A Meta-Analysis of Research on Protection Motivation Theory

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This article reports the first meta-analysis of the literature on protection motivation theory (Rogers, 1975, 1983; Rogers & Prentice-Dunn, 1997), a model of disease prevention and health promotion that has generated research for over two decades. The literature review included 65 relevant studies (N = approximately 30,000) that represented over 20 health issues. The mean overall effect size ($d+$ = .52) was of moderate magnitude. In general, increases in threat severity, threat vulnerability, response efficacy, and self-efficacy facilitated adaptive intentions or behaviors. Conversely, decreases in maladaptive response rewards and adaptive response costs increased adaptive intentions or behaviors. This held true whether the measures were based on intentions or behaviors, and suggests that PMT components may be useful for individual and community interventions.

The two leading causes of death in the United States are cardiovascular disease and cancer. Although hereditary factors are important, behavioral factors contribute to development of these diseases (Blanchard, 1994). Specific behaviors have been identified which, if followed, could possibly prevent or provide early detection of certain types of cancer and cardiovascular disease. The steps recommended for protection against heart disease include having routine physical examinations, monitoring blood pressure routinely, exercising aerobically for at least 20 min three times per week, eating a well-balanced diet that is low in salt and fat, maintaining a healthy weight level, and abstaining from smoking (Taylor, 1995). For protection against cancer, some of the same behaviors are recommended, especially smoking abstention.

In addition to preventive behaviors, actions that would enable early detection of certain cancers have been suggested, such as routine breast self-examination, Pap smears, and mammograms for women, and testicular self-examination for men. Recommendations for these protective behaviors are expressed routinely in the media, at doctors' offices, and in pamphlets provided by the American Heart Association, American Cancer Society, and similar groups. Given these specific

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and straightforward recommendations, why do many people still engage in potentially harmful or negligent (i.e., maladaptive) behaviors?

A similar question regarding why some people take precautions whereas others do not could be applied to injury prevention. With the media attention, ad campaigns, and laws encouraging such actions as the use of seat belts, car safety seats for children, safe driving practices, and bicycle helmets, why do people choose maladaptive responses (i.e., they do not take the precautionary measures that are recommended)?

A large amount of research has been conducted to understand how people choose to behave when faced with various threats. In addition to prevention of cancer, heart disease, and injuries, research on protective behaviors has encompassed such diverse areas as food safety (Schafer, Schafer, Bultena, & Hoiberg, 1993); safer-sex behaviors (Ahia, 1991); environmental hazards (Vaughn, 1993); prevention of nuclear war (Axelrod & Newton, 1991); and protection of others, such as children (Campis, Prentice-Dunn, & Lyman, 1989).

The literature addressing the psychosocial factors involved in the selection of health behaviors has been extended recently to include adherence to medical-treatment regimens. For example, physicians prescribe medications as well as specific behaviors for the monitoring and maintenance of medical conditions, such as asthma (Mesters, Meertens, Kok, & Percel, 1994), diabetes (Palardy, 1996), muscular dystrophy (Flynn, Lyman, & Prentice-Dunn, 1995), and cardiac problems (Plotnikoff, 1994). Gaining an understanding of the psychosocial variables involved in adherence to medical regimens is of importance not only to those who suffer from such diseases and their families, but also to the health-care services and physicians who are providing coverage for medical expenses associated with such ongoing medical conditions.

Protection Motivation Theory and Other Models

Several theories attempt to explain how protective behaviors are initiated or maintained. Weinstein (1993) reviewed four of the key theories describing health-protective behaviors—the health belief model (HBM), protection motivation theory (PMT), the theory of reasoned action (TRA), and subjective expected utility (SEU) theory—finding more similarities than differences among them. The four theories share the idea that motivation toward protection results from a perceived threat and the desire to avoid the potential negative outcome. The theories also share a cost–benefit analysis component in which the individual weighs the costs of taking the precautionary action against the expected benefits of taking that action.

The specific key factors incorporated in the risk and nonrisk variables of each model differ. For example, the perceived effectiveness (or response efficacy) of taking the precautionary action is regarded as an important variable in

the HBM and in PMT. However, this is not so in the other two models. With the TRA and SEU theory, the individual's assessment of response efficacy cannot be determined directly. In addition, both SEU theory and the TRA, although quite detailed, are more cumbersome to use than the HBM or PMT.

A primary difference between the HBM and PMT is the way in which the two are organized (Prentice-Dunn & Rogers, 1986). The HBM is organized as a catalog of variables contributing to behavior. PMT is organized along two processes that attempt to match the cognitive processes that people use in evaluating threats (the threat-appraisal process) and in selecting among coping alternatives (the coping-appraisal process).

PMT is the only one of the four models reviewed by Weinstein (1993) to include self-efficacy as a separate component. Research on self-efficacy beliefs has yielded converging evidence that self-efficacy is an important influencing agent in motivational, cognitive, and affective processes (Bandura, 1992). Schwarzer (1992) suggested that self-efficacy is warranted as an important component of any health behavior theory.

Origin and Structure of PMT

PMT was originally developed to explain the effects of fear appeals on health attitudes and behaviors (Rogers, 1975). Fear-arousing communications have a significant impact on the selection of behaviors. A meta-analysis (Sutton, 1982) conducted on studies of fear-arousing communications published between 1953 and 1980 showed that increases in the perceived level of fear consistently resulted in increases in acceptance of the proposed adaptive behavior or intention. Also, increments in perceived response efficacy increased the intentions to select the adaptive response.

An extensive narrative review of the literature and research on PMT (Rogers & Prentice-Dunn, 1997) indicated that PMT has been applied to a diverse array of topics, including areas of interest beyond health-related issues. Besides health promotion and disease prevention, PMT has been ex-tended to injury prevention, political issues, environmental concerns, and protecting others. Thus, the protection motivation concept involves any threat for which there is an effective recommended response that can be carried out by the individual.

PMT was developed based on expectancy–value theory (Rogers, 1975) and revised to include reward and self-efficacy components (Maddux & Rogers, 1983; Rogers, 1983). Inputs to the model (Figures 1 and 2) include environmental sources of information (e.g., verbal persuasion and observational learning) and intrapersonal sources (e.g., personality aspects and feedback from prior experience). Prior experience includes feedback from personal experiences associated with the targeted maladaptive and adaptive responses.

As mentioned previously, PMT is organized along two cognitive mediating processes: the threat-appraisal process and the coping-appraisal process.

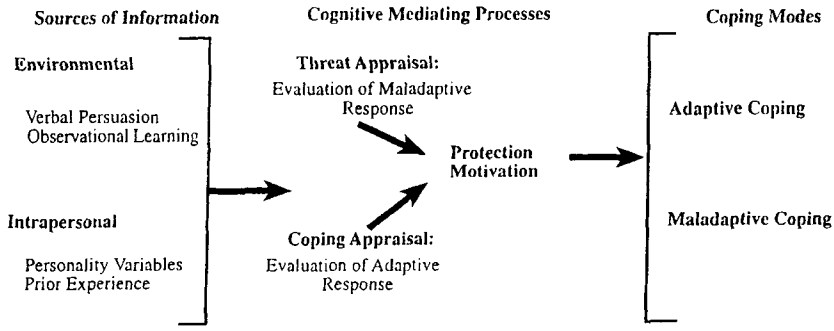

Figure 1. Overall model of protection motivation theory.

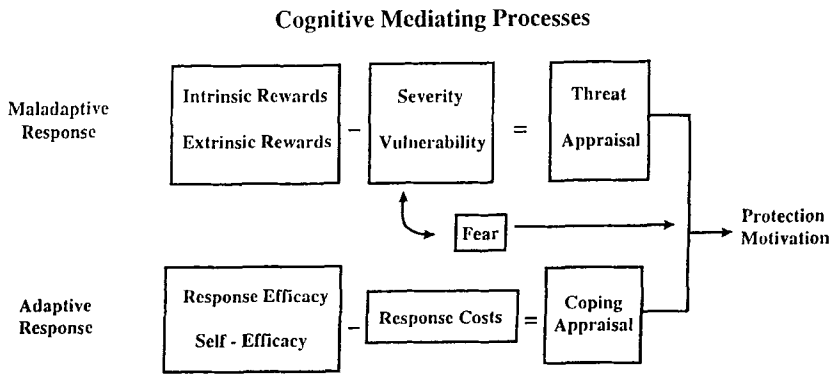

Figure 2. Cognitive mediating processes of protection motivation theory.

Assessments of threat and coping factors combine to form the intervening variable protection motivation. Protection motivation is similar to other types of motivation in that it arouses, sustains, and directs activity. The threat-appraisal process is addressed first, since a threat must be perceived or identified before there can be an evaluation of the coping options.

Threat appraisal evaluates the maladaptive behavior. Factors comprising the threat-appraisal process are maladaptive response rewards (intrinsic and extrinsic) and the perception of threat (severity and vulnerability). Rewards will increase the probability of selecting the maladaptive response (not to protect the self or others), whereas threat will decrease the probability of selecting the maladaptive response. The coping-appraisal process evaluates the ability to cope with and avert the threatened danger. Factors comprising the coping-appraisal process are efficacy variables (both response efficacy and self-efficacy) and

response costs. Response efficacy is the belief that the adaptive response will work, that taking the protective action will be effective in protecting the self or others. Self-efficacy is the perceived ability of the person to actually carry out the adaptive response. Response costs are any costs (e.g., monetary, personal, time, effort) associated with taking the adaptive coping response. Response efficacy and self-efficacy will increase the probability of selecting the adaptive response, whereas response costs will decrease the probability of selecting the adaptive response.

The output of these appraisal-mediating processes is the decision (or intention) to initiate, continue, or inhibit the applicable adaptive responses (or coping modes). Thus, the typical dependent variables in research on PMT are measures of behavioral intentions (Rogers & Prentice-Dunn, 1997). The purpose of PMT research is usually to persuade people to follow the communicator's recommendations; so, intentions indicate the effectiveness of the attempted persuasion.

Rogers and Prentice-Dunn (1997) reviewed the literature on PMT and found good support of PMT and its components. However, their conclusion was based on a narrative review. A more quantitative understanding of the model variables would provide an assessment of the magnitude of the contribution of the PMT components. For example, do some of the variables relate more strongly to behavioral intentions than do others? One way to assess the strength of relations between variables and an outcome measure is to conduct a meta-analysis. A meta-analysis is a quantitative, statistically based tool used to evaluate the results of numerous studies in a field of interest.

Method

Literature Search

A keyword search of PsycInfo and Dissertation Abstracts International was performed using the words *protection motivation*, *coping appraisal*, *threat appraisal*, *fear motivation*, *fear arousal*, *threat severity*, *threat vulnerability*, *rewards*, *response costs*, *response efficacy*, *self-efficacy*, *adaptive responses*, and *maladaptive responses*. The references cited in the identified studies were reviewed for inclusion as well. The searches extended from 1976 to the present. A manual search of key journals to obtain recent articles was also made (a list of these journals is available from the authors). Finally, researchers known to use PMT were contacted about studies not yet published.

Design and Reporting Requirements

The studies were required to include an assessment of intention or actual behavior. The purpose of the intention or behavior must have been to prevent a

potentially harmful consequence, either by stopping an existing deleterious action (e.g., quit smoking), by maintaining a protective behavior (e.g., continuing exercising), or by initiating a protective action (e.g., wearing sunscreen). In addition, the study must have included an analysis of one or more of the key components of the PMT model (rewards, threat severity, threat vulnerability, response efficacy, self-efficacy, and response costs), as developed and revised by Rogers (1983). Studies that directly tested a portion or portions of PMT were included, even if PMT was not specifically referenced. However, studies designed to specifically test theories other than PMT were excluded from the analysis because of the difficulty of accurately converting other theories' factors into PMT variables, as defined in the PMT model.

Classification and Coding Systems

Studies were coded by sample demographics, study design parameters, subject matter addressed, and PMT variables investigated. Two judges independently coded parameters and statistics for each study, from which effect sizes were calculated. The judges resolved discrepancies through discussion and documented all such cases to ensure consistency throughout the coding process.

The following specific variables were coded: (a) status of group (independent variable or variables assessed; e.g., threat vulnerability, self-efficacy, response efficacy and self-efficacy combined); (b) number of subjects; (c) age of subjects; (d) type of subjects (e.g., college students, community sample, patients); (e) topic addressed (e.g., smoking cessation, exercise initiation, healthy eating); (f) stage of change (e.g., cessation of harmful behavior, initiation or maintenance of protective behavior); (g) type of dependent measure (intentions or behaviors); (h) specific dependent measure used; and (i) methodological quality of the study.

Methodological Study Quality

Two judges independently rated the methodological quality of the studies using a nine-item scale developed by Suydam (1968). This quality rating scale provides a systematic method for evaluating study quality. Factors influencing study quality were rated on a 5-point Likert-type scale ranging from 1 (*poor*) to 5 (*excellent*). Discrepancies were resolved through discussion, and consensus was reached on an appropriate solution. The following factors were included in the judgment of study quality: internal validity and external representativeness, reliability of instrument, appropriateness of statistical analyses, interpretations from the data, and adequacy of the report.

Statistical Procedures

Effect sizes and confidence intervals were calculated for each study using the computer software program, DSTAT (Johnson, 1989). DSTAT was designed using the *d* statistic (Cohen, 1977), the standardized mean difference between groups, as the common measure among the studies. The procedures outlined by Hedges and Olkin (1985) for calculating effect sizes were used. The *d* values were corrected for small-sample size bias. However, it should be noted that the sample sizes for the studies in this meta-analysis were predominantly large, so the corrections for small sample size yielded only negligible changes.

Several studies included different measures of the same or similar constructs. In such cases, these measures were combined into one effect size as representative of that study. This procedure prevents overweighting of effect sizes for a particular study by using two effect sizes, while other studies are only represented once. However, a few studies made the same assessments on distinct, separate groups of individuals. In such cases, these effect sizes were included as if they were separate studies since people were only counted once. When a nonsignificant difference was reported without summary statistics, the effect size was assumed to be 0.00. Confidence intervals were calculated on the effect sizes to determine if the effect was statistically different from zero.

For each PMT variable of interest, the effect sizes of the studies were integrated to yield a composite (mean) effect size ($d+$). The composite effect size is a weighted mean effect size that takes into account differences in sample size (Hedges & Olkin, 1985).

The group mean effect sizes were calculated and documented for each of the PMT model variables both prior to and after homogeneity analyses were performed. The homogeneity analysis addresses how consistent the studies are in their analyses of the variables of interest. The data set in this meta-analysis was expected to be inherently heterogeneous because of the wide range of measures used to evaluate the PMT variables. The study parameters (i.e., the variables of interest that were coded, other than the independent and dependent variables) were also evaluated for differences that could explain the heterogeneity in the data group. This process of determining the relation between study characteristics and effect sizes is called *model testing*, and DSTAT provides both categorical and continuous model-testing computations.

A failsafe N (FSN) was calculated for all statistically significant composite effect sizes (Rosenthal, 1984). The FSN provides an indication of the number of studies (not reported or located) without a significant difference (or $d = 0.00$) that would be required to make the calculated effect nonsignificant. The FSN is reported for evaluating the extent to which a file-drawer problem might exist (i.e., studies with nonsignificant differences were filed away and not published).

Results

Sample Characteristics

There were 65 studies included in this meta-analysis, which represents 29,650 individual participants. Most of the studies included multiple PMT components ($N = 49$), while relatively few studies ($N = 16$) assessed only one of the factors of interest. Of the 65 studies, 27 (41.5%) used measures of intentions only, 22 (33.9%) used measures of behaviors only, and 16 (24.6%) used measures of intentions and behaviors. The quality ratings consisted of nine questions with Likert-type scores ranging from 1 (*poor*) to 5 (*excellent*). A mean item score of 4.2 suggests that, in general, the studies showed fairly good methodological properties.

Sixty-six percent of the studies fell into one of six categories of subject matter studied: cancer prevention (11 studies, 17%), exercise/diet/healthy lifestyle (11 studies, 17%), smoking (6 studies, 9%), AIDS prevention (6 studies, 9%), alcohol consumption (5 studies, 8%), and adherence to medical-treatment regimens (4 studies, 6%). The remainder of the studies (only one or two studies for each category) included the following subject areas: prevention of nuclear war, environmental protection, wearing bicycle helmets, driving safely, child-abuse prevention, reducing caffeine consumption, seeking treatment for sexually transmitted diseases, inoculation against influenza, saving endangered species, improving dental hygiene, home radon testing, osteoporosis prevention, marijuana use, seeking emergency help via 911, pain management during and recovery after dental surgery, and safe use of pesticides.

Mean Effect Sizes

The effect size and associated confidence interval, number of studies, number of individual participants for each of the PMT variables, and p levels are shown in Table 1. In accordance with the theory, increases in threat severity, threat vulnerability, response efficacy, and self-efficacy significantly facilitated adaptive intentions or behaviors. Conversely, decreases in maladaptive response rewards and adaptive response costs significantly increased adaptive intentions or behaviors. This is consistent with the PMT model. *Vulnerability and Severity* includes a group of studies in which the independent variable consisted of threat-vulnerability and threat-severity components combined. Likewise, *Response Efficacy (RE) and Self-Efficacy (SE)* includes a group of studies in which the independent variable consisted of a combination of response efficacy and self-efficacy. Increases in these combined groups significantly increased adaptive intentions and behaviors.

Most of the effect sizes were in the moderate range (Cohen, 1977), and all of the mean effect sizes were statistically significant. For comparison purposes,

Table 1

Effect Sizes for PMT Variables for Both Pre- and Post-Homogeneity Analysis

PMT variable	*N*	N_m	*d*+	95% CI	*Q*
Pre-homogeneity analysis					
Threat vulnerability	25	6,029	+0.41	+0.37 to +0.45	385.90
Threat severity	21	3,356	+0.39	+0.34 to +0.45	201.21
Rewards	6	2,796	+0.39	+0.33 to +0.44	21.76
Vulnerability and severity	15	16,923	+0.54	+0.52 to +0.57	26.34
Response efficacy (RE)	36	7,086	+0.54	+0.51 to +0.58	391.57
Self-efficacy (SE)	41	7,666	+0.88	+0.84 to +0.92	804.60
Response cost	15	3,963	+0.52	+0.47 to +0.57	262.62
RE and SE	7	643	+0.41	+0.27 to +0.55	20.26
Post-homogeneity analysis					
Threat vulnerability	15	2,434	+0.21	+0.15 to +0.27	19.40
Threat severity	13	2,096	+0.48	+0.41 to +0.55	19.48
Rewards	5	1,247	+0.52	+0.43 to +0.61	7.56
Vulnerability and severity	14	1,754	+0.37	+0.28 to +0.47	12.34
RE	22	2,652	+0.55	+0.49 to +0.62	28.49
SE	18	2,568	+0.45	+0.38 to +0.52	27.46
Response cost	9	1,457	+1.05	+0.96 to +1.15	11.54
RE and SE	6	562	+0.48	+0.34 to +0.63	10.52

Note. *N* = number of studies, N_m = number of individual participants, *d*+= mean effect size for the group, CI = confidence interval, *Q* = homogeneity statistic. All *d*+ values are $p < .0001$.

based on surveys of research within clinical and social psychology, Cohen specified magnitudes of effect to be roughly 0.20, 0.50, and 0.80 for small, medium, and large effects, respectively. In a meta-analytic evaluation of psychotherapy outcome research, the mean effect size for studies comparing two or more treatments was 0.50, while the mean effect size for studies comparing treatment versus no treatment was 0.85 (Kazdin & Bass, 1989).

For the present study, the heterogeneous effect sizes ranged from 0.39 to 0.88; while the homogeneous effect sizes ranged from 0.21 to 1.05. However, for most of the variables, a large percentage of the outliers had to be removed to achieve homogeneity (40% for vulnerability, 38% for severity, 39% for response efficacy, 56% for self-efficacy, and 40% for response costs). Both rewards and the combined RE and SE groups included a small number of studies ($N = 6$ and 7, respectively) and required the removal of only one outlier each to achieve homogeneity. Only one outlier was removed from the combined threat-vulnerability and threat-severity group.

Prior to the homogeneity correction, the factors showing the strongest impact on protection motivation were self-efficacy ($d+ = 0.88$), followed by response efficacy ($d+ = 0.54$), combined threat vulnerability and severity ($d+ = 0.54$), and response cost ($d+ = 0.52$). In an experimental design, an effect size of 0.88 represents about 87% of the experimental group selecting the adaptive response, while only 50% of the control group chose the adaptive response; an effect size of 0.54 represents about 76% for the experimental group versus 50% for the control. In a correlation, an effect size of 0.88 represents 70% of the total subject pool selecting the adaptive response, while 30% selected the maladaptive response. Similarly, an effect size of 0.54 represents 63% of the subjects selecting the adaptive response versus 37% selecting the maladaptive response.

Analyses were conducted to determine if there were any patterns to subclassifications that would help to explain the heterogeneity of the data. In general, the quality rating of the studies did not systematically vary with effect size. The one exception was a difference in mean effect size based on the quality rating of the study for self-efficacy measures. For self-efficacy, lower quality ratings were associated with lower effect sizes: specifically, for quality ratings of 27.0 to 35.0, $d+ = 0.35$; for ratings of 35.5 to 41.0, $d+ = 0.87$; and for ratings of 41.5 to 44.5, $d+ = 1.24$. Thus, better designed studies tended to yield stronger relations between SE and adaptive intentions or behaviors.

Stage of Change in Behavior

Differences in composite effect size based on stage of change in behavior (cessation, initiation, or maintenance) were evaluated. *Cessation* was defined as stopping a maladaptive behavior (e.g., quitting smoking); *initiation* was defined as beginning an adaptive behavior (e.g., beginning routine breast self-examination); and *maintenance* was defined as continuing the change (e.g., continuing to exercise). For threat vulnerability and threat severity, the mean effect sizes were similar within each variable for cessation and initiation: Vulnerability, cessation $d+ = 0.34$, $k = 6$, initiation $d+ = 0.30$, $k = 14$; Severity, cessation $d+ = 0.37$, $k = 5$, initiation $d+ = 0.38$, $k = 14$. There were too few evaluations of

maintenance to calculate mean effect sizes. Maladaptive response rewards were not analyzed further because there were only six values. However, for the coping variables (RE, SE, and response cost), the cessation stage was associated with higher effect sizes than was the initiation stage: RE, cessation $d+ = 0.72$, $k = 9$, initiation $d+ = 0.47$, $k = 23$; SE, cessation $d+ = 1.22$, $k = 9$, initiation $d+ = 0.68$, $k = 25$; Response Cost, cessation $d+ = 1.03$, $k = 5$, initiation $d+ = 0.46$, $k = 8$. For RE, the mean effect size for maintenance ($d+ = 0.60$, $k = 4$) was between the values for cessation and initiation and was not statistically different from either. For SE, the mean effect size for maintenance ($d+ = 1.29$, $k = 6$) was about the same as the mean effect size for cessation. For response cost, the mean effect size for maintenance ($d+ = 0.54$, $k = 2$) was lower than for cessation, but was not significantly different from initiation. Thus, for the coping variables, the cessation stage appeared to be associated with greater intentions to adopt the recommended behavior; but for the threat variables, the stage of change made no significant difference.

Age of Subjects

For the threat variables, age of subjects made little difference with regard to effect size. However, for the coping variables, effect sizes tended to be lower for children than for adults and college students. This observation is made cautiously, however, as there were only a few studies that included children. Although there was typically no difference between adults and college-age students, there was a stronger relation between SE and adaptive behaviors for adults than for college-age individuals.

Intention–Behavior Relation

To analyze for a difference between intentions and behaviors, the studies that measured both intentions and behaviors were combined into a subsample. The mean effect sizes were obtained for the intention measures and for the behavior measures. For the threat variables, the total number of studies that looked at both intentions and behaviors was 23. The effect size for intentions was 0.56, with a 95% confidence interval (CI) of +0.52 to +0.60; and as expected, the effect size for behaviors was smaller ($d+ = 0.41$, 95% CI = +0.37 to +0.44). For the coping variables, 22 studies measured both intentions and behaviors as outcomes. The effect size for intentions was 0.70, with a 95% CI of +0.64 to +0.77; and again, the effect size for behaviors was smaller ($d+ = 0.51$, 95% CI of +0.45 to +0.58). Thus, for both threat and coping variables, behaviors were attenuated from intentions. However, the magnitude of the effect sizes was still in the moderate range.

Specific Health Problems

Specific topics that have been studied more extensively than others were analyzed to provide a flavor for the relative importance of PMT variables within each area. For cancer prevention, threat variables (k = 18, $d+$ = 0.49, 95% CI = +0.48 to +0.51) in general showed stronger relations with protective behaviors than did coping variables (k = 18, $d+$ = 0.40, 95% CI = +0.36 to +0.44). However, threat vulnerability and SE appeared to be associated with the strongest effects. In contrast, coping variables for smoking cessation and prevention of smoking (k = 13, $d+$ = 0.56, 95% CI = +0.48 to +0.64) showed much stronger effects than did the threat variables (k = 8, $d+$ = 0.25, 95% CI = +0.12 to +0.38). Adherence to medical-treatment regimens and healthy diet and exercise (k = 10, $d+$ = 0.98, 95% CI = +0.88 to +1.08) showed exceptionally strong relations between coping variables and suggested behaviors, in comparison to cancer and smoking studies. The AIDS-prevention coping variables (k = 18, $d+$ = 0.65, 95% CI = +0.58 to +0.72) were more strongly related to adaptive behaviors than cancer prevention, not significantly different from smoking, and less strongly related than medical regimen adherence and healthy diet and exercise. These findings indicate that coping beliefs are important in all of the widely studied areas, but may be especially influential in adherence to medical-treatment regimens and AIDS prevention.

Persistence of Attitude and Behavior Change

There were eight measures of follow-up coping variables (4 RE measures, 4 SE measures) that showed a homogeneous overall mean effect size of 0.50 (95% CI = +0.36 to +0.64). The topic areas included in the follow-up data were: adherence to a medical-treatment regimen of exercise as an intervention for hypercholesterolemia, smoking cessation, exercise programs for improved fitness, and self-management of asthma. All of the subjects in the follow-up studies came from the community, were patients, or were parents of patients. The follow-up intervals ranged from 1 month to 12 months after treatment. Such consistent results in follow-up measures suggest that treatment interventions can be maintained over time.

Sources of Heterogeneity

Additional findings from the subanalyses suggest that the heterogeneity in the data may be partially attributed to differences in (a) dependent variables and (b) perception about the PMT factor, relative to the expected goal and suggested behaviors. In addition, population characteristics, such as age, may have contributed to the heterogeneity.

Table 2

Selected Findings in Subanalyses of the Data

Effect sizes for different measures of the dependent variable

Study	Dependent variable	
	Use sunscreen	Stay out of the sun
Jones & Leary (1994)	1.12	0.24
Mermelstein & Riesenberg (1992)	1.01	0.06
Wichstrom (1994)	1.01	0.10

Perceived effectiveness of the same behavior for different purposes

Study	Effect sizes based on using condoms to	
	Prevent pregnancy	Prevent AIDS
Wulfert & Wan (1993)	0.74	0.17

Differential influence of factors based on population differences

Study	PMT variable	Effect sized based on population differences		
		Children	Adolescents	Adults
Sturges & Rogers, 1996	TS + TV	0.30	-0.03, *ns*	0.21
	RE + SE	0.76	-0.03, *ns*	0.27

Several studies were selected to illustrate the wide variety of perspectives that seem to affect the decision to adopt the recommended health suggestion (Table 2). In the first example, when faced with the threat of skin cancer, the subjects consistently endorsed using sunscreen as a protective behavior, yet consistently rejected staying out of the sun as a protective behavior, both of which are standard recommendations. Perhaps "staying out of the sun" may have a higher response cost than "using sunscreen." In the second example (Wulfert & Wan, 1993), people endorsed using condoms to protect against unwanted pregnancy much more strongly than to protect against contracting AIDS. Therefore, the same behavior was endorsed much more strongly depending on the purpose or goal. In the example about smoking (Sturges & Rogers, 1996), the population groups differed in their intentions to adopt recommended protective behaviors.

Adolescents were not affected by the threat or coping manipulations; however, children and adults were. In addition, the coping variables had a much greater relation to children's intentions than did the threat variables. These examples illustrate the wide variability that can be found in outcomes based on the selection of the dependent measure, the target of the recommended health behavior, and the differences in population group characteristics. Thus, the heterogeneity in the data appears to come from many directions.

Discussion

Theoretical Implications

PMT has been shown to be a viable model on which to base individual and community interventions. The PMT model provides an understanding of why attitudes and behavior can change when people are confronted with threats. The effect sizes for all of the PMT model variables were statistically significant and in the predicted directions, indicating that changes in protective behaviors corresponded with the psychosocial variables included in the model.

The mean effect sizes demonstrate that each component of PMT is linked with healthy outcomes. The theory explains why. The decision to take protective action is a positive function of severity because one must believe that there is some harm (e.g., lung cancer for smokers), and that one is vulnerable to this harm. These considerations must override the rewards, both intrinsic (e.g., bodily pleasure of inhaling) and extrinsic (e.g., peer approval). This appraisal of threat supplies the motivation to initiate the coping process. To decide to adopt the recommended coping response, one must believe that performing the coping response will avoid the danger and that one has the ability and will to perform the response. These considerations must outweigh the costs (e.g., withdrawal symptoms) of performing the coping response.

In general, coping variables showed slightly stronger relations with the adaptive behaviors than did the threat variables. However, both coping and threat were in the moderate range. The approximate effect size of 0.40 for the threat variables represents roughly 70% of an experimental group versus only 50% of a control group selecting the adaptive behavior. The approximate effect size of 0.56 for the coping variables represents roughly 76% of an experimental group versus only 50% of a control group selecting the adaptive behavior.

It should be noted that PMT does not assume that the decision maker is rational. Research on formal reasoning has shown that people often inadvertently change the meaning of information and fail to consider all of the possible interpretations. There are numerous other biases in human thinking, and entire theories that explore them (e.g., prospect theory, cognitive-experiential self-theory). With respect to just one component of PMT (vulnerability), numerous factors

make it difficult for humans to accurately estimate outcome probabilities (e.g., the availability heuristic, the shift from statistical evidence to global intuition). In view of these considerations, it might be concluded that no components of a rational choice model could be supported empirically. Each component of PMT and the appraisal processes will be affected by these cognitive and motivational biases. Although these relatively nonrational, sometimes automatic processes will prevent a veridical mapping of the objective information, it is important to note that the final threat and coping appraisals will reflect them and thus correspond closely with measures of intentions and behavior. The meta-analysis demonstrated that these rational components had significant effects on intentions and behavior.

Practical Implications

The stage of change in behavior (initiation, cessation, maintenance) seemed to be a greater factor when addressing the impact of coping variables than threat variables. Threat was equally effective at each stage. Coping variables (SE, RE, and response cost) were more strongly related to intentions or behaviors in the cessation stage than in the initiation stage. This could have important implications when working with clients or patients. Although, in general, beliefs in the ability to cope appear to be related to protecting oneself, these beliefs may be more important when stopping a maladaptive behavior than when initiating an adaptive action.

Age made little difference in the relation between threat variables and the recommended intentions or behaviors. Because only a few studies included children, the tendency for coping variables to relate to protective behaviors at a lower magnitude than for college-age students and adults must be made tentatively. However, the college-age group showed lower relation between SE and protection motivation than did adults. Together, these may be an indication that, as we mature, we have experienced more successes in coping in general; thus, our beliefs regarding the effectiveness of coping strategies are more salient.

Usually studies of PMT involve motivating people to adopt the communicator's health (or safety) recommendation. Thus, the focus has been on the most immediate measure of the effectiveness of the communication, which is the intention to accept the recommendation. To sustain intentions may require additional interventions, such as relapse-prevention training and booster treatments. Thus, it would generally be expected that behaviors would follow intentions, but show a lower magnitude of effect. Although behaviors were attenuated to some extent from the intentions, both effects were in the moderate range. The studies that included follow-up data supported the conclusion that treatment interventions can be sustained over time—that decisions made become decisions implemented.

The strong relation for the coping variables in both AIDS prevention and adherence to medical-treatment regimens would suggest target areas for health professionals in developing interventions and identifying potential road blocks to improved or protected health. Additionally, a review of follow-up studies indicates that coping beliefs (for SE and RE) appear to be consistently maintained and related to engaging in protective behaviors. Thus, SE and RE might be the most important and fruitful areas in which to intervene to achieve the greatest benefits for clients and patients.

Subanalyses of the data suggest that some target behaviors may inherently carry with them greater response costs than others (e.g., staying out of the sun vs. using sunscreen to protect against skin cancer). In addition, the same behavior may not be perceived to be equally effective for countering different outcomes. For example, in Wulfert and Wan's (1993) study, RE was much more highly correlated with using condoms to protect against pregnancy than to protect against AIDS. Identifying what is being asked of the person in terms of coping resources, whether in terms of perceptions about SE or beliefs in the RE of the recommendation or the costs associated with adopting the protective behavior, should help to target areas on which to work with patients and clients.

Although all of the PMT variables exerted moderate effects in general, some may be more important in one area of protection versus another. Understanding the relative impact of the key variables associated with the targeted protective behavior would be important in formulating treatment interventions and persuasive communications. Reviews of specific health areas must be used to determine the emphasis placed on different PMT variables particular to that area (e.g., cancer prevention or adherence to medical-treatment regimens). Such information may help to pinpoint areas for intervention, or at the very least to identify obstacles to improved health or safety.

Limitations

One limitation of the study was the heterogeneity of the data. The broad scope of a theory such as PMT contributes to the difficulty in arriving at a homogenous sample without removing an unacceptable number of studies. One way to handle this, as was done in this article, is to report the data both pre- and post-homogeneity analysis, to accommodate those who prefer homogeneous data, regardless of the number of studies eliminated. Alternatively, those who believe that removing much more than 20% to 25% of the studies to arrive at homogeneity is unacceptable can focus on the heterogeneous sample numbers. Whatever the preference, the PMT model was supported with both heterogeneous and homogeneous samples. Given the inherent heterogeneous nature of the sample, moderate effect sizes are quite impressive.

Another limitation was that some of the subanalyses involved a small number of studies in one or more of the subgroups. This required more caution in using such numbers. In addition, there are a few of the PMT model variables that have not been researched extensively, such as maladaptive response rewards (only 6 studies). Response costs could also use more evaluation, especially since the composite effect size changed so dramatically from pre- to post-homogeneity.

Finally, it should be noted that the meta-analytic technique is not ideally suited for testing theories that involve numerous variables. Although our meta-analysis indicated that PMT components exert effects of appreciable magnitude, the technique focuses on comparisons between a single component and outcome. Thus, the assessment of the intricacies of the model are lost in the process.

Each component of PMT proved to be significantly related to healthy attitudes and behavior. The theory helps us to understand the relationships. That the effect sizes were all significant offers the hope that the model's components can be used in the battle for disease prevention and health promotion.

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