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Variety and hyperpalatability: are they promoting addictive overeating?[1–3]

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The hypothesis that food has evolved from a necessity and a boring staple to an object of desire and a substance of abuse has been debated for decades (1). However, over the past 10 y, empirical studies have revealed overlaps between maladaptive food intake patterns, which are sometimes seen in obesity, and drug addiction (2). As a result, ''addiction'' to palatable food has been suggested, with neurochemical and behavioral similarities seen in both human studies and in animal models (2, 3). In laboratory animals, signs of opiate-like withdrawal can be seen after administration of naloxone in cases in which the animals have a history of chronic overconsumption of sucrose. Furthermore, cross-tolerance and sensitization have been reported between alcohol, amphetamine, or cocaine and the overconsumption of sucrose. With these behaviors are concomitant changes in the mesolimbic dopamine and opioid systems that are consistent with the effects seen in response to most drugs of abuse, although the animals are dependent on a palatable food. Human studies have been conducted using psychometric tools to characterize food addiction (the Yale Food Addiction Scale) (4), with the findings suggesting increased neural activation in reward-related brain regions as a correlate of food addiction score (3). Other work has linked obesity with neural indications of addiction (5). Collectively, on the basis of these and other complementary data it is plausible that an addictive response to palatable food may, in part, promote increased food intake that can sometimes lead to obesity.

The recent work by Epstein et al (6) reported in this issue of the Journal extends the food addiction hypothesis by presenting new data that focus on the concept of habituation to palatable food in women. It is known that repeated exposure to drugs of abuse can facilitate tolerance, whereby prolonged repeated exposure to a drug of abuse produces a state in which increasing amounts of the drug are needed to produce euphoric effects. Contrary to what one might expect from the addiction hypothesis, previous studies have shown that under normal conditions humans tend to habituate to the presentation of the same food, but this effect may be short-term (7). Here, Epstein et al explored the temporal effects of exposure to palatable food on habituation, by randomly assigning obese and nonobese women to receive a palatable macaroni-and-cheese meal either every day or once per week for 5 wk. Habituation and reduced intake were observed faster in both obese and nonobese women in the daily presentation group than in the groups exposed to the palatable food weekly (6).

The findings of Epstein et al (6) provide support and guidance in developing dietary advice, such as the suggestion that people try to eat the same food each day, in which case habituation may develop that would reduce the likelihood of overeating and subsequent obesity. However, previous work has shown that having a variety of tastes available can actually promote energy intake (8). Thus, variety in palatable food choices appears to be important in determining whether or not habituation or perhaps tolerance to food can develop. In our modern-day food environment, monotony and similarity in meals are rare. The variety of ethnic foods, multiple fast-food restaurants on virtually every corner, and the many choices of highly palatable food that these establishments have to offer creates a diverse, delicious abundance of food from which we choose our meals. Furthermore, advances in food production and farming, as well as importation of food from other countries, allows us to eat fruit and vegetables throughout the year, which adds more variety and choice to our food selections. Thus, the work of Epstein et al is important to consider in contemplating and designing meal plans in our variety-rich environment. Clearly, school-lunch planners and public health officials should note that diversity in the menu is not necessarily a virtue, and in fact it may be associated with promoting excess food intake and increased body mass index.

Although the work of Epstein et al (6) is a very important addition to the literature, it is limited by including only women as subjects. It is known that other addictions (eg, alcohol, tobacco) show clear sex differences in terms of how humans respond to drugs and drug cues. Furthermore, work by Wang et al (9) has shown that inhibitory cognitive control over the desire to eat is suppressed in women, but not in men, and this may be a contributing factor to sex differences in obesity. Thus, it will

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be important to further explore whether the findings obtained in the present study extend to men.

In summary, the finding that long-term habituation to palatable food can occur is important to furthering our understanding of regulating food intake, and perhaps in curtailing addictive overeating. Nonhomeostatic eating is being increasingly studied, spurred in part by efforts to understand and lessen the obesity epidemic. Although we have learned a lot about reward-driven feeding behavior in recent years, particularly with regard to addictive eating, we have yet to identify a behavioral intervention that is promising. Food addiction research and translation to human overeating and obesity are strengthened by finding habituation. If energy intake is decreased after repeated exposures to the same palatable foods, the next step will be to understand the brain mechanisms that co-occur with this behavior. It is becoming clear that new pharmacologic therapies for overeating may end up being established drug addiction treatments (10). Knowledge of the feeding patterns and types of foods that produce habituation compared with sensitization is essential in furthering our approach toward studying the treatment of some forms of overeating as an addiction.

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