



Predicting sugar consumption: Application of an integrated dual-process, dual-phase model



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ABSTRACT

Excess consumption of added dietary sugars is related to multiple metabolic problems and adverse health conditions. Identifying the modifiable social cognitive and motivational constructs that predict sugar consumption is important to inform behavioral interventions aimed at reducing sugar intake. We tested the efficacy of an integrated dual-process, dual-phase model derived from multiple theories to predict sugar consumption. Using a prospective design, university students ($N = 90$) completed initial measures of the reflective (autonomous and controlled motivation, intentions, attitudes, subjective norm, perceived behavioral control), impulsive (implicit attitudes), volitional (action and coping planning), and behavioral (past sugar consumption) components of the proposed model. Self-reported sugar consumption was measured two weeks later. A structural equation model revealed that intentions, implicit attitudes, and, indirectly, autonomous motivation to reduce sugar consumption had small, significant effects on sugar consumption. Attitudes, subjective norm, and, indirectly, autonomous motivation to reduce sugar consumption predicted intentions. There were no effects of the planning constructs. Model effects were independent of the effects of past sugar consumption. The model identified the relative contribution of reflective and impulsive components in predicting sugar consumption. Given the prominent role of the impulsive component, interventions that assist individuals in managing cues-to-action and behavioral monitoring are likely to be effective in regulating sugar consumption.

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In the context of a global pandemic of obesity and associated chronic illnesses including diabetes, cardiovascular disease, and certain cancers, the impact of high intake of dietary sugar is a principal concern (Swinburn et al., 2011). Research has indicated that consumption of added sugars in the diet (i.e., sugars added to foods during preparation or processing, or added at the table; Johnson et al., 2009) is related to a number of metabolic problems and adverse health conditions, and is considered a major factor contributing to a positive energy balance and weight gain (Malik,

Popkin, Bray, Després, & Hu, 2010). This has led health organizations to publish recommendations for reductions in the intake of added dietary sugars (Johnson et al., 2009; WHO, 2015). For example, the American Heart Association recommends that no more than 100 calories per day (equivalent to about 6 teaspoons of sugar) for women and 150 calories per day (about 9 teaspoons of sugar) for men should be taken as added sugars (Johnson et al., 2009). In response to the proliferation of evidence highlighting the need for dietary sugar reduction in the prevention of chronic illnesses and conditions, researchers have begun to explore the determinants of dietary sugar intake, particularly the psychological and behavioral factors (e.g., de Bruijn & van den Putte, 2009; Naughton, McCarthy, & McCarthy, 2015; van der Horst et al., 2007). The goal of such research is to provide formative evidence

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that can be used as a basis for effective behavioral interventions to reduce sugar intake. The research has identified belief-based factors from social cognitive theories such as attitudes, intentions, and perceived control as important in predicting sugar consumption. However, research adopting these theories has indicated that they explain modest variance in sugar consumption, and fail to account for the multiple factors and processes that underpin sugar consumption (Tak et al., 2011; van der Horst et al., 2007). In the current study, we aim to extend this research by testing the efficacy of an integrated theoretical model in predicting dietary sugar consumption. Recognizing that intake of dietary sugar may not be solely determined by conscious, reflective processes, the model will account for the non-conscious, impulsive processes that lead to sugar consumption (c.f., Keatley, Clarke, & Hagger, 2012; Perugini, 2005; Proulx et al., 2014). We also aim to test the role that volitional processes (e.g., planning) have in predicting individuals to enact their intentions.

1. Dual-process models of health behavior

A common assumption of the social cognitive and motivational theories applied to predict health behaviors (e.g., theory of planned behavior, social-cognitive theory, health belief model) is that action is determined by a deliberative process (Biddle, Hagger, Chatzisarantis, & Lippke, 2007; Conner & Norman, 2015). The theories assume that individuals act on the basis of evaluating the available information regarding future courses of action (e.g., weighing up perceived costs and benefits) and make decisions accordingly. Other motivational approaches such as self-determination theory (Deci & Ryan, 2000) also assume that actions are based on conscious deliberation. The theory predicts that individuals will be motivated to act if the behavior is perceived as servicing some sort of desired or personally-relevant need. Syntheses of research has demonstrated that constructs from these social cognitive and motivational theories (e.g., internal and external motivation, intentions, attitudes, subjective norm, self-efficacy, risk perceptions) have typically accounted for non-trivial variance in behavior across numerous domains (McEachan et al., 2016; Ng et al., 2012; Rich, Brandes, Mullan, & Hagger, 2015). Nevertheless, effect sizes of the salient predictors on behavior have been modest, with substantive variance in behavior remaining unexplained. Furthermore, there is evidence that measures reflecting factors related to non-conscious, automatic processes such as past behavior and self-reported habit and automaticity account for substantive variance in health behavior independent of the constructs from social cognitive and motivational theories (Allom, Mullan, Cowie, & Hamilton, 2016; Arnautovska, Fleig, O'Callaghan, & Hamilton, 2017; Gardner, 2015).

These findings are consistent with dual-process theories in which behavior is viewed as a function of conscious, reflective processes that involve deliberation over a course of action, consistent with the constructs typically identified in social cognitive and motivational theories, and non-conscious processes that reflect impulsive, spontaneous pathways to action that operate beyond an individual's awareness (Evans & Stanovich, 2013; Sheeran, Gollwitzer, & Bargh, 2013; Strack & Deutsch, 2004). The non-conscious processes likely reflect well-learned patterns of action that are driven by organized knowledge structures or 'schema' activated by the cues or contexts linked to the behavioral response in memory. Such knowledge structures may be represented by implicitly-held attitudes or beliefs toward particular concepts or actions. Research has demonstrated that measures of implicit beliefs, such as the implicit association test (IAT; Greenwald, Nosek, & Banaji, 2003), have independent effects on behavior in health contexts when included in predictive models alongside explicitly-

measured constructs that reflect deliberative, reflective processes (Keatley et al., 2012; Perugini, 2005; Sheeran et al., 2013). Such research has provided new insight into the relative contributions of the explicit and implicit constructs that determine action. Importantly, behaviors like eating highly palatable foods, such as those high in sugar, are reinforced over time through endogenous reward systems via the dopaminergic pathways in the mesolimbic system in the brain. They are therefore more likely to be determined by non-conscious, impulsive pathways (Stice, Figlewicz, Gosnell, Levine, & Pratt, 2013). Drawing from this research, we aim to examine the extent to which implicit attitudes toward sugar, which reflect the impulsive determinants of behavior, impact sugar consumption in a model that incorporates constructs representing both explicit and implicit processes.

2. Motivational and volitional components of action: dual-phase models

Research applying social cognitive and motivational models in health behavior has identified a shortfall in the strength of the relation between intentions and behavior (Orbell & Sheeran, 1998; Rhodes & de Bruijn, 2013). While intention-behavior relations are often non-trivial in size and statistically significant, the size of the relation is often modest indicating that many individuals may not enact the health behavior even though they intend to do so (Orbell, 2004). Dual-phase models such as the model of action phases (Heckhausen & Gollwitzer, 1987) and health action process approach (HAPA; Schwarzer, 2008) propose that volitional processes such as planning may help 'bridge the gap' between intentions and behavior. Such processes are proposed to act in a 'post-decisional' manner in a volitional phase that follows the motivational phase. For example, the model of action phases suggests that individuals who furnish their intentions with specific action plans,¹ stating when and where the behavior will be enacted, are more likely to act on their intentions. In this case, the plans serve to moderate the intention-behavior relationship. According to the HAPA, action plans, along with coping plans that focus on managing potential barriers and setbacks, explain why intentions result in behavioral enactment. In this case, the plans serve as mediators of the intention-behavior relationship. Research has supported the moderating and mediating roles for planning in health behavior research providing confirmatory support for the role for volitional processes in explaining and modifying the effects of intention on action (e.g., Hagger et al., 2016; Zhou et al., 2015). Researchers have, therefore, begun to incorporate volitional components in integrated dual-phase models that aim to provide a comprehensive account of the motivational and volitional processes that lead to action. In the current research we aim to incorporate planning constructs that represent volitional processes in the dual-phase approaches alongside intentions in a comprehensive, integrated account of the factors that impact on sugar consumption.

3. Proposed integrated model and hypotheses

The aim of the current study was to test an integrated dual-process, dual-phase model derived from multiple theories to predict sugar consumption in a sample of university students. The proposed model is presented in Fig. 1 and hypothesized relations among model constructs are summarized in Table 1. The motivational phase comprises hypotheses derived from research

¹ Action plans and implementation intentions are frequently conceptualized with identical content (Hagger & Luszczynska, 2014). For the purpose of the current article, we consider them synonymous.

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