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Research report

Questionnaire and laboratory measures of eating behavior. Associations with energy intake and BMI in a community sample of working adults ☆

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ABSTRACT

Purpose: The present research compared a self-report measure of usual eating behaviors with two laboratory-based behavioral measures of food reward and food preference. *Methods:* Eating behaviors were measured among 233 working adults. A self-report measure was the Three Factor Eating Questionnaire (TFEQ) Restraint, Disinhibition and Hunger subscales. Laboratory measures were the (RVF) and Explicit Liking (EL) and Implicit Wanting (IW) for high fat food. Outcome measures were body mass index (BMI), and energy intake measured using three 24-h dietary recalls. *Results:* Significant bivariate associations were observed between each of the eating behavior measures and energy intake, but only Disinhibition and Hunger were associated with BMI. Multiple regression results showed RVF and EL and IW predicted energy intake independent of the TFEQ scales but did not predict BMI. *Conclusion:* Laboratory and self-report measures capture unique aspects of individual differences in eating behaviors that are associated with energy intake.

Introduction

Individual differences in stable eating behaviors are important influences on food choices, energy intake, and body mass index (BMI). In a high-risk food environment, most individuals will overeat to a certain extent. However, some individuals are more susceptible than others, and are at higher risk for excess energy intake and weight gain (Blundell & Cooling, 2000; Blundell et al., 2005; French, Epstein, Jeffery, Blundell, & Wardle, 2012). The ability to identify these susceptible individuals would advance both theoretical development in eating behaviors research and the development of interventions to prevent obesity.

Several theories conceptualize susceptibility to overeating and have developed measures of individual differences in eating behaviors related to energy intake and body weight (see French et al., 2012 for a review). The particular measures considered in this paper were chosen as potential indicators of individual differences in susceptibility to overeating as part of a community-based randomized trial to examine the effects of chronic exposure to large portion sizes. One of the most often-used questionnaire measures is the Three Factor Eating Questionnaire (TFEQ) (Bellisle et al., 2004; Bryant, King, & Blundell, 2007; Dykes, Brunner, Martikainen, & Wardle, 2004; Hays & Roberts, 2008; Lindroos et al., 1997; Stunkard & Messick, 1985). More recently, laboratory-based measures of food reward and food preference have been developed, including a measure of the reinforcing value of food (RVF) (Epstein, Carr, Lin, Fletcher, & Roemmich, 2012; Epstein, Leddy, Temple, & Faith, 2007; Epstein, Temple, Naderhiser, et al., 2007), and a measure of explicit liking (EL) and implicit wanting (IW) for food (Finlayson & Dalton, 2012; Finlayson, King, & Blundell, 2008). The laboratory measures consist of direct observation of behavior in the laboratory setting and theoretically measure somewhat different behavioral mechanisms believed to underlie susceptibility to overeating.

The TFEQ represents an empirical approach to develop a measure of eating behaviors that would distinguish normal weight from overweight and obese people (Stunkard & Messick, 1985). At the time this measure was developed, obese people were believed to have different eating behaviors and different behavioral and emotional responses to situations involving food choices compared to normal weight people. The TFEQ has an extensive research literature that includes large population-based cohorts, participants in clinical weight loss interventions, and college student samples across multi-country, prospective and cross-sectional studies (Barkeling, King, Naslund, & Blundell, 2007; Bellisle et al., 2004; Borg, Fogelholm, & Kukkonen-Harjula, 2004; Chambers & Yeomans, 2011; Drapeau et al., 2003; Dykes et al., 2004; Hainer et al., 2006; Harden, Corfe, Richardson, Dettmar, & Paxman, 2009; Hays et al., 2002; Levine et al., 2007; Lindroos et al., 1997;

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McGuire, Wing, Klem, Lang, & Hill, 1999; Ouwens, van Strien, & van der Staak, 2003; Provencher, Drapeau, Tremblay, Despres, & Lemieux, 2003; Savage, Hoffman, & Birch, 2009; Schubert & Randler, 2008; Teixeira et al., 2010; Vogels, Diepvens, & Westerterp-Plantenga, 2005; Wing et al., 2008).

The TFEQ consists of three distinct constructs: Restraint, Disinhibition and Hunger (Karlsson, Persson, Sjostrom, & Sullivan, 2000; Stunkard & Messick, 1985). Restraint reflects the degree to which a person exerts behavioral control over their own eating behavior. Disinhibition reflects a person's stable underlying readiness to eat in response to environmental triggers, such as the sight and smell of palatable food, social or emotional eating. Hunger reflects a person's stable underlying sensitivity to Hunger feelings and predisposition to eat. Of the three subscales, Disinhibition has been associated consistently with higher BMI and energy intake (Bellisle et al., 2004; Bryant et al., 2007; Dykes et al., 2004; Provencher et al., 2003). Disinhibition may be most closely related to food sensitivity or factors that influence the onset of eating. However, the failure to inhibit eating, once started, could be related to weak satiety processes or to weaker volitional controls (cognitive or motivational) on eating behavior. Recently, some researchers have conceptualized Disinhibition as internal and external control of eating (Bond, McDowell, & Wilkinson, 2001; Karlsson et al., 2000). However, most of the existing research retains the three-scale configuration of the questionnaire.

Restraint has been associated inconsistently with BMI (Dykes et al., 2004; French & Jeffery, 1994; French & Jeffery, 1997; French et al., 1994; Hays & Roberts, 2008; Lindroos et al., 1997; Provencher et al., 2003; Williamson et al., 1995). Both higher and lower energy intake has been observed among restrained eaters compared with those who are less restrained (Bellisle et al., 2004; Dykes et al., 2004; French & Jeffery, 1994; French & Jeffery 1997; French, Jeffery, & Murray, 1999; French et al., 1994; Hays & Roberts 2008; Lindroos et al., 1997; Provencher et al., 2003; Williamson et al., 1995). Associations tend to vary by age, gender and obesity status. Among younger college student women, higher Restraint scores tend to be associated with lower energy intake and body weight, while the opposite tends to be observed among overweight samples in clinical and community settings (French & Jeffery, 1994; French & Jeffery, 1997; French, Jeffery, & Wing, 1994).

A small but growing body of empirical data has revealed interactions between Disinhibition and Restraint in association with energy intake and body weight. For example, high Restraint combined with high Disinhibition attenuated weight gain over time (Hays & Roberts 2008; Williamson et al., 1995). In a laboratory experimental study, high Disinhibition with high Restraint was associated with higher energy intake in an ice cream preload paradigm (Westerhoefer, Broeckmann, Munch, & Pudel, 1994).

Hunger scores have shown fewer associations with outcomes in the literature to date, (Provencher et al., 2003 observed positive associations with energy intake). In theory, those who report chronically high levels of Hunger are more susceptible to overeating compared with those who do not report being often hungry. Correlations between Disinhibition and Hunger tend to be high (Bellisle et al., 2004; Dykes et al., 2004), while Restraint and Disinhibition and Restraint and Hunger tend to have lower correlations with each other (Dykes et al., 2004; Williamson et al., 1995).

More recently, the concept of RVF evolved from the theoretical literature on behavioral choice theory and applications to drug addiction (Epstein, Leddy, et al., 2007; Epstein, Temple, et al., 2007). Individuals for whom food has a high reward value are hypothesized to work harder to gain access to food compared to those who do not find food as reinforcing. In theory, compared to those for whom food is less reinforcing, those who find food highly reinforcing should be more responsive to food and eating opportunities in their environment, and as a result, may be more likely to be overweight or to have higher BMI. Epstein and colleagues have developed a measure of the RVF to quantify individual differences in RVF (Epstein, Carr, Lin, & Fletcher, 2011; Epstein, Leddy, et al., 2007; Epstein & Saelens, 2000; Epstein, Temple, et al., 2007; Epstein et al., 2004; Giesen, Remco, Douven, Tekelenburg, & Jansen, 2010; Hill, Saxton, Webber, Blundell, & Wardle, 2009; Saelens & Epstein, 1996; Temple, Legierski, Giacomelli, Salvy, & Epstein, 2008). RVF is measured using a laboratory-based computer task in which individuals have to "work" via computer clicks to gain access to food reinforcers. The RVF can be measured in an absolute sense by providing only access to food, or in a relative sense, in which two or more alternative reinforcers are available (food and non-food) to study how participants allocate time and effort for each alternative. It is also possible to study the RVF of different types of foods, rather than a food versus an alternative.

In cross-sectional studies, higher RVF scores have been observed among overweight compared with normal weight adults (Epstein, Dearing, & Roba, 2010; Epstein, Leddy, et al., 2007; Epstein, Temple, et al., 2007; Goldfield & Lumb, 2009). Higher energy intake in the laboratory setting has been observed among those with higher RVF compared to those with lower RVF (Epstein, Leddy, et al., 2007; Epstein, Temple, et al., 2007; Epstein et al., 2004; Epstein et al., 2011). In addition, food reinforcement is positively associated with energy intake measured by repeated 24-h recalls and food frequency questionnaires (Epstein, Carr, et al., 2012). One study examined the moderating effect of weight status on the Restraint-RVF association (Goldfield & Lumb, 2009). Those with high Restraint and low food reinforcement had lower BMI, and those with high Restraint and high food reinforcement had higher BMI (Goldfield & Lumb, 2009). In this study, food reinforcement was measured using a self-report questionnaire, not the laboratory behavioral measure (Epstein et al., 2010). Another study found higher BMI among those with high food reinforcement and high Disinhibition compared with low food reinforcement and low Disinhibition (Epstein, Linn, et al. (2012).

Recently, another laboratory behavioral measure of eating motivation has been developed. The concepts of liking and wanting of food in human appetite are based on theories related to hedonic processes involved in satiety (Berridge, 2007; Blundell et al., 2005) and distinct psychological components of food reward (Berridge, 1996). In humans, the construct of wanting is considered a motivational process that generates an impulsive attraction towards a specific food. Wanting independent from liking may refer to the compulsive element to eating. Liking represents the sensory pleasure-giving aspect of food. Liking may lead to wanting, but a food can also be liked in the absence of wanting (and sometimes wanted more than it is liked). As well as having separate meanings, further rationale for this distinction comes from behavioral neuroscience showing that liking (affective behavioral responses) and wanting (food motivation) have separate neural substrates in the brain (Berridge, 1996; Berridge, 2007). In humans, these same underlying neurochemical systems are implicated in the behavior of obese adults who binge eat (Davis et al., 2009) and possibly in other eating disordered behaviors (Berridge, 2009). The human constructs of liking and wanting recently have been operationalized for behavioral assessment in the laboratory using a photographic, visual analogue rating and choice reaction-time paradigm (Finlayson, King, & Blundell, 2007; Finlayson et al., 2008). As liking and wanting are theorized to be largely overlapping processes, it is expected that separate measures of liking and wanting will often covary under normal circumstances. Although liking is generally viewed as a more stable, persistent response for food, food wanting can more readily transfer from one food to another. In previous research, liking and wanting have been shown to similarly predict actual food choice and food intake under different laboratory and free-living situations (Dalton, Blundell, Finlayson, & biPlease