his own preliminary choice.

Now consider the effects of this completed choice structure on p's assignment of states of C to self and other. The assignment of unit evaluations to p' and o, as an outcome of the resolution of disagreement, has two important consequences. First, p may be led to believe that he and o possess different states of C. Second, p may be led to believe that he and o possess particular states of C, specifically those that are balanced with the unit evaluations p has made. For example, from the fact that, "I was right and he was wrong in this instance," p may be led to believe, "We differ in this ability, and I am better at this task than he is." Thus, as a result of differential unit evaluations the possibility now exists that p will assign differentially evaluated states of C to self and other, states of C that are in balance with p's unit evaluations.
But the assignment of states of C depends also on the diffuse status characteristic D. For, from assumption 2.3 (page 10) we are led to expect that assignment of states of C will occur only if they are balanced with general expectation states attributed to p' and o on the basis of their respective states of D. If p is in the expectations state \( \{\pm\} \) [00], he may entertain the possibility that "I am better on this ability than he is," if in a particular instance he has concluded, "I was right and he was wrong." But if in a particular instance he has concluded "I was wrong and he was right," a possibility not precluded by our theory, we do not believe he will entertain the idea that "He is better at this task than I am." In our view, the resolution of disagreements on a given step in the process will lead to an assignment of specific performance expectations only if such an assignment will simultaneously balance unit evaluations and general expectation states. Hence,  

**Assumption 3.5.** At any stage of the process: If p assigns unit evaluations to persons, then the possibility exists that p will also assign those states of C which balance with his assignment of unit evaluations if and only if such assignment is in balance with his assigned general expectation states.

Let us consider the import of these assumptions for some specific cases. Consider a p in a \( \{\pm\} \) [00] expectation state who makes a P-response on a given trial. By assumption 3.4, and the definition of P-response, he

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It is not intended at present that this assumption apply necessarily to cases other than where p and o possess different states of D and where D is activated. The process might operate quite differently in situations where, for example, p and o both possess the high state of the characteristic D.
will assign a positive unit evaluation to self and a negative unit evaluation to other. By assumption 3.5, there now exists a possibility that p will assign the positively evaluated state of C to self and the negatively evaluated state of C to other, since an assignment is consistent with both his unit evaluations and his assignment of general expectation states to self and other. Thus p may change his expectation state from \( \frac{1}{2} + \frac{1}{2} [00] \) to \( \frac{1}{2} + \frac{1}{2} [-+] \).

By a similar line of reasoning, the possibility exists for a p who starts out in a \( \frac{1}{2} + \frac{1}{2} [00] \) expectation state, and makes an O-response to change his expectation to \( \frac{1}{2} - \frac{1}{2} [++] \).

Consider, on the other hand, a p who initially is in a \( \frac{1}{2} + \frac{1}{2} [00] \) state and makes an O-response. By assumption 3.4 and definition of an O-response, he will assign a negative unit evaluation to self and a positive unit evaluation to other. But any assignment of states of C which balance with p's unit evaluations will be imbalanced with the GES's that have been attributed to p' and o. Hence, by assumption 3.5, such an assignment of states of C cannot take place. Although we assume that p in this situation may be under some pressure or tension, we expect him to remain in a \( \frac{1}{2} - \frac{1}{2} [00] \) state as a result of this sequence of events. By a parallel line of reasoning, we expect a p who is initially in a \( \frac{1}{2} - \frac{1}{2} [00] \) state and makes a P-response to continue in a \( \frac{1}{2} - \frac{1}{2} [00] \) state.

Now suppose that, as a result of events at earlier stages of the process, p has in fact assigned states of C to self and other. What can we say about his behavior at later stages of the process? For example, consider a p who, on a given step of the decision-making process is in a
expectation state, faces a disagreement with $o$, and makes a $P$-response. By assumption 3.4 $p$ assigns positive unit evaluations to self and negative to other. Such an assignment is consistent with his assignment of states of $C$. We expect, therefore, that his specific performance expectations will continue unchanged to the next step of the process. By a similar line of reasoning we argue that a $p$ who on some step of the process is already in a $[-+]$ expectation state, who faces a disagreement, and who then makes an $O$-response, maintains his expectation state into the next step of the process.

On the other hand, consider the case of a $p$ who on some step of the process is in a $[-+]$ state, who faces a disagreement and who then makes an $O$-response. By assumptions 3.3 and 3.4, and the definition of $O$-response, he assigns a negative unit evaluation to self and a positive unit evaluation to other on this step. This creates an imbalance, and the question arises whether this will affect his assignment of states of $C$. But if $p$ were to change his assignment of states of $C$, in order to bring about balance with unit evaluations, he can only create, as a consequence, imbalance with his assignment of general expectation states. By assumption 3.5 this reassignment of states could not occur. Therefore we do not expect a $p$ who has moved to a $[-+]$ state and then made an $O$-response to change his expectation state. Similarly we do not expect a $p$ who has moved to a $[-+]$ state who makes a $P$-response to change his expectations. Thus, one of the very important consequences of our assumptions is that if $p$ at some step of the process once enters either a $[-+]$ or $[-+]$ expectation state, under
continual disagreement, he will remain in that state from that time on.

That p has assigned specific performance expectations at some stage of the process affects not only his expectation state from that time on; there is also the fact that now there is some basis for the assignment of unit evaluations where before there was not. Given that p has already assigned states of C to self and other, we can assume that this assignment will in turn affect how p assigns unit evaluations to persons in this self-other choice structure. For,

Assumption 3.6. At any stage of the process: if p has already assigned positively and negatively evaluated states of C to self and other, then he will tend to assign positive and negative unit evaluations to p' and o in balance with his assignment of states of C.

Several important implications of assumption 3.6 should be noted. First, once p has assigned states of C to self and other, his process of making final decisions is more likely to be structured in the order: who is right and then what is right than was true before he assigned states of C. Second, taken together with earlier assumptions, 3.6 implies that a p in a $\langle +,+ \rangle$ state will be more likely than a p in a $\langle +,0 \rangle$ state to make P-responses whereas a p in a $\langle -,+ \rangle$ state will be more likely than a p in a $\langle +,0 \rangle$ state to make O-responses. In general, we assume p will not make responses that are imbalanced with his expectation states; thus, assumption 3.6 is crucial to understanding how the process comes to be self-maintaining.
D. An alternative formulation of assumption 3.6.

There is a plausible, more general formulation of assumption 3.6 that would allow for a more rapid process of assignment than the one we have described. We have assumed that an individual in a \(0^+\) or \(0^-\) state, when faced with the dilemma of a disagreement, has no person basis for deciding who is correct before he decides which alternative is correct. Given our present knowledge it would be equally plausible to assert that the general expectation states associated with the states of \(D\) are themselves sufficient to provide a basis for deciding who is correct and who incorrect. In that case, we might assume that unit evaluations of persons precede evaluations of alternatives, and that the self-other choice structure even at this early stage of the process will be completed so as to balance with general expectation states. The effect of this in general would be to make the \(0^+\) and \(0^-\) states (or equivalently the \(D^+\) and \(D^-\) states) more nearly alive with respect to the likelihood of a \(P\)- or an \(O\)-response than is the case in the formulation we have given in section C. The alternative form of assumption 3.6 would be as follows,

Assumption 3.6* At any stage of the process: if \(p\) has already assigned positive and negative states either of general expectations \(o_+\) or \(o_-\) of \(C\), then he will tend to assign positive and negative unit evaluations of persons in balance with his assignment of states of general expectations or \(C\).

Thus if only general expectation states have been assigned by \(p\) to self and other, which is true at the initial stages of the process, these expectation states will already affect how \(p\) assigns unit evaluations
to p' and o. Further if both general and specific states have been assigned there is no question as to the manner in which unit evaluations are to be assigned under assumption 3.6*. For by assumption 3.5 general and specific states can come to be assigned if and only if the general and specific expectation states are themselves in balance.

In what follows we will use assumption 3.6 but we will indicate, where appropriate, differences in specific predictions between assumption 3.6 and assumption 3.6*.

E. Assigning probabilities

The assumptions of Section C enable us to completely specify the possible sequences of events, for any p on the nth step of the assignment process, and the possible states that p might be in at the start of the nth + 1 step. To each possible event we now want to assign a probability.\(^5\)

For convenience we label expectation states in the following manner:

1 = \( \begin{array}{c}
\cdot
\end{array} \) [00]

2 = \( \begin{array}{c}
-\cdot
\end{array} \) [++]

3 = \( \begin{array}{c}
\cdot
\end{array} \) [00]

4 = \( \begin{array}{c}
-\cdot
\end{array} \) [++]

From the assumptions we have made so far it is clear that there is a possibility of a P-response, or alternatively of an O-response, for a p

\(^5\) It should be remarked at this point that the manner in which the next set of assumptions are stated and even the fact that one can assign probabilities to events anticipates a mathematical model such as the one which is described in Section IV.
in every one of the four possible expectation states. We will use the letter $\chi_i$ (where $i = 1, 2, 3, 4$, the index denoting the expectation state) to represent the probability of a P-response, and $\bar{\chi}_i = 1 - \chi_i$ to represent the probability of an O-response. The assigned probabilities, then, are:

**Assumption 3.7.** Whatever p's expectation states and responses on the first $n-1$ steps, if p is in the $i$th expectation state on the $n$th step of the process, then he will make a P-response with probability $\chi_i$ or an O-response with probability $\bar{\chi}_i$.

The $\chi_i$ are underived quantities in our theory and are determined experimentally. The most important feature of assumption 3.7 is that these probabilities do not depend on what step in the process we happen to be at. They depend only on p's expectation state and therefore are assumed to be the same for every step of the process. There are two further underived quantities: For a p in state 1 on the $n$th step of the process, there is some probability that he will, if he makes a P-response, move to state 2 to begin the $n+1$ step; correspondingly, for p in state 3 there is some probability that if he makes an O-response, he will move to state 4 to begin the $n+1$ step. Roman letters $r$ and $d$ denote these probabilities, respectively. Probabilities that states 1 or 3 are not changed, i.e., that p remains in those states, will then be $\bar{r} = 1 - r$, and $\bar{d} = 1 - d$.

**Assumption 3.8.** Whatever p's expectation states and responses on the first $n-1$ steps, if p is in expectation state 1 on the $n$th step of the process and makes a P-response, he will move to state 2 with probability $r$ or remain in state 1 with probability $\bar{r}$. 
Assumption 3.9. Whatever p's expectation states and responses on the first n-1 steps, if p is in expectation state 3 on the nth step of the process and makes an O-response, he will move to state 4 with probability d or remain in state 3 with probability \( \frac{d}{3} \).

The principal force of assumptions 3.8 and 3.9 is that the probabilities of transition from state to state depend only on p's expectation state at the nth step, together with his response on that step. Thus, changes in expectations do not depend on the whole past history of the expectation process. Furthermore, assumptions 3.8 and 3.9 assert that the probabilities \( r \) and d are the same at every step of the process; they are not seen to change as the process itself advances.

Finally: in section C, where we have specified the set of action possibilities that can occur at any stage of the process, we sometimes assumed that only one possibility could occur. For example, although the response alternatives ordinarily allow both a P and an O-response, when p's choice structure assigns a positive evaluation to p' and a negative evaluation to o, and O-response is not possible. Furthermore, once p is in expectation state 2 or 4 we no longer permit any possibility of changing expectation state. In such cases we may speak of a unique alternative at a given stage of the process, and,

Assumption 3.10. At any stage of the process: given a unique alternative for p, that alternative occurs with probability 1.

To illustrate how the assumptions about the action space, together with the assumptions about assigning probabilities, completely define the
process of assignment, Figure 5 shows the structure of the nth step of the process starting from any expectation state. For example, Figure 5a shows a step in the assignment process for an actor starting in state 1. Disagreement, experimentally controlled, occurs with probability $1$. The disagreement is resolved with a P-response with probability $\chi$. If a P-response occurs, $p$ changes his expectation state to state 2 with probability $r$. If $p$ changes his expectation state, the nth+1 step of the process begins with $p$ in state 2 (Figure 5b), from which state he may make a P-response with probability $\chi_2$ or an O-response with probability $\chi_2$, but from which in either case he does not change expectations. Figures 5c and 5d may be read in the same straightforward manner.

Figure 5. P's action space on the nth and n+1 step of the process, given $p$ in any of the four expectation states on the nth step.

<table>
<thead>
<tr>
<th>Expectation State at start of the nth step</th>
<th>Experimentally Controlled Disagreement</th>
<th>Observed Unit Response Evaluation States at start of p' and o of n+1 step</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P$</td>
<td>$O$</td>
<td>$0$   $(-)$ $\chi$ $[00]$</td>
</tr>
<tr>
<td>$(-)$</td>
<td>$O$</td>
<td>$[00]$</td>
</tr>
<tr>
<td>$+$</td>
<td>$P$</td>
<td>$(+)$ $\chi$ $[00]$</td>
</tr>
<tr>
<td>$+$</td>
<td>$O$</td>
<td>$[00]$</td>
</tr>
</tbody>
</table>

Figure 5a. P starts step in state 1.
Expectation State at start of nth step.  Experimentally Controlled Disagreement  Observed Response  Unit Evaluation of $p'$ and $o$  Expectation State at start of $n+1$ step.

$\begin{align*}
+ & [-+] \\
\downarrow \\
D & \\
\downarrow \\
P & \longrightarrow \ (++) \rightarrow \ [-+] \\
\downarrow \\
O & \longrightarrow \ (++) \rightarrow \ [-+] \\
\downarrow \\
\vdots \\
\end{align*}$

Figure 5b. P starts in state 2. In view of assumption 3.6 we might reverse the order in which the observed response and unit evaluations occur; since, however, they are in 1:1 correspondence it makes no difference in which order they occur in the figure.

$\begin{align*}
+ & [-+] \\
\downarrow \\
D & \\
\downarrow \\
P & \longrightarrow \ (-) \rightarrow \ [-+] \\
\downarrow \\
O & \longrightarrow \ (-) \rightarrow \ [-+] \\
\downarrow \\
\vdots \\
\end{align*}$

Figure 5c. P starts in state 3.

$\begin{align*}
+ & [-+] \\
\downarrow \\
D & \\
\downarrow \\
P & \longrightarrow \ (+) \rightarrow \ [-+] \\
\downarrow \\
O & \longrightarrow \ (+) \rightarrow \ [-+] \\
\downarrow \\
\vdots \\
\end{align*}$

Figure 5d. P starts in state 4. Again the order in which unit evaluations and observed response occurs might be reversed without altering the outcome.
IV. Formalization of the Allocation Process.

In formalizing our theory we take as the basic units of analysis the four types of expectation patterns p can hold, and the two types of resolution behavior in which he can engage, i.e., making a P-response or making an O-response.

As the n-step process proceeds, the subject makes a sequence of P- or O-responses and moves through the basic expectation states \( \mathcal{E}^+ \) [00], \( \mathcal{E}^- \) [+] , \( \mathcal{E}^+ \) [00], \( \mathcal{E}^- \) [-]. We assume that movement through the expectation states can be described by means of a Markov chain whose states are the four expectation patterns. To specify this chain we must specify the transition probabilities \( P_{ij} \); that is, the probability that the subject moves to state \( j \) on the \( n+1 \) step of the process given that he is in state \( i \) on the \( n \)th step. We compute these probabilities by making use of the assumptions of Section III, which determine the possibilities and probabilities of p's action space. The structure of this action space has been represented in Figure 5. From the tree diagrams in Figure 5, we can determine the transition matrix \( P \), for the expectation process. We shall refer to this Markov chain as the expectation process.

Matrix of One-step Transition Probabilities for the Expectation Process

<table>
<thead>
<tr>
<th>( P )</th>
<th>( \mathcal{E}^+ ) [00]</th>
<th>( \mathcal{E}^- ) [+]</th>
<th>( \mathcal{E}^+ ) [00]</th>
<th>( \mathcal{E}^- ) [-]</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \mathcal{E}^+ ) [00]</td>
<td>( 1-\alpha_1 r )</td>
<td>( \alpha_1 r )</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>( \mathcal{E}^- ) [+]</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>( \mathcal{E}^+ ) [00]</td>
<td>0</td>
<td>0</td>
<td>( 1-\alpha_3 d )</td>
<td>( \alpha_3 d )</td>
</tr>
<tr>
<td>( \mathcal{E}^- ) [-]</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 1
During the course of p's decision-making process this expectation process is not observed. The expectation states have the function of theoretical constructs in our model. In general terms what is being assumed in this, and other expectation models, is the following pattern of events. At all times p is in an expectation state, and given a situational event—such as a disagreement with o—his response to that event is determined by the expectation state he is in. Thus, his expectations will affect the way he responds to his environment. But there is another crucial facet to this relation between p and his environment; namely, the effect of his response on the expectation state he is in. In general, p's response may (1) have no effect on his expectation state—as in the case where he moves from a $+\frac{1}{2}$ [00] state to a $\pm \frac{1}{2}$ [00] state; or (2) it may "disconfirm" his expectation state—as when he makes a P-response and pressures are generated on p which may result in change of state, for example, moving from a $\pm \frac{1}{2}$ [00] to a $+\frac{1}{2}$ [-] state; or (3) it may "confirm" his existing expectation states—as when he makes a P-response and moves from a $+\frac{1}{2}$ [+] to a $+\frac{1}{2}$ [++] state. Thus in terms of our model, p's behavior is described as a probabilistic function of his expectation state—given a situational event; and p's expectation state is in turn a probabilistic function of his behavior—given a particular response to his environment.

At the initial step of the process, we know p's general expectation

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state and assume that he has not assigned states of C to himself and C; hence p by assumption is either in \( \Big[ \begin{array}{c} \gamma + 1 \\ 00 \end{array} \Big] \) or \( \Big[ \begin{array}{c} \gamma - 1 \\ 00 \end{array} \Big] \). For the remainder of the process, p's expectation state is unknown and unobservable, so that we are interested in reasoning from his observable response process to his expectation process and, in turn, from the expectation process to his response process. We now turn our attention to this problem.

The transition matrix \( P \) can be partitioned into four submatrices; a matrix \( P_1 \), describing the expectation process for the states \( \Big[ \begin{array}{c} \gamma + 1 \\ 00 \end{array} \Big] \) and \( \Big[ \begin{array}{c} \gamma + 1 \\ 00 \end{array} \Big] \); a matrix \( P_2 \), for the process involving the states \( \Big[ \begin{array}{c} \gamma + 1 \\ 00 \end{array} \Big] \) and \( \Big[ \begin{array}{c} \gamma + 1 \\ 00 \end{array} \Big] \); and two zero matrices \( M \) and \( N \) which, respectively, describe the process from states 1 and 2 to 3 and 4, and 3 and 4 to 1 and 2. As a consequence of our assumptions, \( P_1 \) and \( P_2 \) may be used independently in describing the behavior of p; whether \( P_1 \) or \( P_2 \) is applicable depends upon p's initial state of D, which is always known. M and N are not relevant to our problem of describing p's behavior.

For convenience, \( P_1 \) is presented below. All observations to be made about \( P_1 \) can be translated to comparable observations about \( P_2 \). \( P_1 \) represents the one-step transition probabilities of a two-state Markov chain for the expectation process for a p who enters S with the positively evaluated state of the diffuse status characteristic. In using \( P_1 \) (or \( P_2 \)), we assume that the response of the subject depends only on the expectation state he holds on the nth step and not, for example, on his response on the nth - 1 step. The effect of his responses on the nth - 1
step is already represented in our model by the expectation state he has moved to on the nth step, given his prior response.

Matrix of One-step Transition Probabilities for Expectation Process involving:

<table>
<thead>
<tr>
<th>States</th>
<th>( [00] )</th>
<th>( [+-] )</th>
</tr>
</thead>
<tbody>
<tr>
<td>nth step</td>
<td>( \begin{pmatrix} \frac{1}{3} &amp; \frac{2}{3} \ \frac{1}{3} &amp; \frac{2}{3} \end{pmatrix} )</td>
<td>( \begin{pmatrix} \frac{1}{3} &amp; \frac{2}{3} \ \frac{1}{3} &amp; \frac{2}{3} \end{pmatrix} )</td>
</tr>
<tr>
<td>nth + 1 step</td>
<td>( \begin{pmatrix} (1 - r) &amp; r \ 0 &amp; 1 \end{pmatrix} )</td>
<td>( \begin{pmatrix} (1 - r) &amp; r \ 0 &amp; 1 \end{pmatrix} )</td>
</tr>
</tbody>
</table>

Table 2

In fact, \( P_1 \) is an absorbing Markov chain, representing the fact that, under continual disagreement, we expect \( p \) to eventually end up in an expectation state compatible with the interaction process, and, once there, to remain. While our model predicts that \( p \) will be absorbed into an expectation state, it does not predict that \( p \) will absorb into a \( P \) or \( O \)-response. It predicts that once \( p \) is in the absorbing expectation state \( [+-] \), he will make \( P \)-responses with probability \( \chi_2 \) and \( O \)-responses with probability \( \chi_2 \). This can be easily seen by reviewing the tree diagram of \( p \)'s action space for these states shown in Figures 5a and 5b, Section III.

To fully describe \( p \)'s behavior in \( S \), given that we always know his initial expectation state, we must therefore estimate the values of three parameters \( \chi_1, r, \) and \( \chi_2 \). To do this we make use of the formal properties.
of this type of Markov chain to derive theoretical quantities describing various aspects of p's behavior in S. Given empirical estimates for these quantities, empirical estimates for our parameters $\lambda_1$, $\rho$, and $\lambda_2$ can then be obtained. With these, the behavior of p can be probabilistically described in S. To test our model, still other theoretical quantities, logically independent of those used in estimating $\lambda_1$, $\rho$, and $\lambda_2$, are derived from our stochastic model. These are then compared with our predicted quantities, given estimates for $\lambda_1$, $\rho$, and $\lambda_2$.

To illustrate the nature of one of these quantities which can be derived from our model, we shall consider a quantity which gives us the predicted sequence through time of P-responses, the "P-response curve." To obtain the P-response curve, for a subject starting out in a given expectation state, we need the mean number of P-responses on the nth trial given that p is initially in state i.

It can be shown that for our model the mean number of P-responses on the nth trial if the process starts in state 1 is

$$M_1 [\# \text{ of P-responses on nth trial}] = \lambda_2 + (\lambda_1 - \lambda_2) (1 - \lambda_1 \rho)^n$$

while the mean number of P-responses on the nth trial if the process starts in state 3 is

7 For additional discussion of estimating and testing quantities, see Appendix.

3 For the derivation of these two quantities.
(2) \[ M_3 [\text{# of P-responses on the nth trial}] = \chi_4 + (\chi_3 - \chi_4) (1 - \chi_3 d)^n \]

From expressions (1) and (2) families of curves can be generated which describe the behavior of p, through time, given an initial state of the characteristic D. It should be observed that each expression is the sum of two components, and that the components on the right tend to zero as n increases. This represents one of the important consequences of our theory and model; namely that under the fixed conditions of interaction in S, p's behavior will approach a stable pattern.

To illustrate the use of these quantities, assume \( \chi_1 = \chi_3 = .6 \), \( r = d = .2 \), \( \chi_2 = .8 \), and \( \chi_4 = .3 \). Then from (1) and (2) we obtain specific curves for the observable responses of p, given that he is initially a \( \chi^{-+} [00] \) or \( \chi^{++} [00] \) expectation state. These curves are given in Figure 5.
In general, these theoretically predicted response curves will depend only upon p's initial state and the values of the parameters in our specific interaction situation.

We can note with respect to the above examples that different response curves would have been obtained if assumption 3.6* held rather than 3.6 (assuming, of course, that all remaining assumptions hold). Assumption 3.6* would have lead us to predict that $\alpha_1 > \alpha_3$ and that the response curves for the starting states under the two different assumptions would differ as follows:

1. the response curve for a p initially in a $\frac{1}{2} + \frac{1}{2} [00]$ state would begin at a larger value,
2. the response curve for a p initially in a $\frac{1}{2} - \frac{1}{2} [00]$ state would begin at a smaller value,
3. both curves would be flattened because the asymptotic value of each curve will not much differ from the initial value.

These changes are illustrated in Figure 7 where for each starting state the solid lines are the response curves given previously (see Figure 6) and the dotted lines are possible response curves under assumption 3.6* for $\alpha_1 = .75, \alpha_3 = .50$. 


It is important to observe that we can empirically distinguish between the two assumptions as a consequence of our having extended the theory in a formal manner to a specific action process. Without this formalization it would have been difficult to have made precise enough predictions to have decided between the two assertions. Whether assumption 3.6* holds rather than assumption 3.6 is an open question which can now be decided by empirical test.

V. Summary

Our starting point has been experiments of Strodtbeck, Torrance, Hurwitz, Zander, and Hymovich, and others, in which actors faced with a valued, collective task, who differ with respect to characteristics like sex, color, occupation, etc., are observed to differ also with respect to power and prestige in the group, in such a way that the status differences correlate with the power-prestige differences. We reason
that: (1) Because actors care about the outcome, they are trying to discover any cue that will indicate to them who will have the best solutions; (2) such cues, in the absence of any other basis will be provided by any characteristic that has the following three properties—it is differentially evaluated, associated with specific performance characteristics, and associated with general, or global, expectations of inferiority and superiority; (3) though initially, whatever the characteristic that is relevant to the task-outcomes, actors have not attributed specific performance expectations to each other in the situation, they will come to see the status-characteristic as relevant and use it as a basis for assigning expectations about performance of the task at hand; unless, of course, they have specific prior knowledge that the status characteristic is not relevant; (4) if the status-characteristic is seen as a basis for assigning specific performance expectations, we expect the assignment to occur in only one way: namely, so that the general and specific expectations are balanced; (5) finally, the observed power-prestige order can be viewed as a function of the underlying expectation states, so that if these are balanced with the status-characteristic, the power-prestige order will be found to correlate with it.

We have extended this theory to a dynamic model of a specific action process through which allocation can take place. We are given as further conditions that p and o are in an n-step, multi-stage, non-veridical, decision-making situation at each step of which they are required to make a binary choice, exchange information about their choice, are experimentally
manipulated so as to discover that they disagree, and then must make a final decision. On resolving this disagreement they will come to believe one actor right, the other wrong; and there will be some pressure to generalize these unit-step evaluations to ascertain the relative abilities of the two actors at the task. This will occur only if such assignment is balanced with the general expectation state. Once assigned, the specific performance expectations then come to determine the action process. The process of change in the underlying expectation states we have formulated as a Markov chain of which the observed response process is a probabilistic function.

The relation of the two parts, Section II and Section III, merits some further comment. As was noted in the introduction the specific action process we have formulated is only one of several that might be imagined: for example, still using the expectation action situation referred to in Section II (see footnote 1), one might have looked at an actor p who, in making a decision, had the right to ask help of two other actors, o_1 and o_2, who differed with respect to a diffuse status characteristic. The observed response process would then have been a request for help from one or the other actor, while the underlying process would still be one in which p attributed expectations to the other two. Hence the theory of Section II does not compel us to look on the formulation in Section III as the one and only dynamic model consistent with it; indeed if this were not the case one could raise serious questions as to the usefulness of the theory.
I. Estimation of Parameters

We will begin estimation of the parameters of the model with estimation of $\lambda_1$ and $\lambda_3$. Since the estimation of both quantities is essentially identical in procedure, we will treat in detail only the estimation of $\lambda_1$.

The estimation of $\lambda_1$ is based on the fact that if $P$ begins the process in state 1, he cannot change state until he makes a $P$-response. This means that the length of an initial run of $0$-responses is a function only of $\lambda_1$ and not of change-of-state parameters. Hence, it suffices to obtain an expression for the expected value of the length of an initial run of $0$-responses in order to estimate $\lambda_1$.

The probability that the length of an initial run of $0$-responses is $n$ trials can be found by observing that:

the probability that the length is 0 trials is $\lambda_1$,
the probability that the length is 1 trial is $\lambda_1 \lambda_1$,
the probability that the length is 2 trials is $\lambda_1^2 \lambda_1$,

and so on

It can thus be shown that the probability that the length is $n$ trials is given by

$$P(X_1^n) = \lambda_1^n.$$
The expected value of this probability mass function is given by

\[
\sum_{n=0}^{\infty} n \frac{\lambda_1^n}{\lambda_1},
\]

which is a familiar form whose sum is given by

\[
\frac{\lambda_1}{(1 - \frac{\lambda_1}{\lambda_1})^2},
\]

which can be simplified to

\[
\lambda_1 / \lambda_1.
\]

This means that if \( k \) is the observed mean value of the length of initial O-response runs, then \( \lambda_1 \) can be easily estimated by setting \( \lambda_1 / \lambda_1 \) equal to \( k \). When this is done,

\[
\lambda_1 = \frac{1}{1 + k}.
\]

The estimation of \( \lambda_3 \) is along similar lines, with the difference that the length of initial runs of P-responses is the quantity of interest. Hence, if \( c \) is the observed mean value of the length of initial P-response runs for a \( p \) who begins in state 3, then

\[
\lambda_3 = \frac{c}{1 + c}.
\]

The estimation of \( \lambda_2 \) and \( \lambda_4 \) is somewhat more difficult. Since, as in the previous case, the estimation procedure for each parameter is...
essentially identical, we will deal in detail only with $\chi_2$.

Recall from Section IV that our model of the expectation process is an absorbing Markov chain with a single absorbing state. To estimate $\chi_2$ we need only observe that once the process has reached absorption it becomes an independence trials process and the best estimate of $\chi_2$ is simply the mean proportion of responses which are P-responses while the process is in absorption. Hence the problem of estimating $\chi_2$ reduces to the problem of obtaining an estimate of how many steps it takes for the process to reach absorption. Such an estimate can be obtained by using the value of $\chi_1$ and various hypothetical values of $r$ in carrying out simulation runs on a high-speed computer.

The final two parameters to be estimated are $r$ and $d$. Again, we will describe only the estimation of $r$, since $d$ is estimated in an essentially identical fashion. The simplest expression which is sufficient for the estimation of $r$ is the expression for the expected value of the number of P-responses in $N$ trials. Such an expression is obtained as follows. Let $U^P_n (n = 0, 1, ..., N-1)$ be a counting function which takes on the following values:

$U^P_n = 1$ if response on trial $n$ is a P-response
$U^P_n = 0$ if response on trial $n$ is an O-response

If $S^P_N = U^P_0 + U^P_1 + ... + U^P_{N-1}$, then the expected value of $S^P_N$ given that the process starts in state 1, $E_1 (S^P_N)$, is the expression desired.
The expected value of $U_n$ can be found by noting that

$$E_1(U_n) = P_1(U_n = 1)$$

and that

$$P_1(U_n = 1) = P(U_n = 1/Z_n = 1) P_1(Z_n = 1) + P(U_n = 1/Z_n = 2) P_1(Z_n = 2)$$

where $Z_n$ is a random variable which takes on the value 1 if the expectation state on trial $n$ is state 1 and the value 2 if the expectation state is state 2.

It can be clearly seen from Figure 5, that

$$P(U_n = 1/Z_n = 1) = \chi_1$$

and

$$P(U_n = 1/Z_n = 2) = \chi_2$$

The expressions for $P_1(Z_n = 1)$ and $P_1(Z_n = 2)$ are obtained from the one-step transition matrix of the Markov chain which is labeled $P_1$;

$$P_1 = \begin{pmatrix}
1 & 2 \\
1 - \chi_1 r & \chi_1 r \\
0 & 1
\end{pmatrix}.$$ 

It can be shown that the probability that the process is in any particular state at trial $n$ is given by a vector $\pi_n$ which is equal to $\pi_0 P_1^n$ where $\pi_0$ is the initial vector of the chain.\(^1\) In this case, $\pi_0 = (1, 0)$.

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\(^1\)For a more detailed treatment of Markov chains, see Kemeny and Snell (1960)
Raising $P_1$ to the $n$th power gives

$$P_1^n = \begin{pmatrix} 1 & 1 - (\chi_1 r)^n \\ 2 & 1 - (1 - \chi_1 r)^n \end{pmatrix}.$$ 

Hence

$$\frac{1}{P_1^n} = \begin{pmatrix} 1 & 2 \\ (1 - \chi_1 r)^n & 1 - (1 - \chi_1 r)^n \end{pmatrix}.$$ 

This means that

$$P_1(Z_n = 1) = (1 - \chi_1 r)^n$$

$$P_1(Z_n = 2) = 1 - (1 - \chi_1 r)^n$$

hence that

$$P_1(U_n^p = 1) = \chi_1 (1 - \chi_1 r)^n + \chi_2 [1 - (1 - \chi_1 r)^n].$$

Therefore,

$$E_1(S_N^p) = \sum_{n=0}^{N-1} P(U_n^p = 1)$$

$$= \sum_{n=0}^{N-1} \left[ \chi_1 (1 - \chi_1 r)^n + \chi_2 [1 - (1 - \chi_1 r)^n] \right]$$

$$= N \chi_2 + (\chi_1 - \chi_2) \frac{1 - (1 - \chi_1 r)^n}{n=0}.$$
We next observe that had the process begun in the absorbed state that

\[ E_A(S_N^p) = N \alpha_2. \]

Taking the difference \( E_1(S_N^p) - E_A(S_N^p) = \Delta^p \) we obtain

\[ \Delta^p = \frac{(\alpha_1 - \alpha_2)}{\alpha_1}. \]

Using the previously obtained estimates of \( \alpha_1 \) and \( \alpha_2 \) and the observed values of \( \Delta^p \), we obtain an estimate of \( r \).

II. Testing the Model

There are a great many empirical quantities which can be used to test the model, given that we have estimates for the parameters. A quantity of particular interest is the expected value for the number of alternations in \( N \) trials. An alternation is defined for any two adjacent responses as the occurrence of either a P-response on the first and an O-response on the second or vice versa. We will define a counting function for alternations as follows:

\[ U_n^A = 1 \quad \text{if the response on trial } n \text{ is a P-response and the response on trial } n+1 \text{ is an O-response or vice versa.} \]

\[ = 0 \quad \text{otherwise.} \]
Then,

\[ P_1(U_n^A = 1) = P(U_n^A = 1/Z_n = 1) P_1(Z_n = 1) + P(U_n^A = 1/Z_n = 2) P_1(Z_n = 2) \]

From Figure 5 of Section III we obtain

\[ P(U_n^A = 1/Z_n = 1) = \sum_{i=1}^{n-2} \gamma_1 \chi_1 + \sum_{i=1}^{n-1} (\gamma_1 \chi_2 + \gamma_1 \chi_1) \]

\[ P(U_n^A = 1/Z_n = 2) = 2 \gamma_1 \chi_1 \chi_2 \]

Therefore,

\[ P_1(U_n^A = 1) = (1-\gamma_1 r)^n \left( \sum_{i=1}^{n-2} \gamma_1 \chi_1 + \sum_{i=1}^{n-1} (\gamma_1 \chi_2 + \gamma_1 \chi_1) + 2[1-(1-\gamma_1 r)^n] \gamma_1 \chi_2 \chi_2 \right) \]

The above expression is itself useful and can be used to generate a response curve for alternations, i.e., the probability that an alternation occurs on the nth step of the process, which can be compared to the observed proportion of alternations at each step of the process. However, we are primarily interested in the expected value for the total number of alternations in N trials.

Hence, let

\[ S_N^A = \sum_{n=0}^{N-2} U_n^A \]

Then

\[ E_1(S_N^A) = \sum_{n=0}^{N-2} E(U_n^A) \]

\[ = \sum_{n=0}^{N-2} P(U_n^A = 1) \]
\[
\begin{align*}
    &\sum_{n=0}^{N-2} \left[ (1-\alpha_1 r)^n (\chi_1 \alpha_1 + \chi_1 \alpha_1 r + \chi_1 r \chi_2) + 2 \alpha_2 \alpha_2 [1-(1-\alpha_1 r)^n] \right] \\
    &= 2(N-1) \alpha_2 \chi_2 + (\alpha_1 \alpha_1 + \chi_1 \alpha_1 r + \chi_1 r \chi_2 - 2 \alpha_2 \chi_2) \left[ \frac{1-(1-\alpha_1 r)^{N-1}}{\alpha_1 r} \right]
\end{align*}
\]

which is the desired expression.

For large \(N\) we have

\[
E_1(S^A_N) = 2(N-1) \alpha_1 \chi_2 + \left( \alpha_1 \alpha_1 + \chi_1 \alpha_1 r + \chi_1 r \chi_2 - 2 \alpha_2 \chi_2 \right) \left[ \frac{1-(1-\alpha_1 r)^{N-1}}{\alpha_1 r} \right].
\]

Substituting estimated values for the parameters in the above expression gives a predicted value for the mean number of alternations over \(N\) trials.

Other quantities which can be used to test the model will not be derived formally. Rather they are listed below with the appropriate mathematical expressions.

(i) Assuming \(p\) starts in state 1, the mean number of times that the responses on trial \(n\) and \(n+1\) are both \(P\)-responses is given by

\[
(N-1) \alpha_2^2 + \left[ \chi_1^2 r + \chi_1 \alpha_2 r - \chi_2^2 \right] \left[ \frac{1-(1-\alpha_1 r)^{N-1}}{\alpha_1 r} \right].
\]

(ii) Assuming \(p\) starts in state 1, the mean number of times that the responses on trial \(n\) and \(n+1\) are both \(O\) responses is given by

\[
(N-1) \alpha_2^2 + \left[ \chi_1^2 - \chi_2^2 \right] \left[ \frac{1-(1-\alpha_1 r)^{N-1}}{\alpha_1 r} \right].
\]
(iii) The mean number of initial P-response runs for p starting in state 1 is given by

\[ \frac{\alpha_1 \alpha_2 + \alpha_1 \alpha_2^r}{\alpha_2 (1 - \alpha_1^r)} \]

It is generally true that these quantities are logically independent of each other and of alternations. An exception, however, is that the expression for alternations determines the sum of (i) and (ii).
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