Distinctions Between Worry and Perceived Risk in the Context of the Theory of Planned Behavior

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Worry and risk perception were integrated into the theory of planned behavior (TPB) within health and non-health domains (flossing and academic coursework, respectively). Models were estimated and replicated in 2 undergraduate samples (*n*s = 191 and 309), with effects of worry and risk on intentions expected to occur primarily through attitudes. Past behavior was modeled through effects on all TPB constructs and through interactions with worry and risk. Worry positively predicted intentions and attitudes (and norms in the non-health domain) for those at the lowest levels of prior behavior. Risk perceptions negatively predicted intentions and self-efficacy (and attitudes in the health context) also for those at low levels of prior behavior. Implications for further theory development are discussed.

The theory of planned behavior (TPB; Ajzen & Madden, 1986) has been extensively applied to describe and predict behavior across a wide variety of contexts. Recently, there has been recognition of the value of integrative models, in which constructs from more than one theoretical framework are combined in unique ways (Baranowski, 1993; Fishbein, 2000; Fishbein & Cappella, 2006; Nigg, Allegrante, & Ory, 2002). The focus of these integrative models is not simply on testing whether a single theory holds in a particular context, but on continual theory development via the extension and improvement of current well-established theories, with the eventual goal of optimal intervention development. Our purpose is to integrate the widely studied concepts of worry and risk perception into the broader theoretical framework of the TPB to be applied to two behaviors: flossing (a health behavior), and studying (a non-health behavior).

Theoretical Framework

The TPB (Ajzen & Madden, 1986) is an extension of the theory of reasoned action (TRA; Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975), which

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proposes that the likelihood of a behavior depends on one's intention to perform that behavior, where intention is a direct function of attitudes toward engaging in the behavior and perceptions of normative influence. The TPB extended the TRA with the incorporation of *perceived behavioral control* (PBC), which is defined as an individual's perception of the ease or difficulty associated with performance of the behavior (Ajzen & Madden, 1986). PBC has often been compared to the similar construct of self-efficacy (Bandura, 1977). Though some have made conceptual distinctions between the two (e.g., Armitage & Conner, 2001), in this work we focus on self-efficacy. The effects of self-efficacy on behavior may be direct, as well as indirect (via intentions).

The TPB has been extensively applied across health contexts. For example, Godin and Kok (1996) showed that, for a variety of health behaviors (e.g., addictive behavior, exercise behavior, HIV/AIDS-related behavior), TPB constructs explain approximately 41% of the variance in intentions and 34% of the variance in behavior. Other reviews of TPB applications to specific areas—for example, exercise (Blue, 1995; Hausenblas, Carron, & Mack, 1997) and condom use (Albarracin, Johnson, Fishbein, & Muellerleile, 2001)—have reported similar findings.

A meta-analysis by Armitage and Conner (2001) demonstrated support of the TPB in applications across both health and non-health domains. Furthermore, a number of recent individual studies have examined the predictive utility of the TPB within a non-health context; for example, recycling (Valle, Rebelo, Reis, & Menezes, 2005) and job search (van Hooft, Born, Taris, & van der Flier, 2005; Wanberg, Glomb, Song, & Sorenson, 2005). Still, the vast majority of applications of the TPB have been to predict health behaviors, and more research is needed to clarify possible contextual limitations of the theory. The present study expands on previous work by testing and replicating an integrative model in two domains.

Integrative Models

There have been several discussions of the potential value of integrative models (Baranowski, 1993, 2005; Nigg et al., 2002; Weinstein & Rothman, 2005). One advantage of such models stems from the notion that integrative models are not simply explaining a greater amount of variance in outcomes because there are a greater number of putative predictors of behavior, but certain combinations of constructs might uniquely contribute to a greater proportion of variance explained (Weinstein & Rothman, 2005).

Fishbein (2000) as well as Bryan and colleagues (Bryan, Aiken, & West, 1997; Bryan, Schindeldecker, & Aiken, 2001) presented models that are a

theoretical integration in the context of HIV prevention and include constructs from the TPB and other models of health behavior, such as the health belief model (HBM; Rosenstock, 1990) and social cognitive theory (SCT; Bandura, 1986). For example, Bryan et al. (1997, 2001) showed that perceived susceptibility to STDs was both directly and indirectly related to intentions to use condoms through perceived benefits and affective attitudes. Similarly, Jackson and Aiken (2000) showed direct and indirect relationships from perceptions of risk for skin cancer to intentions for sun protection, via perceived benefits. Perceived risk has been previously included as a distal predictor of intentions through its effects on attitudes and beliefs, likely because risk is included as a formal component in the HBM (Rosenstock, 1990). The construct of worry, on the other hand, has not received the same attention in prior integrative models, making it less clear how it will predict outcomes in the present study.

Overview of Research on Worry and Risk

The constructs of worry and perceived risk are sometimes discussed together, as both refer to reactions to or beliefs about potential negative consequences. The distinction is that worry has been described as an emotional response to a threat (e.g., affective responses), whereas perceived risk has been described as a cognitive assessment (e.g., perceptions of vulnerability; Sjöberg, 1998). There has been a recent spate of interest in affect as a predictor of health behavior and decision making (cf. Chapman & Coups, 2006; Loewenstein, Weber, Hsee, & Welch, 2001; Slovic, Peters, Finucane, & MacGregor, 2005).

McCaul and Mullens (2003) argued that worry (as well as affect more generally) is missing from the majority of health models, including the TPB. There is evidence showing that worry and risk may be at least modestly correlated with one another (e.g., Collins, Halliday, Warren, & Williamson, 2000; Easterling & Leventhal, 1989; Sjöberg, 1998), suggesting that both constructs may operate in a similar manner in predicting outcomes in the present study. The moderate size of these correlations, however, suggests that they are also conceptually different psychological variables.

The effect of worry has been examined across a number of contexts, with a positive association between worry and health-protective behavior observed frequently (for a review, see McCaul & Mullens, 2003). For example, a number of studies have shown that worry about breast cancer is positively related to screening behaviors and mammography adherence (Cameron & Diefenbach, 2001; Cameron & Reeve, 2006; Diefenbach, Miller, & Daly, 1999; McCaul, Branstetter, O'Donnell, Jacobson, & Quinlan, 1998;

McCaul, Schroeder, & Reid, 1996; Mullens, McCaul, Erickson, & Sandgren, 2004; Wilcox, Ainsworth, LaMonte, & DuBose, 2002). Worry has also been linked to screening for bowel cancer (Wardle et al., 2000), condom use (Mahoney, 1995; Pleck, Sonenstein, & Ku, 1991), HIV testing (Crosby, Bonney, & Odenat, 2004), and smoking cessation (Dijkstra & Brosschot, 2003).

Weinstein (1982) examined perceptions of worry across 45 health threats, finding that perceived worry predicted an interest in reducing one's risk of the health threat, over and above perceived severity of the risk and likelihood estimates. In contrast to these findings, however, Aiken, Gerend, and Jackson (2001) and meta-analytic work by McCaul, Branstetter, Schroeder, and Glasgow (1996) support that there is considerable variability in the relationship between worry and breast cancer screening, with correlations ranging from significantly negative to significantly positive. Inconsistencies have been noted in health contexts other than breast cancer screening as well (Wilcox et al., 2002). The discrepancies may have to do with how worry is defined; for example, worry about cancer is likely to be positively related to cancer screening, whereas worry about the screening test itself is likely to be negatively related to screening (Hay, Buckley, & Ostroff, 2005).

Perceived risk is a cornerstone of the HBM, and reviews have typically found moderate to strong relationships of perceived risk to health behavior (Harrison, Mullen, & Green, 1992; Janz & Becker, 1984). As with worry, however, there is some variability. For example, there is ample evidence of positive relationships between perceived risk and outcomes (McCaul, Branstetter et al., 1996; McCaul, Schroeder et al., 1996; Mullens et al., 2004; Wardle et al., 2000; Weinstein, 1982), but also of no relationship between perceived risk and outcomes (Cameron & Diefenbach, 2001; Diefenbach et al., 1999; Mahoney, 1995; Norman & Brain, 2005; Pleck et al., 1991). Negative relationships between perceived risk and outcomes have also been observed (e.g., Cameron & Reeve, 2006; Gerrard, Gibbons, & Bushman, 1996; van der Pligt, 1996), although negative correlations that emerge in cross-sectional research can be interpreted as testing the hypothesis that those who already engage in a health-protective behavior subsequently show lower perceived risk for a health threat (Brewer, Weinstein, Cuite, & Herrington, 2004; Weinstein & Nicolich, 1993).

Therefore, more studies across various contexts are needed in order to clarify the precise situations in which both worry and risk will relate to outcomes, and whether such relationships will be positive or negative. Negative relationships that have been observed in cross-sectional research also raise an interesting question regarding the role of past behavior. The present study examines the role of past behavior as a direct predictor of intentions, as well as an indirect predictor through all other TPB constructs. Including past

behavior in this manner is consistent with potential extensions of the TPB proposed by Conner and Armitage (1998), and may speak to differing perspectives in the literature regarding whether the role of past behavior on future acts is simply a matter of automatic practice (i.e., habit), or whether its role can be explained by a reasoned-action perspective in which past behavior may actually be exerting an influence over the decision-making process (Ajzen, 2002; Ouellette & Wood, 1998).

To address the possibility that previously observed negative relationships of worry and risk to intentions are a result of the notion that such relationships are conditioned on past behavior (i.e., those who already engage in a health-protective behavior subsequently show lower perceived risk for a health threat; Weinstein & Nicolich, 1993), we estimate the interactions between worry and past behavior and between risk and past behavior. A significant interaction would be indicative of differential relationships of worry and risk to behavioral intentions as a function of one's current level of behavior.

Hypothesized Integration of Worry and Risk Into the TPB

The hypothesized model for the present research is depicted in Figure 1. The TPB specifies attitudes, norms, and self-efficacy as proximal predictors of intentions, with the effects of other constructs on intentions mediated through these three core variables (Fishbein & Ajzen, 1975). Several theoretical papers that discuss extensions of the TPB maintain this underlying structure (e.g., Aiken et al., 2001; Baranowski, 1993; Fishbein, 2000).

Based on the available theoretical and empirical evidence, it is expected that worry and risk will act as distal predictors of intentions to floss and study, with the effect of these variables on intentions at least partially mediated by the more proximal TPB constructs. Indirect, as well as direct relationships from perceived risk to intentions through attitudes have been well-supported by the literature (see Bryan et al., 1997; Jackson & Aiken, 2000).

There has also been some support for relationships of worry to attitudes. A recent study in the context of genetic testing for breast cancer showed that worry was positively associated with attitudinal outcomes such as perceived health and psychosocial benefits and beliefs regarding the emotional consequences of being tested (Cameron & Reeve, 2006). In addition to indirect effects on intentions through TPB constructs, direct effects on intentions might be expected because of previously observed effects of worry as a motivator of behavior (see McCaul & Mullens, 2003) and because affective variables are capable of driving health behaviors without being mediated by more cognitive variables (Richard, van der Pligt, & de Vries, 1996).

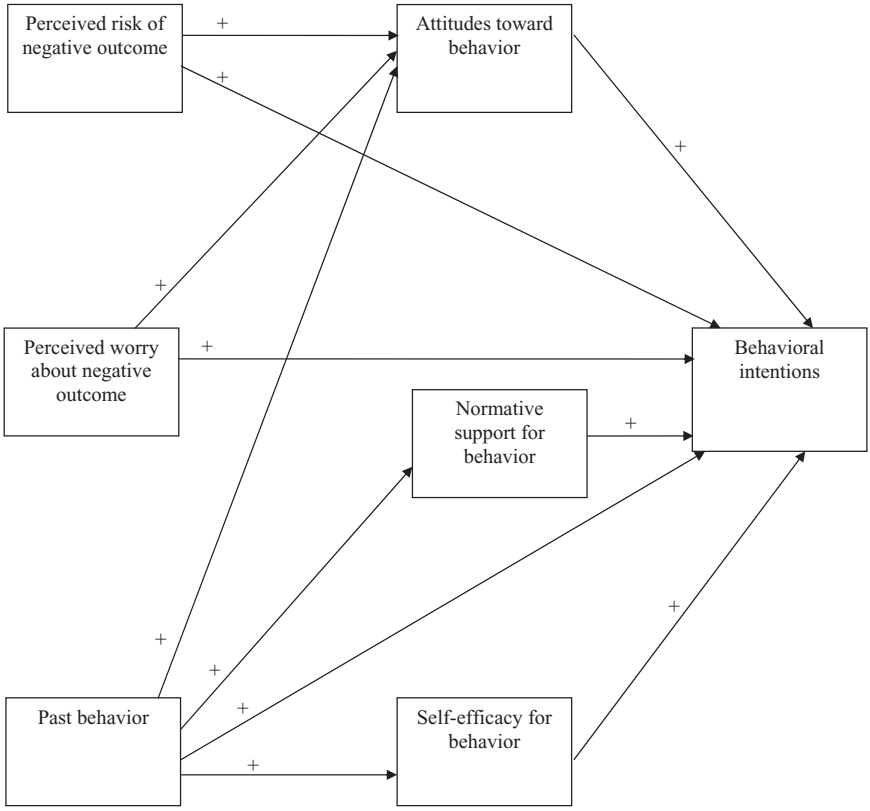

Figure 1. Hypothesized structure of model relationships. Paths from worry and risk to self-efficacy and norms were still tested in both samples, but were considered exploratory.

There simply has not been as much research examining links from risk perceptions and worry to norms and self-efficacy. As noted by Cameron and Reeve (2006),

> considerable research has examined the roles of perceived risk and illness worry in decisions to engage in health-related behaviors, with particular attention to their motivational influences on protective actions. Yet, little is known about how risk perceptions and worry influence the processing of information and formation of attitudes about health behaviors. (pp. 211–212)

In one of the present contexts (i.e., studying), an individual with higher perceived risk of poor grades could assume via false consensus that others

have similarly poor study habits to their own (descriptive norms) and hold biased beliefs about the importance that others place on studying (injunctive norms). Similarly, individuals who believe they are at risk for failure might be subject to an experience of learned helplessness that would subvert their feelings of self-efficacy for changing the situation. Therefore, we will still test (and attempt to replicate) paths from worry and risk to all TPB variables for completeness, but we acknowledge that the paths from risk and worry to norms and self-efficacy are of a more exploratory nature than those from risk perceptions and worry to attitudes and intentions.

The main effect of past behavior and its interactions with worry and risk will be included as an exogenous predictor of TPB constructs. It is unclear whether past behavior will significantly interact with risk perceptions and worry, but main effects of risk and worry on intentions and the other TPB constructs can be interpreted in light of these interactions. We hypothesize the same model structure across the health and non-health contexts (cf. Armitage & Conner, 2001), but we explore whether the strength of these relationships is similar, and whether the proposed mediational relationships hold across contexts.[2]

Method

Participants

Participants in the original sample (i.e., Sample 1) were 191 undergraduate students (113 female, 59.2%; 78 male) aged 18 to 36 years ($M = 19.2$ years, $SD = 1.9$) who were recruited through introductory psychology classes at the University of Colorado at Boulder.[3] Approximately 87% of

[2]Much of the prior research on the construct of worry, specifically, has been in the context of breast cancer, and thus has been limited to females, making it unclear whether worry will function similarly across gender. There were no a priori reasons to believe that the hypothesized model might perform differently across demographic groups, considering that prior studies of the TPB have shown that the theory holds across cultures and groups (e.g., Fishbein, 2000). The consistency of the proposed model across individual-difference dimensions was explored during analyses. Although mean differences in several constructs were observed across gender (notably, attitudes toward flossing, intention to floss, past flossing behavior, and risk perceptions in the context of flossing; as well as worry about grade point average in the studying model), it is of importance that model relationships did not differ by participant sex. Thus, the role of gender will not be discussed further.

[3]Some of the data from Sample 1 in this paper are being used in a separate paper that is currently under review (Schmiege, Klein, & Bryan, 2008). The goal of that paper is different from the present paper, in that we examined behavior 3 months following an experimental manipulation of comparative feedback (presented alone or with objective feedback) across the health and non-health contexts. The Sample 1 data presented here are used in that paper only as pretest covariates of scores prior to the experimental manipulation.

participants were Caucasian, 5% were Hispanic, 3% were African American, less than 1% were Native American, less than 1% were Asian, and 4% were mixed/other. Approximately 60% of participants were freshmen, 32% were sophomores, 5% were juniors, and 2% were seniors.

Participants in the replication sample (i.e., Sample 2) were 309 undergraduate students (181 female, 58.6%; 128 male) aged 17 to 29 years ($M = 18.9$ years, $SD = 1.5$) who were also recruited through introductory psychology classes at the University of Colorado at Boulder. Approximately 84% of participants were Caucasian, 6% were Hispanic, 1% were African American, less than 1% were Native American, 6% were Asian, and 3% were mixed/other. Sixty-three percent of participants were freshmen, 25% were sophomores, 7% were juniors, and 5% were seniors.

Procedure

An institutional review board approved the procedures for both studies. Sample 1 participants were run in small groups in our laboratory, where they completed measures on a computer; whereas Sample 2 participants completed measures online. Participants in each sample completed a questionnaire addressing the following areas: (a) psychosocial correlates of flossing, studying, or both; (b) intention measures for flossing, studying, or both; (c) average flossing behavior, studying behavior, or both in the 3 months prior to the study; and (d) demographic variables. For Sample 1, all 191 participants responded to the questions about flossing and studying. However, for Sample 2, participants were randomly assigned to complete the flossing questionnaire ($n = 142$) or the studying questionnaire ($n = 167$).

Measures

All psychosocial variables were measured on 7-point Likert-type scales ranging from 1 to 7. Scales were constructed by calculating the mean of all the items comprising a scale. All scales were found to comprise a unitary trait (i.e., the items of each scale held together well) in both samples. In the text that follows, Cronbach's alphas are provided before the slash for Sample 1, and after the slash for Sample 2. All alphas were .71 or greater across scales and samples.

Psychosocial variables pertaining to flossing include *perceived risk* of negative outcomes (e.g., gum disease, gingivitis, tooth extractions) associated with poor oral health (5 items; $\alpha = .80/.80$; e.g., "What is the chance that you will develop gum disease sometime in your life?"; "What is the chance that

you will have teeth extracted (pulled) sometime in your life?"); *worry* about risk for gum disease (3 items; $\alpha = .79/.78$; e.g., "How worried are you about your current level of risk for gum disease?"; "How disturbed are you with your current level of risk for gum disease?"); *attitudes* toward flossing (8 items; $\alpha = .89/.92$; e.g., "I think it is very important for people to floss their teeth regularly"; "Flossing regularly would be *good/bad*, *very unpleasant/very pleasant*"); *social norms* pertaining to flossing (8 items; $\alpha = .71/.78$; e.g., "Most of my friends floss their teeth regularly"; "Most people who are important to me think that I should floss my teeth regularly"); and *self-efficacy* for flossing (8 items; $\alpha = .89/.90$; e.g., "I feel confident that I could make flossing a part of my regular routine"; "I feel confident that I know how to floss correctly"). Four items assessed *intentions to floss* over the span of the subsequent 3 months ($\alpha = .89/.93$; e.g., "How likely is it that you will floss regularly in the next 3 months?"; "How likely is it that you will buy dental floss in the next 3 months?").

Psychosocial variables pertaining to studying paralleled the items for flossing and include *perceived risk* of negative outcomes (e.g., bad grades, limited career opportunities) associated with lack of studying/poor study habits (5 items; $\alpha = .76/73$; e.g., "What is the chance that poor grades will keep you from obtaining the career you want after college?"; "What is the chance that you will get a bad grade on a test due to lack of studying?"); *worry* about grade point average (GPA; 3 items; $\alpha = .82/.74$; e.g., "How worried are you about your GPA?"; "How satisfied are you with your GPA?" [reverse-scored]); *attitudes* toward studying and toward outcomes related to studying, such as grades and performance in college (8 items; $\alpha = .85/.88$; e.g., "I think it is very important for people to have good study habits"; "For me, studying every day would be *very bad/very good*, *very unpleasant/very pleasant*"); *social norms* pertaining to studying (8 items; $\alpha = .79/.82$; e.g., "Most of my friends study every day"; "Most college students think it's important to study every day"); and *self-efficacy* for studying (8 items; $\alpha = .80/.84$; e.g., "I feel confident that I could make studying a part of my regular routine"; "I feel confident that I know how to study correctly"). In addition, five items assessed *intentions to study* over the span of the subsequent 3 months ($\alpha = .62/.64$; e.g., "How likely is it that you will study every day in the next 3 months?"; "How likely is it that you will study regularly instead of going out with your friends/significant other in the next 3 months?").

Past behavior, measured contemporaneously with the psychosocial constructs, assessed average behavior per week in the 3-month period before the study. Participants were asked to estimate average behavior in terms of the prior 3 months as a way to minimize estimation bias from variability that might occur as a result of atypical weeks (e.g., high studying behavior during midterms). Flossing behavior was measured by asking how many times per

week participants flossed their teeth, on average, in the past 3 months on a scale ranging from 0 to 14 times (in increments of 1). Studying behavior was measured with a parallel item that assessed the average number of hours per week participants studied in the prior 3 months.

Results

Correlations Among Constructs

Correlations among the flossing-related psychosocial constructs and scale means and standard deviations are presented in Table 1. Correlations for Sample 1 participants are shown above the diagonal, while correlations for Sample 2 participants are shown below the diagonal.

Relationships among the constructs were overwhelmingly similar across the two samples. The core TPB appeared to be supported, based on zero-order correlations, with positive correlations observed among attitudes, social norms, self-efficacy, and intentions; and, as expected, positive correlations between all TPB constructs and past behavior. Worry and risk were strongly correlated with each other, and risk perceptions were negatively correlated with attitudes, self-efficacy, and intentions; while worry was negatively related to self-efficacy. Risk (and, to a lesser degree, worry) was negatively correlated with past behavior, however, reflecting lower risk perceptions among those already engaging in the behavior.

Correlations among the studying-related psychosocial constructs and scale means are presented in Table 2, with correlations for Sample 1 participants shown above the diagonal and those for Sample 2 participants shown below the diagonal. As with flossing, there was support for relationships among the TPB across samples, with positive correlations observed among attitudes, social norms, self-efficacy, and intentions; and between past behavior and the TPB constructs. Although worry and risk were again highly correlated, differences emerged in how each related to other model constructs. Risk was negatively correlated with self-efficacy and intentions. Worry was not correlated with level of past behavior, however, and instead showed positive correlations with attitudes and norms, at least for those in Sample 2.

Model Estimation

Models were estimated separately for flossing and studying using Mplus Version 4.1 (Muthén & Muthén, 2005). Rather than estimate separate models

Table 1

Correlations Among Flossing-Related Variables

	Sample 1		Sample 2								
Variable	*M*	*SD*	*M*	*SD*	1	2	3	4	5	6	7
1. Risk perception	2.70	1.16	3.70	1.05	—	.61***	−.30***	−.04	−.30***	−.27***	−.18**
2. Worry about gum disease	2.53	1.15	2.90	1.23	.56***	—	−.13†	−.08	−.26***	−.12†	−.17
3. Attitudes toward flossing	5.78	0.95	5.90	1.10	−.19*	.07	—	.39***	.47***	.57***	.41***
4. Norms for flossing	4.24	0.79	4.39	0.89	−.15†	.06	.47***	—	.28***	.38***	.24***
5. Self-efficacy for flossing	4.70	1.28	4.43	1.46	−.35***	−.26**	.47***	.35***	—	.62***	.45***
6. Intention to floss	4.06	1.82	4.33	1.96	−.29***	−.09	.50***	.42***	.70***	—	.66***
7. Past flossing behavior	2.55	2.84	3.61	3.75	−.28***	−.15†	.28***	.39***	.58***	.61***	—

Note. Correlations for Sample 1 ($n = 191$) appear above the diagonal; correlations for Sample 2 ($n = 142$) appear below the diagonal.
†$p < .10$. *$p < .05$. **$p < .01$. ***$p < .001$.

Table 2

Correlations Among Studying-Related Variables

	Sample 1		Sample 2								
Variable	*M*	*SD*	*M*	*SD*	1	2	3	4	5	6	7
1. Risk perception	4.04	1.23	4.05	1.17	—	.55***	−.02	.07	−.34***	−.17*	−.17*
2. Worry about GPA	3.33	1.34	3.91	1.25	.49***	—	.02	.11	−.15*	.08	.11
3. Attitudes toward studying	5.59	0.97	5.81	0.93	.09	.28***	—	.49***	.37***	.36***	.23***
4. Norms for studying	4.16	1.07	4.47	0.95	.16*	.28***	.43***	—	.32***	.24***	.20**
5. Self-efficacy for studying	4.43	1.08	4.43	1.12	−.32***	−.14†	.33***	.26***	—	.55***	.43***
6. Intention to study	4.63	1.12	4.68	1.03	−.22**	.06	.26***	.32***	.45***	—	.52***
7. Past studying behavior	9.84	6.88	10.90	7.27	−.15*	.05	.25***	.25***	.27***	.43***	—

Note. Correlations for Sample 1 ($n = 191$) appear above the diagonal; correlations for Sample 2 ($n = 167$) appear below the diagonal.
†$p < .10$. *$p < .05$. **$p < .01$. ***$p < .001$.

for Sample 1 and Sample 2 to test for model replicability, a multiple group (or stacked) model was specified for each behavior in which the model parameters were simultaneously estimated for Samples 1 and 2. In the first model estimated (for both flossing and studying separately), all paths were constrained to be equal across samples in order to arrive at a baseline model as a point of comparison for later models in which paths were allowed to differ across the two samples. The equality constraints on corresponding paths across Samples 1 and 2 were then relaxed one by one to determine whether each path relationship was identical across samples. Change in model fit between the fully constrained, baseline model and each model with a single freed path was assessed with chi-square difference tests, in which a significant chi-square value indicated that the specific model parameter should be allowed to differ by sample and that the given path did not replicate.

There are two paths that significantly differed across samples in the flossing model, and two paths were significantly different in the studying model. Differences among samples are represented in Figures 2 and 3 by path coefficients that are presented in boldface and by a heavier line demonstrating the path. Furthermore, two coefficients are presented for such paths, with path coefficients for Sample 1 depicted before the slash, and coefficients for Sample 2 depicted after the slash. Although it was the unstandardized coefficients that were constrained to equality across groups (Bollen, 1989), standardized coefficients are presented for ease of interpretation. For all path coefficients that were not significantly different across samples, the average of the standardized coefficients for the two groups is presented.

Model predicting intention to floss. The model predicting intention to floss is depicted in Figure 2. Nonsignificant paths are not depicted (but were still estimated) for ease of presentation. Overall model fit was good: $\chi^2(37, N = 190, \text{Sample 1}; N = 142, \text{Sample 2}) = 44.47$, *ns*; (comparative fit index [CFI] = .99; root mean square error of approximation [RMSEA] = .04 with 90% confidence intervals [CIs] = .00 to .07; standardized root mean square residual [SRMR] = .05. The core TPB relationships were supported such that attitudes, norms, and self-efficacy all positively predicted intentions.

Worry positively predicted attitudes and intentions, but both of these effects were qualified by a significant interaction between worry and past behavior, suggesting that the effects of worry on intentions and on attitudes are conditioned by levels of past behavior. These interactions were interpreted in supplemental regression analyses by examining the main effect of worry on intentions and then on attitudes at 1 *SD* below the flossing mean, 1 *SD* above the flossing mean, and at the flossing mean (Aiken & West, 1991). All predictor variables were mean-centered prior to their inclusion in the regression equation. The pattern of the interaction suggests a positive

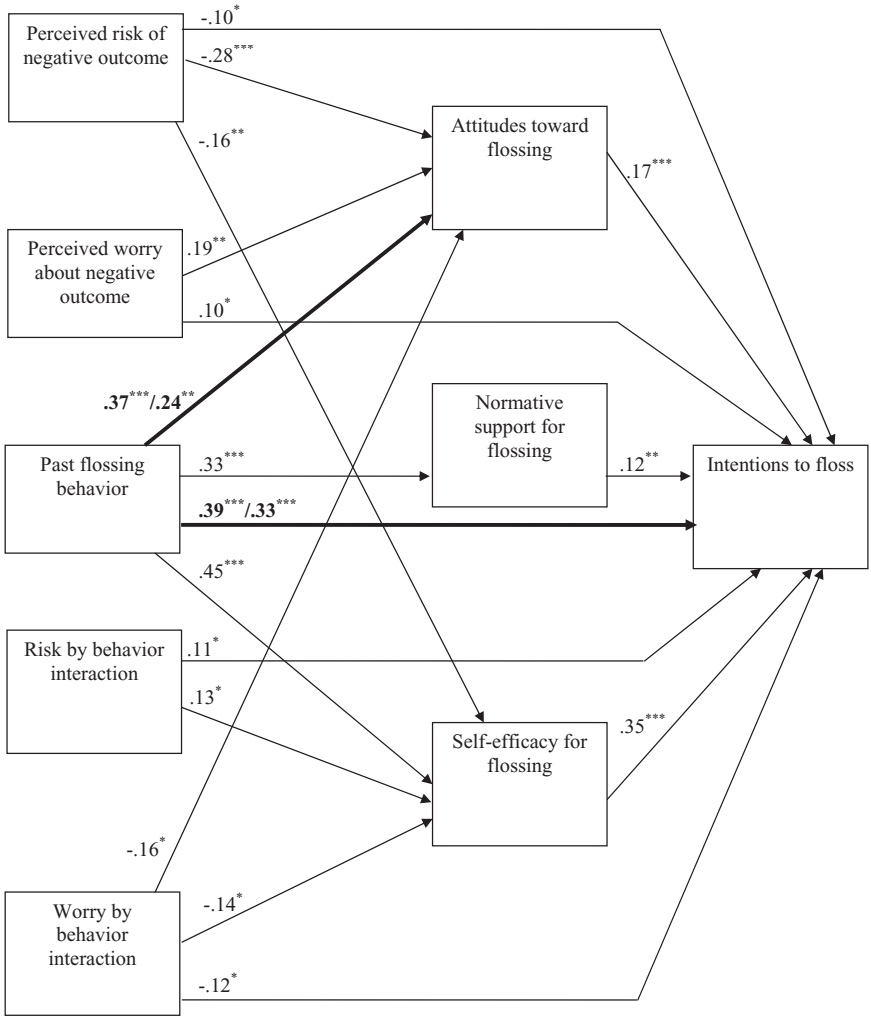

Figure 2. Model predicting intentions to floss using a combination of theory of planned behavior predictors with worry, perceived risk, and past behavior. Model fit: $\chi^2(37, N = 190$, Sample 1; $N = 142$, Sample 2) = 44.47, *ns*; CFI = .99; RMSEA = .04; 90% confidence interval = .00–.07; SRMR = .05. Significance of path coefficients: $^{+}p < .10$; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$. Model paths that did not replicate across samples are denoted by a heavier line and the presence of two path coefficients with the Sample 1 coefficient before the slash and the Sample 2 coefficient after the slash.

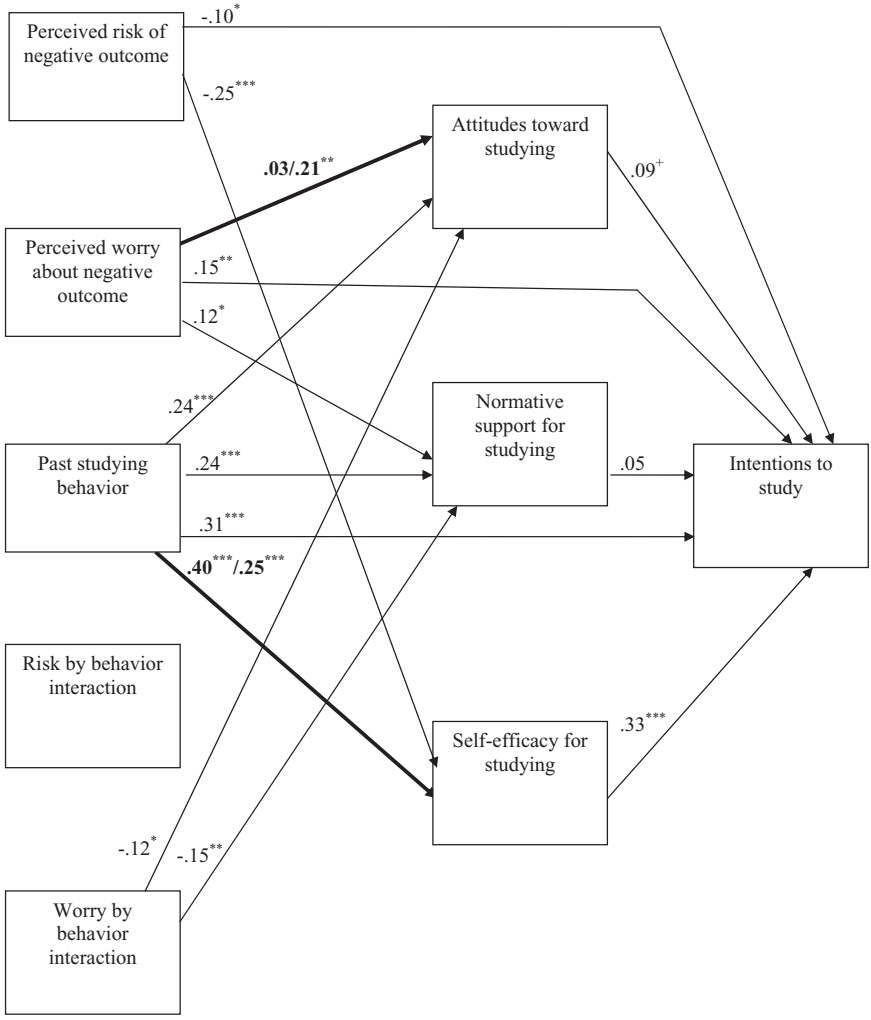

Figure 3. Model predicting intentions to study using a combination of theory of planned behavior predictors with worry, perceived risk, and past behavior. Model fit: $\chi^2(37, N = 191$, Sample 1; $N = 160$, Sample 2) = 47.36, *ns*; CFI = .98; RMSEA = .04; 90% confidence interval = .00–.07; SRMR = .05. Significance of path coefficients: $^{+}p < .10$; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$. Model paths that did not replicate across samples are denoted by a heavier line and the presence of two path coefficients with the Sample 1 coefficient before the slash and the Sample 2 coefficient after the slash.

relationship of worry to attitudes and to intentions for those with the lowest prior flossing behavior, but weak or no relationships for those at average or high levels of flossing behavior.

Perceived risk was negatively related to attitudes, self-efficacy, and intentions, indicating that higher perceptions of risk were associated with less favorable attitudes toward, lower self-efficacy for, and lower intentions to floss. These findings may best be interpreted in light of the role of past behavior, and the main effects of risk perceptions were qualified by significant risk by past behavior interactions on self-efficacy and intentions and a marginally significant ($p < .10$) interaction on attitudes. These interactions were again interpreted in supplemental regression analyses. Risk negatively predicted self-efficacy and intentions, except for those at the highest levels of pre-test behavior, where the effect of risk was nonsignificant.

A main purpose of measuring past behavior was to consider the effects of worry and risk in light of levels of previous behavior. However, in addition to its role through several interactions with risk perceptions and worry, past behavior was positively associated with attitudes, normative support, self-efficacy, and intentions. The finding that several variables accounted for variance in intentions over and above past behavior provides an indication that it is not merely force of habit driving the prediction of intentions.

To summarize, there is evidence that the integration of worry, risk, and past behavior in the model increased the proportion of variance accounted for in intentions beyond that accounted for by the TPB constructs. Attitudes, norms, and self-efficacy alone accounted for 51% of the variance in intentions across samples. These values increased to 63% and 62% for Samples 1 and 2, respectively, with the inclusion of worry, risk, and past behavior. Furthermore, worry and risk accounted for 8%, 1%, and 11% of the variance in attitudes, norms, and self-efficacy, respectively, across samples. With the inclusion of past behavior, these values increased to 22%, 8%, and 27%, respectively, for Sample 1; and to 16%, 14%, and 27%, respectively, for Sample 2.

Model predicting intention to study. The model predicting intention to study is depicted in Figure 3. Again, for ease of presentation, nonsignificant paths are not depicted, but were still estimated. Overall model fit was good: $\chi^2(37, \text{Sample 1}, N = 191; \text{Sample 2}, N = 160) = 47.36$, *ns*; CFI = .98; RMSEA = .04, 90% CI = .00–.07, SRMR = .05. There were a number of similarities to the flossing model, although several key differences emerged. There was less support here for the core TPB relationships such that self-efficacy was the only significant predictor of intention. The path from attitudes to intention only reached marginal levels of significance ($\beta = .09$, $p = .06$), and norms did not significantly predict intention. These patterns did not differ across samples.

Similar to the flossing model, worry positively predicted behavioral intentions, and worry positively predicted attitudes, but only for those in Sample 2. In contrast to the flossing model, worry also positively predicted social norms, an effect that was consistent across samples. The significant effects on attitudes and norms (but not on intentions) were qualified by a significant interaction between worry and past behavior, again providing evidence that these effects are conditioned by levels of past behavior. Supplemental regression analyses demonstrated that worry positively predicts norms and attitudes for those average and low on prior studying behavior, but that the effect of worry was nonsignificant for those already studying at high levels.

Perceived risk was negatively related to self-efficacy and intentions, but did not relate to attitudes (as it did in the flossing model) or to normative support. Interestingly, neither of these effects was qualified by a significant interaction with past behavior, suggesting that the negative relationships hold, regardless of one's level of prior behavior.

As can be seen in the model, past behavior was positively associated with attitudes, normative support, self-efficacy, and intentions. Consistent with the model for flossing, the finding that several variables account for variance in intentions over and above past behavior provides an indication that it is not merely habit driving the prediction of intentions.

There is evidence here, as well, that the inclusion of worry, risk, and past behavior increased the proportion of variance accounted for in intentions beyond that accounted for by the TPB constructs. Attitudes, norms, and self-efficacy alone accounted for 28% of the variance in intentions across samples. These values increased to 39% and 34% for Samples 1 and 2, respectively, with the inclusion of worry, risk, and past behavior. Furthermore, worry and risk accounted for 0.4%, 3%, and 11% of the variance in attitudes, norms, and self-efficacy, respectively, for Sample 1; and 6%, 3%, and 11%, respectively, for Sample 2. With the inclusion of past behavior, these values increased to 7%, 9%, and 25%, respectively, for Sample 1; and to 14%, 12%, and 17%, respectively, for Sample 2.

Discussion

The present study was an attempt to integrate risk perceptions and worry about negative outcomes into the broader theory of planned behavior across two domains of behavior. The proposed model was estimated in two independent samples of participants, and the results were overwhelmingly consistent across samples. Although this is not surprising because both samples came from the same population of introductory psychology students from the same university, this consistency does lend greater confidence to observed model relationships.

The proposed model was partially supported, although the pattern of results differed somewhat across the health and non-health domains. There was strong support for the core TPB within the health context such that more favorable attitudes, higher self-efficacy, and greater normative support for flossing were all associated with increased behavioral intentions. Within the non-health context, greater self-efficacy for studying exerted the greatest influence on intention to study. Attitudes toward and norms for studying did not predict intentions over and above the strong effects of self-efficacy. There were also powerful direct and moderated effects of past behavior on intentions. Although this effect alone was not surprising, it makes the significant effects of the TPB constructs on intentions even more compelling because they were occurring over and above past behavior.

Inclusion of past behavior in the model also sheds light on findings related to perceived risk and worry. Higher levels of worry were associated with more positive behavioral intentions and attitudes across both the health and non-health domains (and norms within the non-health domain), although supplementary analyses suggest that this relationship tended to occur for those at low or average levels of prior behavior. Greater perceptions of risk were associated with lower attitudes to floss, as well as with weaker intentions and lower self-efficacy across both the flossing and studying models. Again, these results should be viewed in light of past behavior such that the relationships were strongest for those at the lowest levels of prior behavior. Our data suggest that worry and risk were most influential for those not already engaging in high levels of the behavior; and this pattern of findings may clarify previous discrepancies in the literature regarding the role of worry and risk.

The observed negative relationships of risk perceptions with intentions, attitudes and self-efficacy, though consistent with other research (Cameron & Reeve, 2006; Klein, Geaghan, & MacDonald, 2007), do not necessarily imply that greater risk perceptions resulted in decreased behavioral intentions. There are two perspectives that have emerged with regard to the function of risk, termed the *motivational hypothesis* and the *accuracy hypothesis* (Brewer et al., 2004; Gerrard et al., 1996; Weinstein & Nicolich, 1993). The motivational perspective is reflected by a positive relationship between risk and behavior, whereby greater perceptions of risk facilitate behavioral promotion. The accuracy hypothesis is reflected by a negative relationship between risk and behavior and is based on the notion that higher levels of action result in reduced risk perceptions (i.e., risk could be considered an outcome, rather than a determinant of attitudes, norms, self-efficacy, and intentions/behavior). The cross-sectional nature of the present study design prevents the opportunity to disentangle these hypotheses, although the negative relationship between past behavior and risk perceptions can certainly be explained by

the accuracy hypothesis. Experimental paradigms manipulating perceived risk with regard to a novel health and a non-health-related threat would be informative in this regard to truly understand the influence of risk on model constructs and on behavior.

Overall, the findings provide support for integrating worry as a potential determinant of behavioral intentions, whereas they provide relatively less support for integrating perceived risk as a motivator of behavior. This is supported by several other empirical articles, such as Cameron and Reeve (2006) and Cameron and Diefenbach (2001), who observed greater effects for worry than risk on beliefs about and interest in genetic testing for breast cancer. Peters, Slovic, Hibbard, and Tusler (2006) found that worry about medical errors was a better predictor of intentions to take precautionary actions than were risk perceptions. One possible explanation for the relative support of worry over risk in these models may relate to the idea that risk is a cognitive variable, whereas worry has been characterized as an affective variable. Richard et al. (1996) noted that "at least for some behaviors, the predictive ability of the TPB may be enhanced if affective factors are incorporated in the model" (p. 113). The recent interest in affect as a predictor of health behavior and decision making (cf. Chapman & Coups, 2006; Loewenstein et al., 2001; Slovic et al., 2005) and the general lack of affective variables in models of health behavior (McCaul & Mullens, 2003) may speak to the unique contribution of worry to the present integrative model.

This does not mean, however, that worry is the only affective variable of importance or that worry will always be a more influential factor than risk. Cameron and Reeve (2006) hypothesized that there may be a differential impact of worry and risk when the effectiveness of an action is unknown such that risk appraisals will be associated only weakly with use of that action, whereas worry may motivate its use because of hopes that it may provide some protection. This line of reasoning could certainly explain the effects of worry over risk as a motivator of behavior in the context of flossing because the distal nature of outcomes associated with lack of flossing leaves some uncertainty about the effectiveness of the behavior to protect against later outcomes. Although previous research has examined motivation to act under variable situations of outcome certainty (Roberts, 2000), we were unable to find any studies that include the role of worry in examining the effect of outcome certainty. Future studies that assess the role of worry and risk when level of outcome certainty is varied experimentally may contribute to an understanding of potential differential effects of worry and risk in this regard.

Another possibility is that the effectiveness of worry in predicting behavioral intentions might be linked with the degree of emotion associated with the outcome (i.e., worry will be most influential for behaviors that are more emotionally laden). This is consistent with the notion that worry is an

affective response to a threat (Sjöberg, 1998). Future studies would need to explicitly test the emotional content of the behaviors at focus in order to examine the role of worry as a function of the level of emotion associated with the behavior.

Related to level of emotion is variability among behaviors with regard to approach versus avoidance orientations.[4] Some protective behaviors might be undertaken simply to avoid a potentially negative outcome, whereas there might be greater heterogeneity underlying motivations behind other behaviors. Worry motivates efforts to avoid harm, and the worry–intentions relationship may not be as readily observed with more approach-oriented goals. These speculations underscore the importance of determining moderators of these effects to uncover situations in which worry may more effectively promote a positive behavior, as well as ones in which risk may be more influential, and we view this as an exciting direction for future research.

Flossing and studying were not necessarily of interest in and of themselves, but were selected as exemplars of health and non-health behaviors. The choice of these two behaviors as exemplars may have influenced observed patterns of results across the domains. In addition to representing the health versus non-health domains, there might have been aspects of the two behaviors that differed in systematic ways (indeed, outcome certainty as a difference has already been given as one example). Caution should be taken in generalizing the findings of the present study to health versus non-health behaviors at a more general level. Furthermore, it will be important for future studies to match the health versus non-health behaviors on several dimensions (e.g., outcome certainty, emotionality of outcome, degree to which the outcome in question facilitates approach vs. avoidance orientations) to assess better whether it is the health versus non-health domains, per se, or if there are certain broader conditions of a behavior that explain the observed patterns of results.

The cross-sectional nature of the data is also a limitation. It was certainly logical to place intentions at the end of the model as an assessment of potential future actions and to place behavior at the beginning as an assessment of actions in the 3 months prior to the study. However, even though the placement of worry and risk as precursors to attitudes, norms, and self-efficacy was driven by theory and the model was replicated in a second sample of participants, other plausible models certainly exist.

Another limitation is that it would have been ideal to examine the role of past behavior on later behavior, instead of simply on behavioral intentions. However, we do observe high correlations of past behavior with intentions, and in the absence of any experimental manipulation or life-changing event,

[4]We thank an anonymous reviewer for this explanation.

one could reasonably expect consistency in behavior over time, as well as consistency in a link between intentions and later behavior.

The models developed in the present study contribute to an understanding of the potential of an integrated-models approach and offer one possible extension beyond the core theory of planned behavior. Worry and risk explained unique variance in intentions beyond that explained by the TPB constructs; and, more importantly, variance in the TPB constructs (particularly attitudes and self-efficacy) was explained by worry and risk. An implication of the latter is that some level of perceived worry or risk may be a necessary condition for intervening on the standard TPB variables. Although they were correlated with each other, worry and risk tended to be differentially related to the TPB constructs, and these distinctions have the potential to inform further theory development, as well as the design of behavioral interventions.

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