

The Theory of Planned Behavior and Healthy Eating

Mark Conner
University of Leeds

Paul Norman
University of Sheffield

Russell Bell
University of Manchester

Application of the theory of planned behavior (TPB) to healthy eating in 144 health promotion clinic attendees is reported. Respondents completed self-report TPB measures after the clinic (Time 1) and 6 months later (Time 2) with a measure of perceived past behavior. Intention stability was assessed on Time 1–2 differences. Six years later (Time 3), respondents completed measures of healthy eating intentions and behavior. Intentions were predicted by attitudes, perceived behavioral control, and perceived past behavior (cross-sectionally). Healthy eating behavior (Time 3) was predicted from intentions (Time 2). As intention stability increased, intentions and perceived past behavior became stronger and weaker predictors of behavior, respectively. Implications for understanding health cognitions in long-term performance of health behavior are discussed.

Key words: theory of planned behavior, health behavior, health cognitions, healthy eating

This research examined the power of the theory of planned behavior (TPB) to predict long-term healthy eating intentions and behavior. In recent years, increasing evidence has suggested a link between various aspects of diet and life-threatening diseases such as cardiovascular disease (CVD; Van Horn & Kavey, 1997) and cancer (Wong & Lam, 1999). The relationship between such diseases and various aspects of diet is complex. Nevertheless, three aspects of diet have been particularly implicated in healthy eating: total fat and saturated fat in the diet, dietary fiber, and fruit and vegetable consumption (see Kumanyika et al., 2000). Evidence has also been reported that these aspects of diet have become incorporated into the general public's conceptions of what constitutes healthy eating (Povey, Conner, Sparks, James, & Shepherd, 1998).

The evidence relating dietary fat to health is well established and has been incorporated into consensus recommendations in the United States (e.g., American Cancer Society Advisory Committee on Diet, Nutrition, and Cancer Prevention [ACS], 1996; U.S. Department of Agriculture/U.S. Department of Health and Human Services [USDA/USDHHS], 1995) to consume no more than 30% of daily energy from fat (and less than 10% of calories from saturated fat) to reduce the risk of CVD and cancer. Similar recommendations have been produced in the United Kingdom

(e.g., Committee on Medical Aspects of Diet, 1991). Research has also indicated the health benefits of increased dietary fiber consumption on lipid and glucose metabolism and in preventing colon cancer (Anderson, Smith, & Gustafson, 1994; Brown, Rosner, Willett, & Sacks, 1999; Wolk et al., 1999). Again, this has been translated into recommendations (e.g., ACS, 1996; Krauss et al., 1996) to increase dietary fiber consumption (to 20–30 g/day). Finally, epidemiological evidence indicates that increased levels of fruit and vegetable consumption are protective against cancer and CVD (Appel et al., 1997; Deckelbaum et al., 1999; Giovannucci, & Willett, 1994; Ness & Powles, 1997). Recommendations (e.g., USDA/USDHHS, 1995) have focused on increasing the portions of fruit and vegetables consumed to at least five per day (e.g., the 5 A Day campaign; Heimendinger, Van Duyn, Chapelsky, Foerster, & Stables, 1996).

Despite widespread acceptance of these recommendations, relatively few studies have examined the determinants of these components of healthy eating and, in particular, the factors influencing performance over prolonged periods (which is presumably necessary for health benefits to accrue). One of the models frequently used by health psychologists to examine such influences on behavior is the TPB (Ajzen, 1988, 1991). In the study that follows, the TPB is used as a theoretical framework to predict people's intentions to eat a healthy diet and subsequent healthy eating behavior. *Healthy eating* is defined in relation to current dietary recommendations as being a diet low in fat, high in fiber, and high in fruit and vegetable consumption.

The TPB describes the proximal influences on a person's decision to engage in a behavior and is an extension of the theory of reasoned action (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975). In the TPB, behavior is determined by intentions to engage in that behavior and by perceived behavioral control (PBC). Intentions tap a person's decision to exert effort to perform the

Mark Conner, School of Psychology, University of Leeds, Leeds, England; Paul Norman, Department of Psychology, University of Sheffield, Sheffield, England; Russell Bell, Department of General Practice, University of Manchester, Manchester, England.

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Correspondence concerning this article should be addressed to Mark Conner, School of Psychology, University of Leeds, Leeds LS2 9JT, England. E-mail: mc@psychology.leeds.ac.uk

behavior. PBC is the perception of the extent to which performance of the behavior is within one's control or is easy–difficult and is similar to Bandura's (1986) concept of self-efficacy. Intentions are determined by attitudes, subjective norms, and PBC. Attitudes represent the overall evaluation of the behavior. Subjective norms represent perceived pressure from significant others to perform the behavior. Meta-analytic reviews of the TPB provide strong support for the TPB in terms of the percentage of variance explained in behavior and intentions (see Armitage & Conner, 2001b; Godin & Kok, 1996). For example, Armitage and Conner (2001b) reported that attitude, subjective norms, and PBC accounted for a frequency weighted average of 39% of the variance in intention across 154 applications, whereas intentions and PBC accounted for 27% of the variance in behavior across 63 applications.

The TPB has been applied to a number of food-related behaviors, including reduction in fat intake (e.g., Paisley & Sparks, 1998), health-related eating behaviors (Ajzen & Timko, 1986), and healthy eating (Povey, Conner, Sparks, James & Shepherd, 1999). However, the majority of these studies have examined intentions rather than behavior (for a review, see Godin & Kok, 1996) and have been cross-sectional in design (e.g., Ajzen & Timko, 1986). Even the few prospective studies available (e.g., Povey et al., 1999) tend to use short-term follow-ups (e.g., less than 1 month). In contrast, it is the long-term performance of behaviors such as healthy eating that are associated with major health benefits. Hence, studies examining the power of the TPB to predict long-term performance of health-related eating are required. In addition, relatively few studies have tested the power of the TPB to predict intentions prospectively (but see Armitage & Conner, 1999), which would support the proposed causal ordering of TPB variables.

The TPB has been held to be a sufficient model of behavior in that other influences are assumed to be mediated through components of the TPB (Ajzen, 1991). However, several studies have demonstrated an impact of additional variables on behavior, even after the TPB variables have been taken into account (for a review, see Conner & Armitage, 1998). Although several such variables have been examined, the strongest evidence is associated with the role of past behavior. It has been suggested that many behaviors are determined by past behavior rather than by cognitions such as those described in the TPB (Sutton, 1994). This argument was based on the results of a number of studies showing past behavior to be the best predictor of future behavior (e.g., Conner, Warren, Close & Sparks, 1999; Godin, Valois, & Lepage, 1993). In relation to healthy eating, one might expect past behavior to be a particularly strong determinant of future behavior because of the habitual nature of much eating behavior (Kumanyika et al., 2000; Verplanken & Faes, 1999).

Nevertheless, establishing the role of past behavior within the TPB is not without methodological problems. As Ajzen (1991) argued, one reason that past behavior might predict future behavior over and above components of the TPB is that the two behavior measures possess common method variance not shared by other variables in the TPB. Conner et al. (1999) demonstrated that one way to circumvent this problem is to use different measures of past and future behavior. The research reported here adopted this approach by using a self-estimate of healthy eating as the measure of past behavior (i.e., perceived past behavior) and a future behavior

measure based on responses to a validated food frequency questionnaire. This allowed us to estimate the impact of past behavior on future behavior uncontaminated by common method variance effects.

The present research also examined the moderating role of the temporal stability of intentions in the TPB. As Ajzen (1996) argued, "To obtain accurate prediction of behavior, intentions . . . must remain reasonably stable over time until the behavior is performed" (p. 389). Intentions measured prior to performance of a behavior may change as a result of new information or unforeseen obstacles and therefore result in reduced predictive power. Temporal stability may be particularly important when predicting long-term performance of a behavior because, presumably, new information and obstacles are more likely to be encountered over time. The moderating role of temporal stability has been addressed in two recent studies, as outlined below. (For earlier studies, see also Bagozzi & Yi, 1989; Doll & Ajzen, 1992.)

Sheeran, Orbell, and Trafimow (1999) demonstrated that when intentions are stable, intentions are more predictive, whereas past behavior is less predictive of subsequent behavior (e.g., studying over the winter vacation). Conner, Sheeran, Norman, and Armitage (2000) demonstrated intention stability moderation effects for both attending a health screening and eating a low-fat diet over a 3-month period. In both cases, intentions were stronger predictors of behavior when intentions were stable. The impact of past behavior was moderated by intention stability in one study and by PBC stability in the other study. The direction of effect was the same in both cases: Greater stability resulted in weaker past behavior–behavior relationships. This finding is important because it implies that stable intentions are capable of overcoming one's past behavioral tendencies. Nevertheless, these moderating effects of stability were only demonstrated over relatively short periods of time. The present research examined the moderating effect of intentions stable over a prolonged period of time (6 months) in predicting behavior 6 years later. It is important to look at these longer time periods with behaviors such as healthy eating because long-term performance of the behavior is necessary for health benefits to accrue.

To summarize, the TPB (in a configuration including attitude, subjective norm, PBC, and intentions) was applied to the prediction of healthy eating intentions and healthy eating behavior over a prolonged time period (6 years). The additional variable of perceived past behavior and the moderating role of intention stability were also examined. We predicted that intention stability would moderate both the relationship between intentions and behavior and the relationship between perceived past behavior and behavior. In addition, to further our understanding of healthy eating, we examined the same relationships in three eating behaviors (eating a diet low in fat, eating a diet high in fiber, and eating a diet high in fruit and vegetables), which made up our measure of healthy eating.

Method

Respondents

Patients attending health promotion clinics at their physicians' general practices were recruited into the study by practice staff. These health promotion clinics focused on a wide range of health-related issues (e.g.,

exercise, alcohol, smoking), including dietary change. Patients wishing to eat a more healthy diet who were not experiencing any diet-related illnesses were given information on the benefits of healthy eating and advised to attempt to change their diet. Healthy eating was defined as low dietary fat consumption, high dietary fiber consumption, and high fruit and vegetable consumption. Current recommendations on each of these three aspects of healthy eating were provided to patients. The health promotion clinics were brief, low-technology interventions typically lasting 30 min. The majority of the clinics were run by practice nurses, although a few were run by general practitioners. Subsequent analyses (not reported here) showed that the effectiveness of the intervention was unrelated to its length or to the type of health professional running it (Conner, Bell, & Norman, 1995). At the end of the clinic, patients were given a questionnaire by the practice nurse or general practitioner to complete after their clinic appointment. Prepaid return envelopes were included so that patients could post their questionnaires directly to the authors. Completed Time 1 questionnaires were received from 251 patients (out of approximately 350 distributed). Six months later, these patients were sent a second questionnaire to complete and return using a prepaid envelope. Completed Time 2 questionnaires were received from 188 patients (75% response rate). After another 6 years, these same patients were sent a third questionnaire to complete and return using a prepaid envelope. Completed Time 3 questionnaires were received from 146 patients (78% response rate). In total, we were able to match up 144 patients who provided complete data at three time points.

The sample ($N = 144$) were aged between 20 and 68 years ($M = 47.8$, $SD = 12.6$) and roughly evenly split between manual ($n = 64$) and nonmanual ($n = 80$) occupations on the basis of the occupation of head of household. However, the sample was biased in terms of the number of women ($n = 119$) compared with men ($n = 25$).¹ To test for other potential biases in this sample, we compared the responses of those returning all three questionnaires ($N = 144$) with those who only returned the Time 1 questionnaire (an additional $n = 107$). No significant differences were found between the two groups on any of the measures in the Time 1 questionnaire, $F(4, 246) = 0.63$, $p > .50$.

Measures

Responses from the first questionnaire (Time 1) were used to compute the intention stability measure. TPB measures and a measure of perceived past behavior in the second questionnaire (Time 2) were used to predict intentions at Times 2 and 3 and behavior at Time 3. Each of the TPB measures was based on standard wording recommended for measuring components of the TPB (Ajzen, 1991; Conner & Sparks, 1996).

Intention to eat a healthy diet was assessed as the mean of five items, each measured on 7-point bipolar scales ("I intend to eat a healthy diet in the future," *definitely do not–definitely do*; "I will try to eat a healthy diet in the future," *unlikely–likely*; "I want to eat a healthy diet in the future," *strongly disagree–strongly agree*; "I expect to eat a healthy diet in the future," *unlikely–likely*; "How likely is it that you will eat a healthy diet in the future?" *unlikely–likely*; all scored -3 to $+3$). Cronbach's alphas were .89, .95, and .94 for Times 1, 2, and 3, respectively. Test-retest reliability (Times 1–2) was acceptable ($r = .48$).

Attitude was assessed as the mean of six semantic differential scales ("My eating a healthy diet would be/is . . ." *bad–good*, *harmful–beneficial*, *unpleasant–pleasant*, *unenjoyable–enjoyable*, *foolish–wise*, *unnecessary–necessary*; all scored -3 to $+3$). Cronbach's alphas were .84 and .83 for Times 1 and 2, respectively. Test-retest reliability (Times 1–2) was acceptable ($r = .51$).

Subjective norm was assessed by a single item (e.g., "People who are important to me think I should eat a healthy diet," *unlikely–likely*; scored -3 to $+3$). Test-retest reliability (Times 1–2) was acceptable ($r = .38$).

PBC was assessed as the mean of six 7-point unipolar ($+1$ to $+7$) items ("For me to eat a healthy diet in the future is . . ." *difficult–easy*; "I am

confident that if I ate a healthy diet I could keep to it," *strongly disagree–strongly agree*; "Whether I do or do not eat a healthy diet in the future is entirely up to me," *strongly disagree–strongly agree*; "How much control do you feel you have over eating a healthy diet in the future," *no control–complete control*; "I would like to eat a healthy diet but don't really know if I can," *strongly agree–strongly disagree*; "I am confident that I could eat a healthy diet if I wanted to," *strongly disagree–strongly agree*). Cronbach's alphas were .73 and .74 for Times 1 and 2, respectively. Test-retest reliability (Time 1–2) was acceptable ($r = .53$).

Perceived past behavior was assessed at Time 2 as the mean of two items (e.g., "How successful have you been in eating a healthy diet over the past six months?" *not at all–very successful*; "How much have you eaten a healthy diet over the past six months?" *not at all–very much*; both scored $+1$ to $+7$). The two items correlated .66.

Behavior at Time 3 was assessed using a 33-item food frequency questionnaire (FFQ). The food items were commonly consumed food categories arranged in terms of food groups. These were dairy products, meats and fish, bread and cereals, fruit and vegetables, and desserts and snacks. Each food was rated on the frequency it was eaten, on a scale with six categories: *2 or more times a day, every day, 3–5 times a week, 1–2 times a week, 1–3 times a month, and rarely/never*. This measure was a slightly adapted version of the FFQ developed by Cade and Margetts (1988; see also Povey et al., 1999). Margetts, Cade, and Osmond (1989) demonstrated the FFQ to be valid against 24-hr dietary records taken 3 years earlier in a U.K. sample of 433 men and women. The two measures gave similar estimates of fat (Spearman's $\rho = .36$, $p < .001$) and fiber intake (Spearman's $\rho = .26$, $p < .001$; no value for fruit and vegetables reported). Using this measure, standard portion size data, and nutritional data, we were able to compute measures of percentage fat intake (i.e., percentage of calories derived from all fat in the diet; $M = 34.9$, $SD = 6.45$), fiber intake (i.e., grams of fiber consumed per day; $M = 9.65$, $SD = 3.40$), and fruit and vegetable intake (i.e., portions of fruit and vegetables consumed per day; $M = 4.23$, $SD = 0.96$). To compute an overall measure of healthy eating behavior, each of the three measures was standardized and a sum computed (after multiplying the percentage calories from fat measure by -1). The summated score was significantly correlated with each of the standardized variables used to compute it ($r_s = .68, .77, .82$, $p_s < .01$ for fat, fiber, and fruit-and-vegetable measures, respectively). In a separate sample of 14 individuals, the FFQ measure of healthy eating correlated strongly ($r = .84$, $p < .01$) with a similar measure based on a 7-day weighed dietary record ($r_s = .84, .58, .69$, $p_s < .05$ for fat, fiber, and fruit-and-vegetable measures, respectively).

Intention stability was based on the measures of intentions at Times 1 and 2. Several indices of temporal stability have been reported in the literature. A common measure of stability is the correlation coefficient between answers to repeated questions (Batista-Foguet & Saris, 1997)—that is, test-retest correlations. To compute an individual difference measure this correlation needs to be a within-subject correlation (Sheeran et al., 1999). Campbell (1990) presented three alternative measures of temporal stability that avoid the loss of data entailed in using a correlational measure² because of lack of variability in responses within a time point: the sum of absolute differences between the repeated items at the two time points (sum of absolute differences), the average absolute difference adjusted for maximum possible change (mean adjusted difference), and the

¹ Because the sample of male respondents was relatively modest, we repeated the analyses reported in the results using only the female respondents. This did not substantively alter the findings.

² The correlation measure is potentially problematic with a limited number of data points because of the tendency for all items within a time point to receive the same value, making the computation of a correlation impossible. This would result in the loss of approximately 60% of respondents in the reported data.

Table 1
Means, Standard Deviations, and Intercorrelations for All Study Variables ($N = 144$)

Variable	1	2	3	4	5	6	7	8	9	10	11	<i>M</i>	<i>SD</i>
1. Healthy eating behavior (Time 3)	1.00	.68	.77	.82	.29	.24	-.01	.19	.08	.23	.39	0.10	2.24
2. Percentage fat (Time 3)		1.00	.21	.31	.24	.25	.06	.09	.17	.21	.34	34.86	6.45
3. Fiber intake (Time 3)			1.00	.57	.19	.13	-.07	.15	-.05	.15	.18	9.65	3.40
4. Fruit and vegetable intake (Time 3)				1.00	.22	.17	-.02	.21	.06	.16	.36	4.23	0.96
5. BI (Time 2)					1.00	.49	.24	.59	.53	.51	.47	1.94	1.16
6. Attitude (Time 2)						1.00	.24	.37	.36	.30	.36	2.04	0.89
7. Subjective norm (Time 2)							1.00	.31	.26	.17	.03	1.56	1.56
8. PBC (Time 2)								1.00	.43	.41	.35	5.11	1.16
9. BI stability (Times 1–2)									1.00	.37	.37	0.04	0.87
10. Perceived past behavior (Time 2)										1.00	.15	4.73	1.69
11. BI (Time 3)											1.00	1.65	1.24

Note. For correlations greater than .17, $p < .05$; for correlations greater than .22, $p < .01$; and for correlations greater than .28, $p < .001$ (all two-tailed). BI = behavioral intention; PBC = perceived behavioral control.

number of items exhibiting any change (number items changing). We used a measure of stability that was zero minus the mean of these three standardized measures on the basis of the Time 1 and Time 2 measures of intentions (i.e., higher scores indicate greater stability). These three measures showed good internal reliability (Cronbach's $\alpha = .94$) and a moderately strong correlation with the within-subject correlation measure, $r(50) = .42$, $p < .01$.

Results

Table 1 reports the intercorrelations, means, and standard deviations for the different measures of future behavior, the Time 2 TPB measures, intention stability, and perceived past behavior (Time 3 intentions were also included for completeness). Intentions (Time 2) were significantly correlated with all other variables. Healthy eating behavior (Time 3) was significantly correlated with intentions, attitudes, PBC, and perceived past behavior. Percentage fat intake was significantly correlated with intentions, attitude, and perceived past behavior. Fiber intake was significantly correlated with just intentions. Finally, fruit and vegetable intake was significantly correlated with intentions and PBC.

The regression of intentions measured at Time 2 or Time 3 onto other TPB variables measured at Time 2 is reported in Table 2. For Time 2 healthy eating intentions, attitudes and PBC were the two significant correlates, explaining 43% of the variance. The addition of perceived past behavior explained an additional significant proportion of the variance in intentions. The final equation explained 50% of the variance in intentions cross-sectionally, with attitudes, PBC, and perceived past behavior being significant correlates. For Time 3 intentions, attitudes and PBC were significant prospective predictors (Table 2, Time 3 intentions column), explaining 20% of the variance. However, the addition of perceived past behavior did not significantly increase the proportion of variance explained, and only attitudes and PBC were significant in the final equation, explaining 20% of the variance. Thus, attitudes and PBC were both strong positive predictors of healthy eating intentions 6 years later.

For predictions of healthy eating and its component behaviors, we used moderated regression analysis to test our moderation

hypotheses (Baron & Kenny, 1986) and mean-centered variables to minimize problems of multicollinearity (Aiken & West, 1991). The multiple regression of each measure of behavior onto the direct predictors from the TPB (i.e., intentions and PBC; Step 1), perceived past behavior (Step 2), intention stability, Intentions $\times$ Intention Stability and Perceived Past Behavior $\times$ Intention Stability (Step 3) is reported in Table 3. We chose to enter both interactions together because increasing intention stability was predicted to simultaneously increase the predictive power of intentions and decrease the predictive power of past behavior (Conner et al., 2000; Sheeran et al., 1999).

In relation to healthy eating behavior (see Table 3), the TPB explained 9% of the variance, although only intentions were significant. The addition of perceived past behavior to the equation did not explain a significant additional proportion of the variance in behavior. However, the addition of intention stability and the two interactions did explain a significant proportion of additional

Table 2
Hierarchical Regressions of Behavioral Intentions on Variables and Perceived Past Behavior at Time 2 ($N = 144$)

Predictor (Time 2)	β	
	Time 2 intention ^a	Time 3 intention ^b
Step 1		
Attitude	.31***	.29***
Subjective norm	.02	-.13
PBC	.47***	.28***
Step 2		
Attitude	.27***	.29***
Subjective norm	.01	-.13
PBC	.38***	.30***
Perceived past behavior	.27***	-.04

Note. PBC = perceived behavioral control.

^a $R^2 = .434$ for Step 1; $\Delta R^2 = .061$ for Step 2 ($ps < .001$). ^b $R^2 = .198$, $p < .001$ for Step 1; $\Delta R^2 = .061$, ns for Step 2.

*** $p < .001$.

Table 3

Hierarchical Regressions of Behavior Measures (Prospective Analysis) on Intentions, PBC, Perceived Past Behavior, Intention Stability, Intentions $\times$ Intention Stability, and Perceived Past Behavior $\times$ Intention Stability ($N = 144$)

Predictor	β			
	Healthy eating behavior ^a	Percentage fat ^b	Fiber intake ^c	Fruit and vegetable intake ^d
Step 1				
Intentions (Time 2)	.27**	.29**	.16	.15
PBC (Time 2)	.03	-.08	.06	.12
Step 2				
Intentions (Time 2)	.23*	.23*	.13	.13
PBC (Time 2)	.01	-.10	.05	.12
Perceived past behavior (Time 2)	.11	.13	.06	.05
Step 3				
Intentions (Time 2)	.39**	.31*	.20	.30*
PBC (Time 2)	.00	-.14	.09	.09
Perceived past behavior (Time 2)	.19*	.16	.14	.11
BI stability (Times 1–2)	-.17	.03	-.25*	-.16
Intentions $\times$ BI Stability	.37***	.24*	.08	.35**
Perceived Past Behavior $\times$ BI Stability	-.28**	-.14	-.16	-.22*

Note. PBC = perceived behavioral control; BI = behavioral intention.

^a $R^2 = .085$, $p < .01$ for Step 1; $\Delta R^2 = .009$, ns for Step 2; $\Delta R^2 = .091$, $p < .01$ for Step 3. ^b $R^2 = .062$, $p < .01$ for Step 1; $\Delta R^2 = .013$, ns for Step 2; $\Delta R^2 = .034$, ns for Step 3. ^c $R^2 = .038$, ns for Step 1; $\Delta R^2 = .003$, ns for Step 2; $\Delta R^2 = .054$, $p < .05$ for Step 3. ^d $R^2 = .058$, $p < .01$ for Step 1; $\Delta R^2 = .002$, ns for Step 2; $\Delta R^2 = .075$, $p < .01$ for Step 3.

* $p < .05$. ** $p < .01$. *** $p < .001$.

variance. The interactions between intentions and intention stability ($\beta = .37$, $p < .001$) and between perceived past behavior and intention stability ($\beta = -.28$, $p < .01$) were significant, with the final equation explaining 19% of the variance in behavior. Neither intention stability nor PBC were significant predictors of behavior in this final equation, although intentions and past behavior were significant.³

We probed the nature of the two significant interactions using simple slope analyses (Aiken & West, 1991) by examining the regression lines at three levels of intention stability (the hypothesized moderator)—that is, the mean level and at one standard deviation above and below the mean. Simple slope analyses demonstrated that when intention stability was high, intentions were strongly related to behavior ($B = .71$, $p < .001$), whereas perceived past behavior was not ($B = -.05$, ns). At moderate levels of intention stability, both intentions ($B = .39$, $p < .01$) and past behavior ($B = .19$, $p < .05$) were significantly related to behavior. However, at low levels of intention stability, intentions were not significantly related to behavior ($B = .07$, ns), whereas perceived past behavior was strongly related to behavior ($B = .43$, $p < .01$). Thus, the power of intentions to predict healthy eating behavior 6 years later became stronger as intention stability increased. In contrast, the power of perceived past behavior to predict healthy eating behavior 6 years later became stronger as intention stability decreased.⁴

Table 3 also contains the results of the regressions of each of the three behaviors that make up the healthy eating behavior measure (percentage fat intake, fiber intake, fruit and vegetable intake) onto intentions and PBC (Step 1), perceived past behavior (Step 2), intention stability, Intentions $\times$ Intention Stability, and Perceived Past Behavior $\times$ Intention Stability (Step 3). In reporting the

findings, we focused on the final step of analysis for each behavior. For percentage fat intake,⁵ intentions and Intentions $\times$ Intention Stability were the only significant predictors explaining 11% of the variance in behavior. Simple slope analysis demonstrated that intentions became increasingly stronger predictors of percentage fat intake as intention stability increased from low ($B = .10$, ns) to moderate ($B = .31$, $p < .05$) to high ($B = .52$, $p < .01$). The lack of a significant Perceived Past Behavior $\times$ Intention Stability effect indicated that the impact of perceived past (healthy eating) behavior on percentage fat intake did not differ as a function of intention stability. For fiber intake, only intention stability

³ We also tested for the impact of other variables (attitude, subjective norms) and interactions between intention stability and these other variables using a stepwise procedure. In no case did these significantly increase the amount of variance explained. In addition, we tested for the effects of PBC stability (measured in a similar way to intention stability) and interactions between this variable and other variables using a stepwise procedure. Again, this did not significantly increase the amount of variance explained.

⁴ Because the two interaction terms were in the equation simultaneously, we also could have examined the impact of different levels of intentions (or past behavior) on the relationship between behavior and past behavior (or intentions) at each level of intention stability. We did not pursue that strategy here because these effects would only have been on the constant in the equation and not on the regression coefficient, which was the focus of attention here.

⁵ To ease interpretation of the analyses of perceived fat intake, this measure has been multiplied by -1 such that, like the other measures, higher scores can be interpreted as related to a more healthy eating behavior.

emerged as a significant predictor (9.5% explained variance). However, this effect is probably a statistical artifact because intention stability was not significantly related to fiber intake in the simple correlations (Table 1). Finally, for fruit and vegetable intake and intentions, Intentions $\times$ Intention Stability and Perceived Past Behavior $\times$ Intention Stability were the only significant predictors explaining 13% of the variance in behavior. Simple slope analyses revealed similar results to those for the healthy eating behavior measure. When intention stability was high, intentions to eat healthily were strongly related to fruit and vegetable intake ($B = .60, p < .01$), whereas perceived past (healthy eating) behavior was not ($B = -.08, ns$). At moderate levels of intention stability, intentions to eat healthily ($B = .30, p < .05$) were significantly related to fruit and vegetable intake, and past (healthy eating) behavior was not ($B = .11, ns$). However, at low levels of intention stability, intentions to eat healthily were not significantly related ($B = .00, ns$), but perceived past (healthy eating) behavior was significantly related ($B = .30, p < .01$), to fruit and vegetable intake. Thus, the power of healthy eating intentions to predict fruit and vegetable intake 6 years later became stronger whereas the power of perceived past behavior became weaker with increasing intention stability.

Discussion

This research used the TPB to predict healthy eating intentions and behavior following attendance at health promotion clinics in a primary care setting. The TPB was found to be predictive of healthy eating intentions, explaining 43% of the variance in behavioral intentions cross-sectionally and 20% prospectively (over a 6-year interval). In addition, perceived past behavior was found to be predictive of intentions cross-sectionally but not prospectively. Few studies have compared the ability of the TPB to predict intentions cross-sectionally versus prospectively (but see Armitage & Conner, 1999). It is interesting to note that the TPB is able to explain intentions even prospectively over considerable time gaps. The lack of impact of perceived past behavior in the prospective analyses is interesting because it suggests that intentions are more strongly controlled by the cognitive factors described in the TPB than by simple reflection on past behavior. Previous research has produced mixed evidence concerning the impact of past behavior on intentions within the TPB (for a review, see Conner & Armitage, 1998).

The TPB was also found to predict healthy eating behavior 6 years later. Intentions were significant prospective predictors of healthy eating behavior, explaining 9% of the variance in behavior. Moreover, perceived past behavior did not have a significant additional effect, suggesting that the TPB provides a sufficient (Ajzen, 1991) account of the determinants of long-term healthy eating. It is noteworthy that the findings reported here estimated a perceived past behavior–behavior relationship unconfounded by common method variance effects (Conner et al., 1999). However, these main effects were qualified by two predicted interactions. As predicted from previous research (Conner et al., 2000; Sheeran et al., 1999), there was a positive Intentions $\times$ Intention Stability interaction and a negative Perceived Past Behavior $\times$ Intention Stability interaction in regressions predicting healthy eating behavior 6 years later. Increasing intention stability was associated with intentions becoming stronger and perceived past behavior

becoming weaker predictors of subsequent behavior. Only when intention stability was low did perceived past behavior have a strong effect on subsequent behavior.

The above findings support and extend two previous studies that used a similar design (Conner et al., 2000; Sheeran et al., 1999) over shorter time periods. These findings provide insight into why individuals with equivalent intentions might differ in their capacities to enact their intentions. Stable intentions were more likely to be translated into subsequent action, whereas when intentions were unstable, perceived past behavior drove subsequent behavior. Therefore, future research might usefully examine both extremity and stability of intentions in trying to understand intention–behavior and past behavior–behavior relationships. This contrasts with other researchers (e.g., Ouellette & Wood, 1998) who have suggested that it is the frequency of performance of the behavior that influences the relative power of past behavior and intentions to predict behavior. The present findings for a frequently performed behavior would suggest that the key factor is the temporal stability of intentions. When such intentions are stable, they can have a long-term impact in guiding even frequently performed behaviors.

The regressions with the three eating behaviors used to tap overall healthy eating behavior also revealed a number of interesting findings (Table 3). The regressions with fruit and vegetable intake revealed findings broadly similar to those with the overall healthy eating behavior measure (i.e., increased fruit and vegetable intake was associated with positive intentions, a Positive Intention $\times$ Intention Stability interaction, and a negative Perceived Past Behavior $\times$ Intention Stability interaction). Thus, increasing stability of intentions to eat healthily was associated with (healthy eating) intentions becoming stronger predictors and perceived past (healthy eating) behavior becoming a weaker predictor of subsequent fruit and vegetable intake. The regressions with percentage fat intake indicated a significant positive effect of intention and a positive Intention $\times$ Intention Stability interaction. Thus, increasing stability of intentions to eat healthily was associated with (healthy eating) intentions becoming stronger predictors of subsequent (lower) fat intake. The regressions with fiber intake revealed no readily interpretable effect of any variable.

Together, these findings would suggest that percentage fat intake and fruit and vegetable intake were more readily predictable from healthy eating intentions than was fiber intake. In addition, more stable healthy eating intentions were more predictive of percentage fat intake and fruit and vegetable intake. However, only in the case of fruit and vegetable intake was increasing stability of healthy eating intentions also associated with a weakening of the effect of perceived past behavior. These findings may be attributable to the lack of exact correspondence between these behavior measures and the predictor variables. In addition, it may be the case that respondents found it easier to monitor and change percentage fat intake or fruit and vegetable intake than fiber intake when trying to enact healthy eating intentions (for similar research on the impact of providing personalized feedback on percentage fat intake, see Armitage & Conner, 2001a). These findings would suggest that interventions designed to increase healthy eating behavior may need to increase the strength and stability of intentions to eat healthily and also increase knowledge about how to translate these intentions into action (particularly in the case of fiber intake).

The reported results have a number of theoretical implications. First, the TPB is able to successfully predict performance of a behavior over considerable periods of time. This adds to the existing research, which demonstrates that intentions can predict behavior over varying time periods (see Randall & Wolff, 1994). This is important because it suggests that the TPB is able to predict the initiation and maintenance of a health behavior (Norman & Conner, 1996). Second, the importance of the temporal stability of health cognitions is highlighted. Stable intentions appear to be an important moderator variable. The temporal stability of cognitions may represent a key measure of the "strength" of health cognitions (Ajzen, 1996, p. 389) in relation to its power to predict the long-term maintenance of a health behavior.

A number of methodological limitations to the reported research should be considered. First, the sample studied was self-selecting in that respondents were people who had agreed to attend a health promotion clinic. This may have resulted in a sample with an overall higher degree of motivation and less overall variability in motivation to engage in healthy eating. However, in terms of impacts on the reported findings, this might have been expected to simply weaken the observed relationships. In addition, the sample overrepresented women. Previous research has found that women place greater value on their health and are more likely to engage in health-protective behaviors compared with men (e.g., Liang, Shediak-Rizkallah, Celentano, & Rohde, 1999). Caution, therefore, is warranted in making generalizations.

Second, the focus on self-report data may have opened the research to consistency biases. In particular, the findings would be strengthened by more objective behavioral measures such as observation of eating behavior, validation by significant others, or bodily composition or physiological data. Nevertheless, there is reason to believe that the present findings have some generality. Meta-analytic data have demonstrated that the TPB predicts objectively measured behavior almost as well as self-reported data (Armitage & Conner, 2001b). In addition, the two observed interaction effects with intention stability have also been reported for a more objective measure of a health behavior (screening attendance; Conner et al., 2000, Study 1).

Third, the measure of perceived past behavior that was used to remove effects of common method variance between the behavior measures might be criticized as lacking in validity compared with the FFQ-based measure. Nevertheless, there is evidence that the two behavior measures show convergence. At Time 3, in addition to the FFQ-based measure of healthy eating behavior, we also included the self-reported healthy eating measure. The correlation between the two was moderately strong, $r(142) = .43$, $p < .001$, indicating some degree of convergent validity to the two behavior measures.

In conclusion, practical implications can be drawn from the reported study. Interventions to promote health outcomes through changing various aspects of healthy eating should target attitudes and PBC to increase healthy eating intentions. Such intentions were found to be predictive of healthy eating over considerable time periods. In addition, where intentions were stable, intentions were found to be strongly predictive, whereas past behavior was unrelated to healthy eating behavior. Fishbein and Ajzen (1975) suggested that persuasive communications targeting beliefs about the salient outcomes of a behavior are the best way to change attitudes. Bandura (1986) outlined four ways in which perceptions

of control over a behavior can be enhanced: through personal mastery experience by the setting and achieving of subgoals (e.g., eating or avoiding particular foods), through observing others' successes, through standard persuasive techniques, and through the use of relaxation techniques (e.g., to control feelings of arousal or anxiety). Further research might usefully address the extent to which such interventions are also effective in increasing the temporal stability of intentions. Finally, the findings for the three eating behaviors suggested that fruit and vegetable intake and percentage fat intake were more under the control of healthy eating intentions than fiber intake. Thus, to increase fiber intake, interventions may also need to increase knowledge about the sources of fiber in the diet.

References

- Aiken, L. S., & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions*. Newbury Park, CA: Sage.
- Ajzen, I. (1988). *Attitudes, personality, and behavior*. Buckingham, England: Open University Press.
- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50, 179–211.
- Ajzen, I. (1996). The directive influence of attitudes on behavior. In P. Gollwitzer & J. A. Bargh (Eds.), *Psychology of action* (pp. 385–403). New York: Guilford.
- Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. Englewood Cliffs, NJ: Prentice Hall.
- Ajzen, I., & Timko, C. (1986). Correspondence between health attitudes and behavior. *Journal of Basic and Applied Social Psychology*, 7, 259–276.
- American Cancer Society Advisory Committee on Diet, Nutrition, and Cancer Prevention. (1996). Guidelines on diet, nutrition, and cancer prevention: reducing the risk of cancer with healthy food choices and physical activity. CA: *A Cancer Journal for Clinicians*, 46, 325–341.
- Anderson, J. W., Smith, B., & Gustafson, N. (1994). Health benefits and practical aspects of high-fiber diets. *American Journal of Clinical Nutrition*, 59(Suppl.), 1242S–1247S.
- Appel, L. J., Moore, T. H., Obarzanek, E., Valmer, W. M., Svetkey, L. P., Sacks, F. M., et al. (1997). A clinical trial of the effects of dietary patterns on blood pressure. *New England Journal of Medicine*, 336, 1117–1124.
- Armitage, C. J., & Conner, M. (1999). The theory of planned behaviour: Assessment of predictive validity and "perceived control." *British Journal of Social Psychology*, 38, 35–54.
- Armitage, C. J., & Conner, M. (2001a). Efficacy of a minimal intervention to reduce fat intake. *Social Science and Medicine*, 52, 1517–1524.
- Armitage, C. J., & Conner, M. (2001b). Efficacy of the theory of planned behaviour: A meta-analytic review. *British Journal of Social Psychology*, 40, 471–499.
- Bagozzi, R. P., & Yi, Y. (1989). The degree of intention formation as a moderator of the attitude-behavior relationship. *Social Psychology Quarterly*, 52, 266–279.
- Bandura, A. (1986). *Social foundations of thought and action: A cognitive social theory*. Englewood Cliffs, NJ: Prentice Hall.
- Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, 51, 1173–1182.
- Batista-Foguet, J. M., & Saris, W. E. (1997). Tests of stability in attitude research. *Quality and Quantity*, 31, 269–285.
- Brown, L., Rosner, B., Willett, W. W., & Sacks, F. M. (1999). Cholesterol-lowering effects of dietary fiber: A meta-analysis. *American Journal of Clinical Nutrition*, 69, 30–42.

- Cade, J. E., & Margetts, B. M. (1988). Nutrient sources in the English diet: Quantitative data from three English towns. *International Journal of Epidemiology*, 17, 844–848.
- Campbell, J. D. (1990). Self-esteem and clarity of the self-concept. *Journal of Personality and Social Psychology*, 59, 538–549.
- Committee on Medical Aspects of Diet. (1991). *Report on dietary reference values for food energy and nutrients for the UK*. London: Her Majesty's Stationery Office.
- Conner, M., & Armitage, C. J. (1998). Extending the theory of planned behavior: A review and avenues for further research. *Journal of Applied Social Psychology*, 28, 1430–1464.
- Conner, M., Bell, R., & Norman, P. (1995). *Health promotion interventions in general practice: Effects upon patients' health beliefs and adoption of healthy lifestyle behaviours*. Unpublished manuscript, University of Leeds, England.
- Conner, M., Sheeran, P., Norman, P., & Armitage, C. J. (2000). Temporal stability as a moderator of relationships in the theory of planned behaviour. *British Journal of Social Psychology*, 39, 469–493.
- Conner, M., & Sparks, P. (1996). The theory of planned behaviour and health behaviours. In M. Conner & P. Norman (Eds.), *Predicting health behaviour: Research and practice with social cognition models* (pp. 121–162). Buckingham, England: Open University Press.
- Conner, M., Warren, R., Close, S., & Sparks, P. (1999). Alcohol consumption and the theory of planned behavior: An examination of the cognitive mediation of past behavior. *Journal of Applied Social Psychology*, 29, 1675–1703.
- Deckelbaum, R. J., Fisher, E. A., Winston, M., Kumanyika, S., Lauer, R. M., Pi-Sunyer, F. X., et al. (1999). Summary of a scientific conference on preventive nutrition: Pediatrics to geriatrics. *Circulation*, 100, 450–456.
- Doll, J., & Ajzen, I. (1992). Accessibility and stability of predictors in the theory of planned behavior. *Journal of Personality and Social Psychology*, 63, 754–765.
- Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention, and behavior*. New York: Wiley.
- Giovannucci, E., & Willett, W. C. (1994). Dietary factors and risk of colon cancer. *Annals of Medicine*, 26, 443–452.
- Godin, G., & Kok, G. (1996). The theory of planned behavior: A review of its applications to health-related behaviors. *American Journal of Health Promotion*, 11, 87–98.
- Godin, G., Valois, P., & Lepage, L. (1993). The pattern of influence of perceived behavioral control upon exercising behaviour: An application of Ajzen's theory of planned behavior. *Journal of Behavioral Medicine*, 16, 81–102.
- Heimendinger, J., Van Duyn, M. A., Chapelsky, D., Foerster, S., & Stables, G. (1996). The national 5 A Day for Better Health Program: A large-scale nutrition intervention. *Journal of Public Health Management and Practice*, 2(2), 27–35.
- Krauss, R. J., Deckelbaum, R. J., Ernst, N., Fisher, E., Howard, B. V., Knopp, R. H., et al. (1996). Dietary guidelines for healthy American adults: A statement for health professionals from the Nutrition Committee, American Heart Association. *Circulation*, 94, 1795–1800.
- Kumanyika, S. K., Van Horn, L., Bowen, D., Perri, M. G., Rolls, B. J., Czajkowski, S. M., & Schron, E. (2000). Maintenance of dietary behavior change. *Health Psychology*, 19(Suppl.), 42–56.
- Liang, W. C., Shediach-Rizkallah, M. C., Celentano, D. D., & Rohde, C. (1999). A population-based study of age-gender patterns of health-related behaviors. *American Journal of Preventive Medicine*, 17, 8–17.
- Margetts, B. M., Cade, J. E., & Osmond, C. (1989). Comparison of a food frequency questionnaire with a diet record. *International Journal of Epidemiology*, 18, 868–873.
- Ness, A. R., & Powles, J. W. (1997). Fruit and vegetables, and cardiovascular disease: A review. *International Journal of Epidemiology*, 26, 1–13.
- Norman, P., & Conner, M. (1996). The role of social cognition models in predicting health behaviours: Future directions. In M. Conner & P. Norman (Eds.), *Predicting health behaviour* (pp. 197–225). Buckingham, England: Open University Press.
- Ouellette, J. A., & Wood, W. (1998). Habit and intention in everyday life: The multiple processes by which past behavior predicts future behavior. *Psychological Bulletin*, 124, 54–74.
- Paisley, C. M., & Sparks, P. (1998). Expectations of reducing fat intake: The role of perceived need within the theory of planned behaviour. *Psychology and Health*, 13, 341–353.
- Povey, R., Conner, M., Sparks, P., James, R., & Shepherd, R. (1998). Interpretations of healthy and unhealthy eating and implications for dietary change. *Health Education Research*, 13, 171–183.
- Povey, R., Conner, M., Sparks, P., James, R., & Shepherd, R. (1999). The theory of planned behaviour and health eating: Examining additive and moderating effects of social influence variables. *Psychology and Health*, 14, 991–1006.
- Randall, D. M., & Wolff, J. A. (1994). The time interval in the intention-behaviour relationship: Meta-analysis. *British Journal of Social Psychology*, 33, 405–418.
- Sheeran, P., Orbell, S., & Trafimow, D. (1999). Does the temporal stability of behavioral intentions moderate intention-behavior and past behavior-future behavior relations? *Personality and Social Psychology Bulletin*, 25, 721–730.
- Sutton, S. (1994). The past predicts the future: Interpreting behaviour-behaviour relationships in social psychological models of health behaviour. In D. R. Rutter & L. Quine (Eds.), *Social psychology and health: European perspectives* (pp. 71–88). Aldershot, England: Avebury.
- U.S. Department of Agriculture/U.S. Department of Health and Human Services. (1995). *Nutrition and your health: Dietary guidelines for Americans* (4th ed.). Washington, DC: U.S. Government Printing Office.
- Van Horn, L., & Kavey, R. E. (1997). Diet and cardiovascular disease prevention: What works? *Annals of Behavioral Medicine*, 19, 197–212.
- Verplanken, B., & Faes, S. (1999). Good intentions, bad habits, and effects of forming implementation intentions on repeated behaviour. *European Journal of Social Psychology*, 29, 591–604.
- Wolk, A., Manson, J., Stampfer, M., Colditz, G., Hu, F., Speizer, F., et al. (1999). Long-term intake of dietary fiber and decreased risk of coronary heart disease among women. *Journal of the American Medical Association*, 281, 1998–2004.
- Wong, B. C. Y., & Lam, S. K. (1999). Diet and cancer. *GI Cancer*, 3, 1–10.