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Exploring the Theory of Planned Behavior to Explain Sugar-Sweetened Beverage Consumption

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Abstract

Objective—To describe sugar-sweetened beverage (SSB) consumption, establish psychometric properties and utility of a Theory of Planned Behavior (TPB) instrument for SSB consumption.

Methods—This cross-sectional survey included 119 southwest Virginia participants.

Respondents were majority female (66%), white (89%), $\leq$ high school education (79%), and averaged 41.4 (± 13.5) years. A validated beverage questionnaire was used to measure SSB.

Eleven TPB constructs were assessed with a 56-item instrument. Analyses included descriptive statistics, one-way ANOVAs, Cronbach alphas, and multiple regressions.

Results—Sugar-sweetened beverage intake averaged 457 (± 430) kilocalories/day. The TPB model provided a moderate explanation of SSB intake ($R^2=0.38$; $F=13.10$, $P<0.01$). Behavioral intentions had the strongest relationships with SSB consumption, followed by attitudes, perceived behavioral control, and subjective norms. The six belief constructs did not predict significant variance in the models.

Conclusions and Implications—Future efforts to comprehensively develop and implement interventions guided by the TPB hold promise for reducing SSB intake.

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Keywords

beverages; health behavior; psychometrics

Introduction

The intake of sugar-sweetened beverages (SSB) in the US and the associated compelling health implications have received heightened attention in recent years. This increased focus has prompted the proposition and debate of taxing SSB^{1, 2}. Despite this controversial tax dispute and the strong scientific data indicating associations among SSB and numerous health issues such as obesity, diabetes, cardiovascular disease, and oral health^{3, 4}, clearly absent from the literature are behavioral trials that specifically target SSB consumption among adults.

Supported by the facts that intake of caloric beverages doubled from 1977 to 2002 across all age groups in the US⁵, and that SSB currently contributes approximately 10% of total energy intake for US adults⁶, SSB are an obvious target for behavioral interventions. As behavioral scientists begin to strategize on appropriate experimental approaches to reduce SSB consumption, health behavior theory should serve as the foundation for program planning and evaluation. Indeed, reviews of literature on other health behavior change interventions have consistently found larger effects for theory-based interventions compared to those lacking a comprehensive theoretical basis^{7, 8}. Unfortunately, there have been few theoretical attempts aimed at understanding or intervening to reduce SSB consumption^{9, 10}, and none among adults.

The Theory of Planned Behavior (TPB) is one of the most well-studied and valuable theories for explaining and predicting behavior and has been applied to a wide variety of health contexts, including eating and drinking behaviors¹¹⁻¹⁶. The TPB posits that behavioral intention is the most proximal determinant of a person's behavior and antecedents to behavioral intentions include three independent constructs: one's positive or negative evaluation towards performing the behavior (attitudes), one's perception about the social expectations or how others would approve and disapprove of the behavior (subjective norms), and beliefs related to the perceived ease or difficulty of completing a particular behavior (perceived behavioral control)^{17, 18}. Furthermore, attitudes are influenced by behavioral beliefs and evaluation of behavioral outcomes, subjective norms are influenced by normative beliefs and motivation, and perceived behavioral control is influenced by control beliefs and perceived power. Finally, implementation intention or the idea of advanced planning to incorporate the behavior change, has also shown to be an important predictor of behavioral intention enactment¹⁹.

In the context of addressing SSB behaviors, the underlying long-term goal of this research is to comprehensively apply health behavior theory at all phases of intervention development, implementation, and evaluation. While the TPB can be used for all phases of intervention development, implementation, and evaluation, in a review of 24 interventions (of which five were nutrition related) the TPB was used less frequently for invention development purposes and more often for process and outcome evaluation purposes¹⁴. Given the demonstrated usefulness of the TPB on understanding a wide variety of individual level health behaviors, including eating behaviors,^{13, 20} and capitalizing on recommendations urging health educators and researchers to comprehensively and explicitly apply the TPB to behavior change interventions^{14, 20}, this theory was chosen as an appropriate fit to guide our SSB research and advance application of the TPB. For example, once TPB constructs related to SSB are identified and more fully understood, interventions can be developed to target and

change beliefs, attitudes, subjective norms, and/or perceived behavioral control, which may lead to subsequent changes in intentions and SSB behaviors²⁰. Since the TPB is an individual-level behavioral theory, full socio-ecological influences on SSB are not captured¹⁷.

This research targets the Appalachia region of rural Southwest Virginia. The education, health, and economic disparities of this region are well-documented and residents often lack access to health care services and face water quality issues²¹. These compounded disparities signify the need to reach individuals in this region and to develop and implement theory-driven behavioral interventions targeting nutrition behaviors.

To gain theoretical perspective and promote development of an empirical assessment instrument for future SSB interventions, the objectives of this formative research were to: 1) describe SSB consumption, 2) adapt a previously developed and validated TPB instrument for SSB consumption and explore the psychometric properties of the adapted instrument, and 3) explore the utility of the TPB to explain SSB consumption.

Methods

Recruitment and Procedures

This study was approved by the Virginia Tech Institutional Review Board. The target population included adults residing in southwest Virginia. Median annual household income in this region is \$30,900, compared to a US average of \$42,000²². This region is predominantly white (95%), with equal distribution of men and women, and approximately 32% of the population with less than a high school education, 52% with a high school education, and 16% with a college degree²². Our sampling plan was designed to match the regional education level distribution to promote generalizability of the findings.

Three community health workers were hired and trained to recruit participants according to the proportional sampling plan. Participants were recruited through word-of-mouth at a variety of diverse settings including worksites, GED programs, and a training center. Surveys were administered in small groups, whereby a trained research assistant read the survey out loud while the participants recorded their own answers. Participants received a \$20 gift card.

Instruments

SSB Intake—The valid and reliable 19-item quantitative beverage intake questionnaire to assess beverage intake patterns over the past month was used²³. The instrument queries seven frequencies including: never or less than 1 time/week, 1 time/week, 2-3 times/week, 4-6 times/week, 1 time per day, 2 times per day, or 3 or more times per day. Portion sizes are also reported in fluid ounces and include less than 6, 8, 12, 16, or more than 20. SSB intake is quantified by summing kilocalories from seven items including regular soft drinks, sweetened juice beverage/drink, sweetened tea, coffee with sugar, mixed alcoholic drinks, meal replacement shakes/protein drinks, and energy drinks.

Theory of Planned Behavior—Although the referent behaviors are different across previously developed TPB measures, these instruments have notable and consistent similarities across anchored scales for attitudes, subjective norms, perceived behavioral control, and intention. Furthermore, given that beliefs are an integral component of Azjen's TPB model, including them in this developmental phase was important, despite the fact that the majority of quantitative instruments do not account for these belief statements^{14, 20}. As a logical extension for the first phase of instrument development, we adapted a comprehensive

physical activity TPB instrument to anchor the targeted behavior to SSB²⁴. This adapted 56-item instrument accounted for 11 theoretical constructs (Figure 1). Survey adaptations were made and reviewed by three doctoral-level behavioral scientists with nutrition expertise. The instrument was then pilot tested with six individuals resulting in improvements related to layout and flow of the questionnaire, clarification of instructions, and pictorial representation for the referenced behavior “less than 1 cup of sugar-sweetened drinks each day.”

Demographics—Demographic questions included race/ethnicity, gender, age, education levels, income levels, health status, and self-reported height and weight.

Data Analysis

Descriptive statistics including frequencies, means, and standard deviations were used to summarize all responses. Skewness, kurtosis, and Kolmogorov-Smirnov tests were used to confirm normal data distribution. One-way ANOVA tests were used to examine associations of demographic characteristics with SSB intake. Cronbach alphas and item analysis statistics were used to evaluate the internal consistency and guide decision making. Pearson correlations were examined to explore the relationships among constructs. Hypothesized relationships among the TPB constructs (as illustrated in Table 1) were investigated using sequential multiple regression. Sequential multiple regression allows entry of variables into the model in a pre-determined order, in this case as guided by the TPB, and allows focus on changes in the proportion of total variance (R^2)²⁵. All independent variables were centered prior to analyses and standardized coefficients are reported and interpreted. Significance is reported at both the $P < 0.05$ and $P < 0.01$ levels. PASW Statistics (version 18.0, SPSS Inc., Chicago, IL, 2009) was used to analyze data. The multiple regression analyses rule-of-thumb ($n \geq 50 + 8m$, where m equals the number of predictor variables) to detect a moderate effect size with 80% power and an alpha of 0.05 was applied²⁶. A priori hypothesis included a maximum of five predictor variables per model; therefore ≥ 90 participants provide sufficient power. Given the timeline and resources to execute this study, we aimed to survey 120 participants.

Results

Of the 120 participants, one was excluded due to a large amount of incomplete data resulting in 119 participants included in these analyses. The majority of participants were female (66%), white (89%), with $\leq$ high school education (79%), an approximate average annual income of \$28,700 ($\pm 17,300$), and a mean age of 41.4 (± 13.5) years. As compared to the demographic profile of the region, educational achievement levels were appropriately represented, as are race and average income levels; however, men were somewhat underrepresented in the sample. Body Mass Index (BMI) was calculated using self-reported height and weight and revealed that 67% of participants were categorized as overweight or obese. As compared to their counterparts, men ($F = 5.9$, $P = 0.02$) and younger ($F = 3.7$; $P = 0.01$) participants consumed significantly more SSB kcals/day. However, SSB kcals/day did not vary by race, educational attainment, income level, or BMI. Mean intake of sugar-sweetened beverages was 457 (± 430) kcals/day or 38 (± 34) fluid ounces/day. Of all respondents, 82% exceeded the recommendation to limit SSB intake to 0-8 ounces/day^{27, 28}.

Figure 1 illustrates the resulting adjusted Cronbach alphas and Pearson correlation coefficients among the TPB constructs. This figure does not infer causality among the constructs, rather illustrates the bidirectional relationship among constructs. Of the 11 TPB constructs, four constructs (implementation intentions, behavioral intentions, normative beliefs, and control beliefs) had strong internal consistency for all items included, hence no

changes were made. For three constructs (behavioral beliefs, motivation to comply, and attitudes) Cronbach alphas improved with dropping one or more items. Item analysis revealed no improvements with dropping items for the three remaining constructs (perceived power, subjective norms, and perceived behavioral control). Correlations among behavioral intention, implementation intentions and SSB consumption were significant. Attitudes, subjective norms, and perceived behavioral control were all significantly correlated with behavioral intentions. Four of the six belief constructs correlations were not significantly correlated to hypothesized constructs.

In the TPB model to explain SSB consumption, addition of each sequential construct significantly improved the variance explained by the model and 38% of the variance in SSB consumption is explained by behavioral intentions, perceived behavioral control, subjective norms, and attitudes (Table 1). Behavioral intentions had the strongest relationship with SSB intake, followed by attitudes, perceived behavioral control, and subjective norms. In a subsequent analysis, we controlled for age, gender, and education level. As expected, the overall explained variance increased; however, only slightly to 41% ($F=9.0$; $P<0.01$). These demographic variables were not significant and did not result in any meaningful change in interpretation of the TPB coefficients (data not shown).

The model to explain SSB attitudes from behavioral beliefs and evaluation of behavioral outcomes was not significant (Table 1). The subjective norms model was significant, yet the interaction term did not yield significant improvements in the R^2 . Interpretation of the coefficients indicates that normative beliefs provide the only meaningful explanation of subjective norms. A similar phenomenon is revealed in the perceived behavioral control model, whereby the overall model is significant, yet perceived power accounts for the explained variance as coefficients associated with control beliefs and the interaction term are not significant.

Discussion

The average amount of empty calories consumed from SSB in this population has alarming implications for obesity and obesity-related chronic diseases. This study is an essential preliminary step to guide emerging programming efforts and establish appropriate metrics for SSB interventions. The amount of variability (38%) explained by the primary constructs of the TPB indicates that behavioral intentions, perceived behavioral control, subjective norms, and attitudes provide a moderate explanation for SSB intake. Evidenced by the non-significant beta coefficient, our findings also suggest that implementation intentions may be redundant to the broader concept of behavioral intentions when considering SSB intake.

In general the resulting TPB constructs had moderate to high internal consistency. Contrary to our hypothesis, four of the six belief statements revealed weak correlations and insignificant contribution to the models. It is feasible that the belief statements included in this phase were not appropriate items and therefore it is premature to reject the belief constructs at this early formative instrument development phase. As a result of this study, and as recommended in application of the TPB²⁰, we are currently conducting an elicitation phase (i.e. eight focus groups) to better understand the salient beliefs associated with SSB in the target southwest Virginia population. The underlying behavioral beliefs associated with attitudes, perceived behavioral control, and subjective norms have been previously established as important constructs for planning and implementing TPB interventions^{11, 18, 20}; however, belief statements are rarely assessed in quantitative evaluations of health behaviors. For example, in a systematic review of the TPB interventions or evaluation¹⁴, only one of 24 studies measured the belief statements²⁹. Future research is needed to discern the utility of behavioral beliefs in the evaluation of

health behavior interventions, including SSB consumption. In the future, we intend to apply findings from this formative study and the elicitation phase to revise the TPB instrument for SSB, and subsequently develop, implement, and test TPB-guided SSB interventions.

Since previous TPB instruments for attitudes, subjective norms, perceived behavioral control, and intention are remarkably similar, despite diverse referent behaviors, conducting this development phase on an adapted instrument was a logical first step and extension of the research. While the behavioral beliefs are an important part of the theory and require additional work, we still found that a priori hypotheses were, on the whole, supported. Understanding the efficiency of the TPB for SSB is important, as the theory has been shown to vary widely across behavioral categories. Our findings can be compared to eight eating behavior studies reviewed by Godin and colleagues, where the average correlations between eating behavior intentions and attitude, subjective norm, and perceived behavioral control was 0.34, 0.16, and 0.32, respectively¹³. Our findings reveal stronger correlations with SSB intentions. Our correlation of -0.51 between behavior and intention is comparable to the average correlation of 0.46 in the other 26 health behavior papers. The majority of papers reviewed included four variables (attitude, subjective norm, perceived behavioral control, and intention) to explain behavior¹³. Based on a similar number of predictor variables, the amount of variance explained by our SSB model (R^2 of 0.38) is comparably stronger than the two eating behaviors papers and 35 health behavior papers reviewed by Godin, which reveal average R^2 of 0.25 and 0.34, respectively. Similar to previous findings that highlight the utility of applying the TPB to understanding eating intentions and behaviors¹⁵, our findings are important because they help establish the usefulness of a TPB-guided framework to understand and intervene on SSB behaviors.

There are only two known behavioral intervention studies that have examined changes of SSB behavior among adults, neither of which were designed a priori to intervene on or test specific effects of decreasing SSB^{30, 31}. These studies illustrate that reductions in SSB are feasible; however, they also indicate the need for theoretically-guided prospective studies to investigate the effectiveness of intervention strategies that specifically target SSB consumption among adults. While the predictive capability of perceived behavioral control, subjective norms and attitudes has been shown to vary substantially across health behaviors, our study results indicate that when developing and executing SSB interventions, it will be important to address perceived behavioral control, subjective norms and attitudes.

While the representativeness of the sample promotes generalizability to the greater health disparate southwest Virginia region, the participants are not representative of the greater US population and the sample size is relatively small. This study should be replicated in a larger more diverse sample and include advanced analysis techniques such as structural equation modeling and Bayesian Information Criteria³². Since no objective measures of SSB exists, a validated self-reported SSB instrument was used²³; nevertheless, the self-report can be viewed as a study limitation.

Implications for Research and Practice

These new findings contribute to the body of knowledge related to theoretical approaches aimed at understanding SSB. While this study reveals promise in the utility of the TPB to explain SSB behaviors, it also highlights the need for further qualitative investigation of beliefs surrounding SSB consumption. Developing appropriate metrics for behavioral interventions is a critical step, yet the resources required to appropriately accomplish this task are frequently underestimated. Nutrition educators and behavioral scientist need to comprehensively understand how theoretical constructs, and the measurement of those constructs, influence intention and targeted behaviors. It is equally as important to recognize

and utilize intervention strategies to address TPB constructs, including transmission of information, persuasive communication, increasing skills, goal setting, rehearsal of skills, modeling, planning and implementation, and social encouragement and support¹²⁻¹⁴. The instrument from this study and the developing SSB-TPB framework are particularly timely and applicable given the recent media attention, proposed sin tax, and emerging public health concerns related to SSB. While economic and/or environmental efforts to reduce SSB are important, behavioral interventions are also needed to complement and enhance these efforts.

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Figure 1.
Internal Reliability of Scales (adjusted Cronbach α), One Example Item for Each Scale, and Relationships (Pearson Correlation Coefficients) among the Theory of Planned Behavior Constructs for Sugar Sweetened Beverage Consumption
* $P < 0.001$

Table 1
Prediction of Sugar Sweetened Beverage (SSB) Consumption from the Theory of Planned Behavior Constructs

Predictor Variable	F	R ²	Standardized Coefficients in Final Model
Model 1: Predicting SSB Consumption			
Step 1: Implementation Intentions	21.23**	0.16 ^t	0.18
Step 2: Behavioral Intentions	20.15**	0.27 ^t	-0.32*
Step 3: Perceived Behavioral Control	17.26**	0.32 ^t	-0.22*
Step 4: Subjective Norms	13.10**	0.38 ^t	-0.18*
Step 4: Attitudes	13.10**	0.38 ^t	-0.26**
Model 2: Predicting Attitudes related to SSB			
Step 1: Behavioral Beliefs	1.75	0.17	0.06
Step 1: Evaluation of Behavioral Outcomes	1.75	0.17	0.17
Step 2: Interaction Behavioral Beliefs × Evaluation of Behavioral Outcomes	1.85	0.22	0.15
Model 3: Predicting Subjective Norms related to SSB			
Step 1: Normative Beliefs	17.85**	0.25 ^t	0.48**
Step 1: Motivation to Comply	17.85**	0.25 ^t	0.13
Step 2: Interaction Normative Beliefs × Motivation to Comply	11.60**	0.25	-0.01
Model 4: Predicting Perceived Behavioral Control related to SSB			
Step 1: Control Beliefs	17.44**	0.23 ^t	-0.09
Step 1: Perceived Power	17.44**	0.23 ^t	0.46**
Step 2: Interaction Control Beliefs × Perceived Power	11.80**	0.24	0.07

* $P < 0.05$;

** $P < 0.01$;

^t $\Delta R^2 < 0.05$