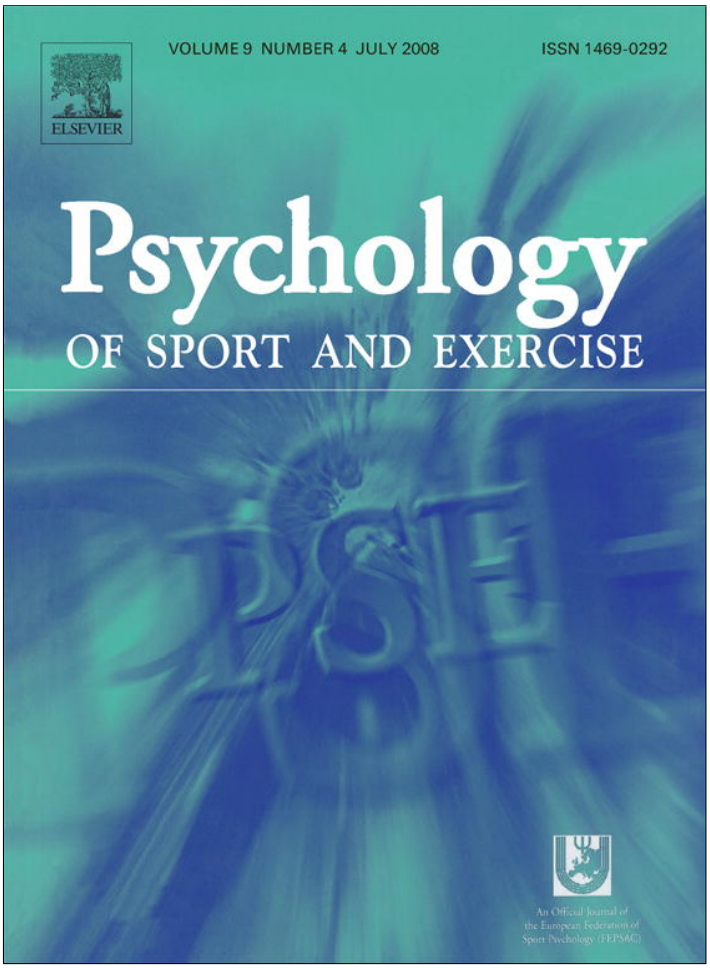

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Theory of Planned Behavior: Implications for an email-based physical activity intervention

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Abstract

Objectives: A 3-week study was conducted to determine the effect of persuasive messages sent via email on psychological constructs associated with Theory of Planned Behavior (TPB) and exercise behavior in sedentary college students ($N = 170$).
Methods: Participants (105 M; 65 F; 94% Caucasian; $20.2 \pm .9$ years) completed the Godin Leisure Time Exercise Questionnaire (GLTEQ) and self-report measures of the TPB. Participants received persuasive messages every other day for 2 weeks. One randomly assigned group received positively framed messages (PFM; $n = 57$); the other received negatively framed messages (NFM, $n = 57$); and the control group (CG; $n = 56$) received none. Participants completed the GLTEQ and TPB questionnaires following the 2-week treatment phase and again 1 week later.
Results: ANCOVA results revealed that PFM reported higher exercise behavior levels than both NFM and CG at follow-up ($p < .05$) and retention ($p < .05$). For exercise intention, PFM and NFM reported significantly higher levels than CG at follow-up ($p < .05$), while PFM reported higher levels than NFM and CG at retention ($p < .05$). Also, pairwise comparisons revealed higher intention levels for NFM compared to CG at retention ($p < .05$). PFM reported higher levels of affective attitude compared to CG at follow-up ($p < .05$) and retention ($p < .05$), while NFM reported higher levels than CG at follow-up ($p < .05$).

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For instrumental attitude, all three groups were statistically different ($p < .05$) at retention (PFM > NFM, NFM > CG, PFM > CG).
Conclusions: Only positively framed persuasive messages sent via email improved exercise behavior. Both types of messages affected attitude, and intention in sedentary young adults. This research provides useful information for creating interventions to enhance exercise adherence.
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Keywords: Adherence; Intention; Attitude; Subjective norm; Perceived behavioral control

Introduction

Considerable evidence exists supporting the physiological and psychological benefits associated with regular physical activity. Exercise has been shown to positively affect one's ability to maintain a healthy body weight through the balance of caloric intake and expenditure (National Institute of Health, 1985). In turn, a decreased risk for development of obesity-related health issues such as heart disease and adult-onset diabetes has been indicated for individuals engaging in regular physical activity (Byers et al., 2002). Despite this compelling evidence, researchers report that 30% of Americans participated in no leisure-time physical activity in the past month (Pratt, Macera, & Blanton, 1999). Thus, a great deal of work is needed to identify physical activity interventions that may improve exercise adherence.

Over the last 25 years, researchers have developed a number of interventions designed to improve exercise adoption and maintenance. Dishman and Buckworth (1996) reported that exercise levels improved between 50% and 67% following physical activity intervention studies. While these numbers are somewhat impressive, the physical activity rates in the population have not followed suit. The problem exists not with the intervention types, but with the practicality and applicability of those interventions into the general population. The most successful interventions contained behavior modification strategies, emphasized lower intensity activity, and utilized a mediated approach (Dishman & Buckworth, 1996). Although it is possible to develop interventions containing behavior modification strategies that emphasize lower intensity activities, mediated approaches tend to be somewhat costly when compared against electronic messaging. The use of telephone, mail, and print materials has been effective in previous studies, but deployment of interventions such as these may be enhanced with the use of the Internet.

The key factor in creating high impact interventions is to make mediation affordable for large-scale use. Internet usage has skyrocketed in the past decade which may signify email as the most realistic option for deploying large-scale physical activity interventions. The Internet is used by a variety of populations as evidenced by more than 20% of people over the age of 65 reported using the Internet, with two out of three having used the Internet to seek health information (Fox, 2004).

Based on available evidence regarding the benefits of exercise interventions using alternative approaches such as telephone (Chen et al., 1998; King, Haskell, Young, Oka, & Stefanick, 1995; King, Taylor, Haskell, & DeBusk, 1988), mail (Fries, Bloch, Harrington, Richardson, & Beck, 1993; King, Frey-Hewitt, Dreon, & Wood, 1989) and print materials (Brown & Lee, 1994;

Mayer et al., 1994; Reid & Morgan, 1979), the use of electronic mail appears to be a logical next step. Given the recent explosion in internet usage, it is not surprising that research supports electronic mail as an effective means of changing behavior in the medical field (Lobach, 1996). In addition, one study has reported email as a promising medium through which physical activity interventions can be administered (Plotnikoff, McCargar, Wilson, & Loucaides, 2005). Plotnikoff and colleagues (2005) found that participants receiving weekly email messages based on social cognitive theory were more efficacious with behaviors related to physical activity and exercised more compared to a control group (CG). Over 66% of adults have access to the Internet (Fox, 2004), which underscores the importance of developing quality interventions using this powerful delivery mechanism.

To date, only two research studies have examined the difference between positively framed messages (PFM) and negatively framed messages (NFM) for improving exercise behavior (Jones, Sinclair, & Courneya, 2003; Jones, Sinclair, Rhodes, & Courneya, 2004). According to research on this topic, people respond more favorably to PFM as opposed to NFM with regard to preventative health behaviors (Jones et al., 2003). Initial empirical support for the use of persuasive messages to promote physical exercise comes from Jones et al. (2003) who investigated the effects of source credibility and message frame (positive vs. negative) on college students' intentions to engage in physical activity. Unfortunately, a follow-up study conducted by Jones and colleagues (2004) did not corroborate their previous study.

A more recent investigation by Chatzisarantis and Hagger (2005) found that persuasive messages targeting salient behavioral beliefs were more effective for improving attitudes and intentions than messages targeting nonsalient beliefs. This provides evidence that persuasive messages can impact aspects of the Theory of Planned Behavior (TPB) (Ajzen, 1985), which is the primary impetus for this investigation.

The TPB (Ajzen, 1985) has been widely cited in literature dealing with behavior change regarding physical activity as is evidenced by the vast amount of research on the topic (Blue, 1995; Godin, 1993, 1994; Godin & Kok, 1996; Hagger, Chatzisarantis, & Biddle, 2002; Hausenblas, Carron, & Mack, 1997; Jones et al., 2003). Given the wealth of evidence linking the TPB to exercise behavior, it is imperative that researchers evaluate interventions targeted at TPB constructs. The TPB is an extension of the theory of reasoned action (Fishbein & Ajzen, 1975) which stipulates that an individual's intention to perform a given behavior is the strongest predictor of actual behavior. Under the TPB, Ajzen contended that intention is influenced by three additional psychological factors: attitude, which is subcategorized into affective attitude (enjoyment) and instrumental attitude (benefit), subjective norm, and perceived behavioral control.

The TPB is proposed to act as a linear model with each construct directly relating to intention. Accordingly, the greater an individual's perceived behavioral control, affective attitude, instrumental attitude, and subjective norm, the greater their intention to perform the behavior should be. Therefore, the purpose of this study was to evaluate the impact of the proposed intervention on affective attitude, instrumental attitude, intention, and exercise behavior. It was hypothesized that both the group receiving PFM and the group receiving NFM would report significantly higher scores on these four dependent measures compared to the CG at follow-up and retention. Also, it was hypothesized that the PFM group would report significantly higher means for the same four variables compared to the NFM group at follow-up and retention.

Method

Participants and procedure

Five-hundred sixty-five division 1 university students were recruited from six general education courses for this investigation. These courses were selected based on their close representation of the university population. Of the 565 students, 170 (105 M; 65 F; 94% Caucasian; 20.2 $\pm$ .9 years) met the criteria for inclusion and volunteered to participate. The inclusion criteria required were as follows: (1) must check email account $\geqslant$1 time/day; (2) must not plan to or currently declare physical education as their major; and (3) must not meet American College of Sports Medicine guidelines (2000) for regular physical activity (30 min of moderate or vigorous intensity $\geqslant$5 days/week). Fig. 1 depicts the flow of participants through each stage.

Prior to data collection, the Human Subjects Committee approved the project and all participants completed an informed consent. The participants were then randomly assigned to one of three groups: PFM ($n = 57$; 34 M; 23 F; 95% Caucasian; 20.4 years), NFM ($n = 57$; 35 M; 22 F; 93% Caucasian; 20.2 years), Control ($n = 56$; 36 M; 20 F; 95% Caucasian; 20.0 years) using a randomization table. However, this design did not meet guidelines for a randomized control trial because researchers were aware of group allocation (participants were not) (Sibbald & Roland, 1998). After completing self-report baseline measures of TPB constructs and exercise behavior, the PFM and NFM groups received emails every other day for 2 weeks while the CG received none. Participants in all three groups completed the questionnaires for TPB and exercise behavior measurement as a 2-week follow-up and 1 week later to determine retention effects. Data collection was conducted within the context of the students' existing classrooms during their normal class time on the same day of the week.

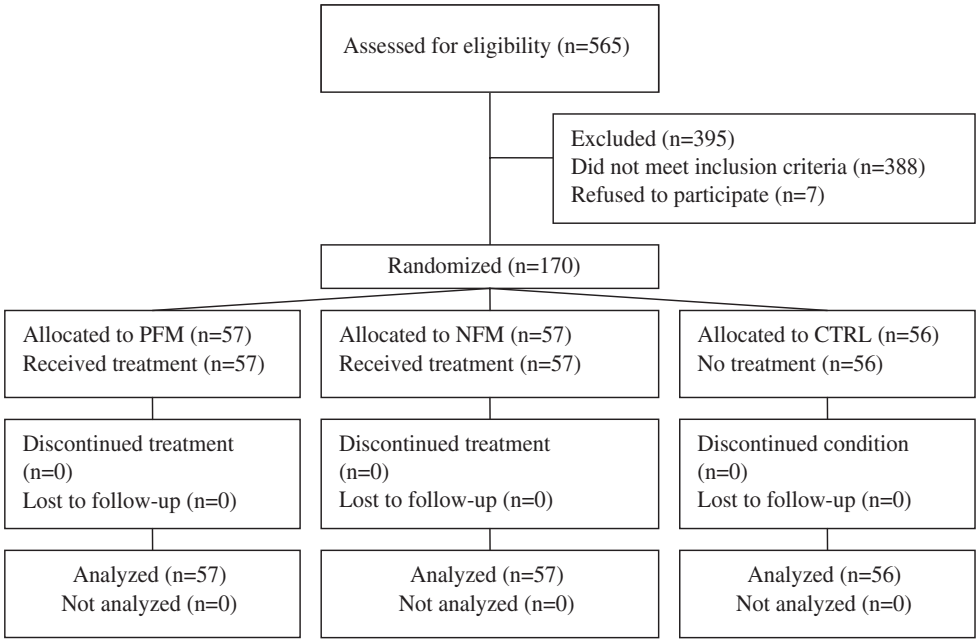

Fig. 1. Participant selection flow chart.

Instruments

Exercise behavior was measured with the Godin Leisure Time Exercise Questionnaire (GLTEQ) (Godin & Shephard, 1985). This instrument contains three open-ended questions covering the frequency of mild (e.g. easy walking), moderate (e.g. fast walking), and strenuous (e.g. jogging) exercise performed during free time. Duration of these intensities was set at 30 min in accordance with ACSM guidelines (2000) for recommended physical activity levels. Exercise behavior was defined by the frequency of moderate and vigorous exercise sessions reported. Mild intensities were eliminated from calculation based on incongruence with ACSM guidelines (2000). Two-week test–retest reliability for the GLTEQ has been demonstrated ($r = .74$) (Godin & Shephard, 1985) and significant ($p < .05$) correlations with both $V_{O_2\,max}$ ($r = .38$), and body fat ($r = .21$) (Godin & Shephard, 1985). These data support the use of the GLTEQ as a valid and reliable measure of self-reported exercise behavior.

Attitude was measured using responses to one open-ended statement: 'For me, exercising over the next 2 weeks would be'. This statement was paired with 6 bipolar 7-point adjective scales as previously utilized by Rhodes and Courneya (2005). Instrumental attitude was assessed by responses on three (useless–useful, foolish–wise, harmful–beneficial) of the six items. Affective attitude was measured with responses on the remaining three (unenjoyable–enjoyable, boring–interesting, stressful–relaxing) items. Previous research (Rhodes & Courneya, 2005) has identified the adjectives used as being construct distinctive for instrumental and affective attitude. Reliability was $\alpha = .74$ and .80 for affective attitude and instrumental attitude, respectively. These adjective scales were recommended by Ajzen (2002) as valid measures of both instrumental attitude and affective attitude.

Intention was assessed using the same item as Rhodes and Courneya (2005) and rated on an open scale. The item was: 'Over the next 2 weeks, I intend to exercise __ times per week'. Previous research has indicated this item as having the strongest predictive validity with exercise behavior when compared against other intention items (Courneya, 1994). Subjective norm was assessed with two separate items, as utilized by Rhodes and Courneya (2005). The two items measuring subjective norm were: 'Most people in my social network want me to exercise regularly in the next 2 weeks', and 'Most people in my social network would approve if I exercised regularly in the next 2 weeks'. Both questions assessing subjective norm were measured with unipolar ($+1$ to $+7$) scales ranging from *strongly disagree* to *strongly agree*. Reliability between the items was $\alpha = .73$. These items were selected based on validity of past research with undergraduate students (Rhodes & Courneya, 2005).

Perceived behavioral control was measured by three items as utilized by Rhodes and Courneya (2005). The items were: 'How confident are you over the next 2 weeks that you could exercise regularly if you wanted to do so' (very unconfident–very confident), 'How much personal control do you feel you have over exercising regularly in the next 2 weeks' (very little control–complete control), and 'How much I exercise in the next 2 weeks is completely up to me' (strongly disagree–strongly agree). The three questions preceded scales ranging from $+1$ to $+7$. Aggregate reliability for the scale was $\alpha = .69$. These items were selected based on validity from previous research by Rhodes and Courneya (2005).

Each email the treatment groups received contained two messages. The first targeted instrumental attitude through citation of CDC statements regarding the health benefits associated

with physical activity. The second message was created for this investigation around the notion of improving affective attitude for exercise. The subject line in each email communication urged the participant to either engage in activity (PFM) or to discontinue sedentary behavior (NFM). The intervention messages are available upon request to the 1st author.

Statistical analysis

This study used a randomized-groups pretest–posttest research design and the data were analyzed using analysis of covariance model (ANCOVA) to test for statistical differences among the groups at follow-up and retention posttest assessments. Pretest data were initially analyzed for group differences to describe the initial status of the participating groups. Data were also examined for outliers and to compare the within-group regression slopes (test the interaction between the pretest data and the grouping variable) to determine whether the ANCOVA assumption of equal slopes was met. When the assumption was not met, the Johnson–Neyman procedure (Pedhazur, 1997, pp. 592–594) was used to identify critical points on the pretest measures that indicated group differences on the follow-up and retention measures. Generalized η^2 (Olejnik & Algina, 2003) and the standardized mean difference between groups were computed as effect sizes to quantify the degree to which groups differed. When the omnibus null hypothesis was rejected, pairwise contrasts were examined using the Bonferroni adjustment to control familywise error rate at .05.

Results

Baseline

Table 1 provides descriptive statistics and the results from a series of ANOVA *F*-tests to compare the three population means using the baseline data. On all of the baseline measures the CG had the highest means. But the differences between the groups were statistically significant on only three of the baseline measures: Intention, Subjective Norm and Perceived Behavioral Control. Pairwise contrasts between groups were then examined using the Bonferroni adjustment to control the Type I error rate. The results of these analyses indicated that for all three of these measures the CG had statistically higher means than the NFM group and statistically higher means than the PFM group on both Intention and Perceived Behavior. No statistically significant differences were found between the PFM and the NFM groups. Other observed differences may be attributed to sampling error. To reduce sampling error and control for initial differences, the baseline data were used as covariates when comparing the groups on the follow-up and retention measures.

Interaction tests

Before comparing the three groups on the follow-up and retention measures, the analysis of covariance assumption of equal within-group regression slopes (no interaction between the baseline data and the grouping variable) was tested for each of the six follow-up and retention measures. Table 2 summarizes these results. Four statistically significant interactions were identified, three involving the follow-up measures (Exercise Behavior, Affective Attitude, and

Table 1
Group minimum, maximum, means, standard deviations (SD) and ANOVA results for affective attitude, strenuous exercise, instrumental attitude, subjective norm, and perceived behavioral control at baseline

Outcome	PFM	NFM	CG	*F*	*p*
Exercise behavior					
Minimum	.0	.0	.0		
Maximum	2.0	5.0	5.0		
Baseline means	1.56	1.57	1.64	.11	.901
SD	(.794)	(.957)	(1.08)		
Intention					
Minimum	.0	.0	.0		
Maximum	5.0	4.0	5.0		
Baseline	1.58	1.53	2.16	4.75	.010
SD	(1.23)	(1.13)	(1.26)		
Affective attitude					
Minimum	−2.0	−1.3	−1.3		
Maximum	1.7	1.7	2.7		
Baseline	.21	.39	.65	2.88	.059
SD	(1.05)	(.77)	(1.12)		
Instrumental attitude					
Minimum	−2.7	−2.0	−3.0		
Maximum	3.0	3.0	3.0		
Baseline	1.43	1.86	1.88	1.42	.24
SD	(1.92)	(1.18)	(1.69)		
Subjective norm					
Minimum	2.0	2.0	1.5		
Maximum	7.0	6.5	7.0		
Baseline	4.91	4.66	5.28	3.82	.024
SD	(1.33)	(1.11)	(1.21)		
Perceived behavior control					
Minimum	3.0	2.3	3.3		
Maximum	7.0	7.0	7.0		
Baseline	4.88	5.07	5.77	10.02	.000*
SD	(1.15)	(1.09)	(1.14)		

*$p < .008$.

Perceived Behavioral Control) and one involving the retention Exercise Behavior measure. Before further examining these interactions and comparing the groups on these measures using the Johnson–Neyman procedure, we present the results on the follow-up and retention measures where an interaction was not statistically significant at $\alpha = .05$.

Follow-up

No interaction between baseline data and the treatment factor was found with three outcomes: Intention, Instrumental Attitude, and Subjective Norm. Table 3 presents the adjusted group

Table 2
Tests for the equality of regression slopes for follow-up and retention scores on baseline scores

Variable	Follow-up			Retention		
	F	p	η^2	F	p	η^2
Exercise behavior	5.173	.007	.048	5.325	.006	.055
Intention	1.928	.143	.019	.378	.686	.003
Affective attitude	18.287	.000	.119	2.183	.116	.019
Instrumental attitude	1.178	.311	.013	2.570	.080	.023
Subjective norm	1.477	.231	.014	.313	.731	.003
Perceived behavior control	5.238	.006	.039	1.670	.191	.019

Table 3
Adjusted group means, F-statistic, p-value, and effect size for variables not interacting with baseline

	PFM	NFM	CG	F	p	η^2
Follow-up						
Intention	3.35	2.91	1.96	8.795	.000*	.090
Instrumental attitude	2.51	2.46	2.27	1.789	.170	.020
Subjective norm	5.26	5.22	5.16	.232	.793	.002
Retention						
Intention	3.17	2.13	1.07	28.064	.000*	.249
Affective attitude	1.66	1.42	1.13	3.987	.020*	.034
Instrumental attitude	2.64	2.24	1.93	4.548	.034*	.213
Subjective norm	5.37	4.88	4.55	6.406	.002*	.071
Perceived behavioral control	5.30	5.26	4.69	5.008	.008*	.056

PFM = positively framed group, NFM = negatively framed group, C = control group.
*$p < .05$.

means, the analysis of covariance F-statistic, p-value, and η^2 for these measures. Although the PFM group consistently had highest adjusted mean scores and the CG had the lowest adjusted mean scores, the observed differences were statistically significant for only the Intention measure. Pairwise comparisons between all groups using the Bonferroni adjustment can be found in Table 4. Results indicated that both the PFM and NFM groups differed significantly [$p < .001$ ($d = .76$) and $p < .016$ ($d = .52$)] from the CG, respectively. The difference between the PFM and NFM was not statistically significant ($p = .568$, $d = .23$).

Retention

As was found with the follow-up data, the PFM consistently had the highest adjusted mean scores and the CG had the lowest adjusted means. Unlike the follow-up measures, all five of the outcome measures were statistically significant at the .05 level. Table 3 presents the adjusted means and summarizes the statistical analyses. For all five outcomes using the Bonferroni

Table 4
Summary of pairwise group comparisons for the PFM, NFM, and control group: affective attitude, exercise behavior, instrumental attitude, intention, subjective norm, and perceived behavioral control

Outcome	PFM vs. CG	NFM vs. CG	PFM vs. NFM
Follow-up			
Exercise behavior	PFM > CG	NS	PFM** > NFM
Intention	PFM > CG	NFM > CG	NS
Affective attitude	PFM* > CG	NFM* > CG	NS
Instrumental attitude	NS	NS	NS
Subjective norm	NS	NS	NS
Perceived behavior control	PFM > CG	NFM* > CG	PFM > NFM
Retention			
Exercise behavior	PFM > CG	NS	PFM** > NFM
Intention	PFM > CG	NFM > CG	PFM > NFM
Affective attitude	PFM* > CG	NS	NS
Instrumental attitude	PFM > CG	NFM > CG	PFM > NFM
Subjective norm	PFM > CG	NS	NS
Perceived behavior control	PFM > CG	NFM > CG	NS

PFM = positively framed group, NFM = negatively framed group, CG = control group.
*For high baseline scores, **for low baseline scores, NS = non-significant.

adjustment, the PFM group scored higher, statistically, than the CG on Intention ($p = .000$, $d = 1.41$), Affective Attitude ($p = .016$, $d = .46$), Instrumental Attitude ($p = .000$, $d = 1.26$), Subjective Norm ($p = .002$, $d = .67$) and Perceived Behavioral Control ($p = .015$, $d = .56$). The NFM group scored significantly higher than the CG on three outcome measures: Intention ($p = .001$, $d = .71$), Instrumental Attitude ($p = .026$, $d = .54$), and Perceived Behavior Control ($p = .007$, $d = .53$). Finally, the PFM group scored significantly higher than the NFM group on two outcomes, Intention ($p = .001$, $d = .70$) and Instrumental Attitude ($p = .000$, $d = .72$).

Johnson–Neyman analyses

Differences between the treatment groups on Affective Attitude and Perceived Behavioral Control at the time of follow-up and differences between groups on Exercise at both follow-up and retention depended on the initial levels of these measures. To identify points on the baseline measures where differences between groups was statistically significant at the .05 level, the Johnson–Neyman procedure was used.

Exercise behavior

At both the follow-up and retention the difference in Exercise Behavior between the PFM and CGs depended on the baseline scores $F(1,110) = 4.142$, $p = .004$, $\eta^2 = .028$ and $F(1,113) = 10.395$, $p = .002$, $\eta^2 = .077$, respectively. The interactions between baseline and the grouping variable were ordinal. For the range of the baseline data, the PFM group had significantly higher Exercise Behavior scores than the CG at both follow-up and retention, but

the difference between the groups was greater for those with baseline Exercise Behavior scores of 0 than for baseline scores of 2. For example, at follow-up the difference between PFM and CGs was 4.28 for those who scored 0 (did not previously exercise) at baseline and 2.60 for individuals scoring 2 at baseline. The pattern was the same at retention.

For the comparison between the NFM and CGs the interaction was not statistically significant at either the follow-up [$F(1,110) = 1.20$, $p = .277$, $\eta^2 = .010$] or retention [$F(1,110) = .791$, $p = .376$, $\eta^2 = .007$]. Adjusted means on the follow-up measures were 3.91 and 2.97 for the NFM and CGs, respectively. At retention the adjusted means were 3.71 and 3.42 for the NFM and CGs, respectively. Neither difference was statistically significant, $F(1,111) = 3.71$, $p = .057$, $\eta^2 = .032$ at follow-up or at retention, $F(1,111) = .293$, $p = .589$, $\eta^2 = .003$.

Finally for the comparison between the PFM and the NFM groups, at both follow-up and retention the magnitude of the differences between groups depended on baseline scores, $F(1,113) = 14.937$, $p = .000$, $\eta^2 = .097$ and $F(1,113) = 10.395$, $p = .002$, $\eta^2 = .077$, respectively. In the range of the available baseline data, the interactions at both time points were ordinal. At the time of follow-up, Exercise Behavior scores for the PFM group were significantly higher than the NFM group, but the difference 4.97 was greater among individuals who at baseline scored 0 than the difference, .54 among individuals who scored 2 at baseline. The same pattern was observed at retention. Individuals in the PFM group who scored 0 or 1 at baseline reported significant higher values on the retention Exercise measure than individuals in the NFM group. The difference between the PFM and NFM was not statistically significant for baseline scores of 2 or above.

Affective attitude

For the Affective Attitude measure the CG had higher scores on the Affective Attitudes at follow-up than the PFM group if the baseline score was below −.82. The PFM group had higher Affective Attitude scores than the CG when the baseline score was above .13. For the comparison between the NFM group and the CG, the NFM group had a higher Affective Attitude scores when baseline scores were above .17. For the comparison between the PFM and the NFM, the interaction between the baseline measure and the groups was not statistically significant [$F(1,113) = 3.821$, $p = .053$, $\eta^2 = .016$]. The adjusted means for the PFM and NFM groups were 1.53 and 1.41, respectively. The observed difference was not statistically significant [$F(1,114) = .570$, $p = .452$, $d = .10$].

Perceived behavioral control

The difference in Perceived Behavioral Control between the PFM and CGs did not depend on baseline scores [$F(1,110) = 1.693$, $p = .196$, $\eta^2 = .012$]. The adjusted follow-up means were 5.74 and 5.38 for the PFM and CGs, respectively. This difference was statistically significant, [$F(1,111) = 7.128$, $p = .009$, $d = .47$]. The difference between the NFM and CGs did depend on the baseline scores [$F(1,109) = 9.962$, $p = .002$, $\eta^2 = .056$]. The NFM group had higher follow-up scores than the CG for individuals scoring above 5.79 on the baseline measure. Differences between the PFM and NFM groups also depended on the baseline scores [$F(1,113) = 4.387$, $p = .038$, $\eta^2 = .020$]. The PFM group had higher scores on the follow-up measure for individuals having baseline measure below 5.38. No statistically significant difference between the two groups was found for individuals above 5.38 on the baseline measure.

Discussion

The study examined the effectiveness of email-based persuasive messaging on exercise behavior and TPB constructs in sedentary college students. Building on concepts derived from Prospect Theory (Kahneman & Tversky, 1979), it was anticipated that PFM would be elaborated to a greater degree because of the preventative nature of exercise. Research shows that preventative behaviors are best promoted by positive messaging (Rothman, Salovey, Antone, Keough, & Martin, 1993; Schneider et al., 2001) as compared with detection behaviors (health screenings), which are elaborated more efficiently through negative framing (Williams, Clarke, & Borland, 2001). Results provide encouragement for future research in the realm of email-based persuasive messaging. Discussion is presented within this context and related to the impact of message framing.

Exercise behavior

Possibly the most intriguing hypothesized findings associated with this investigation were the group differences for exercise behavior at follow-up and retention. We were incorrect in our hypothesis based on the lack of group differences between NFM and the CG at both time points. However, the PFM group reported results as hypothesized. Prospect theory research has suggested that people perceive prevention behaviors (e.g., exercise) as less risky than detection behaviors (e.g., health screenings). In addition, prospect theory stipulates that individuals consider losses associated with riskier options and therefore respond more favorably to NFM (Banks et al., 1995; Detweiler, Bedell, Salovey, Pronin, & Rothman, 1999; Salovey, Rothman, & Rodin, 1998). Thus, preventative behaviors have been promoted more effectively with positive framing (Rothman et al., 1993). The results of this investigation support these findings and contribute to existing prospect theory research. Receiving NFM were, in fact, no more beneficial than receiving no messages at all for improving exercise behavior. In addition to replicating previous research findings (Jones et al., 2003) concerning PFM and the TPB, the results provide some evidence that a brief intervention targeting attitude may impact behavior. This finding also corroborates previous research by Plotnikoff and colleagues (2005) regarding the utilization of electronic mail as a means of delivery for a health-related behavioral intervention.

The interactions at follow-up and retention for the PFM group vs. NFM group provide evidence of prospect theory (Kahneman & Tversky, 1979) at work, but only for individuals reporting very low levels (e.g., 0 or 1 bout/week) of exercise at baseline. Cognitive response theory stipulates that persuasion depends on the favorability of thoughts available when information in processed by the individual (Greenwald, Brook, & Ostrom, 1968). Is it possible that extremely sedentary individuals had more favorable thoughts regarding the messages than did individuals performing slightly higher (but not ACSM recommended) levels of exercise initially? Alternatively, positive framing may have affected more active individuals (e.g., exercised $\geqslant 2$ times/week at baseline) to a lesser degree simply because they had less room for improvement (ceiling effect). Obviously more research is needed to identify the cause of this intriguing finding, but it may be possible that positive framing is more fruitful if messages are targeted at individuals in the lowest stage of change (precontemplation).

Intention

The TPB is developed around the notion that intention is the single best predictor of future exercise behavior. It was hypothesized that the intervention would significantly impact intention, as well as exercise behavior. Some of the findings related to the intention construct were notable ($d = .52$–1.41). The fact that similar results were found for intention and exercise behavior support the findings of previous investigations (Blue, 1995; Rosen, 2000) and speak to the strong predictive relationship between the two.

Affective attitude

Rhodes and Courneya (2005) suggested that future interventions include components designed specifically to impact affective attitude. In an attempt to build upon their research, the current investigation was constructed using this philosophy. The second message within each email was written to specifically target the affective attitude construct by highlighting enjoyable aspects of physical activity. Using the TPB framework as our model, the differences associated with affective attitude may have been the primary cause of differences associated with both intention and exercise behavior. Rhodes and Courneya (2005) provided evidence supporting the linearity of affective attitude within the TPB. Specifically, Rhodes and Courneya (2005) found that increases in affective attitude typically resulted in increases in intention, which is the single largest predictor of exercise behavior. Using this logic, this study may provide evidence of the TPB model presence within the participant population in addition to supporting the intervention itself. However, further research examining path analysis between TPB constructs is needed to justify this claim.

The interactions found within the affective attitude measure merit further discussion. Individuals who reported high baseline levels of affective attitude appear to have been more susceptible to this intervention. This finding suggests that persuasive messages (irrespective of frame) may not be effective for those individuals who have extremely negative perceptions of exercise enjoyment. It is possible that those individuals who are indifferent (or slightly enjoy) exercise may benefit from this type of intervention compared to those who have very negative perceived enjoyment levels. This information is particularly interesting when considering the lack of attitude manipulation reported by previous studies examining message framing in the exercise context (Jones et al., 2003). Further research is needed to identify specific population parameters, but this provides a starting point for those interested in intervention development.

Instrumental attitude

It was anticipated that the treatment groups would report significantly higher levels of the instrumental attitude variable compared to the CG based on the intervention messages. In addition, the PFM group was expected to reveal higher levels compared to the NFM group. The first message in each email was designed to improve this variable, in particular. Similar to the results reported by Jones et al. (2003), persuasive messages did not impact this variable at follow-up. This could have been caused by a ceiling effect within the sample population. College students are keenly aware of the health benefits of exercise, which may have predisposed them to report abnormally high levels of instrumental attitude, regardless of group allocation. At the same time,

retention results suggest that a treatment effect did occur. Not only were all group comparisons significantly different, but effect sizes ranged from moderate to large ($d = .54$–1.26). Jones et al. (2003) suggested that persuasive messaging may not immediately affect attitude, but could require a longer delay with people changing attitudes in order to match their behaviors. This logic would explain why group differences were not present until retention. These findings may point toward using PFM rather than NFM based on the eventual changes in instrumental attitude reported by both treatment groups. However, further research should be conducted with less educated populations to determine either refute or corroborate the mixed results in this investigation.

Subjective norm

Electronically based messages related to the benefits and potential enjoyment of physical activity was hypothesized to have no effect subjective norm. This study provides discriminatory validity based on these findings. This intervention was not designed to have significantly altered one's feelings of whether those in their social network would support exercise behavior because it was not addressed in the persuasive messages sent. Further, subjective norm would likely be an extremely difficult construct to positively change with any type of mediated intervention approach. Nevertheless, one group difference was found at retention, which could have been a byproduct of the persuasive messages, to some extent. However, all groups reported very high scores on the subjective norm construct, suggesting that most people viewed those in their social network as being supportive of exercise behavior.

Perceived behavioral control

Like subjective norm, perceived behavioral control was not supposed to have been affected by this intervention. Surprisingly, group differences suggest otherwise. Given the multitude and magnitude of group differences associated with this construct, further examination of the intervention was warranted. It is possible that the second message within each email may have contained components of control enhancement. In an attempt to highlight the fun, enjoyable aspects of exercise, we may have inadvertently targeted perceived behavioral control. The messages may have given participants new ideas for exercise participation, thereby reducing perceived barriers. Rock climbing, mountain biking, and outdoor running were all highlighted as ways to enjoy exercise, but provided the participants with methods of participation not requiring a gym membership. In this fashion, cost (barrier) is reduced and convenience is enhanced, thereby improving perceived behavioral control. Obviously, more research is needed to examine why perceived behavioral control would be affected by this type of behavioral intervention.

Limitations and conclusions

One limitation of the present study is concerned with generalizability of the sample. The students who participated in this investigation may not have been representative of the worldwide college student population based on the large percentage of Caucasian (94%) individuals analyzed. Universities in other countries or different parts of the US most certainly contain lower

percentages of Caucasian students. Although courses were selected based on the likelihood that they would mirror this universities demographics, future research should replicate the current study in a more diverse population.

Although group assignment was conducted with the use of a randomization table, initial group differences were present. As such, this must be conceded as a limitation of the current investigation. In an attempt to minimize bias, statistical measures were taken to control for these differences. The use of ANCOVA was specifically implemented to reduce the effect of this limitation on the outcome of the present study.

This investigation did not meet the guidelines (Sibbald & Roland, 1998) for a Randomized Control Trial based on the author's knowledge of group assignment. Given the strength of such as design, the results of this study may have been more compelling had a Randomized Control Trial been utilized. Therefore, one must consider these results within the context of a study design conceding limitation.

The self-report nature of the GLTEQ also presents a degree of bias inherent to survey research. Direct observation of physical activity participation would provide a more reliable source of measurement for the exercise behavior variable. Although the GLTEQ has correlated moderately ($r = .38$) with objective measures of physical activity such as $V_{O_2\,max}$ (Godin & Shephard, 1985), survey data is subject to memory and accuracy issues which are recognized as a limitation in this investigation.

Given the lack of available literature on the topic of email-based physical activity interventions, this investigation was conducted with the expectation that many follow-up studies would be performed in the future. Although the positive/negative framing aspect of this study was compelling, the utilization of email for sending persuasive messages appears to be the primary substance of interest for future investigations.

These data provide researchers with valuable information concerning the use of email as an affordable, high-impact intervention tool for promoting exercise from an epidemiological standpoint. This investigation certainly does not answer all questions related to the efficacy and effectiveness of persuasive messages sent via electronic mail. However, the presence of linearity among TPB constructs within this study does provide some evidence that the intervention impacted participants in a fashion consistent with previous research in the field.

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