Stage Theories of Health Behavior: Conceptual and Methodological Issues

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Despite growing interest in stage theories of health behavior, there is considerable confusion in the literature concerning the essential characteristics of stage theories and the manner in which such theories should be tested. In this article, the 4 key characteristics of a stage theory—a category system, an ordering of categories, similar barriers to change within categories, and different barriers to change between categories—are discussed in detail. Examples of stage models of health behavior also are described. Four major types of research designs that might be used for testing stage theories are examined, including examples from the empirical literature. The most commonly used design, which involves cross-sectional comparisons of people believed to be in different stages, is shown to have only limited value for testing whether behavior change follows a stage process.

Key words: stage theories, health behavior, methodology, research design

Stage theories are being used increasingly to investigate health-protective behaviors. They have been applied to the adoption of preventive behaviors (Blalock et al., 1996; Weinstein & Sandman, 1992); to attempts to stop unhealthy behaviors (DiClemente et al., 1991; Prochaska, Redding, & Velicer, 1994); and to the use of medical services (Rakowski et al., 1992). An example may help to illustrate why stage models are so attractive.

Consider AIDS prevention. A great many variables (e.g., social norms, knowledge, efficacy beliefs, and risk perceptions) are likely to influence the performance of unsafe sexual behavior. However, given a list of such variables, how do we design a program to encourage safer behavior? Do different categories of people need different kinds of help? Do certain topics (such as information about vulnerability) need to be addressed before others (such as skills for negotiating condom use)? A stage theory of safer sex behavior would specify an ordered set of categories into which people could be classified and would identify the factors that can induce movement from one category to the next. Given such a theory, a health educator approaching a new population could identify the dominant stage or stages and focus resources on those issues that would move people to the next stage. Thus, if health behavior change proceeds through a series of stages, a theory that correctly describes these stages makes possible the matching of treatments to individuals (because people in different stages have different needs) and the sequencing of treatments (because the stages have a temporal order).

Despite their popularity, there is a great deal of confusion about stage theories. In this article, we discuss the essential characteristics of stage theories. We briefly describe two current stage theories of health behavior and then review the types of tests that should be used to distinguish between stage and continuum processes. Finally, we consider challenges facing the implementation of stage-based behavior change programs. Our aim is to provide guidance in the development and testing of stage theories. Given the limitations in the present empirical literature, it is not possible to determine whether one current stage theory of health behavior is better than another.

What Is a Stage Theory of Health Behavior?

Many of the most familiar theories of health behavior (e.g., theory of reasoned action [Fishbein & Ajzen, 1975]; theory of planned behavior [Ajzen & Madden, 1986]; health
Rather than resembling stages of biological development, stages of health behavior are more like the stages of buying a house. First people decide that they need a new home. Then they search for a house that matches their needs. Once such a house is found, they enter into negotiations with the owner over the final price and the terms of sale. Next, they apply for a mortgage. Finally, the sale is completed and they own a new home. Acquiring a new house is not a steady, incremental process. Quite different issues are important at different times, and at any point the process can be halted, reversed, or even abandoned. Like buying a house, people may pass through some stages of health behavior several times before they succeed in reaching the final end point. Attempting to use a single equation to model the process of purchasing a house would inevitably distort the complex and changing issues involved.

Stages of health behavior resemble the stages of buying a house in another respect. Although there may be a single, most prevalent path through the stages, other paths to action are possible. Just as one can inherit a new home, bypassing all the stages just described, there may be a number of routes to the adoption of a health behavior. A woman's attempt to stop smoking may be sparked by the prohibition of smoking at work and have nothing to do with her health considerations. A homeowner might decide to test for radon because a friend offers him a test kit, bypassing any period of information acquisition. If there are many paths to action and few people follow the sequence of stages laid out in a particular theory, the theory will not be very useful. If a substantial majority follow the specified sequence, a theory can be considered accurate and useful even if other paths to action are possible.

3. Common Barriers to Change Facing People in the Same Stage

The principal goals of research on health-protective behavior are to understand and to influence behavior. Stage ideas will be helpful if they reach these goals if people at one stage have to address similar issues before they can progress to the next stage. Thus, the third feature of a stage theory of health behavior is the requirement that people at a given stage face similar barriers and, consequently, that they can be helped by similar interventions. For example, people who have only heard about a precaution on television may share the need for information about its relevance to their own personal situation before they can be convinced to act.

4. Different Barriers to Change Facing People in Different Stages

If the factors producing movement toward action were the same regardless of a person's stage, a simple intervention could be used for everyone. The concept of stages would be superfluous; a continuum model would be adequate.

To justify calling health behavior a stage process, some barriers must be more important at certain stages than others. Acknowledgment of personal risk, for instance, might be required before people will decide to act, whereas training might be needed before people will carry out that decision.
Other factors, however, might facilitate progress regardless of stage. For example, knowing people who have adopted a precaution may encourage movement toward action, irrespective of a person's stage.

It is easier to point out the differences between caterpillars and butterflies than to understand how the transformation occurs. Similarly, it may be easier to describe stages of health behavior than to identify the factors that produce transitions between these stages. Defining the stages and specifying their sequence (Criteria 1 and 2) are initial steps toward demonstrating that health behavior change follows a stage process. However, discovering the barriers between stages and showing the benefits of using different interventions as people move through the stages (Criteria 3 and 4) constitute the ultimate tests.

Although the stages described by a theory may apply to a wide range of behaviors, the specific factors responsible for transitions between adjacent stages probably vary from one health behavior to another. The factors that help people decide to lose weight, for example, may be quite different from the factors that help people decide to use condoms. A model that describes a specific sequence of stages in the change process could be correct even if it does not identify the barriers between stages. Nevertheless, there is no way to find out if the model is correct without testing its predictions for a concrete behavior; to do so, one must describe the barriers between the stages of this behavior.

Differences in Structure Between Continuum and Stage Theories

Given the prevalence of linear methods in the analysis of behavioral data, it is not surprising that linear models also dominate continuum theories of health behavior. Yet, it is questionable whether linear models are capable of capturing the complex processes that underlie decisions to engage in health behaviors (McGuire, 1973).

An example is the implicit assumption in linear prediction equations that there are no limits to the values that the dependent and independent variables can take on. Many health-relevant variables do have limits. Self-efficacy, for instance, can vary only between complete certainty that one cannot carry out the action and complete certainty that one can. Once people are convinced that they can act successfully, this variable cannot be affected further. Obviously, if a variable has reached its limit and people have still not acted, interventions need to shift their focus to other variable. Although the assessment scales used in research recognize variables' limits, the theoretical implications of these limits are not discussed. Variables are simply combined, usually in linear equations. These equations imply that matching of treatments to individuals because of limits on variables is unnecessary.

Intention to act and likelihood of action are often represented in continuum models as a sum of variables without interaction terms. In such an equation, each variable's contribution is independent of all others' contributions. If perceived risk has a large positive coefficient in a linear regression equation, for example, an increase in perceived risk should produce the same increase in action from people who think the precaution is worthless as from people who think the precaution is highly effective. Thus, in a second respect, linear prediction equations assume implicitly that matching interventions to individuals is unnecessary.

If prediction equations include interaction terms, and are no longer strictly linear, the consequence of increasing one variable depends on the values of the variables with which it interacts. For example, protection motivation theory (Maddux & Rogers, 1983) predicts an interaction between perceived threat and perceived efficacy. The effect of a high-threat message is said to increase with the perceived effectiveness of the preventive action. Interactions like this imply that matching interventions to audiences will be beneficial. However, even with such an equation, it makes no difference whether an intervention changes perceived threat first or perceived efficacy first, or whether both are altered simultaneously. Sequencing of treatments is unnecessary if behaviors can be predicted by a single equation.

Pseudostage Models

Stage-like categories, or "pseudostages," can be created out of any continuum. For example, pseudostages can be created by dividing a continuous scale that measures intentions to act into a small number of categories. The cutpoints and the number of categories would be essentially arbitrary. De Vries and Backstier (1994), for example, created categories of "precontemplators" and "contemplators" by dichotomizing a 5-point intentions scale.

Pseudostages created from a continuum provide a category system, so they satisfy Criterion 1. They also seem to satisfy Criterion 2 because the categories can be arranged in a sequence, with some appearing closer to action than others. However, if the underlying continuum model is correct, people can move to action from any category; they do not need to pass through all the intervening stages first. Furthermore, neither the third nor the fourth stage criteria are met. There is no reason to expect that people in the same region of the continuum are held back by the same barriers or that the nature of the barriers changes from one region of the continuum to another.

In general, an investigator needs to determine whether a proposed set of categories satisfies the requirements of a stage theory or is simply a set of pseudostages masking a continuous process. To answer this question, it is necessary to know how results would differ if behavior change were a stage process rather than a continuous process. The results expected from stages and pseudostages in different types of studies are examined in a later section.

Current Stage Models of Health Behavior

To test the validity of stage models, it helps to understand how such models are formulated. A number of stage-based theories have appeared in the health literature. Some emphasize a particular issue or behavior (e.g., AIDS risk reduction [Catania, Kegeles, & Coates, 1990] or delay in seeking medical care [Andersen, Cacioppo, & Roberts, 1995; Safer,
Tharps, Jackson, & Leventhal, 1979), whereas others offer a theoretical framework that can be applied to a broad range of health behaviors (e.g., the transtheoretical model [Prochaska, DiClemente, & Norcross, 1992], the health action process approach [Schwarzer, 1992], and the precaution adoption process model [Weinstein & Sandman, 1992]). The category systems of the Prochaska et al. (1992) and the Weinstein and Sandman (1992) models are briefly summarized here. Although they have important differences, they both distinguish among three classes of people: those who have not yet decided to change their behavior, those who have decided to change, and those who are already changing.

**Transtheoretical Model of Behavior Change (TTM)**

The TTM (DiClemente & Prochaska, 1982; Prochaska & DiClemente, 1983; Prochaska et al., 1992) is currently the most widely used stage model in health psychology. Although initially developed to examine smoking cessation and recovery in psychotherapy, its theoretical framework has been applied to a broad array of behaviors (e.g., safer sex behavior, exercise adoption, mammography utilization; for a recent summary, see Prochaska, Velicer, et al., 1994; for a detailed critique, see Sutton, 1996, 1997).

The TTM separates behavior change into five discrete stages that are defined in terms of a person's past behavior and his or her plans for future action (Prochaska et al., 1992). To understand these stages, consider the issue of smoking cessation. At the initial stage, *precontemplation*, a smoker expresses no intention of stopping in the near future, typically operationalized as the next 6 months. A smoker who is thinking about quitting sometime in the next 6 months (but is not planning to quit in the next month) is said to have reached the *contemplation* stage. Preparation indicates that the smoker intends to take action within the next month and, furthermore, that she or he reports at least one unsuccessful 24-hour quit attempt in the past year. It is not apparent how it is possible for someone to reach the preparation stage the very first time: *Action* involves successfully altering a behavior for any period of time between 1 day and 6 months. After 6 months, someone is said to have reached *maintenance*. Although progression is primarily forward and sequential, relapse to an earlier stage can occur. Multiple attempts and relapses can result in a spiral-like progression through the behavior-change process (Prochaska, DiClemente, & Norcross, 1992).

Investigators usually assign people to stages on the basis of their responses to questions concerning their prior behavior and current behavioral intentions (e.g., DiClemente et al., 1991; but see McConnaughey, Prochaska, & Velicer, 1985). Although the five stages are designed to be mutually exclusive, the specific time points used to distinguish between stages are somewhat arbitrary. Any shift in these points would alter the distribution of people across stages.

In addition to specifying a classification scheme, stage theories attempt to identify the factors that determine whether people move between stages. The TTM includes a large array of factors that are thought to facilitate movement through the five stages (e.g., Prochaska et al., 1992). For example, 10 processes of change have been identified to represent the cognitive and behavioral strategies people use when attempting to change their behavior (Prochaska, Velicer, DiClemente, & Fava, 1988). Although research has indicated that people at different stages use different techniques and hold different beliefs about the behavior (e.g., Prochaska, DiClemente, Velicer, Ginnip, & Norcross, 1985), the specific strategies and beliefs that cause them to move from one stage to the next are currently not well identified.

**Precaution Adoption Process Model (PAPM)**

The PAPM (Weinstein, 1988; Weinstein & Sandman, 1992) identifies seven stages in the process by which people come to adopt a precaution. At some initial point, people are unaware of the health issue (Stage 1). When people first learn something about the issue, they are no longer unaware, but they are not necessarily engaged by it either (Stage 2). People who reach the decision-making stage (Stage 3) have become engaged by the issue and are considering their response. This decision-making process can result in one of two outcomes: if the decision is made not to take any action, the precaution adoption process ends (Stage 4), at least for the time being. But once people have decided to adopt the precaution (Stage 5), the next step is to initiate the behavior (Stage 6). A seventh stage, if relevant, indicates that the behavior has been maintained over time.

Although the PAPM stages resemble those specified by the TTM, the PAPM identifies people at two new stages. First, it distinguishes between people who are unaware of an issue (Stage 1) and those who know something about an issue but have never actively thought about it (Stage 2). Second, people who have decided not to adopt the precaution (Stage 4) are differentiated from people who are not taking action because they have yet to give the issue serious consideration (Stages 1 and 2).

This conceptual framework has been applied to home radon testing (Weinstein & Sandman, 1992), osteoporosis prevention (Blalock et al., 1996), and hepatitis B vaccination (Hammar, 1997). To assign people to stages, respondents are first asked whether they have ever heard about the action (a "no" answer places a person in Stage 1). People who have heard about it are then asked whether they have never thought about taking the action (Stage 2); are thinking about the behavior, but are undecided (Stage 3); have decided not to act (Stage 4); have decided to adopt the precaution (Stage 5); or have already adopted the precaution (Stage 6). Unlike the TTM, the classification does not involve past behavior or any particular time frame.

The PAPM identifies some of the variables that influence whether people proceed through each of the seven stages. For example, perceptions of personal vulnerability are thought to be crucial in determining whether someone decides to take precautionary action (moving from Stage 3 to Stage 5), whereas going from an intention to act (Stage 5) to actually adopting the behavior (Stage 6) is believed to be strongly influenced by situational obstacles.
Testing the Validity of Stage Theories

Research designs differ greatly in their ability to distinguish between stage and continuum processes. After briefly discussing the assessment of stages, this section examines four kinds of empirical evidence that have been or could be interpreted as supporting a stage model. When possible, examples from the published literature are provided. The examples are all based on the transtheoretical model or the precaution adoption process model, the two models that have received the most empirical attention to date. Because our primary aim is to identify the types of data needed to confirm or disconfirm claims that behavior change follows a stage process, predictions derived from a stage model are compared with those from two pseudostage models: a simple linear continuum model and a more general continuum model that includes interactions. Table 1 summarizes the predictions made by these various models.

Assessing Stages

Not only must one identify the characteristics that distinguish one stage from another, one must measure these characteristics. Because the attributes that define stages of health behavior are usually internal to the individual (e.g., beliefs, plans, attributions), measurement can be imperfect. Small changes in the assessment procedure might make a large difference. For example, of 400 participants in a study of radon testing, 23.7% said that they "planned" to test, but only 13.7% said they had "decided" to test (Weinstein, Lyon, & Sandman, 1996).

Furthermore, people participating in a study of a specific precaution may exaggerate their inclination to take that precaution. A tendency to exaggerate interest in action would weaken predictions from stage models because people who appear to be in a particular stage would be a mixture of those who actually belong in that stage and those who belong in earlier stages.

Research Design 1: Cross-Sectional Comparisons of People in Different Stages

The approach used most often to study stage theories is to compare people in different stages on variables that the theories say should differ across stages (e.g., Blalock et al. 1996; De Vries & Backbier, 1994; Prochaska, 1994; Rakowski et al. 1992; Weinstein & Sandman, 1992). In a study of smoking cessation during pregnancy, for example, De Vries and Backbier (1994) compared pregnant women

<table>
<thead>
<tr>
<th>Type of study/effect</th>
<th>Stage model</th>
<th>Pseudostages created from linear equation without interactions or limits</th>
<th>Pseudostages created from a general algebraic equation, including interactions and limits on variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cross-sectional comparisons</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>a. Attributes of people differ across stages</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. The patterns of differences across stages vary from one attribute to another</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Observed sequences of stages</td>
<td>+</td>
<td>-b</td>
<td>+</td>
</tr>
<tr>
<td>Successive stages follow the hypothesized sequence</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Longitudinal prediction of stage transitions</td>
<td>+b</td>
<td>+b</td>
<td>+b</td>
</tr>
<tr>
<td>Predictors of stage transitions vary from stage to stage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Experimental studies of matched and mismatched interventions</td>
<td>+</td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>a. Interventions matched to stage produce more progress toward action than unmatched or mismatched interventions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Sequencing of interventions according to the sequence of stages maximizes progress toward action</td>
<td>+</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. "+" or "-" indicates whether an effect is or is not predicted by a model.

*Although the amount by which a variable differs between adjacent stages can change from stage to stage if these pseudostages are unequally spaced, a linear model does not permit a variable to differ between some adjacent stages and not between others, nor can a variable increase between one pair of adjacent stages and decrease between another pair.

*Expected but cannot be reliably tested because of the likelihood of missed transitions.
classified as precontemplators, contemplators, or actors. Contemplators and actors held stronger beliefs about the negative consequences of smoking than did precontemplators, whereas actors had significantly higher scores on self-efficacy for quitting than did precontemplators and contemplators. A third variable, social influences, showed an approximately linear increase across the three groups.

Although important variables should differ across the stages of a stage process, such differences can also be created by pseudostages (see Table 1). To see this, assume that two people are in different pseudostages. Because the pseudostages conceal an underlying continuum, the individuals are at different places along this continuum. Thus, they must have different standing on the variables that go into the equation that creates this continuum.

Rakowski et al. (1992), for example, measured the perceived pros and cons of mammography and found that these two variables differed among people in different stages of the transtheoretical model. However, the pros and cons changed smoothly and linearly from one stage to the next, as if the stages represented an underlying continuum that was a linear function of the pros and cons. Such data are more suggestive of a pseudostage model than of a genuine stage process.

What if there is a small difference on some variable between Stages A and B but a large difference between Stages B and C? If the magnitudes of the differences vary across stages and the patterns differ from one variable to the next, the data are suggestive of a stage model. Still, these results also could be produced by a pseudostage model in which the underlying continuum dimension is a nonlinear function of the independent variables.

Overall, cross-sectional comparisons provide a weak test of stage ideas. If there are no differences across stages, if the differences change linearly from one stage to the next, or if the pattern of differences is the same for all variables, it argues against a stage theory. Changes that differ by variable could indicate a stage process or a nonlinear continuum process. The particular stage or nonlinear theory able to predict which variables will change most between which stages is the one that would be supported by such results; merely observing that different variables have different patterns is not conclusive support for either type of theory.

Research Design 2: Examination of Stage Sequences

Longitudinal data can be used to test the assumption that people pass through stages in the sequence hypothesized. Although all stage transitions are of interest, most studies to date have emphasized transitions from pre-action stages to action (DiClemente et al. 1991; Weinstein & Sandman, 1992). For example, Weinstein and Sandman (1992) found that homeowners who ordered radon test kits came predominately from those who had said earlier that they planned to test: the rates of testing from all other stages were much lower and were about the same. Such evidence can be interpreted as supporting two assumptions of the PAPM: (a) that its stages represent qualitative distinctions rather than incremental differences and (b) that the stages are tempo-

rally ordered, with the planning-to-test stage being "closest" to action. Furthermore, the results suggest that planning to test approximates a necessary but not a sufficient condition for action because testing from the decided-to-act stage was still only about 25%.

Given suitable data, longer sequences can be examined. For example, Prochaska, Velicer, DiClemente, Guadagnoli, and Rossi (1991) reported data on smokers and ex-smokers who completed questionnaires every 6 months over a 2-year period and were classified on each occasion as being in the precontemplation (PC), contemplation (C), action (A), or maintenance (M) stage. Over the 2 years, 16% of participants progressed from one stage to the next in the sequence without experiencing any reverses (e.g., PC-PC-PC-C-C), whereas 36% stayed in the same stage (e.g., C-C-C-C-C).

The number who skipped stages was not reported.

Although movement that occurs mainly to adjacent stages in the expected sequence suggests a stage process, such movement is also consistent with a pseudostage model (see Table 1). One would expect small, naturally occurring shifts along a continuum to be more common than large shifts, so movement to nearby pseudostages would be more likely than movement to distant pseudostages.

Any test based on the observed sequence of stages implicitly assumes that the measurement schedule gives a complete picture of the stage transitions that occur. If the measurement interval is too long or individuals can move rapidly through several stages, transitions will be missed. Because of this, it is difficult to argue that signs of skipped stages disprove the idea of a stage process; the intermediate steps might have been overlooked.

If the probability of transitions between pairs of stages is found to decline gradually the farther apart the stages are, this tends to suggest a continuum process. A pattern in which transitions occur almost exclusively from adjacent stages tends to suggest a stage process. But labeling a changing pattern of transition probabilities as "gradual" or "abrupt" is somewhat subjective, so sequence data may not be very conclusive.

Research Design 3: Longitudinal Prediction of Stage Transitions

Prospective studies can be used to test the assumption that different causal factors are important at different stages. If perceived risk proves to be a better predictor of movement between Stages 1 and 2 than between Stages 2 and 3, whereas self-efficacy is a better predictor of the latter transition, it would support a three-stage model of change. The focus of the analysis would be on predicting movement from a given stage to the next stage in the sequence, though prediction of movement to the preceding stage could also be of interest.

We are unaware of any studies that have examined

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1 The assumption that stage transitions are not overlooked is also relevant to the next two types of evidence to be discussed but is less problematic because the time intervals involved are likely to be shorter.
predictors of stage transitions in this way. In a sample of smokers and ex-smokers, Prochaska et al. (1985) used stepwise discriminant analysis to study movement among the stages of the transtheoretical model, but their analysis focused on transitions out of a stage (to all other stages), not transitions to the next predicted stage in the sequence.

In a linear prediction equation, the variables that predict movement along a continuum are independent of one another. Thus, predictors of progress are independent of where an individual stands on the continuum. A longitudinal study of a pseudostage model derived from a linear equation would not find different predictors at different stages. If the model of action contained interactions or limits on variables, however, predictors of progress could depend on a person’s initial standing. Thus, the observation that predictors vary with stage could indicate either a stage process or a nonlinear continuum model. Again, the ability of a theory to predict the observed results would determine whether the data should be seen as supporting that theory.

Research Design 4: Experimental Studies of Matched and Mismatched Interventions

Experiments provide better tests of stage ideas than do correlational research designs. Two specific types of experiments can provide converging evidence of a stage-based process.

Matching treatments to stage. If different variables influence movement at different stages in the postulated sequence, treatments designed to influence these variables will be most effective when applied to people in the appropriate stage. Thus, individuals in a given stage should respond better to an intervention that is matched to their stage than to one that is mismatched (i.e., matched to a different stage). Table 2 presents the expected results of an idealized experiment in a situation containing three stages. As Part I illustrates, the model assumes that Intervention A is necessary to get people in Stage 1 to advance to Stage 2 and that Intervention B is necessary to get people in Stage 2 to move to Stage 3. It follows from these assumptions that combining the matched and mismatched treatments into a single treatment (A + B) will be no better in moving people forward from Stage 2 than the matched treatment alone.

Part II of Table 2 reveals the predictions from this same model when the dependent variable is movement all the way to the final stage (action) rather than simply movement toward action. The key prediction is that neither A nor B alone is sufficient to shift people from Stage 1 to Stage 3. Both treatments are necessary.

Of course, the assumptions in Table 2 are rather unrealistic. For instance, it is assumed that no change occurs in the control condition even though events external to the experiment may well lead to some change. It is also assumed that the “mismatched” treatment has no effect, even though perfectly mismatched treatment may be as difficult to find as a perfectly matched treatment. Furthermore, some of the people stopped at Stage 1 may already possess the resources needed to go from Stage 2 to Stage 3, so Intervention A delivered to people in Stage 1 may be sufficient to move some of them all the way to Stage 3. In a real experiment, a stage process would be indicated if the mismatched treatment was more effective than the mismatched treatment in moving people to the next stage (i.e., one would look for an interaction between treatment and stage).

In a study of home radon testing, Weinstein, Lyon, Sandman, and Cuite (in press) created a “high-risk” treatment intended to convince people in the undecided stage of the PAPM to decide to test and a “low-effort” treatment intended to make it easier for people who had decided to test to carry out this intention. The treatments were combined factorially into four conditions, exactly as in Table 2, and were assigned at random to people in the undecided and decided-to-test stages. As predicted, the data revealed a significant interaction between stage and condition. The high-risk treatment was good at getting undecided people to decide to test but not at getting people to order tests. The low-effort treatment, in contrast, proved quite helpful in getting decided-to-test people to act but produced few test orders from people who were undecided. In addition, as predicted by the last row in Part II of Table 2, the condition in which decided-to-test people received both treatments generated no more testing that the condition in which they received only the low-effort treatment.

Several studies based on the transtheoretical model have compared tailored interventions with standardized interventions (e.g., Campbell et al. 1994; Prochaska, DiClemente, Velicer, & Rossi, 1993; Skinner, Streecher, & Horsley, 1994). Although standardized interventions are not mismatched in the sense in which we have been using the term, according to a stage theory perspective they should be less effective than stage-matched interventions. These studies have kept track of overall changes in behavior but they have not assessed transitions to the next stage in the model.

Table 2 presents the results expected from the experiment in Table 2 under the assumption of a linear continuum process rather than a true stage process. Here, Stages 1 and 2 represent pseudostages created from the variable "commit-
Table 3
Predictions From a Continuum (Pseudostage) Model Under Different Interventions

<table>
<thead>
<tr>
<th>Pre-treatment “stage”</th>
<th>Control</th>
<th>A</th>
<th>B</th>
<th>A + B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 1</td>
<td>(a_1)</td>
<td>(1)</td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Stage 2</td>
<td>(a_2)</td>
<td>(1)</td>
<td>(1)</td>
<td>(2)</td>
</tr>
</tbody>
</table>

Note. Commitment to act (C) is assumed to be an additive function of its underlying causes, and action is assumed to be proportional to commitment (i.e., action = \(aC\)). The continuum of commitment to act is divided into pseudostages (1, 2) and action represents the final stage (3). Stage 1 has mean commitment of \(c_1\) and Stage 2 has mean commitment of \(c_2\). Treatment A produces a positive shift of \(a\) along the continuum, and Treatment B produces a positive shift of \(b\). The no-intervention condition is assumed to produce no movement along the continuum.

The likelihood of acting (i.e., reaching Stage 3) is assumed to be proportional to commitment to act, and commitment to act is itself assumed to be a linear function of underlying variables. For a linear equation, the effects of any intervention will be independent of the person’s position on the continuum (hence independent of the person’s pseudostage), and the effects of the combination treatment in Table 3 will equal the sum of the effects of the separate treatments. In clear contrast to Table 2, action is expected from all conditions and stages. Main effects of stage and treatment, but no Stage × Treatment interaction, are predicted. Thus, an experiment using matched and mismatched treatments can readily distinguish between a stage model and an additive continuum model.

Nonadditive continuum models, in contrast, can produce Stage × Treatment interactions. For example, the theory of planned behavior (Ajzen & Madden, 1986) proposes an interaction between an individual’s intentions to act and his or her actual control over that action: An intervention to increase control should produce more action when applied to people in a high-intention pseudostage than in a low-intention pseudostage.

There is no intervention, however, that, according to the theory of planned behavior, would be more effective in a low-intentions pseudostage than in a high-intentions pseudostage. To produce a stage-like, matching prediction (i.e., one variable particularly effective at one stage, another at a later stage) would require a more complex theory containing at least two separate interaction terms. Furthermore, if, as stage models often suggest, some variables are effective at particular stages and ineffective (rather than less effective) at others, this would require a prediction equation that has not only several interaction terms but also nonlinearity. Thus, although a continuum model could be created to mimic stage predictions, it would have to be much more complicated than any continuum model of health behavior yet proposed.

Because a Treatment × Intervention interaction can be observed with both stage and nonadditive continuum theories, an observed interaction supports one theory over another only if that theory actually predicts which interventions will produce an interaction and predicts the nature of the interaction. Finding an unanticipated interaction does not provide strong support for either theory.

**Sequencing of treatments.** Only stage models predict that the sequencing of treatments is important. For maximum effectiveness, the sequence of interventions should follow the hypothesized sequence of stages (see Table 1). Thus, for people in Stage 1, Intervention A followed later in time by Intervention B should be more effective in promoting movement to Stage 3 than Intervention B followed by Intervention A. In fact, according to Table 2, the former sequence should lead the fraction \(a \times b\) to act (i.e., the proportion in Stage 1 that moves to Stage 2 under Intervention A times the proportion in Stage 2 that moves to Stage 3 under the influence of Intervention B), whereas the latter sequence should lead to no one (i.e., \(0 \times 0\)) to act.

In contrast, according to continuum or pseudostage models, whether based on linear or nonlinear equations, the sequence of treatments should be unimportant. Thus, sequence effects are the most compelling evidence of a stage process. Unfortunately, they are also the most difficult to study.

It would be naive to expect differences due to sequencing if the interventions were to be presented in the same session but in different orders. Experimental tests of sequencing effects need to allow a suitable time interval between treatments. There is a further practical difficulty in that participants who know they are in an experiment are likely to pay attention to all treatments, even treatments that they might ignore under more naturalistic conditions. Thus, effects due to variations in treatment sequence may be diluted as compared with those in situations where the participants are not aware that they are part of a research study. No investigations comparing different sequences of treatments have been published to date.

**Summary.** As Table 1 indicates, various types of data differ greatly in their ability to distinguish between different models. Unfortunately, the great majority of existing studies use cross-sectional comparisons, one of the least diagnostic approaches. With cross-sectional designs, both stage and pseudostage models predict differences among groups. Investigators using cross-sectional designs should focus on whether the patterns of between-stage differences vary from one predictor variable to the next, a pattern that would rule out linear continuum models.

Sequenced interventions that are matched or mismatched are the only unequivocal way to distinguish between stages and pseudostages based on a nonadditive continuum model.

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2 The ability of an intervention to alter a variable may sometimes depend on preceding events regardless of whether change follows a continuum or stage process. For example, Trait A may have a greater effect on variable A if it is preceded after Intervention B than before B. This is not the sequencing issue under consideration here. Rather, we are concerned with a situation in which the effects of the treatments on behavior change or on change in stage depend on the order of treatment, even if the change in variable A produced by Intervention A and the change in variable B produced by Intervention B are independent of treatment order.
Yet, although the effects listed in Table 1 under Categories 1b, 2, 3, and 4a are consistent with both types of models, the models may differ greatly in their ability to predict these effects.

Designing and Evaluating Interventions to Change Behavior

Conclusions about the advantages and disadvantages of stage-based theories must be drawn with caution. First, stage theories are no less diverse than continuum theories. Attempts to demonstrate that change in health behavior is a stage process may fail because the stages have not been correctly identified or assessed, because the barriers between stages have not been correctly identified, or because the behavior change does not proceed by stages. Consequently, if a test of a particular stage model fails to produce the expected results, it does not prove that a stage theory is inapplicable.

A stage model is useful in creating interventions only if it is possible to identify and alter the particular factors that help people move from one stage to the next. In evaluating the advantages of a stage-matched approach, attention should be paid to the possibility that merely describing an intervention as tailored or personalized might increase its effectiveness. Both tailoring and personalizing an intervention may lead participants to feel they are receiving special attention, and this in turn may lead them to process the information provided more thoroughly. Although this factor may enhance the effectiveness of a tailored intervention relative to a standardized intervention, it has no direct bearing on the validity of a stage model.

Tailored interventions are not the exclusive province of stage models. Interventions are frequently designed so that particular versions are targeted to particular subpopulations (e.g., Kalichman, Kelly, Hunter, Murphy, & Tyler, 1993). The same message is delivered to more than one person only if their beliefs match perfectly (e.g., Strecher et al., 1994). This type of approach uses a classification scheme with some similarities to a stage model, but the sequence in which information should be communicated is not considered.

The advantage of a stage-based intervention depends on one’s ability to identify stages accurately and efficiently. If a complex assessment process is required, it may be difficult to apply in a large-scale campaign. Finally, the value of a particular stage-matched intervention must be measured against that of the best available standardized treatment (e.g., Prochaska et al., 1993). The added complexity of implementing a stage-based intervention can be justified only if it significantly outperforms an effective standardized treatment.

There are other challenges facing investigators who choose to implement and evaluate stage-based interventions. The speed with which stage transitions occur must be considered. For some behaviors, transitions between stages could occur quickly, and one might choose to present all of the theoretically necessary information in a single intervention. In general, a public health campaign would need to monitor the stage distribution in the population, changing the amount of information pertaining to each stage as people progress toward action.

Despite these potential problems, stage models offer the possibility of creating programs and treatments that will be more effective and efficient than one-size-fits-all interventions. Most of the evidence produced so far in support of stage models, however, is weak and is consistent with continuum models. It is our hope that this article will help researchers focus on the designs and analyses that are most appropriate for determining the existence of stages of health behavior and the as-yet-untested potential of stage-based programs.

References


