Colon cancer information as a source of exercise motivation for relatives of patients with colon cancer

Erin L. McGowan* and Harry Prapavessis

Faculty of Physical Education and Recreation, Behavioural Medicine Laboratory, University of Alberta, Alberta, Canada; Department of Kinesiology, The University of Western Ontario, London, Ontario, Canada

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Using a Protection Motivation Theory (PMT) framework, this study examined whether factual colon cancer information is a meaningful source of exercise motivation for relatives of patients with colon cancer. One hundred sixty-six inactive relatives were randomly assigned to one of two treatment conditions: PMT group (intervention); and non-PMT group (attention control). At baseline (T1) participants completed demographic information, a questionnaire designed to assess their beliefs toward exercise and colon cancer as well as their exercise intentions. At T2 (one week following T1) participants watched one of two DVD videos that were created for the study. The intervention DVD contained exercise and colon cancer information that was yoked within the four major components of PMT: perceived vulnerability (PV); perceived severity (PS); response efficacy (RE); and self-efficacy (SE), while the attention control DVD contained general diet and cancer information. Immediately following watching the DVD, participants completed the same measures as in T1. Participants assigned to the PMT intervention group showed significant improvement in PV, RE, SE and exercise intentions, whereas participants assigned to the attention control group showed significant improvement only in RE. RE, SE, and PS made significant and unique contributions to prediction of exercise intention. Overall, the results of the present study demonstrate that a single exposure media intervention grounded in a PMT framework can change individuals’ exercise and colon cancer beliefs, as well as change their exercise intentions. Implications of these findings and direction for future research are discussed.

Keywords: protection motivation theory; colon cancer; behavior change intervention; exercise intentions

Introduction

Worldwide in more developed countries, colorectal cancer is one of the leading causes of cancer-related mortality (Quadrilatero & Hoffman-Goetz, 2003). In Canada specifically, during the year 2009, an estimated 22,000 Canadians will be diagnosed with colorectal cancer and 9100 will die of it making colorectal cancer the second leading cause of death from cancer in Canada (Canadian Cancer Society, 2009). Research has convincingly established that exercise and physical activity are consistently related to a risk reduction of colon cancer (Chao et al., 2004; Evenson,
Stevens, Cai, Thomas, & Thomas, 2003; Friedenreich & Orenstein, 2002; Gotay, 2005; Lee, 2003; McTiernan, 2003; Quadrilatero & Hoffman-Goetz, 2003). From the studies that have been conducted, the average risk reduction is 40–50%, but may be as high as 70% (Friedenreich & Orenstein, 2002). This inverse relationship between exercise and colon cancer risk still holds after adjusting for confounding variables such as dietary intake or body mass index (Friedenreich & Orenstein, 2002). Possible mechanisms for protection include the positive effect of exercise on insulin, prostaglandin, and bile acid levels, which all influence the growth and proliferation of colonic cells. Additionally, exercise reduces bowel transit time, thus reducing the duration of contact between fecal carcinogens and colonic mucosa (Batty, 2000).

Given the established protective benefits of exercise for colon cancer, there is a need to develop and test novel, innovative and inexpensive ways to increase the likelihood that people, and in particular those with an elevated risk of colon cancer will adopt healthy exercise patterns. Thus, as relatives of patients with colon cancer are at increased risk for colon cancer (Johns & Houlston, 2001; Keku et al., 2003) they represent an important target population to get active. Specifically, research has established that the familial relative risk is estimated to be 1.21- to 9.33-fold higher than that of individuals’ with no family history (Duncan & Kyle, 1982; Thune et al., 1992).

Accordingly, researchers have begun to explore whether information about the protective benefits of exercise for colon cancer can impact an individual’s motivation to exercise. To date, two studies have been conducted using Roger’s Protection Motivation Theory (PMT; Rogers, 1975, 1983; Rogers & Prentice-Dunn, 1997). PMT is a theoretical framework that was designed to explain health behavior motivation from a disease prevention perspective (Courneya & Hellsten, 2001), and explains behavioral change in terms of threat (i.e. perceived vulnerability (PV) and perceived severity (PS)) and coping appraisal (i.e. response efficacy (RE) and self-efficacy (SE)). Threat appraisal is influenced by: (a) an individual’s judgment of the likelihood of developing a particular health condition (i.e. PV); and (b) an individual’s judgment of the severity of the consequences of developing the health condition (i.e. PS). While coping appraisal consists of: (a) an individual’s belief that the recommended coping response (e.g. exercise) is effective at reducing the risk of the health condition (i.e. RE); and (b) an individual’s belief that they can successfully perform the coping response (i.e. SE). Specifically, it is proposed through PMT that PV, PS, RE, and SE, influences an individual’s intention (or protection motivation) to perform the health behavior, and then intention influences actual exercise behavior (see Figure 1).

Figure 1. Protection Motivation Theory.
Courneya and Hellsten (2001) conducted the first study using PMT to examine whether colon cancer prevention information is a meaningful source of exercise motivation. Participants included 427 male and female undergraduate students who were randomly assigned to read 1 of 16 persuasive communications that independently manipulated the four PMT constructs in a high (e.g., one in nine chance of developing colon cancer) or a low fashion (i.e., 1 in 200 chance of developing colon cancer). Results demonstrated that participants were more motivated to exercise if they were led to believe that colon cancer was a severe disease and that exercise was an effective means of reducing the risk of developing colon cancer. Despite these promising findings, these results are not generalizable beyond an active, healthy, and young undergraduate population. Additionally, the scripts used were not based on factual colon cancer information, and finally, the primary outcome measure was intention to exercise and not actual exercise behavior.

To remedy some of the aforementioned limitations, Graham, Prapavessis, and Cameron (2006) examined whether factual colon cancer prevention information could effectively motivate inactive individuals to consider exercising. Male and female teaching and school staff were randomized into one of three treatment conditions: (a) experimental, (b) attention control, and (c) non-contact control. Participants in the experimental group viewed a DVD which presented exercise and colon cancer information that manipulated the four PMT constructs, while the attention control group viewed a DVD discussing diet and cancer in general. Results indicated that compared to the two control groups, the experimental group scored significantly higher on their overall coping appraisal as well as intentions to exercise. A trend effect in the expected direction also was found for exercise behavior 2 weeks following the intervention. In addition, three of the four PMT constructs were significantly related to exercise intention (PS, RE, and SE). These findings suggest that a media intervention grounded in theory can influence an individual’s intention to exercise, and has a minimal influence on initial exercise behavior.

A design limitation of both the Courneya and Hellsten (2001) and Graham et al. (2006) studies was the absence of a preintervention assessment of PMT beliefs and intentions which prevented conclusions to be inferred about actual change in these constructions. Hence, the purpose of the current study was to extend the current literature by examining the effectiveness of an intervention grounded in PMT that seeks to change beliefs toward colon cancer and exercise and exercise intentions in inactive relatives of patients with colon cancer. A secondary purpose was to examine which of the four PMT variables would predict exercise intention. We felt inactive relatives would be a highly receptive audience to PMT-based information on exercise and colon cancer because of their family connection to the disease (Quadrilatero & Hoffman-Goetz, 2003). More specifically, relatives of patients with colon cancer are at increased risk for colon cancer (Johns & Houlston, 2001; Keku et al., 2003). In addition, inactivity is an independent risk factor for the development of colon cancer, and represents a modifiable lifestyle behavior (Friedenreich & Orenstein, 2002; Lee, 2003; Quadrilatero & Hoffman-Goetz, 2003).

It was hypothesized that relatives receiving the PMT intervention would show higher change scores from baseline in PV, PS, RE, and SE compared to those not receiving the intervention. Consistent with theory (see Figure 1) it was also hypothesized that all four PMT constructs would predict exercise intention. However, it is expected that the coping appraisal constructs would have greater predictive ability compared to the threat appraisal constructs (Milne, Sheeran, & Orbell, 2000).
Method

Participants

Participants included 166 inactive male \((n = 56)\) and female \((n = 110)\), first- and second-degree relatives of patients with colon cancer who ranged in age from 18 to 62 years \((M = 44.5;\ SD = 8.9)\). The majority of the participants \((89.0\%)\) were first-degree relatives and \((95.0\%)\) classified themselves as Caucasian. In order to meet the inactivity eligibility criteria, participants were screened on the stage of exercise readiness questionnaire \((SERQ; Marcus, Rakowski, & Rossi, 1992)\) to ensure that they were “inactive”. No participants were excluded from the study as they were classified as in the pre-contemplation \((1.8\%)\), contemplation \((64.5\%)\), or preparation \((33.1\%)\) stages according to the Transtheoretical Model \((TTM; Prochaska & Velicer, 1997)\). However, one participant was in the action stage, and was included in the study, as they had just started exercising within the past week.

Development of the PMT and other material

An intervention and an attention control DVD were produced for the current study. The intervention DVD was designed to manipulate the four PMT constructs; PV, PS, RE, and SE. The DVD featured three medical oncologists from local cancer centers. The oncologists presented factual information regarding an individual’s PV \((\text{e.g. } \text{“it [colon cancer] is the fourth most common cancer, but unfortunately it is the second most lethal . . .”})\), and the PS of developing colon cancer \((\text{e.g. } \text{“there are several [treatment options] and they really fall into three groups: surgery, chemotherapy, and radiation”})\). A senior Kinesiology professor was enlisted to present information on the links between exercise and colon cancer \((\text{“... in fact, one can reduce at least statistically one’s risk of developing colon cancer by about 50% it appears through exercise programs . . .”} – \text{RE})\), as well as to provide some tips on how to increase one’s SE to engage in exercise \((\text{“write these activity goals out and put reminders around the house . . .”} – \text{SE})\). The viewing time of the DVD was approximately 15 min. A video format for the intervention was chosen as it ensures that the content is standardized, and covers a broad range of literacy levels \((\text{Meade, 1996})\).

The attention control DVD featured two dieticians who provided information on the links between diet and cancer in general. The DVD was designed to help distinguish the effect of the intervention from the non-specific effect of receiving comparable attention. The attention control DVD was approximately 15 min in length.

Measures

Beliefs toward colon cancer and exercise questionnaire

The Beliefs toward colon cancer and exercise questionnaire is a 16-item measure, containing four items for each of the PMT constructs. The questionnaire has been used in the PMT literature by Courneya and Hellsten \((2001)\) and Graham et al. \((2006)\). The items are rated on a 7-point Likert scale, ranging from 1 = “strongly disagree” to 7 = “strongly agree”. Sample items related to colon cancer include: “Personally, I feel vulnerable to developing colon cancer at some point in my life” \((\text{i.e. PV})\); “I feel colon cancer would be a very serious illness for me to develop” \((\text{i.e. PS})\); “I feel that physical exercise would help me to personally reduce my risk of colon..."
Exercise intentions were assessed using three items which are commonly used in the PMT literature and were used by Courneya and Hellsten (2001) and Graham et al. (2006) to evaluate intentions to exercise. The items are rated on a seven-point Likert scale, ranging from 1 = “extremely unlikely” to 7 = “extremely likely”. The scale demonstrated acceptable levels of internal consistency for pre- (α = 0.73) and post-DVD (α = 0.81) assessments.

Procedure and design

Ethical approval was obtained by the host institution’s ethics committee prior to recruiting participants. A two-group randomized control design was used. Participants were recruited through newspaper, online and radio ads, posters, and from the Ontario Familial Colorectal Cancer Registry (http://www.phac-aspc.gc.ca/publicat/cdic-mcc/21-2/f_e.html). The Colon Cancer Family Registry systematically collects information (e.g. family history, biological specimens) from individuals with colorectal cancer and their families for the purpose of conducting research. Interested participants contacted the principal investigator for further details about the research study. Once participants agreed to take part in the study, they were scheduled in for an initial meeting where consent and baseline (pre-DVD) demographic information (i.e. age, gender, stage of exercise readiness, etc.) was obtained. Additionally, participants’ beliefs toward colon cancer and exercise and exercise intentions were collected. One week following the initial meeting, participants returned to view either the intervention or attention control DVD. The DVDs were presented to participants in groups that ranged in size from two to eight participants. Immediately following the viewing, participants were asked to complete the post-DVD questionnaire package, which contained the beliefs toward colon cancer and exercise questionnaire and exercise intention measure. The trial was conducted at the host institution’s Exercise and Health Psychology Laboratory (www.ehpl.uwo.ca) in London, Ontario. The conduct of the trial followed the
principles outlined in the Declaration of Helsinki (revised 2000 http://www.wma.net/e/policy/b3.htm) and the World Health Organization 1998 Good Clinical Research Practice. The overall design of the study can be seen in Figure 2.

Results

Group equivalency

Chi-square and one-way ANOVA procedures were used to test for group equivalency between the two treatment groups on demographic characteristics as these factors may influence beliefs about exercise and colon cancer and exercise intentions. As can be seen in Table 1 there was group equivalency across all demographic variables.

Correlations were also conducted to examine the relationships among the demographic variables (i.e. age, BMI, gender, education level, ethnicity, stage of exercise readiness), the four PMT variables and exercise intentions. Gender was mildly positively correlated with stage of exercise readiness ($r = 0.19, p < 0.001$), baseline intention ($r = 0.14, p < 0.05$), and post-DVD vulnerability ($r = 0.13, p < 0.05$). Age demonstrated a small negative correlation with education level ($r = -0.12, p < 0.05$), and with baseline RE ($r = -0.13, p < 0.05$). Education showed small positive relationships with baseline PS ($r = 0.13, p < 0.05$) and baseline RE ($r = 0.15, p < 0.05$). Stage of exercise readiness showed a small
negative correlation to BMI ($r = -0.28, p < 0.001$). Finally, BMI was mildly negatively correlated to baseline SE ($r = -0.21, p < 0.001$).

**Descriptive statistics for PMT constructs and exercise intentions**

Table 2 represents the descriptive statistics for the PMT and exercise intention constructs.

**Beliefs toward colon cancer and exercise**

Separate 2 (treatment group) $\times$ 2 (time-pre/post-DVD) repeated measures ANOVAs were conducted to examine interaction effects for the PMT constructs. For PV, results revealed a significant interaction effect $F(1, 164) = 11.03, p < 0.001, \eta^2 = 0.06$. The PMT intervention group’s score increased significantly ($p < 0.001, \eta^2 = 0.19$) from pre-to post-DVD while the attention control group’s score remained stable ($p = 0.930, \eta^2 = 0.00$). For RE, results showed a significant interaction effect $F(1, 164) = 21.40, p < 0.001, \eta^2 = 0.12$. The PMT intervention group’s score increased significantly ($p < 0.001, \eta^2 = 0.43$) from pre- to post-DVD, while the attention control group’s score also increased significantly ($p < 0.001, \eta^2 = 0.14$). For SE, results demonstrated a significant interaction effect $F(1, 164) = 8.10, p < 0.005, \eta^2 = 0.05$. The PMT intervention group’s score increased significantly ($p < 0.01, \eta^2 = 0.11$) from pre- to post-DVD while the attention control group’s score decreased ($p = 0.18, \eta^2 = 0.02$). Only a significant time effect $F(1, 164) =$
12.63, \( p < 0.001, \eta^2 = 0.07 \) was evident for PS, as both groups’ scores on severity increased from pre- to post-DVD.

### Exercise intentions

A 2 (treatment group) \times 2 \text{ (time-pre/post DVD)} \text{ repeated measures ANOVA} revealed a significant interaction effect for exercise intention, \( F(1, 164) = 5.55, \ p < 0.05, \eta^2 = 0.03 \). Post hoc tests showed that the PMT intervention group’s score significantly increased (\( p < 0.005, \eta^2 = 0.10 \)) from pre- to post-DVD, while the attention control group’s score remained stable (\( p = 0.94, \eta^2 = 0.00 \)).

### Relationships between PMT constructs and exercise intentions

Bivariate correlations between the variable of interest are presented in Table 3. To determine if change in the PMT constructs covaried with change in exercise intention, a standardized residual change score was calculated for each variable using regression analysis (Schutz, 1989). Specifically, the pre-DVD variable was entered as the independent variable, while the post-DVD variable was entered as the dependent variable. Thus the resulting residual change score, reflects the degree of change from pre-DVD to post-DVD independent of the pre-DVD score (Sallis, Alcarez, McKenzie, & Hovell, 1999). Correlations indicated that change in all of the PMT were associated with change in exercise intentions (Table 4). The regression analysis found that SE, RE, and PS made significant and unique contributions to predicting exercise intentions, explaining 25.9% of the response variance (Table 5).

### Discussion

Our results support the notion that colon cancer information is a meaningful source of exercise motivation for relatives of patients with colon cancer. As hypothesized, the PMT intervention developed for this study was effective in changing participants’
Table 3. Inter-correlations for the PMT variables and exercise intentions.

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<th>8</th>
<th>9</th>
<th>10</th>
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</thead>
<tbody>
<tr>
<td>1. Pre vulnerability</td>
<td>–</td>
<td>0.33**</td>
<td>0.08</td>
<td>-0.01</td>
<td>0.08</td>
<td>0.79**</td>
<td>0.26**</td>
<td>-0.01</td>
<td>-0.05</td>
<td>0.10</td>
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<tr>
<td>2. Pre severity</td>
<td>–</td>
<td>0.30**</td>
<td>-0.12</td>
<td>0.18**</td>
<td>0.29**</td>
<td>0.69**</td>
<td>0.02</td>
<td>-0.02</td>
<td>0.21**</td>
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<tr>
<td>3. Pre response efficacy</td>
<td>–</td>
<td>0.29**</td>
<td>0.39**</td>
<td>0.12</td>
<td>0.47**</td>
<td>0.48**</td>
<td>0.32**</td>
<td>0.43**</td>
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<td>4. Pre self-efficacy</td>
<td>–</td>
<td>0.32**</td>
<td>0.03</td>
<td>0.06</td>
<td>0.17**</td>
<td>0.63**</td>
<td>0.39**</td>
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<td></td>
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<tr>
<td>5. Pre intention</td>
<td>–</td>
<td>0.14*</td>
<td>0.24**</td>
<td>0.21**</td>
<td>0.25**</td>
<td>0.59**</td>
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<td>6. Post vulnerability</td>
<td>–</td>
<td>0.29**</td>
<td>0.18**</td>
<td>0.05</td>
<td>0.22**</td>
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<tr>
<td>7. Post severity</td>
<td>–</td>
<td>0.23**</td>
<td>0.09</td>
<td>0.33**</td>
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<tr>
<td>8. Post response efficacy</td>
<td>–</td>
<td>0.37**</td>
<td>0.47**</td>
<td></td>
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<td>9. Post self-efficacy</td>
<td>–</td>
<td></td>
<td>0.52**</td>
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<td>10. Post intention</td>
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**p < 0.001, *p < 0.05.
Table 4. Inter-correlations for the residual change scores for the PMT constructs and exercise intentions.

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<tbody>
<tr>
<td>1. Residual vulnerability</td>
<td>–</td>
<td>0.18**</td>
<td>0.27**</td>
<td>0.21**</td>
<td>0.21**</td>
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<tr>
<td>2. Residual severity</td>
<td>–</td>
<td>0.20**</td>
<td>0.10</td>
<td>0.24**</td>
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<tr>
<td>3. Residual response efficacy</td>
<td>–</td>
<td>–</td>
<td>0.29**</td>
<td>0.38**</td>
<td></td>
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<tr>
<td>4. Residual self-efficacy</td>
<td>–</td>
<td>–</td>
<td>0.39**</td>
<td></td>
<td></td>
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<tr>
<td>5. Residual intention</td>
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**p < 0.001.

Table 5. Predicting exercise intentions using residual change scores.

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<th>R</th>
<th>R²</th>
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<tbody>
<tr>
<td>Residual vulnerability</td>
<td>0.05</td>
<td>0.86</td>
<td></td>
<td>0.51**</td>
</tr>
<tr>
<td>Residual severity</td>
<td>0.15*</td>
<td>2.64*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residual self-efficacy</td>
<td>0.29**</td>
<td>5.03**</td>
<td></td>
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<tr>
<td>Residual response efficacy</td>
<td>0.26**</td>
<td>4.42**</td>
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**p < 0.001, *p < 0.05.

threat (i.e. PV) as well as coping appraisal (i.e. RE and SE). Specifically, the PMT intervention group believed that they were more vulnerable to developing colon cancer and they also felt that they had greater RE and SE to reduce the threat compared to the attention control group. The effect size for RE was large (0.12) whereas for PV (0.06) and SE (0.05) was medium. This finding is in line with the majority of PMT research (Floyd, Prentice-Dunn, & Rogers, 2000).

The attention control and the PMT intervention group did not differ on their appraisal of the severity of colon cancer (i.e. PS). The failure to manipulate severity may be due to the fact that both treatment DVDs dealt with the topic of cancer, a topic so charged for participants who had loved ones battle the disease that dwelling on it for 15 min is sufficient to modestly increase perceptions of severity. Additionally, as our sample was middle aged they may have been more aware of the severity of cancer as age is a risk factor for developing the disease (Canadian Cancer Society, 2009). Finally, a ceiling effect may have been operating as means scores for PS were high (see Table 2), and thus this may have influenced the impact of the PS material. Our failure to manipulate PS is in line with the Graham et al. (2006) study, as they also did not manipulate PS. However, the Courneya and Hellsten (2001) study was able to manipulate PS, but this may have been due to the fact that they were presenting false cancer information.

Of the four PMT constructs, PV and SE scores were the lowest irrespective of treatment condition (see Table 2). Lower PV scores may have been due to protective denial whereby participants discount the threat of developing a disease in order to protect themselves (cf. Wiebe & Korbel, 2003). A possible reason for lower scores on the SE construct may have been due to the fact that participants were inactive and did not feel confident in their ability to engage in exercise. Another plausible reason is that the PMT intervention material was not powerful enough to dramatically change participants’ SE and PV levels.

As hypothesized, the PMT intervention was shown to be effective at changing participants’ exercise intentions. Specifically, the PMT intervention group scores on
intentions to exercise increased from pre- to post-DVD intervention, while the attention control group scores remained stable across both time points. It should be acknowledged that the effect on exercise intention was small (0.03). The high pre-DVD (baseline) intention scores indicate a ceiling effect was operating which restricted the potential impact of the PMT intervention in influencing post-DVD intention scores. Alternatively, had the PMT intervention succeeded in manipulating PS or manipulating SE to the same extent as RE, it is likely that a larger intentions effect would also have been observed because both of these constructs were independently related to intentions.

With respect to predicting exercise intentions, the residual data from this study provides evidence that changes in the PMT constructs SE, RE, and PS are related to changes in exercise intentions. This is of particular importance as change analyses provide a step toward establishing causal claims between variables (Crocker et al., 2003). These results clearly demonstrate the importance of coping appraisal on exercise intentions, which is in line with the Milne et al. (2000) meta-analysis on PMT research.

Even though the findings from the current study are promising, this study is not without its limitations. The main limitation of the current study is the failure of our PMT intervention materials to successfully manipulate PS. This is problematic, as all components of the PMT framework need to be manipulated to adequately test its ability to facilitate exercise intentions and exercise behavior through colon cancer prevention information. Another limitation is that the sample of males was considerably smaller than the sample of females. A larger sample of males would have allowed us to examine our data across gender. Additionally, the sample was comprised of mostly first-degree relatives of patients with colon cancer. A comparable sample of second-degree relatives would also have allowed us to examine our data across familial history. The present findings also may not be generalizable beyond first- and to a lesser extent second-degree relatives of patients with colon cancer. A final limitation is no measure of exercise behavior was included.

There are a number of fruitful research avenues stemming from the findings of the present study. For instance, according to Estabrooks and Gyurcsik (2003), maintaining an exercise program requires progression through three phases: (1) motivation and intention to exercise, (2) successful initiation, and (3) successful maintenance. The present study only addressed phase 1. Although previous work has shown that colon cancer information grounded in PMT is unlikely to increase exercise behavior beyond one or two weeks posttreatment (Graham et al., 2006), there is evidence that supplementing a PMT intervention with implementation intentions (or action plans) can influence exercise behavior over a longer time frame (Milne, Orbell, & Sheeran, 2002). Delivering an engaging action planning intervention has also been shown to be effective in the maintenance of physical activity in middle-age and older adults (Ziegelmann, Lippke, & Schwarzer, 2006). Experimental evidence establishing that exercise can be initiated (phase 2) and maintained (phase 3) is essential before longitudinal prospective studies can be conducted to evaluate the protective benefits of exercise against colon cancer.

A final recommendation is to consider message tailoring that corresponds with an individual’s style of processing health-relevant information (cf. Salovey & Williams-Piehota, 2004). The premise here is that matched messages will be more effective in promoting behavior change (i.e. exercise and physical activity) than mismatched messages. It is likely that the messages used in the present experiment were not matched to all participants’ processing style.
In conclusion, the results of the present study demonstrate that a single exposure media intervention grounded in a PMT framework is effective in changing relatives’ exercise and colon cancer beliefs, as well as changing their exercise intentions. The results also show that changes in the PMT constructs SE, RE, and PS are related to changes in exercise intentions.

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