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Research report

Sweetened drink and snacking cues in adolescents. A study using ecological momentary assessment ☆

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ABSTRACT

The objective of this study was to identify physical, social, and intrapersonal cues that were associated with the consumption of sweetened beverages and sweet and salty snacks among adolescents from lower SES neighborhoods. Students were recruited from high schools with a minimum level of 25% free or reduced cost lunches. Using ecological momentary assessment, participants ($N = 158$) were trained to answer brief questionnaires on handheld PDA devices: (a) each time they ate or drank, (b) when prompted randomly, and (c) once each evening. Data were collected over 7 days for each participant. Participants reported their location (e.g., school grounds, home), mood, social environment, activities (e.g., watching TV, texting), cravings, food cues (e.g., saw a snack), and food choices. Results showed that having unhealthy snacks or sweet drinks among adolescents was associated with being at school, being with friends, feeling lonely or bored, craving a drink or snack, and being exposed to food cues. Surprisingly, sweet drink consumption was associated with exercising. Watching TV was associated with consuming sweet snacks but not with salty snacks or sweet drinks. These findings identify important environmental and intrapersonal cues to poor snacking choices that may be applied to interventions designed to disrupt these food-related, cue–behavior linked habits.

Introduction

The proportion of adolescents in the US who are overweight or obese is a critical public health concern (Ogden, Carroll, Curtin, Lamb, & Flegal, 2010). Nationwide, the prevalence of being overweight and obese (BMI ⩾ 85 percentile) is 34.2% among all adolescents 12–19 years of age (Ogden et al., 2010). The prevalence of obesity is especially high among lower income families. In California, where this study was conducted, teens 12–17 years of age from lower income families (<300% Federal Poverty Level) are at elevated levels of risk of being overweight (20.7%) or obese (15.4%) compared to teens from higher income families (>300% FPL: 11.8% overweight and 7.5% obese) according to the California Health Interview Survey (2012). Adolescents with high BMI are at increased risk for chronic diseases including cardiovascular disease and type 2 diabetes mellitus among others (Freedman, Mei, Srinivasan, Berenson, & Dietz, 2007; Knight, 2011).

Obesity is, of course, closely related to diet (Baranowski et al., 2000; Goran, 2001; Hill, Melanson, & Wyatt, 2000; Mendlein, Baranowski, & Pratt, 2000), including snacking and sweetened beverage consumption. Evidence is accumulating that consumption of sugar-sweetened beverages is linked to increased body weight (Malik, Schulze, & Hu, 2006) and increased risk of medical problems including diabetes (Centers for Disease Control and Prevention (CDC), 2011; Malik et al., 2010; Vartanian, Schwartz, & Brownell, 2007). In addition, there is evidence that excess consumption of energy-dense snack foods is associated with an unhealthy weight gain (Piernas & Popkin, 2011; Swinburn, Caterson, Seidell, & James, 2004). The current study uses real-world, real-time data collected via Ecological Momentary Assessment (EMA: (Shiffman, 2009; Stone & Shiffman, 1994)) techniques

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to identify environmental and intrapersonal cues associated with habitual consumption of high calorie snacks and sweetened beverages.

Over time, some dietary behaviors may evolve through learning into habits that are initiated by situational cues (stimulus-driven habits). Research in neuroscience (Knowlton, Mangels, & Squire, 1996; Yin & Knowlton, 2006a, 2006b), memory (Nelson & Goodmon, 2003), social psychology (Bargh & Williams, 2006; Dijksterhuis, Smith, van Baaren, & Wigboldus, 2005), and research on appetitive behavior (LaBar et al., 2001) have consistently shown the importance of cues in spontaneously triggering habits and related cognitions. A situation such as a location, social setting, or mood may become a cue for a behavior after repeated co-occurrence with that behavior, especially when the behavior has immediate rewards such as consumption of palatable foods. A friend, for example, may not be associated with having a snack initially, but after repeatedly meeting the friend after school to buy chips and a soda, the sight of the friend may become a cue for the behavior. The current study was especially interested in stimulus–response (S–R) habits formed by this type of instrumental learning that may be highly resistant to modification (Yin & Knowlton, 2006b). After a strong (S–R) habit is formed, the cue (stimulus) can initiate the behavior (response) regardless of anticipated outcomes (Wood & Neal, 2007; Yin & Knowlton, 2006a). The habit is likely to persist even after the outcome contingency has changed (i.e., negative consequences are encountered due to excessive weight gain) and despite learning new facts about obesity (e.g., through traditional education). Habit is supported by neural systems that reflect a set of processes classified as procedural memory, which is independent from declarative or explicit memory (e.g., memory for new facts through education), as documented in a series of studies on multiple brain systems (Knowlton et al., 1996; Ryan & Cohen, 2003). Frameworks incorporating these findings and non-declarative processes have been increasingly applied to a range of appetitive behaviors (for recent reviews, see (Stacy, Ames, Wiers, & Krank, 2010; Stacy & Wiers, 2010)). Poor dietary habits that are allowed to continue unchecked can lead to a lifetime struggle with obesity and related chronic diseases. It is vitally important therefore to identify cues that trigger maladaptive dietary habits to facilitate the design of interventions that will disrupt the cue–behavior link and encourage healthy diets.

Participants may not be aware of the cues that trigger their habits (Dijksterhuis et al., 2005; Knowlton et al., 1996; Wood & Neal, 2007). Self-reports on the causes of behavior may not fully reflect the cue-habit process (Bargh, 2005; Dijksterhuis et al., 2005), and this makes it difficult to assess the cue-habit link with traditional surveys where participants are asked to introspect about their behavior in the previous days or months. It is possible that assessing behavior in real time may better identify cue–behavior patterns that are not captured by conventional, retrospective questionnaires (Shiffman, 1993; Shiffman, Stone, & Hufford, 2008). Real time assessment may be particularly helpful in identifying these linkages if the procedures simply record cue and behavior co-occurrences, facilitating the study of their empirical linkages without requiring participant awareness of the link.

EMA (Shiffman et al., 2008) is an assessment technique with several key features: (a) participants respond to questions during their typical activities in the real-world environment, which permits researchers to generalize the findings to the real lives of the participants, (b) responses of the participants focus on their current situation, activities, and feelings, which can eliminate recall bias associated with assessments that ask for recall of events over longer periods of time, (c) questions are asked at strategically selected times to capture situations, activities, and feelings during target events such as eating and, for purposes of comparison, during random times when participants may not be doing the target activity (i.e., non-eating situations), and (d) data are typically collected multiple times in a day and over several days to capture how behavior changes across situations and to accumulate multiple instances of the events of interest. The design and technology may differ by study question and behavior, but all EMA studies collect data repeatedly from participants on their current state or situation in their natural environment. Researchers then may examine how situations, activities, and feeling states influence the behavior of interest.

EMA has been widely used over a period of more than 20 years to measure health behaviors and antecedents related to smoking (Shiffman, 2005), exercise (Dunton, Whalen, Jamner, & Floro, 2007; Gorely, Marshall, Biddle, & Cameron, 2007; Hausenblas, Gauvin, Downs, & Duley, 2008), and diet (Glanz & Murphy, 2007; Greeno, Wing, & Shiffman, 2000; le Grange, Gorin, Catley, & Stone, 2001), with considerable evidence supporting its validity and utility among adults and youth. EMA procedures have shown less recall bias than retrospective questionnaires among adolescents and children as young as 7 years (van den Brink, Bandell-Hoekstra, & Abu-Saad, 2001), and previous EMA studies among children and adolescents include, for example, physical activity (Dunton, Liao, Intille, Spruijt-Metz, & Pentz, 2011; Dunton et al., 2007) smoking cessation (Gwaltney, Bartolomei, Colby, & Kahler, 2008), and mood (Weinstein & Mermelstein, 2007; Weinstein, Mermelstein, Hankin, Hedeker, & Flay, 2007). Prior EMA studies have successfully examined dietary behavior but largely among participants recruited from obese populations and/or those with eating disorders (Engel et al., 2009; Greeno et al., 2000; Hilbert & Tuschen-Caffier, 2007; Smyth et al., 2009).

The objective of the current study was to empirically identify situations or cues associated with unhealthy snacking and sugar-sweetened beverage consumption among participants recruited from public high schools in lower SES neighborhoods. We anticipated that, although the development of habits is likely to be idiosyncratic, common life experiences across participants would result in some common cue–behavior associations that can be identified using EMA. We also anticipated that multiple situations may cue snacking behaviors and that some of those situations might be related but not co-occurring. We reasoned, for example, that development of a habitual response to one cue (e.g., feeling happy) would not necessarily exclude the development of the same habitual response to a related cue (e.g., feeling sad). The analyses contrasted situational factors associated with consumption of these unhealthy drinks and snacks with those associated with non-sweetened drinks, healthy snacks, meals, and non-eating or drinking occasions. The study focused on cues associated with the consumption of sugar-sweetened drinks, sweet snacks, and salty snacks, which are associated with weight gain and related medical problems (Carels et al., 2001; Centers for Disease Control and Prevention (CDC), 2011; Malik et al., 2010; Piernas & Popkin, 2011; Vartanian et al., 2007). In addition, consumption of these food items is more likely to be under the control of adolescents, compared to meals prepared by adults in the home, making sweetened drinks and energy dense snacks ideal targets for behavioral interventions among adolescents.

Methods

Participants

Participants were recruited from high schools that met the following criteria: (a) minimum of 25% of students in a free or reduced price meal program, (b) minimum of 25% Hispanic students, (c) maximum of 25% Asian students, (d) minimum enrollment of 100, (e) included students between 14 and 17 years of age,