Appetite 96 (2016) 268–279

Contents lists available at ScienceDirect

Appetite

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

Research review

Managing temptation in obesity treatment: A neurobehavioral model of intervention strategies

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ARTICLE INFO

Article history:
Received 20 June 2015
Received in revised form
26 August 2015
Accepted 28 September 2015
Available online xxx

Keywords:
Diet adherence
Obesity
Lifestyle intervention
Food reward
Temporal discounting
Commitment
Executive function

ABSTRACT

Weight loss outcomes in lifestyle interventions for obesity are primarily a function of sustained adherence to a reduced-energy diet, and most lapses in diet adherence are precipitated by temptation from palatable food. The high nonresponse and relapse rates of lifestyle interventions suggest that current temptation management approaches may be insufficient for most participants. In this conceptual review, we discuss three neurobehavioral processes (attentional bias, temporal discounting, and the cold-hot empathy gap) that emerge during temptation and contribute to lapses in diet adherence. Characterizing the neurobehavioral profile of temptation highlights an important distinction between *temptation resistance strategies* aimed at overcoming temptation while it is experienced, and *temptation prevention strategies* that seek to avoid or minimize exposure to tempting stimuli. Many *temptation resistance* and *temptation prevention* strategies heavily rely on executive functions mediated by prefrontal systems that are prone to disruption by common occurrences such as stress, insufficient sleep, and even exposure to tempting stimuli. In contrast, commitment strategies are a set of devices that enable individuals to manage temptation by constraining their future choices, without placing heavy demands on executive functions. These concepts are synthesized in a conceptual model that categorizes temptation management approaches based on their intended effects on reward processing and degree of reliance on executive functions. We conclude by discussing the implications of our model for strengthening temptation management approaches in future lifestyle interventions, tailoring these approaches based on key individual difference variables, and suggesting high-priority topics for future research.

Contents

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http://dx.doi.org/10.1016/j.appet.2015.09.035
0195-6663/

1. Introduction

Obesity is a risk factor for multiple health conditions (Abdullah, Peeters, de Courten, & Stoelwinder, 2010; Bogers et al., 2007; Guh et al., 2009; Hubert, Feinleib, McNamara, & Castelli, 1983; Renehan, Tyson, Egger, Heller, & Zwahlen, 2008; Strazzullo et al., 2010) and affects about one-third of adults and one-sixth of children in the U.S. (Ogden, Carroll, Kit, & Flegal, 2014). Obesity contributes to 9% of all medical expenditures in the U.S. (Trogdon, Finkelstein, Feagan, & Cohen, 2012), and this figure is projected to grow substantially in coming decades (Finkelstein et al., 2012). Effective and affordable approaches to prevention and treatment are urgently needed.

The current front-line therapy for obesity consists of comprehensive lifestyle intervention focused on dietary modification, physical activity, and behavior change strategies (Jensen et al., 2014). Roughly 50% of lifestyle intervention participants lose at least 5–10% of initial body weight (Dansinger, Tatsioni, Wong, Chung, & Balk, 2007; Pi-Sunyer et al., 2007), which is the minimum benchmark for conferring clinically meaningful improvements in cardiometabolic risk factors (Dow et al., 2013; Liu, Wharton, Sharma, Ardern, & Kuk, 2013; Wing et al., 2011). The remaining half of lifestyle intervention participants are non-responders with respect to this outcome. In addition to high nonresponse rates, relapse is common (perhaps the norm). About one-third to one-half of lost weight is regained within one year of treatment discontinuation (Barte et al., 2010; Curioni & Lourenco, 2005; Franz et al., 2007). Even with ongoing, long-term intervention, only about 3.2 kg or 4–5% of lost weight is maintained (Look AHEAD Research Group, 2014; Middleton, Patidar, & Perri, 2012). Increasing response rates and reducing relapse are top priorities for behavioral obesity treatment (MacLean et al., 2015).

One path toward improved weight loss outcomes involves strengthening intervention strategies to help participants manage temptation from the highly palatable but unhealthy foods that permeate modern society. Weight loss outcomes are largely a function of sustained behavioral adherence to any reduced-energy diet (Alhassan, Kim, King, & Gardner, 2008; Dansinger, Gleason, Griffith, Selker, & Schaefer, 2005; Fitzpatrick et al., 2015; Heymsfield et al., 2007), and are not meaningfully affected by the type of diet one follows (Ajala, English, & Pinkney, 2013; Hu et al., 2012; Wycherley, Moran, Clifton, Noakes, & Brinkworth, 2012). Most dietary lapses are precipitated by temptation from palatable food (Cleobury & Tapper, 2014; McKee, Ntoumanis, & Taylor, 2014; Thomas, Doshi, Crosby, & Lowe, 2011). Thus, a promising route to better weight loss outcomes would be to design interventions that not only include diet plans with high acceptability and feasibility (Makris & Foster, 2011; Pagoto & Appelhans, 2013), but also arm patients with effective temptation management strategies.

In this review, we examine the neurobehavioral underpinnings of temptation, and highlight three processes that undermine diet adherence. We then review temptation management strategies in terms of their intended effects on temptation and the demand each strategy places on executive functions. Based on these considerations, we construct a model of temptation management strategies that we hope will guide future efforts to improve weight loss outcomes, particularly in participants who do not respond or relapse with traditional lifestyle interventions.

1.1. Food reward as the basis of temptation

Eating is regulated by two distinct but interconnected neurobehavioral systems: a homeostatic system and a reward-based system. In the homeostatic system, food is a component of a physiological-behavioral homeostatic feedback loop that governs energy balance (reviewed elsewhere; Berthoud, 2012; Harrold, Dovey, Blundell, & Halford, 2012; Hussain & Bloom, 2013; Rui, 2013; Woods & D'Alessio, 2008). In contrast, the reward system influences eating in response to the sensory experience of food. Two dimensions of reward have been distinguished in the literature (Berridge, 2009; Berridge, Ho, Richard, & DiFeliceantonio, 2010; Berridge & Kringelbach, 2008; Berridge & Robinson, 2003; Fulton, 2010; Kringelbach, Stein, & van Hartevelt, 2012). *Liking* reflects the hedonic aspect of reward and applies to the sensory pleasure associated with eating palatable food. *Wanting*, in contrast, manifests as appetitive motivation, desire, craving, and temptation; it is the dimension of reward that challenges self-control. *Wanting* underlies engagement in a variety of appetitive behaviors, including sexual activity (Georgiadis & Kringelbach, 2012), gambling (Joutsa et al., 2012; van Holst, van den Brink, Veltman, & Goudriaan, 2010), and substance abuse (Koob & Volkow, 2010; Pulvirenti & Koob, 1990; Robinson & Berridge, 1993; Schacht, Anton, & Myrick, 2013). When applied to food, *wanting* provides the motivational drive that supports adaptive foraging and hunting behaviors in environments of scarcity (Alcaro & Panksepp, 2011), but contributes to overeating in modern environments characterized by an abundance of hyper-palatable foods that can be obtained with minimal effort. Though *liking* and *wanting* may not be phenomenologically distinct in most day-to-day human experiences (Havermans, 2011), it is increasingly recognized that reward, rather than energy homeostasis, is the primary driver of overeating in modern society (Lowe & Butryn, 2007). Individual differences in food reward processing (Finlayson, King, & Blundell, 2007b; Mela, 2006), reflected in a variety of behavioral (Appelhans et al., 2011b; Epstein, Carr, Lin, & Fletcher, 2011; Epstein, Leddy, Temple, & Faith, 2007; Finlayson, King, & Blundell, 2008; Finlayson, King, & Blundell, 2007a; Giesen, Havermans, Douven, Tekelenburg, & Jansen, 2010; Lansigan, Emond, & Gilbert-Diamond, 2015; Saelens & Epstein, 1996) and biological (Burger & Berner, 2014; Burger & Stice, 2014; Demos, Heatherton, & Kelley, 2012; Guo, Simmons, Herscovitch, Martin, & Hall, 2014; Jonsson et al., 1999; Stice, Spoor, Bohon, & Small, 2008; Stice, Yokum, Burger, Epstein, & Small, 2011; Volkow et al., 2008) measures, are implicated in obesity risk. While the notion of "food addiction" remains controversial (Blundell & Finlayson, 2011; Smith & Robbins, 2013; Wise, 2013), frequent encounters with tempting foods in the modern