Appetite 105 (2016) 652–662

Contents lists available at ScienceDirect

Appetite

journal homepage: www.elsevier.com/locate/appet

Self-regulation interventions to reduce consumption of sugar-sweetened beverages in adolescents

Susan L. Ames [a, *], Ingrid C. Wurpts [b], James R. Pike [a], David P. MacKinnon [b], Kim R. Reynolds [a], Alan W. Stacy [a]

[a] School of Community and Global Health, Claremont Graduate University, 675 West Foothill Blvd. Suite 310, Claremont, CA, 91711-3475, USA
[b] Department of Psychology, Arizona State University, PO Box 871104, 950 S. McAllister, Room 237, Tempe, AZ, 85287-1104, USA

ARTICLE INFO

Article history:
Received 13 November 2015
Received in revised form
2 June 2016
Accepted 28 June 2016
Available online 1 July 2016

Keywords:
Implementation intentions
Go/No-Go
Inhibitory control
Adolescents
Sugar-sweetened beverages
Self-regulation

ABSTRACT

This study evaluated the efficacy of self-regulation interventions through the use of drink-specific implementation intentions and drink-specific Go/No-Go training tasks as compensatory strategies to modify inhibitory control to reduce intake of sugar-sweetened beverages (SSB). In a between-subjects randomized manipulation of implementation intentions and Go/No-Go training to learn to inhibit sugary drink consumption, 168 adolescents reporting inhibitory control problems over sugary drinks and foods were recruited from high schools in southern California to participate. Analysis of covariance overall test of effects revealed no significant differences between the groups regarding calories consumed, calories from SSBs, grams of sugar consumed from drinks, or the number of unhealthy drinks chosen. However, subsequent contrasts revealed SSB implementation intentions significantly reduced SSB consumption following intervention while controlling for inhibitory control failure and general SSB consumption during observation in a lab setting that provided SSBs and healthy drinks, as well as healthy and unhealthy snacks. Specifically, during post-intervention observation, participants in the sugar-sweetened beverage implementation intentions (SSB-II) conditions consumed significantly fewer calories overall, fewer calories from drinks, and fewer grams of sugar. No effects were found for the drink-specific Go/No-Go training on SSB or calorie consumption. However, participants in SSB-II with an added SSB Go/No-Go training made fewer unhealthy drink choices than those in the other conditions. Implementation intentions may aid individuals with inhibitory (executive control) difficulties by intervening on pre-potent behavioral tendencies, like SSB consumption.

1. Introduction

Adolescents commonly consume sugar-sweetened beverages (Harrington, 2008; Jahns, Siega-Riz, & Popkin, 2001; Keast, Nicklas, & O'Neil, 2010). Two large scale national probability samples of over 20,000 youth (ages 12 to 19) covering the years 1999–2004, found that 84% of adolescents reported consuming at least one sugar-sweetened beverage (SSB) in the last 24 h (Wang, Bleich, & Gortmaker, 2008). Further, sugar-sweetened beverage (SSB) consumption has been linked to obesity in youth and adolescents in much research (de Ruyter, Olthof, Seidell, & Katan, 2012; Fiorito, Marini, Francis, Smiciklas-Wright, & Birch, 2009; Ludwig, Peterson, & Gortmaker, 2001; Malik, Schulze, & Hu, 2006), although not every study supports the linkage (Gibson, 2008). Recent reviews report a positive association of SSB consumption with excess calories, energy imbalance, increasing body mass index, and overweight status (Harrington, 2008; Malik et al., 2006; Vartanian, Schwartz, & Brownell, 2007).

Some adolescents have greater difficulty resisting reinforcing foods like sugary drinks, in part as a result of an imbalance in neurocognitive processes that can lead to behavioral control problems (e.g., Ames et al., 2014). When an individual with inhibitory deficits is faced with reinforcing environmental cues, such as sugary drinks, they may have limited capacity to effectively alter or inhibit pre-potent tendencies. In the flow of daily activities, there may be a lack of potential for some youth to engage executive resources before sugar drink or snack consumption is initiated as other factors compete for control processes. Self-regulation strategies may be particularly important for individuals with inhibitory

* Corresponding author.
E-mail address: susan.ames@cgu.edu (S.L. Ames).

http://dx.doi.org/10.1016/j.appet.2016.06.036
0195-6663/

control deficits, in order to help prevent future risk for overweight or obesity.

Since frontal control functions are not yet fully developed in adolescents, use of interventions that do not require much frontal lobe involvement or depth of processing (e.g. implementation intentions) are helpful for youth who do not have full maturation of decision brain regions. In a prospective study that evaluated developmental differences in brain regions of 13 youth every two years, from age 4 to 21, Gogtay et al. (2004) found that regions implicated in executive control functions, mediated by the prefrontal cortex, matured last and during later adolescence. Others have found similar dynamic maturational changes in frontal cortical regions during late adolescence (for review, Giedd, 2008; Sowell, Thompson, & Toga, 2004; Toga, Thompson, & Sowell, 2006). Some impulsive-type behaviors have been attributed to these continued developmental changes (see Crews & Boettiger, 2009; Crews, He, & Hodge, 2007; Spear, 2000).

One potential compensatory strategy to aid individuals with inhibitory control problems is implementation intentions (Gollwitzer, 1993). The general idea of the use of implementation intentions (II) is to intervene on an individual's pre-potent response such that a behavioral tendency or impulse, like drinking sugar-sweetened beverages (SSBs), is inhibited without the need to engage executive processes (Orbell, Hodgkins, & Sheeran, 1997). The absence of compensatory strategies for adolescents with inhibitory control problems may place them at elevated risk for poorer dietary behaviors. Coupled with general inhibitory difficulties mediated by prefrontal systems, the acquisition of relatively automatic responses to specific reinforcing foods - that develop through repeated experiences (e.g., Bargh & Chartrand, 1999; Stacy, 1997) and rewarding effects - may have an even stronger effect on one's ability to inhibit a response (i.e., cue-response link; see Everitt & Robbins, 2005). Yet, all individuals with inhibitory control deficits do not drink or eat impulsively or uncontrollably when exposed to reinforcing foods.

1.1. Implementation intentions, new (alternative) behaviors, and inhibition

Implementation intentions specifically link an intention to perform a behavior with a situation, in the form of "If situation X occurs, then I will perform behavior Y" (Gollwitzer, 1999). Implementation intentions are specific action plans that specify *when*, *where*, *and how* to act in a given situation. Implementation intentions are believed to lead to spontaneous action of a specified behavior when the specified situational cue is encountered. This type of intention focuses on automatic processes and the link between specific behavioral goals and triggering cues. This approach is compatible with basic research revealing the importance of the spontaneous, triggering effects of cues (Stacy & Wiers, 2006). Probably because of its reliance on more spontaneous processes activated by situational cues, implementation intentions have been shown to have strong effects on goal attainment for individuals across a range of health behaviors (for review, Gollwitzer & Sheeran, 2006), including eating behaviors (for review, Adriaanse, Vinkers, De Ridder, Hox, & De Wit, 2011). With respect to diet, findings from a meta-analysis conducted by Adriaanse et al. (2011) revealed a small effect for reducing unhealthy food consumption and a medium effect for enhancing healthy food consumption. The studies reviewed did not specifically test II with respect to inhibiting SSB consumption and only one study addressed youth (age range 11–16; Gratton, Povey, & Clark-Carter, 2007) with a large effect for enhancing fruit/vegetable intake. With respect to inhibitory control, implementation intentions have also shown strong effects on inhibitory task performance for individuals with inhibitory deficits, including schizophrenic individuals (Brandstatter, Lengfelder, & Gollwitzer, 2001) patients with frontal lobe damage (Lengfelder & Gollwitzer, 2001), and youth with ADHD (Gawrilow & Gollwitzer, 2008).

Gawrilow and Gollwitzer (2008) found that children with ADHD performed significantly better (i.e., they effectively inhibited responses) when they formed implementation intentions on a Go/No-Go task and their performance was almost on par with youth without inhibitory control deficits. Given that critical decision points and responses are constrained by the motivational properties of cues that elicit behavior, then, an intervention should link specific cues to behaviors, such that when encountering those cues, an alternative behavior is automatically enacted. An implementation intention essentially "hands over" behavioral control to specific situational cues (e.g., encountering a refrigerator full of soda), which, in turn, spontaneously elicits a particular behavior or goal (e.g., I will resist drinking the soda) and does not rely on much information processing on the part of the individual.

The present study evaluated the influence of implementation intentions on inhibitory control and contrasted effects with drink-specific Go/No-Go training. No-Go training has been shown to be effective in reducing chocolate consumption and increasing dietary control in college students (Houben & Jansen, 2011, 2015) as well as reducing alcohol consumption in college students (Houben, Havermans, Nederkoorn, & Jansen, 2012; Houben, Nederkoorn, Wiers, & Jansen, 2011).

The present study manipulated between-subjects implementation intentions toward inhibitory control with two types of cue-specific versions, one for homework and one for sugar-sweetened beverage consumption to affect inhibitory control. The implementation intentions intervention should assist individuals in suppressing relatively habitual responses, require fewer cognitive resources, and help the individual to enact an alternative behavior (Gollwitzer, 1993). The study also tested the use of two types of Go/No-Go tasks - a Go/No-Go with homework cues, and a sugar-sweetened beverage (cue-specific) Go/No-Go to evaluate the added value of training inhibitory control on these tasks. The drink-specific version of the task is more likely to simulate real-life exposure to SSB cues and should provide information about cue effects that may be fundamental in understanding intervention effects.

2. Methods

2.1. Participants

Participants were 168 adolescents recruited from 12 regular public high schools within 20 miles of Claremont, California. Although 28 schools were identified, schools were enrolled on a first-come, first-serve basis until 12 sites agreed to participate. Schools with at least 25% of their student population enrolled in a free or reduced-cost meal program were classified as eligible for the study to promote participation of students from lower socioeconomic status families at elevated risk of being overweight or obese. Students were eligible if they were: (1) 14–17 years old, (2) able to speak and write English, (3) free of major illness such as heart disease, cancer, and diabetes, (4) not receiving clinical treatment for obesity or an eating disorder, (5) not allergic to wheat, peanuts, milk, or eggs, and (7) able to travel to the assessment site with a parent or guardian who spoke English or Spanish.

Trained research personnel distributed interest forms to high schools that contained two items that measured inhibitory control deficits in response to unhealthy foods. The items included, *'I have a hard time resisting junk food,'* and, *'I can't stop myself from eating junk food even though I know it is unhealthy'*. Examples of junk food were