Using the theory of planned behavior to explain intention to eat a healthful diet among Southeastern United States office workers

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Abstract

Purpose – This study aims to test the utility of the theory of planned behavior (TPB) for explaining intention to eat a healthful diet in a sample of Southeastern US office workers.

Design/methodology/approach – Participants in a worksite nutrition study ($n = 357$) were invited to complete an online questionnaire including measures of TPB constructs at baseline. The questionnaire included valid and reliable measures of TPB constructs: behavioral beliefs, normative beliefs, control beliefs, attitudes toward behavior, subjective norm, perceived behavioral control and intention. Data were collected from 217 participants (60.8 per cent response rate). Confirmatory factor analysis and structural equation modeling were conducted to test the hypothesized TPB model.

Findings – The model fit was satisfactory ($\chi^2 = p < 0.0001$, RMSEA = 0.06, CFI = 0.91, TLI = 0.90, SRMR = 0.09). All structural relationships between TPB constructs were statistically significant in the hypothesized direction ($p < 0.05$). Attitude toward behavior, subjective norm and perceived behavioral control were positively associated with intention ($R^2 = 0.56$). Of all TPB constructs, the influence of perceived behavioral control on intention was the strongest ($\beta = 0.62, p < 0.001$).

Originality/value – Based on this sample of Southeastern US office workers, TPB-based interventions may improve intention to eat a healthful diet. Interventions that strengthen perceived control over internal and external factors that inhibit healthful eating may be particularly effective in positively affecting intention to eat a healthful diet, and subsequent food intake.

Keywords Public health, Diet, Nutrition, Health promotion

Paper type Research paper

Introduction

Unhealthy dietary patterns are a leading cause of disease in the USA and globally (Bauer *et al.*, 2014; Lim *et al.*, 2012). A healthful diet rich in foods such as fruits, vegetables and whole grains is key for prevention of non-communicable diseases (Lim *et al.*, 2012). Most adults in the USA, however, fail to meet federal dietary recommendations for intake of fruits (Moore and Thompson, 2015), vegetables (Moore and Thompson, 2015) and whole grains (Albertson *et al.*, 2016). Increased adherence to a healthful diet is particularly important for populations such as office workers who are at increased risk of obesity and other diet-linked chronic diseases.

Adults employed in sedentary office-based occupations are at increased risk of diet-linked chronic diseases (Buckley *et al.*, 2015). Studies have shown that office workers, on average, maintain low levels of physical activity and high amounts of sedentary behavior (Clemes *et al.*, 2014; Parry and Straker, 2013). Less healthful eating behavior, physical inactivity and prolonged sedentary behavior may independently and interactively increase the risk of chronic diseases among office workers (Dunton *et al.*, 2009; Loprinzi *et al.*, 2014). To prevent chronic diseases, workplace health promotion interventions have been initiated to encourage worker adoption of protective health behaviors, including healthful eating (Cahalin *et al.*, 2015).

The theory of planned behavior (TPB) has been used to develop nutrition interventions targeting dietary behavior in various populations and settings (McDermott *et al.*, 2015). The TPB posits that attitudes toward behavior, subjective norm (i.e. perception of others' beliefs regarding the behavior) and perceived behavioral control (i.e. over the behavior) are a function of sets of behavioral beliefs, normative beliefs and control beliefs, respectively (Ajzen, 1991). Intention to perform a behavior is a function of attitudes toward behavior, subjective norm and perceived behavioral control. The most proximal determinant of behavior (e.g. actual food intake) is intention. A TPB-based nutrition intervention consists of programming designed to influence relevant psychosocial constructs associated with dietary behavior.

Few research studies have examined the applicability of the TPB in explaining intention to eat a healthful diet among office workers. A systematic review and meta-analysis of TPB and dietary pattern studies found that attitudes toward behavior, subjective norm and perceived behavioral control had medium-to-large associations with both intention and behavior (McDermott *et al.*, 2015). None of the studies, however, was conducted with a US office worker population.

Information on TPB constructs among office workers may inform workplace health interventions seeking to increase the prevalence of healthful eating behavior. Because inter-relations of beliefs, attitudes, subjective norm and perceived behavioral control with healthful eating intentions may vary across populations, specific examination in populations targeted for behavior change interventions is useful for intervention planning. For example, the extent to which one cares about others' feelings about her/his healthful eating behavior (i.e. normative beliefs and subjective norm) may determine whether and how interventionists expend scarce resources to develop norms-focused programming (e.g. health communications highlighting the importance of healthful eating among peers). Assessment of the TPB may aid practitioners in targeting psychosocial factors that are most likely to result in improved healthful eating behavior.

The present study uses structural equation modeling to evaluate the utility of the TPB in explaining intention to eat a healthful diet among southeastern US office workers. We employ valid and reliable measures to measure TPB constructs, including Healthful Eating Belief Scales (Blue and Marrero, 2006) to measure behavioral, normative and control beliefs, and to provide important information about the underlying salient beliefs that may be

modified in interventions. The primary objective of our study was to examine the relationships between TPB constructs. Specifically, we hypothesized that the beliefs, attitudes, subjective norm, perceived behavioral control and intention to eat a healthful diet would be associated in the directions posited by the TPB. The secondary objective was to assess whether the behavioral, normative and control beliefs that inform that respective TPB constructs indirectly affect intention to eat a healthful diet, thereby suggesting that interventions targeting beliefs may affect higher-order TPB constructs and subsequently intention to eat a healthful diet. Specifically, we hypothesized that attitudes toward behavior, subjective norm and perceived behavioral control mediated the effect of behavioral, normative and control beliefs, respectively, on intention to eat a healthful diet.

Methods

Sample

The present study uses baseline data collected from participants of the Effects of Physical Activity Calorie Expenditure (PACE) Food Labeling study. All data were collected prior to intervention exposure. The main study investigated the effect of physical activity calorie-equivalent menu labeling on calorie purchasing and levels of physical activity in three worksite cafeterias in North Carolina. Full-time employees and contract workers were eligible for the study if they were at least 18 years of age and reported eating lunch or were willing to eat lunch from the cafeteria at least three times per week. The Institutional Review Board of University of North Carolina at Chapel Hill approved all ethical aspects of the study. Details on the study design and other characteristics can be found elsewhere (Viera *et al.*, 2017).

During December 2015-March 2016, participants enrolled in the main study were invited to complete a questionnaire including measures of TPB constructs. Of 357 participants invited, 217 participants completed the questionnaire (response rate = 60.8 per cent). Three participants did not respond to any of the items and were subsequently dropped from the present analysis. Thus, 214 participants constitute the analytic sample.

Measures

We used the original Healthful Eating Belief Scales to measure behavioral beliefs, normative beliefs and control beliefs (Blue and Marrero, 2006). Blue and Marrero developed these scales to measure the underlying beliefs that inform higher-order TPB constructs (i.e. attitudes toward healthful eating, subjective norm and perceived behavioral control), and therefore, provide more precise assessment of the importance of particular healthful eating-related beliefs in a population. To develop the instrument, Blue and Marrero used free-response interviews to collect data on salient beliefs from a sample of adults at risk of type 2 diabetes in the Midwest ($n = 32$). Each scale consisted of item-pairs that were multiplied to create a product indicator variable. Specifically, behavioral beliefs consisted of nine outcome expectancy items and nine corresponding outcome evaluation items; normative beliefs consisted of six normative belief referent items and six corresponding motivation to comply items; and control beliefs consisted of ten control belief factors and ten corresponding control belief power items. The construct validity, test–retest reliability and Cronbach's alpha reliability of the scales were satisfactory.

To examine congruence of the development sample modal belief sets with those of our sample, we administered open-ended belief elicitation questionnaires based on the original belief elicitation protocol. A content analysis of the elicitation responses ($n = 14$) found that the beliefs reported from the elicitation sample largely agreed with the items on the original Blue and Marrero scales. We then conducted a confirmatory factor analysis to assess the construct validity of the Healthful Eating Belief Scales in this population (Close *et al.*, 2016).

Confirmatory factor analysis is a psychometric technique used to test whether sets of selected observed variables represent hypothesized latent variables (i.e. belief constructs). Results showed that the original hypothesized model was not supported. However, an alternative model achieved acceptable fit through removal of items with high standardized residuals and low factor loadings: $\chi^2 = 80.57$, $p = 0.06$; root mean square error of approximation (RMSEA) = 0.04; comparative fit index (CFI) = 0.98; Tucker–Lewis index (TLI) = 0.97; standardized root mean square residual (SRMR) = 0.05.

In the present study, we used the Healthful Eating Belief Scales, as modified in the alternative model, to measure behavioral, normative and control beliefs. The alternative model fit in the present analysis consisted of five behavioral belief indicator variables, three normative belief indicator variables and five control belief indicator variables. The behavioral beliefs were: delays or prevents diabetes, improves the way I think about myself, improves the way I look, improves my outlook on life, and saves money. The normative referents were: my friends, other family members, and people I work with. The control factors were:

- keeping healthful foods available;
- time to prepare foods that are healthful;
- able to plan meals ahead of time;
- able to keep track of eating; and
- cost of healthful foods not a problem.

We adopted scales used by Blue and Marrero to measure TPB constructs of attitudes, subjective norm, perceived behavioral control and intention with minor timeframe modifications. We changed the timeframe for the attitude and intention items from 2 months to 12 months to align with the main study. Details on these measures can be found in the original scale development paper (Blue and Marrero, 2006).

Data analysis
We calculated univariate statistics of variables to examine distributions and missingness. In the confirmatory factor analysis and structural equation modeling, we treated all indicator variables as continuous given Bentler and Chou's advice that continuous methods can be used when an ordinal variable has four or more categories (Bentler and Chou, 1987; Byrne, 2013). To assess multivariate normality, we inspected the kurtosis values of each variable. Univariate kurtosis values outside |2.0-7.0| indicated that the data were multivariate non-normal (Byrne, 2013). In the case of multivariate non-normality, we proceeded to use robust maximum likelihood estimation for confirmatory factor analysis and structural equation modeling. We calculated bivariate correlations of all TPB latent variables.

We used confirmatory factor analysis to assess the goodness of fit of the hypothesized measurement model comprising all constructs that compose the TPB, as measured by Healthful Eating Belief Scales and other items: behavioral beliefs, normative beliefs, control beliefs, attitudes, subjective norm, perceived behavioral control and intention to eat a healthful diet. The structural model specifying relationships between constructs was fit after the measurement model demonstrated satisfactory fit. We estimated several commonly used indices to examine model fit: χ^2, RMSEA, CFI, TLI and SRMR. We considered model fit to be good if at least one of three rules-of-thumb were true:

(1) RMSEA value close to 0.06 or below;
(2) SRMR value close to 0.08 or below; and
(3) CFI and TLI value close to 0.95 or greater (Hu and Bentler, 1999).

Model re-specifications, guided by theory, were made as needed to improve model fit. The Cronbach's alpha internal consistency reliability coefficient was computed for each scale. The sample size was deemed adequate according to a common rule-of-thumb that a minimum sample size of 100 is sufficient for most structural equation modeling applications (Boomsma, 1985). However, sample size requirements remain an active area of research in the field (Wolf *et al.*, 2013).

To control for the clustering of participants in three worksites, worksite covariates were included on all structural paths. Standardized beta coefficients were calculated to aid interpretation. We used full information maximum likelihood to retain observations with data missing at random. We used Stata version 11.2 and Mplus 7.31 for all analyses. We set a two-tailed alpha of 0.05 for statistical significance.

Results

The sample was primarily female (81.3 per cent), middle-aged (mean = 43.0, SD = 10.3), white (49.5 per cent), married or in a domestic partnership (50.5 per cent), and had at least a bachelor's degree (72.0 per cent) (Table I). All TPB latent variables were positively correlated; belief constructs and corresponding higher-order TPB constructs (e.g. behavioral beliefs and attitudes) exhibited particularly strong correlation (Table II).

Characteristic	$N(\%)$
Age*	43.0 ± 10.3
Women	174 (81.3)
Race	
White	106 (49.5)
Black or African American	86 (40.2)
Asian	8 (3.7)
More than one race	9 (4.2)
Other	5 (2.3)
Education	
Less than bachelor's degree	60 (28.0)
Bachelor's degree and above	154 (72.0)
Marital status	
Single, never married	66 (30.8)
Married/Domestic partnership	108 (50.5)
Widowed	3 (1.4)
Divorced/Separated	37 (17.3)
Occupation	
Administrative or clerical	40 (18.7)
Customer service or sales	43 (20.1)
Financial or technical	74 (34.6)
Management	56 (26.2)

Table I.
Descriptive characteristics of Southeastern US office worker respondents (analytic sample) ($N = 214$)

Notes: *Mean $\pm$ SD. Data were collected between December 2015 and March 2016. The sample comprises office workers at a major health insurer in North Carolina who were enrolled in the baseline phase of a worksite nutrition intervention study ($N = 357$) and completed the questionnaire ($N = 217$; response rate = 60.8%). The analytic sample is 214 participants due to three participants missing on all item data

| Construct	1	2	3	4	5	6	7
1. Behavioral beliefs	–						
2. Normative beliefs	0.54*	–					
3. Control beliefs	0.52*	0.40*	–				
4. Attitudes toward behavior	0.60*	0.33*	0.31*	–			
5. Subjective norm	0.42*	0.77*	0.30*	0.25*	–		
6. Perceived behavioral control	0.39*	0.30*	0.75*	0.24*	0.22*	–	
7. Intention	0.42*	0.37*	0.57*	0.37*	0.36*	0.69*	–
Mean ± SD	100.6 ± 22.4	44.5 ± 19.8	78.0 ± 24.6	22.5 ± 2.9	11.6 ± 2.4	15.2 ± 3.1	12.5 ± 2.6

Notes: The correlation matrix for the latent variables in the structural model (i.e. TPB constructs) was estimated using the TECH4 command in Mplus. The means and SDs were calculated from a sum of items used to represent each construct in the model in Stata. Item-pairs from the Healthful Eating Belief scales were used to measure behavioral ($N = 5$ indicators), normative ($N = 3$ indicators) and control beliefs ($N = 5$ indicators). Additional scales were used to measure attitudes toward behavior ($N = 5$ items), subjective norm ($N = 3$ items), perceived behavioral control ($N = 4$ items) and intention to eat a healthful diet ($N = 3$ items). All item scales were five-point Likert-type, with higher scores indicating more positive healthful eating perceptions; *$p < 0.001$

Confirmatory factor analysis
Owing to high kurtosis values outside the $|2.0\text{-}7.0|$ range indicative of normality, we treated the data as multivariate non-normal with robust maximum likelihood estimation for the confirmatory factor analysis. The model fit was poor: $\chi^2 = p < 0.0001$, RMSEA = 0.08, CFI = 0.83, TLI = 0.81, SRMR = 0.10. Given the poor fit, we excluded two indicator variables of attitude and perceived behavioral control with statistically non-significant R^2 values. The model fit slightly improved, but remained unsatisfactory: $\chi^2 = p < 0.0001$, RMSEA = 0.06, CFI = 0.90, TLI = 0.89, SRMR = 0.08. We then proceeded to assess theory-grounded model modifications by examining the modification indices. We re-specified the model with two error covariances between two indicator variables of attitude and two indicator variables of perceived behavioral control due to modification indices of 16.38 and 16.21, respectively. Although step-wise model modifications are preferred, we proceeded to re-specify both in the same model given the comparable modification indices. The model fit indices appeared to slightly improve: $\chi^2 = p < 0.0001$, RMSEA = 0.06, CFI = 0.91, TLI = 0.90, SRMR = 0.08. We then re-specified the model due to a large modification index (32.59), suggesting that error terms of two indicator variables in attitude should be correlated. The model fit indices appeared satisfactory: $\chi^2 = p < 0.0001$, RMSEA = 0.06, CFI = 0.92, TLI = 0.91, SRMR = 0.07. As there were no other theory-grounded modifications suggested, we considered this to be our final model. The Cronbach's alpha for each scale was acceptable ($\alpha = 0.72\text{-}0.95$).

Structural equation modeling
The hypothesized TPB model was satisfactory according to model fit criteria: $\chi^2 = p < 0.0001$, RMSEA = 0.06, CFI = 0.911, TLI = 0.900, SRMR = 0.094. All TPB relationships were statistically significant and positive (Figure 1). Behavioral beliefs, normative beliefs and control beliefs were positively associated with attitudes ($\beta = 0.60$; $p < 0.001$), subjective norm ($\beta = 0.77$; $p < 0.001$) and perceived behavioral control ($\beta = 0.75$; $p < 0.001$), respectively. In turn, attitudes ($\beta = 0.19$; $p = 0.002$), subjective norm ($\beta = 0.17$; $p = 0.02$) and perceived behavioral control ($\beta = 0.62$; $p < 0.001$) were positively associated with intention.
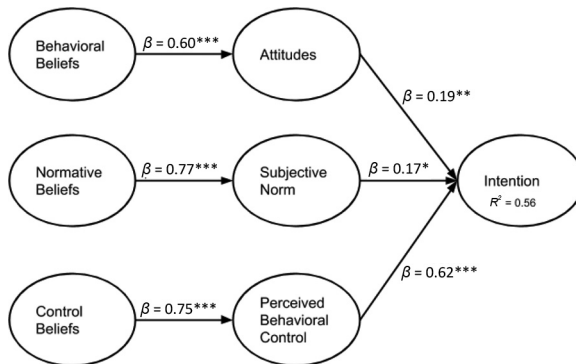
Notes: Standardized structural beta coefficients shown for each path. All constructs were significantly and positively related as posited by the TPB. Perceived behavioral control over healthful eating was particularly strongly associated with intention to eat a healthful diet (standardized $\beta = 0.62$; $p < 0.001$). Worksite path and indirect effect coefficients are not shown. ***$p < 0.001$; **$p < 0.01$; *$p < 0.05$

Additionally, the indirect effects of behavioral beliefs ($\beta = 0.11$; $p = 0.008$), normative beliefs ($\beta = 0.13$; $p = 0.02$) and control beliefs ($\beta = 0.46$; $p < 0.001$) on intention were all statistically significant. Beliefs, attitudes, subjective norm and perceived behavioral control explained over half of the variance in intention to eat a healthful diet ($R^2 = 0.56$).

Discussion

The present study investigated the utility of the TPB in explaining intention to eat a healthful diet in a sample of southeastern US office workers. The TPB model exhibited satisfactory fit to the data according to model fit criteria. We found that beliefs, attitudes, subjective norm and perceived behavioral control explained over half of the variance in intention to eat a healthful diet. These findings suggest that office workers with more positive attitudes toward eating a healthful diet, greater perceived social pressure to eat a healthful diet and greater perceived control in eating a healthful diet reported greater intention to eat a healthful diet in the next 12 months.

The observed associations between TPB constructs are consistent with previous research. A 2015 systematic review and meta-analysis of studies applying the TPB to explain and predict dietary behaviors studies found that attitudes, subjective norm and perceived behavioral control were consistently associated with intention to engage in the behavior as hypothesized (McDermott *et al.*, 2015). Importantly, intention was shown to be a significant predictor of behavior across studies (pooled mean effect size = 0.47). Therefore, TPB-based interventions that modify intention to eat a healthful diet in this population are likely to consequently affect behavior.

Attitude toward behavior, subjective norm and perceived behavioral control significantly mediated relationships between beliefs and intention. These results confirm that Blue and Marrero's scales are indeed tapping beliefs that inform TPB constructs predicting intention. Interestingly, the indirect effect of control beliefs on intention reflected

the outsize impact of perceived behavioral control, and it was about four times larger than those of behavioral beliefs and normative beliefs (β = 0.46l; $p < 0.001$). A potential explanation is that the indirect belief measure of control beliefs may have better encompassed the participants' modal belief set (i.e. items reflected salient beliefs) compared to the behavioral belief and control belief measures.

Of TPB constructs, perceived behavioral control was the most strongly associated with intention to eat a healthful diet. Therefore, interventions that intervene upon perceived behavioral control by improving one's perception that healthful eating is in his/her control might positively impact intention to eat a healthful diet and subsequent healthful eating behavior. One's perception of behavioral control, and related self-efficacy, may be rooted in internal or external factors related to eating a healthful diet (Povey *et al.*, 2000). For instance, perceived behavioral control may reflect internal skills and abilities needed to maintain a healthful diet, such as cooking and planning of healthful meals (Ajzen, 1991). Therefore, nutrition education interventions that build cooking and home food preparation skills may increase one's perceived behavioral control over eating a healthful diet, and subsequently increase the likelihood of healthful eating (Reicks *et al.*, 2014). Meanwhile, external factors such as lack of access and availability to nutritious foods that enable healthful eating might necessitate community and public policy interventions that reduce the cost and improve availability of healthful foods (Larson *et al.*, 2009; Story *et al.*, 2008).

These results must be interpreted along with their limitations. We did not include a measure of healthful eating behavior (i.e. food consumption) in the analysis. A recent systematic review and meta-analysis of TPB applications in dietary behavior research found that the relationship between intention and dietary behavior is strong, but it may vary according to the food intake measurement method (i.e. self-reported or objective) and other unknown variables (McDermott *et al.*, 2015). The original Healthful Eating Belief Scales exhibited poor model fit, indicating that the scales may not have completely captured salient beliefs of the study population. A modified version, however, did achieve good fit. Application of more restrictive goodness-of-fit cutoff criteria may indicate poorer model fit. Findings are generalizable to adults working in office settings located in urban areas of Southeastern USA.

The strengths of the study are myriad. Our findings fill a gap in the literature regarding the TPB as applied to healthful eating behavior among office workers. Therefore, our study contributes important information to the evidence base for uptake of workplace health researchers and practitioners developing nutrition interventions. We assessed the underlying behavioral, normative and control beliefs that are scarcely measured in TPB studies, but important to understanding which particular beliefs compose higher order TPB constructs (i.e. attitudes, subjective norm and perceived behavioral control) and could be targeted through intervention programming. The usage of a structural equation modeling approach to analyze the unobservable psychological variables in the study herein adds robustness to our results by properly accounting for measurement error.

Conclusions

Our findings suggest that interventions to improve healthful eating among Southeastern US office workers may use the TPB to guide intervention development. Intervention components that seek to change attitudes toward healthful eating, perception of others' beliefs about healthful eating, and barriers toward healthful eating may be successful. Given the outsize role of perceived behavioral control on intention, intervention components should consider targeting control beliefs that inhibit consumption of a healthful diet.

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