Adolescent Sugar-Sweetened Beverage Consumption: An Extended Health Action Process Approach

Chun-Qing Zhang & Marco Cheuk-Yiu Wong

Hong Kong Baptist University

Ru Zhang

The Chinese University of Hong Kong

Kyra Hamilton

Griffith University

Martin S. Hagger

University of California, Merced and University of Jyväskylä

Author Note

Chun-Qing Zhang and Marco Cheuk-Yiu Wong, Department of Sport and Physical Education, Faculty of Social Sciences, Hong Kong Baptist University, Hong Kong; Ru Zhang, Department of Sports Science and Physical Education, The Chinese University of Hong Kong, Hong Kong; Kyra Hamilton, School of Applied Psychology, Menzies Health Institute Queensland, Griffith University, Brisbane, Queensland, Australia; Martin S. Hagger, Psychological Sciences, University of California, Merced, USA and Faculty of Sport and Health Sciences, University of Jyväskylä, Jyväskylä, Finland.

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Correspondence concerning this article should be addressed to Dr. Chun-Qing Zhang at Department of Sport and Physical Education, Faculty of Social Sciences, Hong Kong Baptist University. Address: 224 Waterloo Road, Kowloon Tong, Kowloon, Hong Kong SAR, China. Tel: +852-3411 6404. Fax: +852- 3411 5757. Email: cqzhang@hkbu.edu.hk

Abstract

Objective: Consumption of excess added sugar in the form of sugar-sweetened beverages (SSBs) contributes to a wide range of health concerns in adolescents. Identification of modifiable determinants of SSB consumption based on behavioral theory may inform development of interventions aimed at reducing SSB consumption. The aim of the current study was to test the efficacy of an extended version of the health action process approach to predict adolescent SSB consumption.

Methods: Using a prospective design, adolescent students ($N = 450$) self-reported their outcome expectancies, perceived behavioral control, intentions, habit, action, maintenance, and recovery self-efficacy, action and coping planning, perceived affordability, and past behavior with respect to SSB consumption. One month later, participants self-reported their SSB consumption.

Results: A structural equation model revealed significant direct effects of action self-efficacy, outcome expectancies, and perceived behavioral control on intentions to reduce SSB consumption. Significant direct effects of action self-efficacy on maintenance self-efficacy, and maintenance self-efficacy on recovery self-efficacy, were also identified. There were significant direct effects of intentions and maintenance self-efficacy on action and coping planning. Only intentions and perceived affordability had significant direct effects on SSB consumption. There were also indirect effects of outcome expectancy and perceived behavioral control on SSB consumption mediated by intentions. Inclusion of past behavior attenuated model effects, with past behavior the only remaining predictor of SSB consumption.

Conclusions: Findings indicate that adolescent SSB consumption is predicted by intentions and perceived affordability, but effects were extinguished by the inclusion of past behavior. The pervasive effects of past behavior point to the importance of identifying potential mediators of past behavior in future research, and that interventions targeting non-conscious rather than intentional processes may be most effective in reducing SSB consumption.

***Key words**:* sugar-sweetened beverages; sugar intake; young people; health action process approach

The prevalence of child and adolescent obesity has escalated, and is now a global public health concern (Lobstein et al., 2015; Wang, Monteiro, & Popkin, 2002). Recently, the World Health Organization (WHO, 2017) estimated a tenfold increase in the number of obese children and adolescents worldwide, from 11 million in 1975 to 124 million in 2016. Although the cause of child and adolescent obesity is complex and multidimensional, the consumption of sugar-sweetened beverages (SSBs) has emerged as a key contributor. SSBs[1] are energy-dense, nutrient-poor beverages with various forms of added sugar, such as soft drinks and sodas. Epidemiological studies have revealed a positive association between adolescent obesity and SSB consumption (Berkey, Rockett, Field, Gillman, & Colditz, 2004; Ludwig, Peterson, & Gortmaker, 2001; Malik, Schulze, & Hu, 2006). In addition, consumption of SSBs worldwide has increased over the years. For example, 215% and 147% increases in daily caloric consumption per capita attributable to sales of SSB by the Coca-Cola and PepsiCo companies, respectively, were noted between the years 2000 to 2010 in China (Kleiman, Ng, & Popkin, 2012). A recent national survey indicated that 66.6% of Chinese children and adolescents consumed SSB each week, and those with the highest SSB consumption were more likely to be obese (Gui et al., 2017). As a consequence, limiting the consumption of SSBs is a key strategy for weight management and promoting good health in young people (WHO, 2015).

In order to develop effective strategies for reducing the adolescents' consumption of SSB, systematic research identifying of the determinants of SSB consumption is needed (Bere, Glomnes, Velde, & Klepp, 2007). These determinants may comprise demographic (e.g., education, socioeconomic status), ecological (e.g., SSB availability and proximity), and psychological (e.g., attitudes, beliefs, motives) variables. Researchers have, therefore, turned to behavioral theory to guide investigation into identifying these determinants for SSB consumption and, importantly, the processes by which these determinants relate to each other and behavior. The promise of these

[1]Examples of SSBs include, but are not limited to, regular soda, fruit drinks, sports drinks, energy drinks, sweetened waters, and coffee and tea beverages with added sugars (DeSalvo, Olson, & Casavale, 2016).

theories is that they enable identification of the factors that are most proximal determinants of behavior and, with sufficient formative research in the population and behavior of interest, signal the important targets for interventions aimed at fostering greater participation in the behavior (cf., Hagger & Weed, 2019).

However, previous research examining the determinants of SSB consumption has been dominated by single social cognition theories and tended to focus on a relatively narrow set of determinants, particularly those that reflect more reasoned, deliberative determinants of action. For example, multiple studies have applied the theory of planned behavior (Ajzen, 1991), a social cognitive theory that focuses on the belief-based determinants of intentional behavior, to identify the correlates of SSB consumption (e.g., Riebl et al., 2016; Zoellner, Estabrooks, Davy, Chen, & You, 2012). The theory identifies the personal (attitudes), social (subjective norms), and control-related (perceived behavioral control) sets of beliefs that determine intentions to engage in the behavior of interest in future, with intentions expressed as the most proximal predictor. Results have indicated that intention was a consistent and proximal predictor of SSB consumption, with attitudes, perceived behavior control, and subjective norms having significant associations (Riebl et al., 2016; Zoellner et al., 2012; van der Horst et al., 2008). Another important finding of this research is that the social cognitive variables mediated the effect of ecological factors on behavior. For example, van der Horst found that closeness of the nearest store selling SSBs and the density of those stores in the neighbourhood was negatively related to intentions, attitudes, and norms to consume SSBs, which was related to lower consumption.

While the theory has demonstrated utility in identifying correlates of SSB consumption, it likely provides an incomplete account. For example, previous research in multiple health behaviors has noted the imperfect link between intentions and behavior, suggesting that many individuals (up to 42%) do not enact their intentions (Rhodes & de Bruin, 2013; Orbell & Sheeran, 1998; Sheeran & Webb, 2016). This presents a problem when it comes to using such theories as a basis for

behavioral interventions, because facilitating change in the determinants of intention may not lead to very large changes in behavior (Webb & Sheeran, 2006).

Alternatives have been proposed in so-called dual-phase models, which segregate action into a motivational phase in which intentions are formed, and a volitional phase in which they are enacted (e.g., Hagger & Chatzisarantis, 2004; Heckhausen & Gollwitzer, 1987; Rhodes, 2017; Schwarzer, 2008). A prominent dual-phase model is the health action process approach (HAPA; Schwarzer, 2008). As with many dual-phase models, the HAPA outlines the factors that determine intentions, but also specifies the volitional processes such as planning that assist in the enactment of intentions, and 'bridge the gap' between intention and behavior (Hagger et al., 2016). Determinants of intentions include action self-efficacy (beliefs in competence to actually perform the behavior), outcome expectancies (perceived benefits and detriments of possible actions), and risk perceptions (perceived threat or risk to health of failing to act). Two kinds of planning are specified in the HAPA: action planning (i.e., planning when, where, and how to perform the desired health behavior after the form of intention) and coping planning (i.e., plans to cope with challenging situations or obstacles that hinder performance of the intended behavior) (Scholz, Schüz, Ziegelmann, Lippke, & Schwarzer, 2008). These forms of planning are proposed to mediate effects of intentions on behavior, such that individuals reporting strong intentions, and action and coping plans, are more likely to participate in the behavior. A unique aspect of the HAPA is the specification of 'phase-specific' types of self-efficacy. While action self-efficacy is a determinant of intentions, maintenance self-efficacy (confidence in persevering with the action in the face of obstacles) and recovery self-efficacy (confidence in re-engaging in the behavior after encountering unforeseen difficulties) are proposed as predictors of intentions and direct predictors behavior in the volitional phase. The latter effects outline how beliefs in confidence further guide behavior, particularly behavioral maintenance, after decisions have been made.

The HAPA has been widely applied to the prediction health behaviors, with meta-analytic evidence supporting the proposed relations among the key variables, with the exception of risk

perceptions, which have negligible effects (Zhang, Zhang, Schwarzer, & Hagger, 2019). The limited effects of risk perceptions is consistent with research examining risk perceptions in numerous studies where the potential threat is not readily apparent to the target population. For example, threat perceptions are less impactful or relevant in populations where the symptoms or indications signalling the health threat are absent, or the threat is perceived to be temporally distal, such as conditions that manifest later in life (e.g., Barg et al., 2012; Hattar, Pal, & Hagger, 2016; Maher & Conroy, 2016; Protogerou, Johnson, & Hagger, 2018). This is also the case for SSB consumption, research has demonstrated that the knowledge of SSB-related health risks is not associated with adolescent SSB intake (Lundeen, Park, Onufrak, Cunningham, & Blanck, 2018). These findings have led researchers to suggest dropping risk perceptions from the model (Maher & Conroy, 2016; Protogerou et al., 2018). Although the HAPA has been shown to be effective in predicting dietary behaviors in adolescents such as daily fruit and vegetable intake and energy-dense food intake (Luszczynska et al., 2016; Szczepanska, Scholz, Liszewska, & Luszczynska, 2013), it has not been used to predict individuals' SSB consumption. Hence, the main aim of the current study was to apply the HAPA to identify the determinants of SSB consumption in adolescents.

However, just like other social cognition theories, the HAPA and other dual-phase models tend to focus exclusively on the reasoned, intentional processes that lead to action. In order to provide a more comprehensive understanding of the determinants of health behaviors, like SSB consumption, studies have aimed to incorporate other salient processes and factors in models aimed at predicting health behavior. Prominent among these additional processes are factors that reflect implicit, automatic processes that determine behavior (Hagger, Trost, Keech, Chan, & Hamilton, 2017), and factors in the environment that influence behavior (van der Horst et al., 2008). Focusing first on implicit processes, researchers have become increasingly interested in constructs that lead to behavioral engagement with little or no deliberation, and cue up behaviors beyond an individual's awareness. This is consistent with dual-process approaches to behavior (Hagger & Chatzisarantis,

2004; Strack & Deutsch, 2004), which propose that individuals' behavior is often instigated or executed by implicit processes that run independent of intentional processes, and lead to fast, efficient behavioral enactment with little conscious input. These processes may include constructs such as implicit attitudes and motives, behavioral scripts, and habits. Habits, in particular, are a specific type of implicit process in which behavior is automatically activated on presentation of a specific cue or context (Gardner, 2015). Habits tend to be developed through repeated exposure of the behavior in the presents of stable cues or contexts. For example, accompanying every meal or lunch break with a soft drink. For behaviors with which the individual has considerable experience in given contexts, habit is likely to be a pervasive predictor of the individual's future participation in the behavior. Numerous means have been used to tap habits, a prominent one has been the use of self-report measures of habit strength. Given the frequency of consumption of SSBs in adolescents, and that fact that consumption is likely coincide with similar contextual features (e.g., with meals, in cafes, during work breaks), it is likely that habits are a pertinent predictor of this behavior. This has been corroborated in research demonstrating that habit strength is a significant direct predictor of SSB consumption (Kremers, van der Horst, & Brug, 2007). In the context of social cognition theories, it is important, therefore, to consider the influence of habit alongside other predictors. The inclusion of habit also provides an important test of the sufficiency of these theories (c.f., Ajzen, 1991; Hagger, Polet, & Lintunen, 2018). If habit is the only predictor of behavior, it means that constructs representing other processes in the theory are essentially redundant as determinants of behavior. Therefore, in the current study, we will include habit strength as a predictor of SSB consumption alongside other constructs of the HAPA.

Given research outlining the importance of environmental factors such as availability and proximity of retail outlets selling SSB in predicting consumption (van der Horst et al., 2008), a consideration of the ecological determinants of SSB would provide a better account of behavior (c.f., Sallis, Owen, & Fisher, 2015). One very important factor is the relative cost or affordability of SSB for adolescents. Research has demonstrated that the consumption of commodities like

cigarettes and alcohol is related to their affordability (Stuckler, McKee, Ebrahim, & Basu, 2012; Guindon, Tobin, & Yach, 2002), and pricing and taxation measures have been shown to be effective in curbing consumption (Keatley et al., 2018; Stockwell et al., 2013). Similarly, in the context of SSB consumption, taxation has been shown to be effective in reducing SSB intake (Brownell et al., 2009; Colchero, Popkin, Rivera, & Ng, 2016). Relative affordability of SSBs, therefore, is likely to be an important correlate of adolescent SSB consumption, particularly given that adolescents' disposable income is likely to be relatively limited and controlled by their parents.

The Current Study and Hypotheses

The aim of the current study was to apply an extended version of the HAPA (Figure 1) to predict SSB consumption in adolescents attending secondary school. The HAPA was extended to incorporate habit, to represent effects of non-conscious, automatic processes that lead to SSB consumption, and perceived affordability of SSBs, to account for a key environmental factor likely to affect SSB consumption. In addition, given the relatively small effects of risk perceptions in the model, particularly for health behaviors where risk to health is distal or not apparent to the target population (c.f., Lundeen et al., 2018), we dropped this variable from the model. Further, considering the expressed conceptual distinction between perceived behavioral control and self-efficacy, at least in models of intention based on the theory of planned behavior (see Armitage & Conner, 1999), we included segregated forms of perceived control and task self-efficacy in motivational phase of the model. The model was tested using a prospective survey study using self-report measures with constructs from the extended version of the HAPA collected at an initial point in time, and a follow-up measure of SSB consumption taken one month later.

The hypothesized relations among constructs of the extended HAPA model are summarized in Table 1. Hypotheses relating to effects of phase-specific self-efficacy, outcome expectancies, intentions, and planning constructs are consistent with previous theoretical specifications of the HAPA (Schwarzer, 2008; Zhang et al., 2019). Focusing on hypotheses relating to the additional constructs included in the extended HAPA, it was expected that self-reported habit of limiting SSB

intake would predict adolescent SSB consumption, consistent with research examining habitual processes in health behavior within social cognition theories (Hagger et al., 2017; Hamilton, Kirkpatrick, Rebar, & Hagger, 2017; Maher & Conroy, 2016). Consistent with social ecological models (e.g., Sallis et al., 2015), it was expected that perceived affordability of SSB will predict SSB consumption. It was also expected that the intention-behavior relation will be moderated by action planning, a prediction derived from the model of action phases (Heckhausen & Gollwitzer, 1997).

Given the pervasive effects of past behavior on key constructs of psychological theories and their relations with health behaviors (e.g., Albarracín, Johnson, Fishbein, & Muellerleile, 2001; Conner, Warren, Close, & Sparks, 1999; Hagger et al., 2018), we also examined a model including past SSB consumption as a predictor all psychological variables and subsequent SSB. Including past behavior is considered an important test of the sufficiency of the model, such as whether the proposed constructs have unique effects on behavior once past behavior is accounted for, and whether the model constructs can adequately account for the effects of past behavior (Ajzen, 1991). If not, the model is effectively redundant as a means to explain behavior, and likely to be ineffective as formative evidence to guide future intervention. Although it was expected that effects of constructs on intention and SSB consumption would be attenuated with the inclusion of past behavior, we also predicted that the constructs will still account for unique variance in intentions and behavior.

Method

Participants

Participants ($N = 450$; 227 males and 223 females) were adolescent students aged 12 to 17 years recruited from three secondary schools in three districts of Hong Kong. Specifically, 10 students were recruited from each class in each school and a total of 15 classes (form 1 to form 5) from each school, resulting a total of 150 students from each school. A statistical power analysis using the gamma-exponential method (Kock & Hadaya, 2018) revealed that a minimum sample size

of 114 was required to detect a small absolute effect size for model parameters (β = 0.221), based on the averaged path coefficients for effects of social cognition constructs (i.e., action self-efficacy, outcome expectancy, and risk perception) on intention in previous research (Zhang et al., 2019), with alpha set at .050 and power set at .800. This indicated the sufficiency of our final sample size (N = 450).

Design and Procedure

After securing permission to conduct the study from school principals, data were collected in the 2017-2018 school year with the help of class teachers. Informed consent forms were obtained from the parents of each student in advance of data collection. The study adopted a prospective correlational design with a one-month follow-up. The one-month time gap has been widely adopted in previous prospective studies applying social cognitive theories to the prediction health behavior. The one month time gap is sufficient to test model effects because it allows for additional information relating to the behavior to come to a light and influence decision making, but it is considered a relatively short-range prediction (McEachan et al., 2016; Zhang et al., 2019). At the first data collection occasion (time 1; T1), participants completed a questionnaire assessing perceived affordability of SSB around their school, psychosocial variables, and baseline SSB consumption. Age, gender, height, and weight were also measured. One month later (time 2; T2), participants completed a follow-up questionnaire comprising a self-report measure of SSB consumption over the previous month. Questionnaires across T1 and T2 were matched using participants' unique student ID number. The Committee on the Use of Human and Animal Subjects in Teaching and Research (HASC) from Hong Kong Baptist University approved the study protocol.

Measures

Psychological constructs from the extended version of the HAPA were measured on multi-item psychometric scales developed using standardized guidelines and validated in previous studies (e.g., Hamilton, Kirkpatrick, Rebar, & Hagger, 2017; Hagger et al., 2017), adapted to the target

behavior in the current study. Brief details of the measures are provided below. Full study measures including all items and response scales and factor loadings of items on each construct are presented in Appendix A (supplemental materials). Participants were informed that they were participating in a study examining their attitudes and beliefs toward beverage using the reference of limiting SSB consumption according to guidelines specified by the U.S. Beverage Guideline Panel, which state that people should drink at most 8 oz (approximately 240 ml) of sugar-sweetened beverages per day in order to reduce health risks. Participants were presented with a definition of an SSB according to the guidelines. An SSB was defined as a non-alcoholic water-based beverage that contain added sugar, excluding 100% fruit juice, non-sweetened drinks, or artificial sweetened beverages. Each item made specific reference to this guideline. The guideline of limiting SSB consumption was not aimed at manipulating adolescents' SSB consumption, but to provide a reference for participants to respond to the survey items[2].

Intention. Participants' intention to limit their SSB consumption was measured on three items (e.g., "Drinking at most 240 ml of sugar-sweetened beverages per day in the coming month is something I intend to do").

Perceived behavioral control. Perceived behavioral control with respect to limiting SSB consumption was assessed using three items (e.g., "Drinking at most 240 ml of sugar-sweetened beverages per day in the coming month is something totally under my control").

Outcome expectancy. Outcome expectancy regarding limiting SSB consumption was assessed using three items (e.g., "If I drink less than 240 ml of sugar-sweetened beverages every day, it is good for my health").

Action self-efficacy. Action self-efficacy regarding limiting SSB consumption was assessed using three items. Participants were presented with the common stem: "I am sure of myself that I

[2]It is possible that presentation of information regarding SSB consumption, or survey items relating to SSB consumption, may have affected participants' behavior. Although there is research suggesting this 'mere measurement' effect exists, the effects are generally small and trivial (Godin et al., 2010).

can drink less than 240 ml of sugar-sweetened beverages every day, even..." followed by three barriers (e.g., "…when I am having a lot of difficulties").

Maintenance self-efficacy. Maintenance self-efficacy regarding limiting SSB consumption was assessed using three items. Participants were presented with the common stem: "I am sure of myself that I can stick to drinking less than 240 ml of sugar-sweetened beverages every day, even..." followed by the same three barriers (e.g., "…when having a lot of difficulties").

Recovery self-efficacy. Recovery self-efficacy regarding limiting SSB consumption was assessed using three items. Participants responded to respond a common stem: "I am sure of myself that I can perform the behaviors of drinking less than 240 ml of sugar-sweetened beverages every day, even..." followed by three issues (e.g., "…when I failed to do so for a couple of days").

Action planning. Action planning was measured by four items assessing the extent to which participants had made a plan to limit their SSB consumption. Participants were presented with the common stem: "I have made a detailed plan regarding..." followed by the four items (e.g., "…where to purchase low-energy alternatives to sugar-sweetened beverages").

Coping planning. Coping planning was measured by three items assessing the extent to which participants had made a plan to limit their SSB consumption when faced with difficulties and barriers. Participants were presented with the common stem: "I have made a plan regarding..." followed by three difficulties or barriers (e.g., "…how to insist on limiting sugar-sweetened beverage consumption when I face difficulties").

Habit. Self-reported habit for limiting SSB consumption was measured using the 12-item self-report habit index (Verplanken & Orbell, 2003). Participants were presented with the common stem: "Drinking less than 240 ml of sugar-sweetened beverages per day is…" followed by the scale items (e.g., "…something I do frequently").

Sugar-sweetened beverage consumption. Participants self-reported their SSB consumption over the previous month consistent with United States guidelines (Popkin et al., 2006). Participants were first presented with an explanation of volume and energy (Kcal) contained in

containers of typical beverages of water, coke, lemon black tea, orange juice, and coffee latte with illustrations. A formula calculating how many cubes of sugar (20Kcal/piece) each beverage contained was also provided. Participants then responded to seven items from the brief version of the beverage intake questionnaire (BEVQ-15; Hedrick et al., 2012) relevant to the adolescent student population. Participants were asked to report their consumption of seven types of SSBs: (a) sugary non-carbonated beverages (e.g., Minute Maid), (b) carbonate beverages (e.g., cola), (c) sugary tea beverages (e.g., iced black tea), (d) sugary coffee beverages, (e) sports beverages (e.g., Pocari Sweat™), (f) energy drinks (e.g., Red Bull™), and (g) other sugary beverages. Participants were asked to report their frequency of SSB consumption: "During the past month, what was your frequency of consumption of the following drinks (per week/per day)?" with responses provided on seven-point scale (0 = *never* and 6 = *at least 3 times per day*). This was followed by a question asking them to rate their quantity of beverage each time: "On average, how many cans/cartons/cups (240 ml per cup) did you drink each time?", with responses provided on five-point scales (1 = *at most 3/4 cup [180 ml)]* and 5 = *at least two and a half cups [600 ml]*). For participants providing a "never" response to the frequency item, the volume item was recorded as zero. Adolescents' daily SSB consumption was calculated by multiplying the frequency (times/day) and amount of beverage consumption per time (ml/time) for each beverage, and then summing the total consumption of all seven types of SSBs to produce an average daily score for the previous month.

Perceived affordability of SSB. Given that the campuses of Hong Kong middle schools are generally compact and without school canteens or vending machines, perceived affordability of SSBs in the school neighborhood was investigated in the current study. Perceived affordability of SSB around school was assessed with one item (i.e., "The price of SSBs in the neighborhood near my school is inexpensive"). Neighborhood was defined as the neighborhood retail environment within a 10-15 minute walk from schools.

Demographic variables. Participants self-reported their grade (Form 1 to Form 5), gender, height (cm), weigh (kg), and living area (New Territories, Kowloon, and Hong Kong Island).

Data Analysis

Descriptive data was analyzed using IBM SPSS Statistics v. 23 (Armonk, NY: IBM Corp, 2015). The proposed integrative model (see Figure 1) was tested using variance-based structural equation modeling (VB-SEM) using the Warp PLS v. 6.0 software (Kock, 2018). VB-SEM is similar to covariance-based SEM in that items measuring study constructs are set to indicate latent variables so that their measurement error can be explicitly modeled. The advantage of VB-SEM is that it is based on ranked data, which is less affected by issues like model complexity and non-normality. VB-SEM is also better suited to estimate complex models with smaller sample sizes. Items from the behavioral, psychological, and demographic measures were set as indicators of the formative latent variables. Proposed paths among model constructs corresponding to our hypotheses were specified as free parameters. The proposed model is illustrated in Figure 1. In addition, we controlled for effects of demographic variables by including paths from each demographic variable to each of the psychological and behavioral variables in the model. We also specified a modified model in which with past behavior was set as a predictor of all psychological and behavioral variables in the model.

Validity and reliability study measures was evaluated by examining the measurement component of the model. Factor loadings and the composite reliability coefficients (ρ) were expected to exceed .700, and the average variance extracted (AVE) values, which provides an evaluation of whether the items for each measure account for sufficient variance in its underlying factor, was expected to approach or exceed .500. Multiple criteria were used evaluate proposed overall goodness of fit of the model with the data. Overall goodness-of-fit of the model was assessed using Tehenhaus et al.'s (2005) goodness-of-fit (GoF) index with values of .100, .250, and .360, corresponding to small, medium, and large effect sizes, respectively (Tenenhaus, Vinzi, Chatelin, & Lauro, 2005). In addition, the average variance inflation factor (AVIF) value for model parameters is expected to be less than 5.000 for a well-fitting model (Kock, 2018). Finally, the

average path coefficient (APC) and the average R^2 (ARS) are expected to be significantly different from zero[3].

Results

Preliminary Analyses

Means, standard deviations, composite reliability coefficients, and inter-correlations for all model variables are presented in Table 2. Reliability coefficients for all measures were all larger than the .700 cut-off criterion. The only exception was the behavior measures, which were assessed by a combined index of frequencies and volumes. Correlations among psychological constructs were generally positive and statistically significant, except the correlations of outcome expectancy with maintenance and recovery self-efficacy, and the correlation between action and coping planning. In addition, the outcome expectancy, perceived behavioral control, intention, and habit of limiting SSB consumption constructs were significantly and negatively correlated with SSB consumption at T1 and T2, although correlations were generally small in size. Perceived affordability of SSB was positively correlated with SSB consumption at T1 and T2. However, the self-efficacy and planning constructs were not correlated with SSB consumption at T1 and T2. Overall, it seems that the self-efficacy and planning constructs were related to intentions and perceived affordability but not SSB consumption.

With respect to measurement model statistics, almost all of the factor loadings exceeded the .700 criterion, with the exception of one item for action planning and one item for the habit scale of SRHI. AVE for most variables exceeded .500, with the exception of the action self-efficacy (AVE = .471), action planning (AVE = .484), and habit (AVE = .333) constructs. In addition, overall model fit was satisfactory for the models excluding (GoF Index = .238; APC = .092, $p < .001$, ARS = .083, $p = 0.035$; AVIF = 1.057) and including (GoF Index = .327; APC = .099, $p < .001$, ARS = .153, $p < .001$; AVIF = 1.060) past behavior, according to the multiple fit indexes adopted.

[3]Data files and analysis output from the VB-SEM analysis are available online: https://osf.io/x2jhr/?view_only=eb860cbae8004d0a946bbee4cd5abddc

Model Effects

Standardized parameter estimates for the hypothesized paths for the model excluding past behavior are presented in Figure 1[4]. There were significant direct effects of action self-efficacy (β = .143, p < .001), outcome expectancy (β = .235, p < .001), and perceived behavioral control (β = .208, p < .001) on intention. Action self-efficacy had a significant, direct effect on maintenance self-efficacy (β = .369, p < .001), while maintenance self-efficacy had a significant direct effect on recovery self-efficacy (β = .273, p < .001). In addition, maintenance self-efficacy had significant direct effects on action planning (β = .213, p < .001) and coping planning (β = .323, p < .001). Similarly, intention had a significant direct effect on action planning (β = .246, p < .001) and coping planning (β = .208, p < .001). However, effects from maintenance self-efficacy (β = .011, p = .446), recovery self-efficacy (β = -.082, p = .107), action planning (β = .070, p = .259), and coping planning (β = .062, p = .088) on SSB consumption at T2 were small and not significant. Intention had a significant direct negative effect on SSB consumption at T2 (β = -.138, p = .003), while the effect of habit on SSB consumption at T2 was not significant (β = -.105, p = .098). There was a significant direct effect of perceived affordability on SSB consumption (β = .092, p = .025). Moreover, action planning did not moderate the effect of intention on SSB consumption at T2 (β = -.011, p = .421). In terms of indirect effects, we found significant indirect effects of outcome expectancy (β = -.032, p = .013) and perceived behavior control (β = -.029, p = .016) on SSB consumption at T2 mediated by intention.

Standardized parameter estimates for the hypothesized paths for the model for the model including past behavior are presented in Figure 2[5]. Except for the relations among self-efficacy constructs, the sizes of the parameter estimates were attenuated, especially the direct effects on study constructs on SSB consumption behavior at T2. In all cases, these effects became trivial in size and not statistically significant. This is likely to be attributable to the large effect of past

[4]A full breakdown of parameter estimates including direct, indirect, and total effects are provided in Appendix B (online supplemental materials).
[5]A full breakdown of parameter estimates including direct, indirect, and total effects are provided in the table in Appendix C (online supplemental materials).

behavior on SSB consumption at T2 (β = .750, p < .001). Past behavior also had significant and negative effects on outcome expectancies (β = -.205, p = .004), perceived behavioral control (β = -.208, p = .002), intention (β = -.092, p = .024), and habit (β = -.229, p < .001). Effects of past behavior on action self-efficacy (β = -.127, p = .155), maintenance self-efficacy (β = .105, p = .060), recovery self-efficacy (β = -.097, p = .057), action planning (β = -.060, p = .258), and coping planning (β = .058, p = .265) were not significant. The significant and negative effect of past behavior on habit indicates that the more adolescent students consume SSB, the less likely they are to report a habit of limiting SSB consumption.

Discussion

Excessive consumption of added sugars constitutes a major global threat to health, with consumption of SSB making a substantive contribution to excess added sugar consumption among adolescents (Popkin, 2012). To date, there is a dearth of research that has investigated the psychological correlates of adolescent SSB consumption. The aim of the current study was to test an extended version of the HAPA to predict adolescent SSB consumption. The model incorporated constructs relating to key processes that determine SSB consumption including constructs representing intentional, volitional, and automatic processes. The model also incorporated perceived affordability of SSB as a key environmental factor affecting consumption, consistent with social ecological models of behavior. The proposed model was tested in a prospective survey study in a sample of adolescents from three schools in Hong Kong. Consistent with the proposed model, results indicated that intentions to limit SSB consumption and perceived affordability of SSB were significant predictors of SSB consumption. In addition, we found effects of action self-efficacy, outcome expectancy, and perceived behavioral control on intentions, and significant effects of action self-efficacy on maintenance self-efficacy and maintenance self-efficacy on recovery self-efficacy. Intention meditated the effects of outcome expectancy and perceived behavioral control on SSB consumption. In contrast to predictions, self-efficacy, planning, and habit did not predict intentions or SSB consumption. Although the direct effects of intention and maintenance self-

efficacy on action and coping planning were significant, the effects were not translated to SSB consumption. In addition, there was no moderating effect of action planning on the relationship between intention and SSB consumption. Inclusion of past behavior attenuated the influence from other predictors, and was a significant predictor of SSB consumption, with a large effect size, and most of the social cognitive variables in the model, with the exception of the self-efficacy constructs.

Current findings are consistent with findings of previous research (e.g., Barg et al., 2012; Hattar, Pal, & Hagger, 2016; Maher & Conroy, 2016) and meta-analytic reviews (Hagger, Chan, Protogerou, & Chatzisarantis, 2016; Zhang et al., 2019) applying the HAPA, and other integrated social cognitive theories based on the theory of planned behavior, in health-related contexts. Specifically, effects of the self-efficacy constructs and outcomes expectancies on intentions, and intentions on SSB consumption, and the indirect effects of outcome expectancy and perceived behavioral control on SSB consumption via intention, were consistent with previous research. These findings point to the importance of intentions, and the underlying beliefs that determine intentions, in limiting SSB consumption in Hong Kong adolescents, consistent with previous research (Hagger et al., 2017; Riebl et al., 2016; Zoellner et al., 2012). In addition, the lack of mediation or moderation effects of action and coping planning on the relationship between intentions and SSB consumption is in contrast to HAPA predictions, but in line with previous research on sugar consumption (Hagger et al., 2017). Moreover, the phase-specific forms of maintenance and recovery self-efficacy did not predict SSB consumption. Finally, the inclusion of habit in our extended version of the HAPA to account for non-conscious determinants of action, did not lead to a significant increase in variance in SSB consumption. Taken together, these findings seem to suggest that the volitional components of the HAPA, and the non-conscious effects, do not improve our capacity to explain behavior in this context and sample.

However, caution should be applied when highlighting the role of intentions in determining SSB consumption. When we included past behavior as a predictor in the model, effects of intentions

on behavior were substantially attenuated and were trivial in size. The only remaining predictor of SSB consumption was past behavior. The attenuating effects of past behavior has been observed in numerous meta-analyses of social cognitive theories (Hagger et al., 2016, 2018). What are the broader implications for the current findings for theory and research on the determinants of SSB consumption? It seems, at least for this sample and behavioral context, the extended version of the HAPA is not sufficient to account for the effects of previous experience on SSB consumption. As Ajzen (1991) contends, inclusion of past behavior in a theory is a means to test whether the theory provides a sufficient account for behavior. In the current research, this seems not be the case, and findings raise questions over the utility of the current model to explain SSB consumption in this context and population, and, consequently, as a means to provide useful information on which to base behavioral interventions. This is particularly the case as it has been argued that because past behavior has no psychological content, it has little utility in informing strategies for behavior change, as the only determinant of subsequent behavior, is the stability of that behavior itself (Hagger, 2019; Wood, 2017).

Nevertheless, knowledge that past behavior is the predominant predictor of behavior does indicate some relevant information that might be useful going forward. One interpretation of past behavior effects is that they model various forms of non-conscious, automatic processes that lead to action. One such process is habits, and many authors have suggested that direct effects of past behavior reflect effects of habits (Hagger et al., 2016; Ouellette & Wood, 1998; Trandis, 1977), that is well-learned associations between the behavior and environmental contingencies, such as drinking a soft drink with every meal or during each work break. Evidence that past behavior may model habits comes from research demonstrating that past behavior effects are much larger for behaviors that individuals perform regularly in the presence of stable contexts or cues (Ouellette & Wood, 1998). If past behavior reflects habits, one might expect measures of habit to mediate, at least in part, the effects of past behavior on subsequent behavior, an observation that has been made previously (van Bree et al., 2015). We were able to test this premise given that we measured the

subjective experience of the behavior as habitual in the current study. However, our analysis did not support this premise. One possible reason is that our habit measure reflected habits for refraining from drinking SSB and, therefore, may not have had sufficient correspondence with the measure of past SSB consumption. Alternatively, future studies could consider directly measuring the habit of SSB consumption instead of measuring the habit of limiting SSB consumption. A further possibility is that past behavior may model other unmeasured processes that affect behavior independent of reasoned, intentional processes. Such processes may be reflected in constructs such as implicit attitudes and motives (Hagger et al., 2017; Rebar et al., 2016; Keatley et al., 2012), which have been shown to be independently related to health behaviors, including dietary behaviors, and inhibitory control, which reflects capacity to inhibit prepotent impulses. These factors may be particularly relevant determinants of SSB consumption given that consumption of high-sugar beverages is highly rewarding and, therefore, conducive to developing strong automatic associations between the behavior and contexts or cues. These factors may be candidate mediators of past behavior effects, accounting for behavioral consistency over time. We look to future research to examine the extent to which these factors account for past behavior effects in this context.

A further unique contribution of the current extended version of the HAPA, was the inclusion of perceived affordability of SSB. This is consistent with social ecological approaches to health behavior which emphasise the importance of environmental facilitators and constraints on behavior (Golden & Earp, 2012; Sallis et al., 2015; Stokols, 1992). Our findings suggest that perceived affordability of SSB has an important direct effect on adolescent SSB consumption independent of intentions, and suggests that the introduction of price controls such as a ‘sugar tax’ that target price increases in SSB can help reduce consumption (Brownell et al., 2009; Colchero et al., 2016; Falbe et al., 2016). However, it is also important to note that the effect of perceived affordability on SSB consumption in the current study was also attenuated by the inclusion of past behavior, and that both past behavior and SSB consumption were significantly correlated with perceived affordability.

In other words, individuals that consume larger amounts of SSBs are more likely to report greater perceived affordability. The measure, therefore, likely reflects individuals' preferences and behavior, and it is, therefore, unsurprising that effects of perceived affordability is reduced with the inclusion of past behavior. This finding suggests that individuals who regularly consume SSBs view them as affordable, and such beliefs may be independent of their actual affordability. Individuals with strong habits, for example, may feel that the object of their habit is worth the cost. This points to the imperative of independent measurement of environmental factors when incorporating such factors in extended social cognitive models.

What practical advice with respect to SSB consumption among adolescents in this context can be gleaned from current findings? While intentions and perceived affordability were prominent predictors in the model excluding past behavior, their effect was rendered trivial once past behavior was included as an independent predictor. Certainly, the finding that past behavior was sole predictor of SSB consumption raises questions over the value of the proposed extended version of the HAPA in predicting SSB consumption. Given that past behavior signals a prominent role for past experience in determining future SSB consumption, and that the role of reasoned, intentional action is limited, means to promote behavior change through non-conscious processes may be a fruitful avenue for intervention. Approaches such as environmental restructuring and choice architecture, which change behavior by manipulating environmental constraints, or making 'healthful' choices the most viable option at the point of decision, may be effective in this regard. These might include making SSBs more difficult to obtain, which may include price increases, but also the location and positioning of the products on shelves in retail outlets, or reducing availability such as replacing SSBs in vending machines with sugar free options (Hollands et al., 2017). However, it is important to stress that such recommendations are derived by inference that past behavior effects model non-conscious processes that determine behavior, or determinants that are independent of cognition, such as environmental constraints. Since past behavior is not a psychological construct, it does not provide any substantive detail on the nature of the constructs

and mechanisms. There is, therefore, a need for future research which includes measures of these constructs, and tests their capacity in mediating past behavior effects of SSB consumption.

Strengths and Limitations

The current study had numerous strengths including adoption of an integrated approach drawing from multiple theoretical perspectives in our extended version of the HAPA, an appropriately-sized sample of adolescents, measures designed specifically for the current study and behavior, and appropriate prospective design and confirmatory data analytic techniques. Despite these strengths, results should be considered in light of some limitations. First, despite a prospective design enabling prediction of behavior over time, current data are still correlational. This means that any causal inferences are based on theory alone, not the data. Building on the findings of the current study, future studies should adopt experimental or randomized controlled trials in which key variables within the extended version of the HAPA are manipulated and their effects on behavior examined (Rahman et al., 2017). Such designs may permit better causal inference. Second, we relied on self-reported measures of all constructs including SSB consumption and perceived affordability. Such measures are problematic as they may be affected by problems with recall and introduce common method variance into the data. The use of 24-hour dietary recalls may allow for greater measurement precision (Riebl et al., 2016), but inclusion of measures that might provide more objective assessment of behavior, such as amount of money adolescents spend on soft drinks or behavioral observations, is desirable, although they come at an obvious cost. Third, we focused on perceived affordability of SSB around school but did not account for the influence of adolescents' home environments in terms of their parent's behavior and socioeconomic status. Investigation of adolescents' home food environment as well their parents' influence are also important and should be included in future studies of adolescent SSB consumption (Bogart et al., 2017). Fourth, the heterogeneity of participants in the current study might be relatively low, due to the fact that data were collected from three secondary schools in Hong Kong. Future studies should consider replicating current findings in a more representative population recruited from a wider

cross-section of secondary schools (Shrout & Rodgers, 2018). Fifth, socioeconomic status data of the participants were not collected in the current study. Given that the socioeconomic status has been shown to be associated with poorer diet in adolescents, including SSB consumption (Hanson & Chen, 2007), as well as the antecedents of health behavior like self-efficacy and perceived affordability (cf. Orbell, Szczepura, Weller, Gumber, & Hagger, 2017), future studies should examine the influences of socioeconomic status on adolescent SSB consumption and constructs of the extended HAPA. Sixth, the order or presentation of the measures of the extended HAPA constructs was not counter-balanced. Due to the effects of consistency tendency, participants might respond to the subsequent items consistent with their responses to previous items (Chan et al., 2015). It is therefore suggested in the future the order of items can be counter-balanced or presented in a random order to avoid the influence of consistency tendency. Seventh, while the one-month time gap between measures of the extended HAPA constructs was sufficient to test model effects, it reflects on relatively short-term prediction. Future research should consider testing the model using an extended time lag, which would provide a robust test of its longer-range predictive validity. Finally, consumption of SSB is a single behavior in the broader context of added sugar consumption in adolescents' diet and health-related behaviors (Hamilton & Wills, 2017). We did not account for other behaviors such as consuming energy-dense food, physical inactivity, and sedentary behaviors, which may be closely-related to SSB consumption. Future research might find it important to account for other components from the ecological model (Sallis et al., 2015) in order to fully account for environmental factors associated with adolescent SSB consumption such as parenting practice (Pettigrew, Jongenelis, Chapman, & Miller, 2015; Riebl et al., 2016), school and home food environments (Bere et al., 2007; Wiecha et al., 2006), and actual affordability of SSBs relative to income (Singh et al., 2015).

Conclusion

The current study applied an extended version of the health action process approach to predict adolescents' SSB consumption. The HAPA was extended to include constructs relating to

non-conscious processes, habit, and environmental factors, and perceived affordability of SSBs. Current findings supported proposed effects among the motivational variables, and effects of intention on SSB consumption, but effects of volitional factors such as planning constructs and stage-specific self-efficacy were not significant. Perceived affordability was also found to have an independent effect on SSB consumption. Importantly, inclusion of past behavior attenuated effects of intentions and perceived affordability on SSB consumption. The current study demonstrates the importance of past behavior on adolescent SSB consumption, which may model effects of unmeasured non-conscious processes. However, drawing conclusions regarding habits and other implicit processes solely based on the past behavior effects would be ill advised, and future research needs to model the effects of constructs representing these processes alongside past behavior on SSB consumption to verify these inferences.

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Table 1

Summary of Direct and Indirect Effects in the Extended Health Action Process Approach for Adolescent Sugar-sweetened Beverage (SSB) Consumption

Hypothesis	Independent variable	Dependent variable	Mediator(s)	Prediction [a]
H1: Motivational constructs → Intention				
H1a	Action self-efficacy	Intention	-	Effect (+)
H1b	Outcome expectancy	Intention	-	Effect (+)
H1c	Perceived behavioral control	Intention	-	Effect (+)
H2: Phase-specific self-efficacy				
H2a	Action self-efficacy	Maintenance self-efficacy	-	Effect (+)
H2b	Maintenance self-efficacy	Recovery self-efficacy	-	Effect (+)
H2c	Action self-efficacy	Recovery self-efficacy	Maintenance self-efficacy	Effect (+)
H3: Intention & Maintenance self-efficacy → Planning				
H3a	Intention	Action Planning	-	Effect (+)
H3b	Intention	Coping Planning	-	Effect (+)
H3c	Maintenance self-efficacy	Action Planning	-	Effect (+)
H3d	Maintenance self-efficacy	Coping Planning	-	Effect (+)
H4: Social cognitions → SSB Consumption				
H4a	Maintenance self-efficacy	SSB Consumption	-	Effect (-)
H4b	Recovery self-efficacy	SSB Consumption	-	Effect (-)
H4c	Intention	SSB Consumption	-	Effect (-)
H4d	Action Planning Coping	SSB Consumption	-	Effect (-)
H4e	Planning	SSB Consumption	-	Effect (-)
H5: Habit & Perceived affordability → SSB Consumption				
H5a	Habit	SSB Consumption	-	Effect (-)
H5b	Perceived affordability	SSB Consumption	-	Effect (+)
H6: Motivation → Intention → Planning				
H6a	Action self-efficacy	Action planning	Intention Maintenance self-efficacy	Effect (+)
H6b	Outcome expectancy	Action planning	Intention	Effect (+)
H6c	Perceived behavioral	Action planning	Intention	Effect (+)
H6d	control Action self-efficacy	Coping planning	Intention Maintenance self-efficacy	Effect (+)
H6e	Outcome expectancy	Coping planning	Intention	Effect (+)
H6f	Perceived behavioral control	Coping planning	Intention	Effect (+)
H7: Motivation → Intention → SSB Consumption				
H7a	Action self-efficacy	SSB Consumption	Intention Maintenance self-efficacy	Effect (-)
H7b	Outcome expectancy	SSB Consumption	Intention	Effect (-)
H7c	Perceived behavioral control	SSB Consumption	Intention	Effect (-)
H8: Intention → Planning → SSB Consumption				
H8	Intention	SSB Consumption	Action planning Coping planning	Effect (-)
H9: Past behavior → All variables				
H9a	Past SSB consumption	Action self-efficacy	-	Effect (-)
H9b	Past SSB consumption	Outcome expectancy	-	Effect (-)
H9c	Past SSB consumption	Perceived behavioral control	-	Effect (-)
H9d	Past SSB consumption	Intention	-	Effect (-)
H9e	Past SSB consumption	Maintenance self-efficacy	-	Effect (-)
H9f	Past SSB consumption	Recovery self-efficacy	-	Effect (-)
H9g	Past SSB consumption	Action planning	-	Effect (-)
H9h	Past SSB consumption	Coping planning	-	Effect (-)
H9i	Past SSB consumption	Habit	-	Effect (-)
H9j	Past SSB consumption	SSB Consumption	-	Effect (+)

Note. [a] Denotes whether the hypothesis specifies a positive (+) or a negative effect (-).

Table 2

Adolescent Sugar-sweetened Beverage Consumption: Means, Standard Deviations (SDs), Reliabilities, and Factor Inter-correlations for Variables of the Extended Model of Health Action Process Approach

	Mean	*SD*	1	2	3	4	5	6	7	8	9	10	11	12
1. Perceived affordability	2.89	1.22	-											
2. Action self-efficacy	3.04	0.81	.075	.726										
3. Outcome expectancy	3.12	0.56	.026	.157**	.800									
4. Perceived behavioral control	4.31	1.18	-.055	.266***	.221***	.865								
5. Intention	4.04	1.33	.003	.259***	.173***	.394***	.867							
6. Maintenance self-efficacy	2.99	0.83	-.069	.338***	.084	.117*	.189***	.750						
7. Recovery self-efficacy	3.07	0.82	-.049	.310***	.045	.245***	.290***	.272***	.784					
8. Action planning	3.06	0.81	-.043	.242***	.033	.236***	.230***	.237***	.289***	.787				
9. Coping Planning	3.09	0.81	-.060	.229***	.083	.247***	.181***	.327***	.313***	.492***	.778			
10. Habit	3.07	0.67	-.060	.344***	.116*	.438***	.322***	.211***	.357***	.354***	.432***	.814		
11. SSB consumption T1	3.41	2.16	.166***	-.050	-.199***	-.195***	-.163***	.006	-.124**	-.060	.007	-.192***	-	
12. SSB consumption T2	3.64	2.28	.125**	-.034	-.261***	-.207***	-.189***	-.011	-.132**	-.027	.028	-.137**	.814***	-
13. BMI	19.68	2.55	-.024	.025	-.026	-.002	.110*	.041	-.015	.023	.063	-.049	.159**	.015

Note. * $p < .05$; ** $p < .01$ *** $p < .001$; Composite reliability coefficients are displayed along the principal diagonal. SSB = Sugar-sweetened beverage.

Figure 1. Standardized path coefficients for the structural equation model predicting sugar-sweetened beverage consumption based on the extended health action process approach excluding past behavior. Effects of control variables age, gender, and BMI excluded for clarity. All hypothesized effects among psychological variables were hypothesized to be positive in sign, while the effects of psychological variables on adolescent sugar-sweetened beverage (SSB) consumption were hypothesized to be negative in sign.

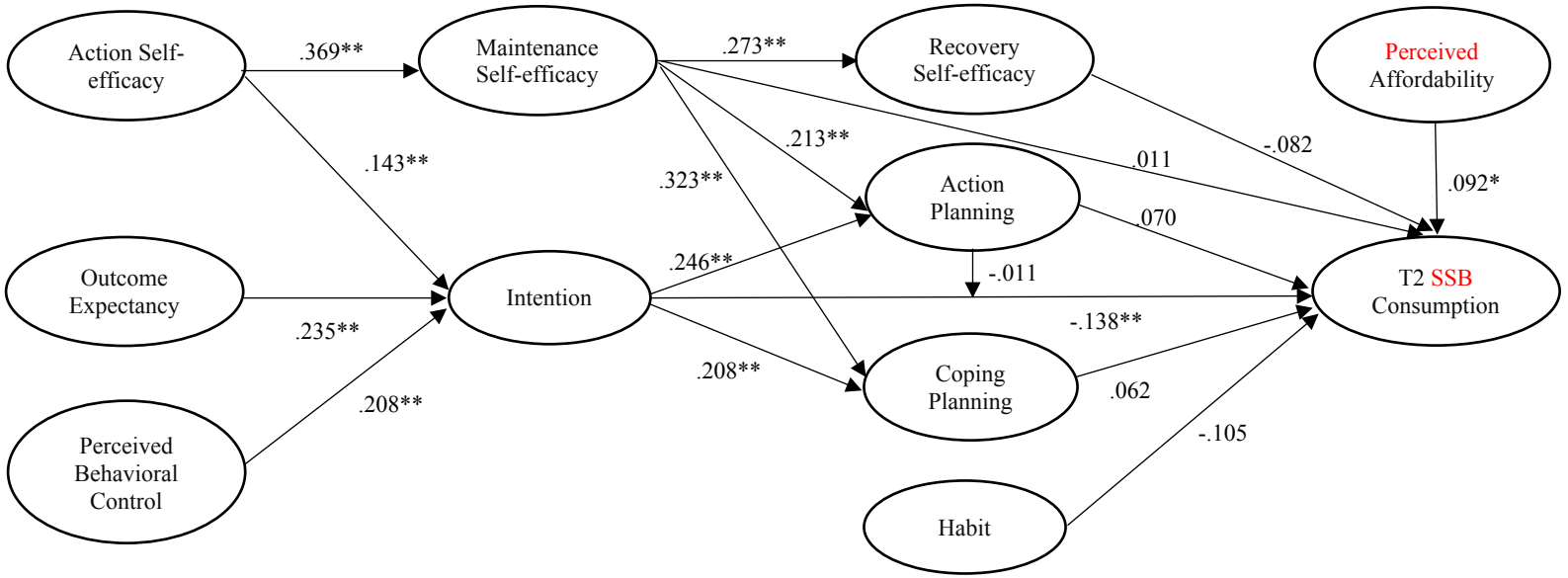
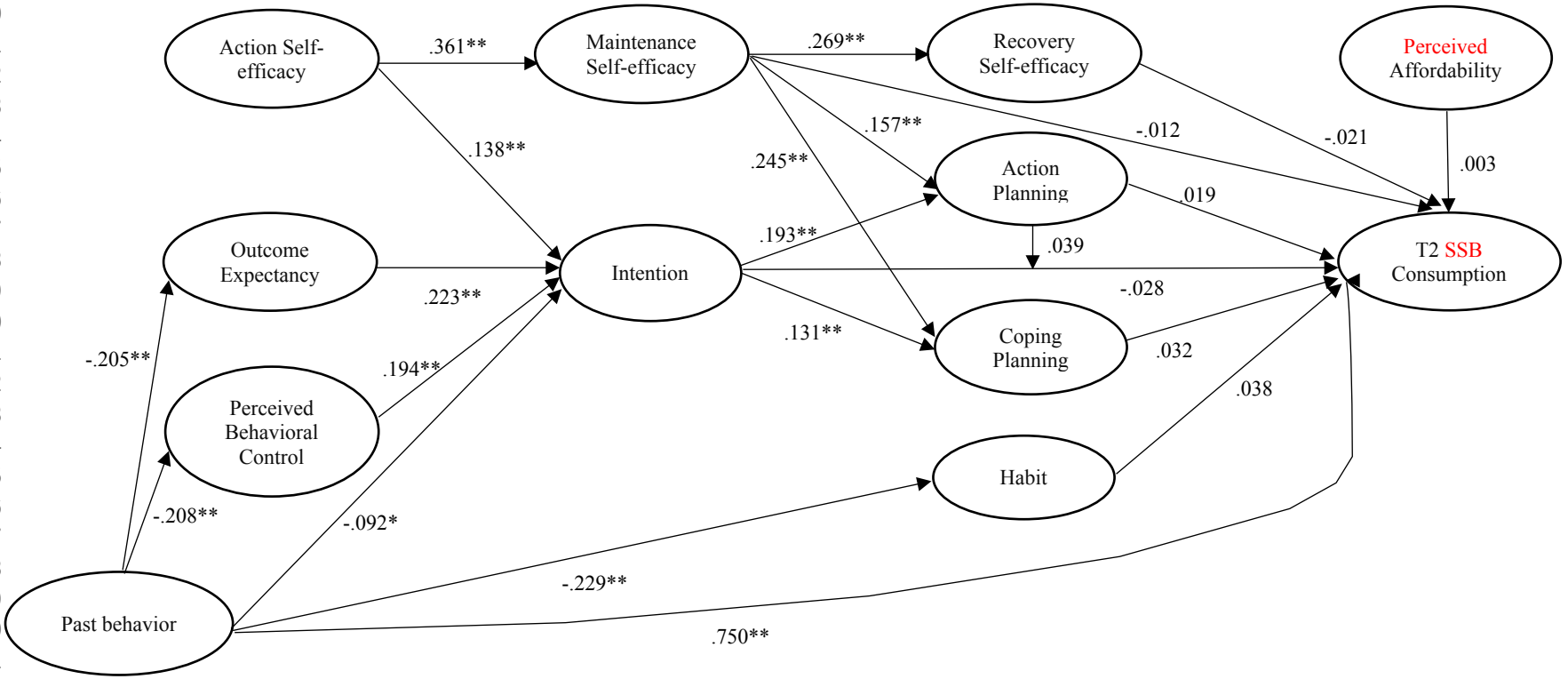


Figure 2. Standardized path coefficients for the structural equation model predicting sugar-sweetened beverage consumption based on the extended health action process approach including past behavior. Effects of control variables age, gender, and BMI excluded for clarity. All hypothesized effects among psychological variables were hypothesized to be positive in sign, while the effects from psychological variables to adolescent sugar-sweetened beverage (SSB) consumption were hypothesized to be negative in sign. The effects of past behaviors on psychological variables were proposed to be negative in sign, while the effect from past behavior to beverage consumption were proposed to be positive in sign. Only significant effects from past behaviors to psychological variables were displayed.



Appendix A

Table A1

Items and Response Scales for Study Constructs

Measure	*Construct and Item No.*	*Item(s)*	*Rating*
TPB questionnaire (Ajzen, 2002)	PBC 1	Drinking at most 240 ml sugar-sweetened beverages per day in the coming month is something totally under my control.	1 = *strongly disagree;* 7 = *strongly agree*
	PBC 2	Drinking at most 240 ml sugar-sweetened beverages per day in the coming month is something I have the ability to complete.	1 = *strongly disagree;* 7 = *strongly agree*
	PBC 3	Drinking at most 240 ml sugar-sweetened beverages per day in the coming month is something totally up to me to decide.	1 = *strongly disagree;* 7 = *strongly agree*
	Intention 1	Drinking at most 240 ml sugar-sweetened beverages per day in the coming month is something I intend to do.	1 = *strongly disagree;* 7 = *strongly agree*
	Intention 2	Drinking at most 240 ml sugar-sweetened beverages per day in the coming month is something I plan to do.	1 = *strongly disagree;* 7 = *strongly agree*
	Intention 3	Drinking at most 240 ml sugar-sweetened beverages per day in the coming month is something I try to do.	1 = *strongly disagree;* 7 = *strongly agree*
HAPA questionnaire (Schwarzer et al., 2003)	ASE 1	I am sure of myself that I can drink less than 240 ml sugar-sweetened beverages every day, even when I am having a lot of difficulties.	1 = *strongly disagree;* 5 = *strongly agree*
	ASE 2	I am sure of myself that I can drink less than 240 ml sugar-sweetened beverages every day, even though many students choose not to do so.	1 = *strongly disagree;* 5 = *strongly agree*
	ASE 3	I am sure of myself that I can drink less than 240 ml sugar-sweetened beverages every day, even when it is difficult not to do so.	1 = *strongly disagree;* 5 = *strongly agree*

OE 1	If I drink less than 240 ml sugar-sweetened beverages every day, it is good for my health.	1 = *strongly disagree;* 5 = *strongly agree*
OE 2	If I drink less than 240 ml sugar-sweetened beverages every day, I will feel better.	1 = *strongly disagree;* 5 = *strongly agree*
OE 3	If I drink less than 240 ml sugar-sweetened beverages every day, I will be more energetic.	1 = *strongly disagree;* 5 = *strongly agree*
MSE 1	I am sure of myself that I can stick to drinking less than 240 ml of sugar-sweetened beverages every day, even when I am having a lot of difficulties.	1 = *strongly disagree;* 5 = *strongly agree*
MSE 2	I am sure of myself that I can stick to drinking less than 240 ml of sugar-sweetened beverages every day, even when even though many students choose not to do so.	1 = *strongly disagree;* 5 = *strongly agree*
MSE 3	I am sure of myself that I can stick to drinking less than 240 ml of sugar-sweetened beverages every day, even when it is difficult not to do so.	1 = *strongly disagree;* 5 = *strongly agree*
RSE 1	I am sure of myself that I can stick to the behaviors of drinking less than 240 ml of sugar-sweetened beverages every day, even if my original plans have changed.	1 = *strongly disagree;* 5 = *strongly agree*
RSE 2	I am sure of myself that I can stick to drinking less than 240 ml of sugar-sweetened beverages every day, even if I failed to do so for a couple of days.	1 = *strongly disagree;* 5 = *strongly agree*
RSE 3	I am sure of myself that I can stick to drinking less than 240 ml of sugar-sweetened beverages every day, even if I failed to do so for a couple of weeks.	1 = *strongly disagree;* 5 = *strongly agree*

	AP 1	I have made a detailed plan regarding what to drink (e.g., drinking low-energy alternatives to sugar-sweetened beverages).	1 = *strongly disagree;* 5 = *strongly agree*
	AP 2	I have made a detailed plan regarding where to purchase low-energy alternatives to sugar-sweetened beverage.	1 = *strongly disagree;* 5 = *strongly agree*
	AP 3	I have made a detailed plan regarding when to drink low-energy alternatives to sugar-sweetened beverages.	1 = *strongly disagree;* 5 = *strongly agree*
	AP 4	I have made a detailed plan regarding what preparation I have to do in order to drink low-energy alternatives to sugar-sweetened beverages.	1 = *strongly disagree;* 5 = *strongly agree*
	CP 1	I have made a detailed plan regarding how to prevent myself relapsing to my previous habit of drinking sugar-sweetened beverages.	1 = *strongly disagree;* 5 = *strongly agree*
	CP 2	I have made a detailed plan regarding how to insist on limiting sugar-sweetened beverage consumption when I face difficulties.	1 = *strongly disagree;* 5 = *strongly agree*
	CP 3	I have made a detailed plan regarding how to insist on limiting sugar-sweetened beverage consumption when I face unexpected situations.	1 = *strongly disagree;* 5 = *strongly agree*
SRHI (Verplanken & Orbell, 2003)	Habit 1	Drinking less than 240 ml of sugar-sweetened beverages per day is something I do frequently.	1 = *strongly disagree;* 5 = *strongly agree*
	Habit 2	Drinking less than 240 ml of sugar-sweetened beverages per day is something I do automatically.	1 = *strongly disagree;* 5 = *strongly agree*
	Habit 3	Drinking less than 240 ml of sugar-sweetened beverages per day is something I do without having to consciously remember.	1 = *strongly disagree;* 5 = *strongly agree*
	Habit 4	Drinking less than 240 ml of sugar-sweetened beverages per day is something that makes me feel weird if I do not do it.	1 = *strongly disagree;* 5 = *strongly agree*

	Habit 5	Drinking less than 240 ml of sugar-sweetened beverages per day is something I do without thinking.	1 = *strongly disagree;* 5 = *strongly agree*
	Habit 6	Drinking less than 240 ml of sugar-sweetened beverages per day is something that would require effort not to do it.	1 = *strongly disagree;* 5 = *strongly agree*
	Habit 7	Drinking less than 240 ml of sugar-sweetened beverages per day is something that belongs to my (daily, weekly, monthly) routine.	1 = *strongly disagree;* 5 = *strongly agree*
	Habit 8	Drinking less than 240 ml of sugar-sweetened beverages per day is something I start doing before I realize I'm doing it.	1 = *strongly disagree;* 5 = *strongly agree*
	Habit 9	Drinking less than 240 ml of sugar-sweetened beverages per day is something I would find hard not to do.	1 = *strongly disagree;* 5 = *strongly agree*
	Habit 10	Drinking less than 240 ml of sugar-sweetened beverages per day is something I have no need to think about doing.	1 = *strongly disagree;* 5 = *strongly agree*
	Habit 11	Drinking less than 240 ml of sugar-sweetened beverages per day is something that's typically "me".	1 = *strongly disagree;* 5 = *strongly agree*
	Habit 12	Drinking less than 240 ml sugar-sweetened beverages per day is something I have been doing for a long time.	1 = *strongly disagree;* 5 = *strongly agree*
BEVQ-15 (Hedrick et al., 2012)	SSB Frequency	During the past month, what was your frequency of consumption of the following drinks?	
		1. Sugary non-carbonated beverages (e.g., Minute Maid)	0 = *never*; 6 = *at least 3 times per day*
		2. Carbonate beverages (e.g., coke)	0 = *never*; 6 = *at least 3 times per day*

		3. Sugary tea beverages (e.g., iced black tea)	0 = *never*; 6 = *at least 3 times per day*
		4. Sugary coffee beverages	0 = *never*; 6 = *at least 3 times per day*
		5. Sports beverages (e.g., Pocari Sweat)	0 = *never*; 6 = *at least 3 times per day*
		6. Energy drinks (e.g., Red Bull)	0 = *never*; 6 = *at least 3 times per day*
		7. Other sugary beverages	0 = *never*; 6 = *at least 3 times per day*
	SSB Quantity	On average, how many cans/cartons/cups (240 ml per container) did you drink each time?	1 = *at most 3/4 cup [180 ml)]* and 5 = *at least two and a half cups [600 ml]*
Perceived affordability of SSB in school neighbourhood	Perceived SSB Affordability	The price of SSBs in the neighborhood near my school is inexpensive	1 = *strongly disagree;* 5 = *strongly agree*

Note. TPB = Theory of planned behavior; HAPA = Health action process approach; ASE = Action self-efficacy; OE = Outcome expectancy; PBC = Perceived behavioral control; MSE = Maintenance self-efficacy; RSE = Recovery self-efficacy; AP = Action planning; CP = Coping planning; SRHI = Self-Report Habit Index.

Table A2

Normalized Pattern Factor Loadings for Psychological Variables in the Proposed Model Predicting Sugar-Sweetened Beverage Consumption Based on the Extended Health Action Process Approach

	ASE	OE	PBC	Intention	MSE	RSE	AP	CP	SRHI
ASE1	.982								
ASE2	.931								
ASE3	.910								
OE1		.965							
OE2		.982							
OE3		.957							
PBC1			.980						
PBC2			.989						
PBC3			.968						
Intention1				.991					
Intention2				.982					
Intention3				.989					
MSE1					.970				
MSE2					.917				
MSE3					.910				
RSE1						.961			
RSE2						.969			
RSE3						.981			
AP1							.975		
AP2							.969		
AP3							.947		
AP4							.696		
CP1								.942	
CP2								.973	
CP3								.984	
Habit1									.878
Habit2									.928
Habit3									.858
Habit4									.599
Habit5									.922
Habit6									.936
Habit7									.928
Habit8									.827

Habit9	.811
Habit10	.919
Habit11	.942
Habit12	.911

Note. ASE = Action self-efficacy; OE = Outcome expectancy; PBC = Perceived behavioral control; MSE = Maintenance self-efficacy; RSE = Recovery self-efficacy; AP = Action planning; CP = Coping planning; SRHI = Self-report habit index (Verplanken & Orbell, 2003).

Appendix B

Standardized Parameter Estimates for the Direct, Indirect, and Total Effects in the Proposed Model Predicting Sugar-Sweetened Beverage (SSB) Consumption Based on the Extended Health Action Process Approach Excluding Past Behavior

Effect	β	CI_{95}		*ES*
		LL	UL	
Direct effects				
ASE → Intention	.143***	.060	.225	.038
OE → Intention	.235***	.136	.334	.078
PBC → Intention	.208***	.121	.295	.061
ASE → MSE	.369***	.286	.452	.137
MSE → RSE	.273***	.188	.359	.077
MSE → AP	.213***	.113	.313	.055
MSE → CP	.323***	.223	.422	.115
Intention → AP	.204***	.104	.304	.051
Intention → CP	.136***	.055	.218	.029
Intention → SSB consumption AP	-.138**	-.234	-.041	.027
→ SSB consumption	.070	-.142	.283	.009
CP → SSB consumption	.062	-.028	.153	.005
MSE → SSB consumption	.011	-.149	.172	.001
RSE → SSB consumption	-.082	-.211	.047	.013
Habit → SSB consumption	-.105	-.263	.054	.020
Affordability → SSB consumption	.092*	.000	.183	.009
AP x Intention → SSB consumption	-.011	-.118	.097	.001
Age → ASE	-.042	-.194	.109	.002
Age → OE	-.014	-.165	.137	.000
Age → PBC	.069	-.082	.220	.004
Age → Intention	-.111	-.071	.091	.014
Age → MSE	.068	.007	.192	.005
Age → RSE	.047	-.045	.092	.003
Age → AP	-.053	-.090	.082	.002
Age → CP	-.068	-.093	.095	.006
Age → Habit	.020	.004	.185	.001
Age → SSB consumption	.060	-.166	.025	.004
Gender → ASE	-.026	-.112	.059	.001
Gender → OE	-.031	-.128	.066	.001
Gender → PBC	.009	-.082	.101	.000
Gender → Intention	.010	-.071	.091	.000

Gender → MSE	.099*	.007	.192	.008
Gender → RSE	.023	-.045	.092	.001
Gender → AP	-.004	-.090	.082	.000
Gender → CP	.001	-.093	.095	.000
Gender → Habit	.094*	.004	.185	.006
Gender → SSB consumption	-.071	-.166	.025	.009
BMI → ASE	.090	-.124	.350	.013
BMI → OE	.113	-.142	.322	.008
BMI → PBC	-.095	-.306	.117	.008
BMI → Intention	.083*	-.008	.175	.010
BMI → MSE	.080	-.104	.264	.007
BMI → RSE	-.062	-.195	.072	.004
BMI → AP	-.058	-.276	.161	.005
BMI → CP	.046	-.078	.171	.004
BMI → Habit	-.067	-.217	.084	.003
BMI → SSB consumption	.052	-.090	.193	.005
Indirect effects				
ASE → MSE → RSE	.101***	.056	.146	.023
ASE → Intention, MSE → AP	.108***	.059	.157	.025
ASE → Intention, MSE → CP	.139***	.088	.190	.026
ASE → Intention, MSE → SSB consumption	-.016	-.081	.049	.001
ASE → Intention, MSE → AP, CP → SSB consumption	-.008	-.071	.055	.000
OE → Intention → AP	.048**	.015	.081	.009
OE → Intention → CP	.032**	.007	.057	.006
OE → Intention → SSB consumption	-.032*	-.061	-.003	.004
OE → Intention → AP, CP → SSB consumption	-.027*	-.058	.004	.004
PBC → Intention → AP	.042**	.011	.073	.008
PBC → Intention → CP	.028**	.008	.048	.005
PBC → Intention → SSB consumption	-.029*	-.055	-.004	.004
PBC → Intention → AP, CP → SSB consumption	-.024*	-.051	.003	.003
Intention → AP, CP → SSB consumption	.023	-.022	.068	.005
MSE → RSE, AP, CP → SSB consumption	.013	-.046	.072	.001
Total effects				
ASE → SSB consumption OE	-.008	-.071	.055	.000
→ SSB consumption PBC →	-.027*	-.058	.004	.004
SSB consumption Intention →	-.024*	-.051	.003	.003
SSB consumption MSE →	-.115*	-.223	-.007	.023
SSB consumption	.024	-.129	.177	.001

RSE → SSB consumption	-.082	-.211	.047	.013

Note. BMI = Body mass index. ASE = Action self-efficacy; OE = Outcome expectancies; PBC = Perceived behavioral control; MSE = Maintenance self-efficacy; RSE = Recovery self-efficacy; AP = Action planning; CP = Coping planning; PB = Past behavior; Affordability = Perceived affordability. β = Standardized path coefficient; CI_{95} = 95% confidence interval of path coefficient; ES = Effect size estimate; LL = lower limit & UL = upper limit.
$^{*}p < .05$ $^{**}p < .01$ $^{***}p < .001$

Appendix C

Standardized Parameter Estimates for the Direct, Indirect, and Total Effects in the Proposed Model Predicting Sugar-Sweetened Beverage (SSB) Consumption Based on the Extended Health Action Process Approach Including Past Behavior

Effect	β	CI_{95}		ES
		LL	UL	
Direct effects				
PB → ASE	-.127	-.372	.118	.016
PB → OE	-.205**	-.355	-.055	.041
PB → PBC	-.208**	-.353	-.064	.044
PB → Intention	-.092*	-.182	-.001	.016
PB → MSE	.105	-.027	.237	.015
PB → RSE	-.097	-.217	.023	.011
PB → AP	-.060	-.239	.120	.007
PB → CP	.058	-.123	.239	.006
PB → Habit	-.229***	-.362	-.097	.055
PB → SSB consumption Age	.750***	.598	.903	.581
→ ASE	-.038	-.186	.111	.001
Age → OE	-.011	-.160	.138	.000
Age → PBC	.070	-.069	.210	.004
Age → Intention	-.112	-.323	.098	.015
Age → MSE	.063	-.045	.171	.005
Age → RSE	.050	-.108	.207	.003
Age → AP	-.053	-.214	.108	.002
Age → CP	-.072	-.215	.071	.006
Age → Habit	.021	-.125	.167	.001
Age → SSB consumption	.017	-.074	.107	.001
Gender → ASE	-.040	-.127	.046	.001
Gender → OE	-.062	-.156	.033	.003
Gender → PBC	-.020	-.113	.072	.000
Gender → Intention Gender	-.002	-.079	.076	.000
→ MSE	.094*	.004	.184	.007
Gender → RSE	.010	-.058	.079	.000
Gender → AP	-.008	-.092	.076	.000
Gender → CP	.002	-.091	.096	.000
Gender → Habit	.072	-.021	.165	.007
Gender → SSB consumption	-.010	-.067	.047	.001
BMI → ASE	.110	-.117	.337	.013

BMI → OE	.073	-.105	.252	.007
BMI → PBC	-.073	-.257	.110	.006
BMI → Intention	.088*	-.006	.183	.010
BMI → MSE	.072	-.105	.250	.006
BMI → RSE	-.054	-.180	.073	.004
BMI → AP	.055	-.121	.231	.005
BMI → CP	.045	-.078	.168	.004
BMI → Habit	-.064	-.238	.111	.005
BMI → SSB consumption	.015	-.076	.105	.001
ASE → Intention	.138***	.057	.219	.036
OE → Intention	.223***	.121	.324	.074
PBC → Intention	.194***	.101	.286	.057
ASE → MSE	.361***	.274	.448	.134
MSE → RSE	.269***	.181	.357	.076
MSE → AP	.210***	.109	.312	.054
MSE → CP	.317***	.213	.422	.113
Intention → AP	.193***	.088	.297	.048
Intention → CP	.131**	.047	.215	.028
Intention → SSB consumption	-.028	-.102	.046	.006
AP → SSB consumption	.019	-.053	.090	.002
CP → SSB consumption	.032	-.054	.118	.003
MSE → SSB consumption	-.012	-.091	.067	.001
RSE → SSB consumption	-.021	-.085	.044	.003
Habit → SSB consumption	.038	-.060	.137	.007
Affordability → SSB consumption	.003	-.064	.071	.000
AP x Intention → SSB consumption	.039	-.067	.145	.004
Indirect effects				
PB → ASE, OE, PBC → Intent	-.104***	-.163	-.045	.018
PB → ASE → MSE	-.046	-.134	.042	.007
PB → Intention, MSE → AP	.004	-.033	.041	.001
PB → Intention, MSE → CP	.021	-.024	.066	.002
PB → MSE → RSE	.028	-.007	.063	.003
PB → AP, CP, RSE, Habit → SSB consumption	-.005	-.036	.026	.004
PB → ASE → MSE → RSE	-.012	-.036	.012	.001
PB → ASE, OE, PBC → Intent → AP	-.030	-.057	-.003	.004
PB → ASE, OE, PBC → Intent → CP	-.028	-.061	.005	.003
PB → Intention, MSE → AP, CP, RSE → SSB consumption	.004	-.006	.014	.003

PB → ASE, OE, PBC → Intention, MSE → AP, CP, RSE → SSB consumption	-.001	-.005	.003	.001
ASE → MSE → RSE	.097***	.052	.142	.031
ASE → Intention, MSE → AP	.102***	.055	.149	.026
ASE → Intention, MSE → CP	.133***	.008	.186	.031
ASE → Intention, MSE → SSB consumption	-.008	-.039	.023	.001
ASE → Intention, MSE → AP, CP → SSB consumption OE	.004	-.012	.020	.000
→ Intention → AP	.043**	.012	.074	.008
OE → Intention → CP	.029*	.004	.054	.006
OE → Intention → SSB consumption	-.006	-.026	.014	.001
OE → Intention → AP, CP → SSB consumption	.002	-.002	.006	.000
PBC → Intention → AP	.037**	.008	.066	.007
PBC → Intention → CP	.025**	.005	.045	.005
PBC → Intention → SSB consumption	-.005	-.021	.011	.001
PBC → Intention → AP, CP → SSB consumption Intention	.002	-.002	.006	.000
→ AP, CP → SSB consumption	.008	-.012	.028	.002
MSE → RSE, AP, CP → SSB consumption	.009	-.030	.048	.000
Total effects				
ASE → SSB consumption OE	-.004	-.039	.031	.000
→ SSB consumption PBC →	-.005	-.025	.015	.001
SSB consumption Intention →	-.004	-.020	.012	.001
SSB consumption MSE →	-.020	-.098	.058	.004
SSB consumption	-.004	-.094	.086	.000
PB → SSB consumption	.748	.589	.907	.579

Note. BMI = Body mass index. ASE = Action self-efficacy; OE = Outcome expectancies; PBC = Perceived behavioral control; MSE = Maintenance self-efficacy; RSE = Recovery self-efficacy; AP = Action planning; CP = Coping planning; PB = Past behavior; Affordability = Perceived affordability. β = Standardized path coefficient; CI_{95} = 95% confidence interval of path coefficient; ES = Effect size estimate; LL = lower limit & UL = upper limit.

$^{*}p < .05$ $^{**}p < .01$ $^{***}p < .001$