EFFECTS OF PERCEIVED SUGAR OR CHOCOLATE INTAKE ON SELF-REPORTED FOOD CRAVINGS, MOOD STATES, AND FOOD INTAKE: A DOUBLE-BLIND, PLACEBO-CONTROLLED STUDY

by

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A thesis submitted in partial fulfillment of the requirements for the degree of

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ABSTRACT

Effects of Perceived Sugar or Chocolate Intake on Self-Reported Food
Cravings, Mood States, and Food Intake: A Double-Blind, 
Placebo-Controlled Study

by

Lara J. Schultz, Master of Science
Utah State University, 1999

Many dieters and compulsive overeaters report that sugar and chocolate are the
most commonly craved foods. Further, many individuals have proclaimed themselves to be
“addicted” to sugar or chocolate. It remains unclear, however, what factors lead to report
of specific food addictions. A number of researchers have suggested that highly repetitive
consumption of sugar and chocolate may result from various physiological processes (e.g.,
neurochemical imbalances, glucose/insulin malfunctioning). However, there is also
considerable evidence that psychosocial factors (i.e., expectancies, classical, and operant
conditioning) play the major role in the development and maintenance of excessive
sugar/chocolate intake. Empirical studies examining factors that underlie this behavior are
almost nonexistent. Therefore, it is useful for researchers to explore perspectives about the
causes of addictive or compulsive behavior. This study addressed the question, “Are adverse eating symptoms/outcomes for women who believe they are addicted to sugar or chocolate explained primarily by learning factors or by the key chemical constituents in these foods?”

This study involved procedures that influenced subjects’ perceptions and expectations about the sugar/chocolate content of a beverage (i.e., real chocolate, sugar versus synthetic substitute [placebo]) in a laboratory taste test situation. In an ABAB experimental design, self-avowed addict and control subjects were tested on four consecutive days, receiving two chocolate/sugar (A) and two placebo (B) beverages. Changes in mood and food cravings were measured, as was an index of perceived eating dyscontrol following the consumption of beverages. In addition to establishing a baseline measure each day, subjects’ mood and cravings were assessed immediately after consumption of chocolate or placebo as well as 45 minutes later.

The responses (mood, food cravings, food intake) that occurred after exposure to drinks containing placebo or sugar/chocolate suggested that subjects do not always respond in the manner they purport to (e.g., increased cravings, mood improvement, subsequent overeating of treats). Other factors such as learning and conditioning may play a key role in accounting for their report of excessive behavior. Specifically, individuals who believe they are addicted to sugar or chocolate evidence similar responses and symptoms irrespective of whether they consumed a placebo versus sugar or chocolate.
ACKNOWLEDGMENTS

I would especially like to thank Dr. David Stein, my chairperson, for his time and energy and overall commitment to this project. Not only has he guided me through all stages of this thesis, but he has also taught me to be a better critical thinker and writer. I have much respect for Dr. Stein’s keen insights into both the conceptual aspects of this topic and to the intricacies of experimental research design. I also appreciate my committee members, Drs. Gretchen Gimpel and Nedra Christensen, for their thoughtful effort in reviewing my work. Finally, I would like to thank my family and friends, who have supported me throughout this process. Their encouragement, kindness, and reminders to laugh often, all helped to make life a bit more enjoyable while completing the final chapters.

Lara J. Schultz
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There is a growing tendency in health care professions and our culture generally to label problematic repetitive behaviors as “addictions.” Traditionally, the concept of addiction has pertained to physiological symptoms of tolerance and withdrawal in drug and alcohol dependency. More recently, however, this definition has broadened greatly. Researchers and lay people alike are foregoing these traditional physiological conditions as requisite to labeling many impulse control problems as addictions. “Addiction” is now being used to denote highly diverse, behavioral excesses involving eating, drinking, gambling, playing video games, setting fires, engaging in sexual intercourse, stealing, and even “loving.” Indeed, behavioral dyscontrol with food in particular is increasingly being called “addictive eating,” especially the binge eating of sugar and chocolate, or other foods many dieters tend to love, but avoid (Brink, 1993; Hetherington & Macdiarmid, 1993; Kayloe, 1993).

In a culture where having healthy eating habits and maintaining an appropriate body weight are greatly emphasized, behaviors that threaten a healthy lifestyle have come to the attention of both lay people and health care professionals. While overeating in general is considered problematic, the repetitive quality of such behavior, especially where individuals avow some loss of personal control, is often viewed by the popular media as pathological. While eating dyscontrol and food cravings have been broadly discussed in the context of addiction, two specific foods of particular interest are sugar and chocolate.
Many dieters and compulsive overeaters report that sugar and chocolate are two of the most commonly craved foods. Further, many individuals have proclaimed themselves to be addicted to these substances (Brink, 1993). It remains unclear, however, what factors lead to specific so-called food addictions.

There is little consensus regarding the basic physiological or biochemical processes that might underlie food craving or eating excesses. It is likely that eating patterns represent complex human behaviors that cannot be understood merely as a response to hunger or biochemical processes. For example, Michener and Rozin (1994) stated that although “craving is an extremely common occurrence... there is almost no literature exploring the basis for cravings or their satisfaction” (p. 419). Certainly, a number of researchers have suggested that highly repetitive consumption of sugar or chocolate may result from various neurochemical imbalances, misperception of hunger cues, mineral and/or vitamin deficiencies, disruption of glucose and insulin functioning, and other physiological functions of the body (e.g., Schifano & Magni, 1994; Schuman, Gitlin, & Fairbanks, 1987; Weil & Rosen, 1983). However, there is also considerable evidence that psychosocial factors play the major role in the development and maintenance of compulsive or chronic binge-eating patterns and craving (e.g., Reid & Hammersley, 1995; Rozin, Levine, & Stoess, 1991; Wardle, 1990). For example, a social learning model suggests that consumption may be strongly related to positive reinforcement (by taste and smell) as well as classical conditioning of anxiety and stress reduction responses (negative reinforcement). In addition, learned expectancies and classically conditioned situational
cues likely play a major role in perpetuating compulsive consumption. Of central interest, therefore, is whether a learning model appears to help explain addictive eating behaviors, specifically the excessive consumption of sugar and chocolate.

As has been noted, empirical studies examining factors that underlie excessive sugar and chocolate intake are almost nonexistent. It is useful, then, for researchers to explore perspectives about the causes of addictive or compulsive behavior. The current study addressed the question, “Are adverse eating outcomes for women who believe they are addicted to chocolate or sugar explained primarily by learning factors or by key chemical components in these foods?” This study involved procedures that influenced subjects’ perceptions and expectations about the sugar or chocolate content of a drink or food item (i.e., sugar, real chocolate, versus synthetic substances [placebo]) in a laboratory taste test situation. Changes in mood and food cravings were measured, as was an index of perceived eating dyscontrol following the consumption of sugar or chocolate beverages (i.e., amount of ice cream eaten after the consumption of each type of beverage). The responses (mood, food cravings, food intake) that occurred as a result of exposure to drinks containing placebos versus a reputed addictive substance (sugar, chocolate) would suggest whether learning factors play a key role in explaining so-called addictive behavior. Specifically, if individuals who believe they are addicted to sugar or chocolate evidenced similar responses irrespective of whether they were consuming a placebo, sugar, or chocolate, it would suggest that expectancies and learning factors play a major role in these responses. If, on the other hand, consuming chocolate or sugar, per se,
led to greater changes in mood, food cravings, and amount of ice cream eaten, relative to a placebo, it would seem that physiological mechanisms and key "addictive substances" are what impact food cravings, mood changes, and overconsumption of sugar or chocolate.
CHAPTER II
REVIEW OF THE LITERATURE

Introduction

In the literature review that follows, the current debate over the definition of addiction will be discussed, and a general definition of behavioral addiction will be offered. It is important for experts to agree upon a common definition of addiction or dependence. Such a consensus would allow researchers to develop more reliable criteria regarding what constitutes more specific problems such as sugar or chocolate “addiction.” In addition to offering a standard definition, current knowledge about mechanisms that may underlie excessive sugar and chocolate intake will be presented. Both physiological and psychosocial explanations for this phenomenon will be outlined. Finally, the available studies that have attempted to tease apart pharmacological versus psychosocial contributors to the overconsumption of sugar and chocolate will be presented. It must be emphasized that although the notion of “chocoholism” and “sugar addiction” have been popularized by the media, few empirical studies have directly attempted to ascertain causal factors related to these behaviors.

Defining Addiction

In recent years, there has been an emerging controversy over the definition of the term “addiction.” One recent trend has been to label any behavior that appears excessive,
extreme, or “out of control,” an “addiction.” However, a more traditional view reserves this term for extreme, maladaptive drug and alcohol use, which sometimes can involve symptoms of physiological tolerance and withdrawal. Travin (1995) interpreted this change from a traditional to a broadened definition of addiction as a result of changes in the criteria of substance dependance between the Diagnostic and Statistical Manual of Mental Disorders (3rd ed.; DSM-III; American Psychiatric Association, 1980) and the third edition, revised (DSM-III-R; American Psychiatric Association, 1987). The DSM-III-R offered the possibility that symptoms could include, but are not limited to, physiological symptoms of tolerance and withdrawal.

In making a case for a broader definition of addiction, Peele (1990) stated, “I argue...that models of addiction have failed precisely because they have ignored social-psychological dimensions of behavior” (p. 514). In discussing “compulsive consumer behavior,” for instance, Faber, O’Guinn, and Krych (1987) identified a number of behaviors that are similar to the common manifestations of traditional (drug/alcohol) addictive behavior. These include the presence of a drive or impulse to engage in the behavior, denial of the harmful consequences, and repeated failure to control the behavior. Likewise, Mendelson and Mello (1986) defined addiction as any behavior that is excessive, compulsive (beyond the control of the person who engages in it), and destructive psychologically or physically. They stated, “When...compulsive behavior becomes the center of one’s existence... we can then say that such a person is to all intents and purposes, addicted” (p. 21).
Goodman (1992) created a set of diagnostic criteria for a nonspecific "addictive disorder" that includes items similar to those of the DSM-III-R (1987) substance dependence disorders. However, Goodman considered acquired tolerance to be a possible, though not necessary, criterion. Also, withdrawal was interpreted as "restlessness or irritability if unable to engage in the behavior" (p. 227).

There are a number of obvious similarities between current conceptualizations of chemical dependencies and what might be called behavioral addictions (e.g., the Diagnostic and Statistical Manual of Mental Disorders (4th ed.) substance dependence and impulse control disorders [DSM-IV; American Psychiatric Association, 1994]). For example, the criteria for a reputed behavioral addiction, pathological gambling, include psychological tolerance and withdrawal, inability to control behavior, preoccupation with behavior, and continuing the behavior despite the harmful consequences (i.e., loss of money, relationships, job). Figure 1 presents a list of the diagnostic criteria (in abbreviated form) of both chemical substance dependence and behavioral pathological gambling. Lines are drawn to reflect items that appear to parallel each other. Although the criteria are specific to each respective disorder, it is apparent how similar the basic features of several criteria are between these two disorders. In promoting these parallels between substance dependence and impulse control disorders, the DSM-IV (1994) has clearly codified the notion of "addictive behaviors" quite broadly.

Akers (1991) has argued that newer conceptions of behavioral addiction afford less clarity and precision. As a result, it becomes difficult to differentiate addictions from
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<th>Criteria for Pathological Gambling</th>
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<td>1. tolerance</td>
<td>1. need to gamble with more money in order to achieve excitement</td>
</tr>
<tr>
<td>2. substance is often taken in larger amounts over a longer period</td>
<td>2. restless or irritable when attempting to cut down or stop gambling</td>
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<tr>
<td>than was intended</td>
<td>3. unsuccessful efforts at controlling, cutting back or stopping behavior</td>
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<tr>
<td>3. withdrawal</td>
<td>4. preoccupation with gambling</td>
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<tr>
<td>4. persistent desire or unsuccessful efforts to cut down or control</td>
<td>5. commits illegal acts in order to obtain money to finance gambling</td>
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<tr>
<td>substance use</td>
<td>6. has jeopardized relationships, job or educational opportunities</td>
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<td>5. spending a great deal of time in activities necessary to obtain,</td>
<td>because of gambling</td>
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<tr>
<td>use or recover from the effects of the substance</td>
<td>7. after losing, will continue to gamble to win back losses</td>
</tr>
<tr>
<td>6. important social, occupational, or recreational activities are</td>
<td>8. uses gambling as a means to escape problems or relieving dysphoric</td>
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<tr>
<td>given up or reduced</td>
<td>mood</td>
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<tr>
<td>7. continued use despite harmful consequences</td>
<td>9. relies on others to provide money to relieve a desperate financial</td>
</tr>
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<td></td>
<td>situation caused by gambling</td>
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<td>10. lies in order to conceal gambling</td>
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Figure 1. Comparison of diagnostic criteria for substance dependence versus pathological gambling. (Criteria adapted from the DSM-IV [American Psychological Association, 1994])

more normal patterns of simple behavioral excesses. Coleman (1976), challenging the entire concept of addiction, implied that even traditional addictive substances such as narcotics are not “addictive.” Instead, he suggests that when the user is convinced that physical habituation will induce cravings, their expectations will produce behaviors that simply appear to be part of an addictive process.

There are a number of researchers who accept a more traditional addiction model,
yet continue to label certain behavioral excesses (i.e., eating, gambling) "addictions." They assume that there is a common, physiological component underlying many of these behaviors. In attempting to uncover a common underlying mechanism for all behavioral excesses, Sunderwirth and Milkman (1991) suggested that repeating powerful, mind-altering activities could lead to physiological changes that are the basis of an addiction. Milkman and Sunderwirth (1982) also suggested that neurochemical processes that occur as a result of arousing activities are similar to those that occur after ingestion of some stimulant drugs.

In an attempt to provide a standard definition of addiction that researchers may use as a common frame of reference, the different theories of so-called addictive behavior were considered. The following criteria appear to be consistent with the views of a number of eminent researchers and the DSM-IV (1994): (a) a maladaptive preoccupation with acquiring the substance or engaging in the addictive behavior; (b) a perceived inability to manage the timing, frequency, duration and/or intensity of the behavior; (c) a strong desire to continue the behavior once started; (d) attempts to reduce or terminate the behavior, once initiated, lead to various aversive mood changes; and (e) the behavior persists and remains unmanageable, despite adverse physical and/or social consequences. This definition can be applied to such behaviors as problematic gambling, sex, stealing, and eating, as well drugs and alcohol. Specifically, this definition could be applied to the excessive consumption of sugar and chocolate, two substances that are commonly viewed as "addictive," and the intake of which many people have difficulty controlling.
Although the current study involved women who believe they are addicted to sugar or chocolate, it should be noted that there are problems with overgeneralizing the term addiction to excessive eating behavior. Many addictions have clearly maladaptive outcomes. Aside from long-term weight gain, there are few meaningful, maladaptive consequences associated with excessive sugar or chocolate intake. Additionally, there may not be any realistic or material consequences to health or lifestyle that would occur if these "sugar and chocolate addicts" suddenly stopped eating these substances. Thus, it is important to note that the issue of severe maladaptive consequence is necessarily absent from the definition being used in the current study.

Excessive Sugar Consumption

Recently, it has been popular in our culture to label individuals who eat excessive amounts of sugar, "sugar addicts." In an editorial, Brink (1993) implored health care professionals to "think of sugar addiction in the same way we think of other drug addictions" (p. 281). However, it is unclear what constitutes sugar addiction, or the factors that lead to this type of behavior in humans.

Although sugar is known to have physiological effects, researchers have yet to identify a strictly biochemical explanation for excessive sugar intake. That many individuals report changes in mood (e.g., reduction in anxiety) after sugar consumption might suggest that psychosocial factors such as expectancies and conditioned cues, and/or physiological factors may be involved in the perpetuation of excessive intake. Both
models, physiological and psychosocial, will be considered in greater detail in the present review. Because no studies have been published to date that examine etiological factors in sugar addiction, results of studies of populations experiencing somewhat similar eating problems (i.e., bulimics and binge eaters) will be considered.

**Physiological Explanations for Compulsive Consumption of Sugar**

**Endocrinological Malfunction**

One explanation for excessive, repetitive sugar consumption implicates malfunctioning endocrine processes. The endocrine system is responsible for regulating blood sugar levels in the body through secretion of insulin, after the ingestion of food containing sugar. Once insulin levels rise, blood sugar levels typically drop again. Many individuals who believe they are addicted to sugar report that this drop leaves them fatigued or without energy, as though they have “crashed.” To feel better, these individuals will then consume more sugar, and the cycle continues. Some evidence for this theory has been offered. Sugar has been found to increase self-reported levels of energy (Hill & Heaton-Brown, 1994). Additionally, Thayer (1987) found that after subjects ingested a sugar snack, there was a pattern of postigestion increases in energy, followed by lower self-reported ratings of energy and increased feelings of fatigue. Plasma glucose levels are known to peak between 30 and 60 minutes after consuming sugar (Blouin et al., 1993; Coffee, 1998).

It is commonly believed among lay persons that sugar increases levels of activity,
especially in children who are considered hyperactive. Although initial research reported some support for this theory (Prinz, Robert, & Hantman, 1980; Wolraich, Stumbo, Milich, Chenard, & Schultz, 1986), more carefully controlled studies (e.g., studies in which parents were blind to whether their child was actually receiving sugar) showed no differential effects for sugar versus placebo on behavior (Behar, Rapoport, & Adams, 1984; Hoover & Milich, 1994).

Many researchers have speculated that abnormalities in glucose or insulin secretion may contribute to the development of eating disorders. Rodin (1985) stated that insulin is mainly responsible for carbohydrate metabolism and has strong appetite-stimulating effects. She speculated that these effects may play a role in the development and maintenance of obesity. Studies involving satiation and hormone release among bulimics suggest that abnormal physiological responses to carbohydrates may partially explain the binge behavior of bulimics (Thompson, Palmer, & Petersen, 1988; Turner et al., 1991). However, Holstein, Gwirtsman, Whalen, and Enns (1986) found no difference between bulimics and controls on an oral glucose tolerance test.

In one study (Blouin et al., 1993), 19 bulimic women and 22 controls were given a glucose or placebo injection under double-blind conditions. Dependent measures (blood samples of glucose, insulin and glucagon, and psychometric assessments of mood and food cravings) were collected at eight different times. Glucose injection appeared to lead to increased ratings of depression, anxiety, fatigue, and bewilderment among bulimics, and heightened subjects’ urge to binge. However, this effect was not found among any of the
control subjects, nor among the bulimics who did not receive glucose. Although this study provided evidence for the involvement of endocrinological factors in disturbances of eating, results from all studies examining the effects of endocrinological factors have been highly mixed, and therefore clear conclusions cannot be drawn.

It has also been proposed that cephalic phase insulin release may play a role in disordered eating because it influences absorption and disposal of metabolites (Powley & Berthoud, 1985). Cephalic phase insulin release, which increases in the mere presence of food, has been conditioned to arbitrary stimuli in rats (Woods et al., 1977). It is possible then, that humans, too, may develop a conditioned insulin response to the presence of certain foods. Moyer, Rodin, and Cummings (1993) examined cephalic insulin secretion among persons with bulimia nervosa. In their study, plasma levels of insulin were measured several times during exposure to and eventual consumption of warmed chocolate chip cookies. No abnormalities in cephalic insulin secretion were found among these subjects. It is clear from the available studies involving glucose and insulin that there is little agreement on whether endocrinological factors might be implicated in disordered eating.

**Neurochemical Imbalance**

**Serotonin.** Brain serotonin (5HT), a neurotransmitter, appears to be involved in disturbances of mood and appetite. In animals, reduction of serotonin uptake has been shown to stimulate food intake, while increasing uptake has led to a reduction in food intake (Blundell, 1984; Fernstrom, 1992) especially for carbohydrates (Wurtman &
Wurtman, 1989). Another study found that 5HT reduced food intake in bulimic women (Brewerton, Murphy, & Jimerson, 1994). In addition, clinical studies have supported the fact that some individuals with eating disorders have reduced serotonin activity (Jimerson, Lesem, Hegg, & Brewerton, 1990). In fact, antidepressants that increase 5HT activity have been found to reduce binge frequency in women with bulimia nervosa. In a study of carbohydrate cravers, plasma serotonin was lower in obese carbohydrate cravers than in obese and lean noncarbohydrate cravers (Blum et al., 1993).

There is some evidence, then, that disordered eating, including excessive sugar intake, may be related to a malfunctioning serotonergic system. However, as Drewnowski (1995) stated, “In theory at least, all carbohydrate-rich snacks ought to be the targets of food cravings, whether they are sweet or not. However, anecdotal reports and clinical observations have consistently shown that the typical targets of cravings by women were such sugar-fat mixtures as chocolate, cakes, pastries, and ice cream” (p. 1083S). Further, it should be noted that some drugs have no effect on serotonin, yet appeared to induce strong cravings for sweets (Nakra & Grossberg, 1986).

**Endogenous opioid peptides.** There is some indication that opiate peptides may play a role in disordered eating. Naloxone, an opioid antagonist, has been found to reduce food intake in normal-weight and obese subjects (Atkinson et al., 1985; Trenchard & Silverstone, 1982; Wolkowitz et al., 1988), as well as in bulimic women (Mitchell, Laine, Morley, & Levine, 1986). Opioid peptides are also thought to control sensory preferences for sweet foods (LeMagnen, 1990), thereby influencing sugar intake. Opioid antagonists
have also reduced consumption of sucrose, glucose and saccharin solutions in rats (Kirkham & Cooper, 1988; Lynch & Libby, 1983). In a study conducted with obese and bulimic women, infusion of naloxone led to a reduced pleasure response to certain sweet and/or high fat foods (Drewnowski, Kurth, Holden-Wiltse, & Saari, 1992). This same effect was found with binge eaters (Drewnowski, Krahn, Demitrack, Nairn, & Gosnell, 1992). In addition, total caloric intake was significantly reduced in binge eaters, but not controls. In summary, there is some evidence that neurotransmitters may contribute to food cravings and overeating.

Orosensory Factors

It has been shown that there are fundamental, individual differences in persons’ taste preference for sweet-tasting substances. Looy and Weingarten (1991) suggested that preferences for sweet foods is based largely on genetic factors. These authors reported that there is a strong correlation between sweet liker/disliker status and the genetically determined ability to taste 6-n-propylthiouracil (PROP). In a study involving rats, taste was a major factor in explaining overconsumption of sugar. When given solutions containing sucrose, rats overate, but when given sugar in a powder form, which is not as orosensorally pleasing, there was no overeating (Sclafani, 1987). This provides evidence that taste per se may partially explain overeating. In a follow-up study (Sclafani & Ackroff, 1994), it was found that food preferences in rats were reinforced by sweet taste, and not postingestive effects of sugar.
Learning Explanations

Classical and operant conditioning, observational and social learning, and cognitive processes such as beliefs, expectancies, and attributions are commonly implicated in addictive processes (Marlatt, Baer, Donovan, & Kivlahan, 1988). The most relevant models for explaining addictive-like behavior with respect to sugar appear to be cognitive expectancy and conditioning models.

Expectancy Models

A number of studies have provided evidence that outcome expectancies play a major role in the development of psychological dependence (Goldman, Brown, & Christiansen, 1987; Lang & Michalec, 1990; Marlatt, 1987). An outcome expectancy refers to the consequences an individual expects will occur after engaging in a certain behavior. Expectations of alcohol content in a drink have been found to play a more significant role in determining perceived intoxication than actual alcohol content (Fromme & Dunn, 1992; Rohsenow & Marlatt, 1981; Stacy, Widaman, & Marlatt, 1990). An expectancy effect has also been found to occur in studies examining causal factors related to the intake of nicotine (Gottlieb, Killen, Marlatt, & Taylor, 1987) and caffeine (Christensen, White, Krietsch, & Steele, 1990). For example, Christensen et al. found that subjects who expected to ingest caffeine reported more caffeine-related symptoms than subjects who did not expect to ingest caffeine, even though neither group was given caffeine.
Subjects’ a priori beliefs about food also have important consequences on consumption. It has been suggested that sensory mechanisms and cognitive variables play a major role in the craving of sweet foods, and are as important or more important than pharmacological factors (Schlundt, Virts, Sbrocco, Pope-Cordle, & Hill, 1993; Weingarten & Elston, 1990). Several researchers have conducted studies in which actual and perceived caloric values of foods have been manipulated (Herman & Mack, 1975; Hibscher & Herman, 1977; Polivy, 1976; Weingarten, Hendler, & Rodin, 1988). Results indicate that both actual and perceived caloric intake affects subsequent consumption in laboratory eating situations. However, Christensen, White, and Krietsch (1985) did not find any expectancy effects in subjects who consumed refined sugar. Bowen, Tomoyasu, Anderson, Carney, and Kristal (1992) found that expectancies for low- and high-fat foods affected some taste variables and hedonic judgments, yet several female subjects detected actual fat content even when given conflicting information. It appears that expectancies cannot fully account for amount of food consumed or hedonic judgments.

In a creative study by Weingarten et al. (1988), plasma levels of glucose, insulin, glucagon, norepinephrine, and fatty free acid in normal-weight bulimic women and controls were measured after consumption of a test meal. Each subject was tested on two different days, eating one of the two possible meals on each occasion. The two test meals were isocaloric, but would have been judged by most dieters as differing in the degree of perceived “forbiddenness” (cottage cheese versus french toast). The researchers found no physiological differences between bulimics and controls, but there were differential profiles
of postabsorptive glucose and postprandial secretion between the two meals. It appeared likely that expectations about the forbiddenness of different foods played a role in the production of postabsorptive glucose secretion.

The counter-regulation theory (Hibscher & Herman, 1977) suggests that once a restrained eater (dieter) has passed his or her perceived caloric limit for the day, (s)he rationalizes that there is no point to attempting further restriction of intake, and thus overeating may occur. Many researchers have found that dieters subsequently eat more after a large food preload than after a small preload, or after consuming nothing (Herman, Polivy, & Esses, 1987; Herman, Polivy, & Silver, 1979). This same behavior occurred when preloads were isocaloric but subjects believed the meal was of high or low caloric content (Polivy, 1976; Spencer & Fremouw, 1979; Woody, Costanzo, Leifer, & Conger, 1981). These studies have all provided evidence that expectations affect food intake.

A number of studies have found evidence that bulimics and highly restrained eaters experience abnormally high levels of hunger after meals or binges compared to controls (Thompson et al., 1988; Walsh, Kissileff, Cassidy, & Dantzic, 1989). At this time, it is not known whether this effect is the result of physiological changes or due to expectations. When studying the effects of sugar consumption on women who eat excessive amounts of sugar, it is essential to consider changes in hunger and subsequent food intake after consumption of a sugary substance.

In a survey conducted on food beliefs of the general population, the majority of respondents believed that sugar influences hyperactivity (Wisocki & King, 1992). In their
study examining the effects of sugar on children considered to be hyperactive, Hoover and Milich (1994) found that parents rated their children’s behavior differently if they thought their child had received sucrose rather than an artificial sweetener. In fact, these parents rated their children’s behavior as significantly worse than parents who expected their children to receive an artificial sweetener.

**Conditioning Model**

It is likely that over time, consumption of sugar can become associated with positive or negative cues in the environment. Eventually, a conditioned response may emerge with repeated pairing of the substance and cues. Within this model are two major components most relevant to excessive eating behavior, positive reinforcement and negative reinforcement.

**Positive reinforcement.** For most people, sweet, sugary foods are considered to be a reward or special treat. As children, we are given cookies and candy to comfort us when experiencing negative emotions such as anger, fear, or sadness. In addition, sweet foods tend to be associated with special occasions and holidays; that is, times when people are cheerful and families come together. It is not surprising, then, that learning factors are considered to be a major factor in uncontrollable intake of sugary foods. Also, most people consider sweet foods to be especially pleasing to the taste, and therefore positively reinforcing. In fact, it has been suggested that food consumption is perhaps the most common form of indulgence and is a self-rewarding mechanism (Christensen, 1993). If eating sugary foods is sufficiently reinforcing, some would suggest that an addictive
process could be developed and maintained. This effect has been documented with other addictive behaviors. In studies exposing alcoholics and opiate addicts to drug-related stimuli, changes in both physical state and subjective cravings have been observed (Childress, McLellan, & O'Brien, 1986; Kaplan et al., 1985; Sideroff & Jarvik, 1979; Teasdale, 1973).

**Negative reinforcement.** This aspect of learning suggests that individuals engage in a behavior to escape or avoid negative consequences. Escaping negative feelings is quite reinforcing and one quickly learns how to escape the negative feelings. Indeed, many individuals report that eating sugary foods relieves their negative affective states. Bruch (1974) suggested that the association between distress and eating in childhood results in the adult eating under conditions of emotional arousal. Several researchers have found that anxiety and distress may precipitate binge eating (Abraham & Beumont, 1982; Cattanach, Malley, & Rodin, 1988). Likewise, Moyer et al. (1993) found no physiological differences between bulimics and normal controls in response to food, yet anger and depression were related to desire to binge. In one study, subjects avowing high craving of sweets reported more negative affective states than low-cravers (Schlundt et al., 1993). In addition, dieters have been found to increase food consumption, regardless of taste properties, when confronted with anxiety-provoking threats to self-esteem (Polivy, Herman, & McFarlane, 1994). It is important, then, to consider how mood is affected by sugar consumption in women who believe they are addicted to sugar.
Excessive Chocolate Consumption

Excessive consumption of chocolate is another behavior of interest at the current time. In studies examining food cravings, chocolate has been identified as the most frequently craved food (Hill & Heaton-Brown, 1994; Hill, Weaver, & Blundell, 1991; Rodin, Mancuso, Granger, & Nelbach, 1991; Rozin et al., 1991; Weingarten & Elston, 1990). In a survey of self-identified “chocoholics,” Hetherington and Macdiarmid (1993) found that subjects reported eating more chocolate, had a higher frequency of craving, were more depressed, and scored higher on questionnaires assessing disordered eating than controls. The authors also found that 76% of the respondents had definitions of chocolate addiction that were based on lack of control over consumption of this substance. In addition, these individuals identified orosensory factors (i.e., taste, smell, texture) as being the addictive components.

Although many researchers have suggested that chocolate craving has a biological basis, there is little evidence to support the contention (Weingarten & Elston, 1991). There are also several theories suggesting a learning model for excessive chocolate intake. Both the physiological and social learning explanations are considered here in greater depth. Many of these explanations are quite similar to those discussed earlier pertaining to sugar intake, but will be briefly reviewed.

Physiological Explanations for Excessive Chocolate Consumption

Several models involving pharmacological properties of chocolate have been
proposed to explain excessive chocolate intake. These models, which will each be considered here, include endocrinological malfunction, neurochemical imbalance, effects of caffeine, and orosensory factors. However, studies examining the effects of chocolate on these different physiological systems have produced contradictory results, making it unclear what effects chocolate has on these systems.

**Endocrinological Malfunction**

Because chocolate contains sugar, the arguments made for excessive sugar consumption can be made for chocolate regarding the effects of glucose and insulin. However, it has been suggested that ingredients in chocolate other than sugar may affect the endocrine system. In one study, experimental subjects were given 100 g of chocolate (of which 55 g were sugar) and control subjects were given only the 55 g of sugar. Results suggested that chocolate provokes a lesser, but longer increase in plasma glucose, insulin, and C-peptides than sugar (Nguyen, Henriet, Dumoulin, Widmer, & Regnard, 1994). This finding may be due to the higher fat content found in chocolate.

Premenstrual cravings for chocolate have been found to occur in many women (Bancroft & Rennie, 1993; Hill & Heaton-Brown, 1994; Rozin et al., 1991; Tomelleri & Grunewald, 1987). Interestingly, the prevalence of chocolate cravings is significantly higher in women than in men, and women also assign higher hedonic ratings to chocolate (Rozin et al.). This suggests that hormonal imbalance may be partially responsible for chocolate cravings. However, as noted earlier, this phenomenon may be due to lack of certain endogenous amines during the premenstrual phase of the menstrual cycle.
Neurochemical Imbalance

**Serotonin.** Because chocolate contains sugar, the processes involving serotonin uptake may impact chocolate intake in the same manner as does sugar consumption.

**Phenylethylamine.** Phenylethylamine (PEA) is an endogenous amine with amphetamine-like properties. In a study involving the drug buproprion, an antidepressant that is structurally similar to PEA, chocolate cravings (but not cravings for other foods) have been reduced or eliminated in individuals who have taken this drug (Mitchell, Mebane, & Billings, 1989). This explanation has also been supported by a series of case studies in which “ecstasy” (amphetamine) abusers began having severe chocolate cravings following abstinence from drug use (Schifano & Magni, 1994). It has also been suggested (Rozin et al., 1991) that the reason women crave chocolate during their premenstrual phase is that monoamine oxidase B (which is structurally similar to PEA) may be low during this time (Redmond, Murphy, Baulu, Ziegler, & Lake, 1975). Phenylethylamine may counteract this loss.

However, PEA involvement does not appear to provide an adequate explanation for chocolate cravings. Other foods (certain cheeses and sausage) contain greater amounts of PEA but are not regularly craved (Hurst, Martin, & Zoumas, 1982; Ingles, Back, Gallimore, Tindle, & Shaw, 1985). In addition, consumption of 200 g of chocolate did not produce a measurable change in urinary levels of PEA (Karoum et al., 1979).

**Caffeine**

It has been suggested that individuals who are compulsive eaters of chocolate are
actually craving the caffeine found in chocolate. It is well established that excessive caffeine intake can lead to certain symptoms of chemical addiction (i.e., tolerance and withdrawal). If amounts of caffeine were large enough in chocolate, this could easily explain why chocolate is considered to be so addictive. However, chocolate products typically contain such a small amount of caffeine that it has been considered an insignificant contributor to caffeine intake (Kanarek & Marks-Kaufman, 1991; Rozin et al., 1991).

Orosensory Factors

Schuman et al. (1987) suggested that “the basis of a specific appetite for chocolate is enigmatic. The most parsimonious explanation probably lies in the taste of chocolate itself” (p. 494). In a study involving taste preferences of different combinations of sweet and fat, the highest “hedonic ratings” of food are given to substances that are both sweet and high in fat content (Drewnowski & Greenwood, 1983). By this standard, chocolate would appear to be the hedonic ideal. In addition, cocoa butter (the fat used in chocolate) melts at body temperature, which produces a distinctive and pleasant oral sensation (Rozin et al., 1991). Also, data suggest that when chocolate is not available, chocolate cravers seek foods that have sensory properties (rather than pharmacological properties) similar to chocolate (Rozin et al.).

Learning Explanations

The arguments made for a social learning model of excessive sugar consumption
can be made for chocolate. However, there are additional factors that relate more specifically to chocolate. In a study by Lappalainen, Sjöden, Karhunen, Gladh, and Lesinska (1994), subjects prevented from tasting chocolate during cue exposure showed inhibited salivation responses. However, salivation was triggered by chocolate cues (sight, thought, and smell of chocolate) after tasting a very small amount of chocolate. The authors suggested that the results indicate "a very robust and rapid learning of conditioned salivation responses" (p. 393). When tasting was prevented, though, cravings were unaffected.

As mentioned previously, it has been established that many individuals eat sweet foods as a means of relieving or escaping from negative affect states. In Hetherington and Macdiarmid's (1993) survey of self-identified chocolate addicts, 51% of the sample reported positive affective responses to consuming chocolate following a craving, whereas 49% felt negatively after eating chocolate. Although many women report using chocolate to improve their mood, some evidence has suggested that these women do not display depressive symptomatology any more than women who do not use chocolate in this manner (Schuman et al., 1987). Macdiarmid and Hetherington (1995) conducted an in-depth study involving mood modulation through chocolate intake. Interestingly, the subjects in the addict group showed no reduction in depression or other negative mood states. These findings appear to refute the negative reinforcement model.
Current Research Most Relevant to the Proposed Study

To date, studies have not directly examined factors that help explain extreme cravings of sugar. However, one study attempted to differentiate the physiological and psychological effects of sugar consumption in normal subjects. Reid and Hammersley (1995) conducted a study in which 60 “normal” (noneating disordered) adults consumed a drink containing either sucrose, saccharine, or water. Subjects in the first two conditions were told that they would be consuming a beverage containing carbohydrates (no mention of the saccharine solution). The sensory cues such as taste and texture were eliminated by having the subjects suck a benzocaine anaesthetic lozenge prior to drinking their beverage. Nose clips were also worn to eliminate the aroma of the drink. Each subject rated their mood (using the Profile of Mood States; Appendix A) immediately before and after drinking the beverage, as well as at 30 and 60 minutes afterwards. In addition, subjects were asked to record all food intake for 24 hours following the experiment. The results indicated that ingestion of sucrose had no substantial effect on mood, hunger, or eating patterns. In addition, sucrose ingestion did not affect subjects’ energy level or carbohydrate content of their next meal. Thus, it appeared as if the mood of normal subjects is unaffected by either pharmacological properties of sugar or their expectation of what they were consuming. However, responses of individuals who believe they are addicted to sugar could well be quite different.

Also, one study (Michener & Rozin, 1994) attempted to discern pharmacological and sensory factors involved in the craving of chocolate. In this study, 34 subjects who
claimed to crave chocolate at least once per week participated. The subjects were
instructed to consume one of six prepared substances upon onset of a chocolate craving.
These substances were: a milk chocolate bar, a white chocolate bar, cocoa capsules,
placebo capsules, nothing, or white chocolate plus cocoa capsules. Milk chocolate
considerably reduced cravings, the white chocolate partially reduced cravings, and the
other three conditions had no effect. These results suggest that pharmacological factors
play no role in the satisfaction of chocolate cravings. However, sensory properties of
chocolate appeared to play some role in satisfying a craving. A major advantage of this
study is that it occurred in a natural setting and subjects ingested each substance upon
experiencing a craving.

The study has limitations, however. The subjects were not blind to what they were
consuming, which likely biased their self-reports. Although the authors suggest that the
differences between milk chocolate and white chocolate were due to effects of aroma, it
seems likely that expectancies about what would satisfy a craving played a major role.
Another limit to this study was that the only measure was one question asking the subjects
to rate their level of craving on a scale from 1 to 100.

In summary, studies involving the effects of sugar and chocolate in bulimic, obese,
anorexic, and noneating disordered individuals have produced mixed results. It is possible
that these substances have pharmacological properties that influence a person’s behavior.
However, there is also strong evidence that social learning factors, especially expectancies,
may play a major role as well. To date, no empirical studies have specifically examined the
population of individuals who believe they are addicted to sugar or chocolate. In addition, few studies have assessed causal factors associated with excessive eating of these substances (e.g., subject is blind to what he or she was consuming). The current study manipulated subjects’ perceptions of what they consumed to better understand the role that expectations and other social learning factors play in excessive eating.

The Current Study

The major purpose of this study was to determine whether key consequences of indulgence among sugar and chocolate addicts (changes in mood, food intake, and food cravings) are largely elicited by the chemical versus social learning factors. The study used a small $n$, quasi-experimental, ABAB design with counterbalanced conditions as shown in Figure 2.

On successive days, women who believe they were addicted to sugar or chocolate, and a control group, were given a sugar (or chocolate) drink, or alternately, a similar-tasting placebo drink. All subjects were led to believe that every beverage contained sugar (or chocolate). Thus, contrasts between subjects’ responses to sugar or chocolate versus the placebo provided insight into the role of social learning factors. The dependent variables reflected likely consequences of addictive behavior for sugar and chocolate addicts: (a) mood changes, (b) changes in reported sugar/chocolate craving after consumption of sugar or chocolate, and (c) grams of sweet, chocolate ice cream consumed following chocolate, sugar, or placebo drink. If individuals who believe
### Figure 2: Quasi experimental design with counterbalanced conditions. ES= experimental subject, CS= control subject, A= placebo, and B= chocolate or sugar.

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they are addicted to sugar or chocolate responded in similar ways after consuming both a placebo and sugar or chocolate beverage, then expectancies and learning factors would appear to largely explain subsequent mood changes, cravings, and overconsumption among sugar and chocolate addicts. If, however, consuming chocolate or sugar led to greater changes in mood, food cravings, and amount of ice cream eaten than placebo, physiological mechanisms would likely be mediating these effects.

**Research Questions**

Do learned expectancies help explain compulsive overeating of sugar or chocolate?

The primary purpose of this study was to find evidence that supports or refutes the theory that social learning plays a role in the development and/or maintenance of overconsumption of sugar or chocolate. The following questions were asked:
1. Do individuals who believe they are addicted to sugar differ from normal controls with respect to (a) changes in mood, (b) reported sugar craving, and (c) amount of ice cream consumed, after the consumption of sugar or a placebo?

2. Do individuals who believe they are addicted to chocolate differ from normal controls with respect to (a) changes in mood, (b) reported chocolate craving, and (c) amount of ice cream consumed, after the consumption of chocolate or a placebo?

3. Do normal controls and individuals who believe they are addicted to sugar respond differently after the consumption of the *placebo drink versus the sugar drink* with respect to (a) mood, (b) reported sugar craving, and (c) amount of ice cream consumed?

4. Do normal controls and individuals who believe they are addicted to chocolate respond differently after consuming *the placebo drink versus the chocolate drink* with respect to (a) mood, (b) reported chocolate craving, and (c) amount of ice cream consumed?
CHAPTER III

METHODS

The effects of two substances (sugar and chocolate) on women who believe they are addicted to one of these substances were investigated in two parallel studies. Study 1 specifically involved women who believe they are addicted to sugar. Study 2 involved those women who believe they are addicted to chocolate and generally replicated procedures used in Study 1. Also, prior to studies 1 and 2, two pilot studies were conducted; one that assessed flavor comparability of placebo (artificial sweetener) versus sugar drink and one that compared chocolate placebo and chocolate drink.

Study 1: Sugar Versus Placebo

Subjects

There were seven female adult subjects in this first study. Four believed they were addicted to sugar (addicted sugar group) and three were matched controls (a suitable match for one designated addict subject was not found). Only female subjects were included in this study so as to eliminate the possibility of confounded results due to sex differences. Subjects were solicited by three different methods: (a) flyers posted on a university campus and at selected area businesses, (b) announcements in the local newspaper, and (c) public service announcements on the local radio stations.
Prospective experimental subjects who responded to ads and announcements were contacted (by telephone) and given a semistructured interview (Appendix B) that assessed their perceptions of their addiction, emotional and physical states related to sugar consumption, and ratings of their perceived control over their consumption of sweets. Also, demographic information was collected, including an estimate of their height and weight. Some of the questions assessing addiction symptoms were open-ended, in order to give the subject an opportunity to spontaneously avow the word “addiction” to their behavior. All experimental subjects met the following criteria: (a) at some point, subjects spontaneously assigned the word “addiction” to their eating behavior; (b) subjects avowed cravings or thoughts about sugar, which they believe led to overconsumption of sugar on at least three occasions per week (preoccupation); (c) subjects avowed that they had little control over their consumption of sugar and/or an inability to manage sugar intake; (d) subjects reported a change in mood, either upon sugar consumption or if their cravings were not satisfied; (e) subjects were not diabetic, hypoglycemic, pregnant, nor did they have food allergies; and (f) subjects did not currently have anorexia nervosa or bulimia nervosa. This latter criterion was assessed through the use of the eating disorder section of the Structured Clinical Interview for the DSM (SCID).

Sixteen women responded to the ads and announcements and each was interviewed. Of these, nine women met the above qualifications, and all initially agreed to participate in the study. When later contacted to schedule a time for the experiment, two
subjects had moved and three stated that they were no longer willing to participate due to other time commitments.

Once the four subjects were selected, three control subjects were solicited through similar methods (see Appendix B). All control subjects met the following criteria: (a) subjects reported that they enjoy eating sugar, but did not meet the selection criteria (a-d) of the addicted group, (b) subjects did not have diabetes, hypoglycemia, or food allergies; (c) subjects did not currently have anorexia nervosa or bulimia nervosa; and (d) subjects matched an addict subject in terms of age (within 5 years), height (within 8%) and weight (within 8%). Subjects ranged in age from 30 to 50 years, weighed between 135 and 218 pounds, and all subjects were Caucasian. All subjects were paid $25 for their participation in the study.

More specifically, sugar addict subject #1 was 50 years old, weighed 160 pounds, and was 5’6” tall, while her matched control was also 50 years old, weighed 145 pounds, and was 5’6”. Addict subject #2 who was 43 years old, weighed 205 pounds, and was 5’6”, and her matched control was 46 years old, weighed 218 pounds, and was 5’2”. The third addict subject weighed 180 pounds, was 5’4”, and was 30 years of age; no match was found for this subject. Finally, addict subject #4 was 47 years old, weighed 135 pounds and was 5’1” tall, while her matched control was 42 years of age, weighed 135 pounds, and was 5’5”.

Dependent Variable Measures

Three measures were used to assess variables reported to be affected by sugar
consumption: the Profile of Mood States (POMS), a cravings rating form, and grams of chocolate ice cream consumed. The POMS was selected as a measurement of mood states because of its frequent use in comparative studies. However, the cravings rating form was developed by the author in order to fit the needs of this study.

Profile of Mood States

The Profile of Mood States (McNair, Lorr, & Droppleman, 1979; POMS) is a 65-item scale of adjectives describing mood states that the subject ranks as applying to herself “right now” on a 5-point scale from “not at all” to “extremely.” Factor analyses have reliably found six mood factors: anxiety, depression, anger, vigor, fatigue, and bewilderenment. The factor structure of this scale is quite stable across different populations (Eichman, 1978), thereby indicating good construct validity. Internal consistency K-R 20 values range from .84 to .95. Test-retest (range of 3-110 days) coefficients range from .65 to .74. Although this latter correlation is not very high, it is “concordant with the purpose of measuring ‘transient, fluctuating affective states’” (Eichman, p. 1016), and, in fact, a “high reliability (stability) of the test may indicate its relative lack of sensitivity to changes of the state, and thus may indicate that the test does not measure what it is suppose to measure--changes in a state” (Weckowicz, 1978, p. 1019). Overall, the POMS appears to be reliable and sensitive to change. It is considered an “excellent research and clinical evaluation psychometric instrument for the assessment of mood and feeling states...” (Weckowicz, p. 1019).
Cravings Rating Form

The Cravings Rating Form (Appendix C) was developed by the present author and is a three-item questionnaire designed to measure the strength of an individual’s craving for sugar “in the present moment.” The subjects were asked to rate, on a Likert scale, the extent of their current craving, how likely they would be to go out of their way to obtain sugar, and how frequently thoughts of sugar are on their mind. The total scores were used as the measure of current craving. In order to increase reliability and validity, a standard definition of “craving” was provided in the questionnaire.

Amount of Ice Cream Consumed

Forty-five minutes after ingestion of sugar drink, the amount of ice cream each subject consumed during a contrived “taste test rating” was measured. To reduce bias due to social desirability factors (i.e., subjects eat less ice cream because they do not want to appear as if they eat a lot), subjects taste tested the ice cream alone in a lab room. Although they were told to eat as much as they cared to, they were also prompted to throw away any ice cream they did not want to finish. A garbage can was provided that contained melted and melting ice cream. By allowing subjects to dispose of uneaten ice cream into a container already containing discarded ice cream, they perceived they were not being monitored (and felt free to eat as much as they liked). However, the garbage can was preweighed so that the exact amount of ice cream each subject consumed could be accurately measured.
Sugar Substitute (Placebo)

Aspartame was used in place of sugar for the placebo condition. Aspartame was chosen because of its sweet, sugar-like taste and because it does not contain the same pharmacological properties or caloric/nutritional content as sugar. Although there has been some suggestion that consumption of aspartame affects subsequent satiation cues and food intake, most research indicates that beverages sweetened with aspartame have no effect on appetite, macronutrient selection or food intake in normal individuals (Black, Leiter, & Anderson, 1993). Additionally, in a study involving rats, there was no effect on sensorimotor function or learning and memory after ingestion of high doses of aspartame (Tilson, Hong, & Sobotka, 1991).

A pilot evaluation of the comparability of sugar versus the placebo was conducted to ascertain whether there were meaningful taste differences between the two beverages consumed by the subjects. Several taste-test trials using different variations/brands of orange drink were conducted. The final trial (involving the drink used in the actual study [Tang® versus Sugar-Free Tang®] ) involved 15 subjects who compared two drinks (the sugar drink [A] and the placebo drink [B]). Each subject was asked to taste and rate each drink (presented in random order) on (1) flavor and (2) overall quality. Results indicate no statistically significant differences between drinks in terms of flavor, $t (14) = .76, p = .458$, or overall quality, $t (14) = .84, p = .413$. Following this task, subjects were given four glasses of orange drink in random order (two placebo and two sugar drink) and asked to decide whether each drink was either A or B (the two drinks previously tasted). Subjects
could not reliably differentiate between drinks, as the average number correct was two out of four, a finding consistent with that of chance alone. This pilot study ruled out taste differences as a confounding variable in this study.

Procedures

The experimenters for this study were female, upper-level undergraduate psychology students at Utah State University. All females were selected so that experimenter gender would not be a confounding variable in this study. Each experimenter ran a minimum of two trial experiments involving undergraduate students. Procedures were clearly and specifically written out, so that standardization could be maximized. In addition, experimenters were blind to the subjects’ condition.

Each subject participated on four consecutive days at the same time (plus or minus one hour) each day. They were randomly assigned to a sequence for alternately receiving sugar or a placebo. There is some evidence that food cravings increase during perimenstrual period, beginning from a few days before the onset of menses and continuing into the first few days of menses (Rozin et al., 1991). Therefore subjects were asked to begin the study between the 7th and 21st day of their menstrual cycle. All subjects were told that it was important to feel (healthwise) approximately the same each day, and therefore, the subject should eat in a consistent manner and receive adequate sleep each night during the course of the study. Subjects were told that each day, the experimenter would ask about her general health. In addition, all subjects were asked to
not eat or drink anything, except water, for three hours prior to the experiment each day. Subjects were also told that they may bring along something to do during “down time” in the study.

On Day 1, all subjects were escorted to a lab room and the experimenter read a standardized explanation for the purpose of the study (Appendix D). All subjects in the study were told that the study investigated the effects of sugar intake on mood state and taste perception over time. In addition, the subjects were told that because these factors may change on a daily basis, it was important to obtain several measures over 4 days. Further, each subject was informed that she would be asked to drink a sugary beverage, wait 45 minutes so that blood levels of glucose, insulin, and neurotransmitter would stabilize, and then would be asked to taste test different flavors of ice cream.

Once the subjects were provided with this information, they were asked to sign a consent form (Appendix E). The consent form noted that the experiment served several purposes and that the subject would be fully informed about the purposes of the investigation at the end of the study. Subjects were then asked their height and weight to ascertain whether there were differences between the experimental and control subjects. In addition, the subject was given a list of 30 different foods and substances (Appendix F) and asked to check any items to which they were allergic or were unwilling to eat; embedded in this list was aspartame. The purpose of this checklist was to confirm that the subject was able and willing to ingest aspartame. By having the aspartame item embedded in a longer list of items, the subjects’ attention would not be drawn to the fact that
aspartame was a critical factor in this study. If the subject checked aspartame in the list, she would be excused from the study. However, no subjects checked this ingredient.

On each of the 4 days, the subject was asked if she was experiencing any symptoms of illness that day, and if so, the subject would be released from the study. Again, no subjects were released for this reason. The subject was then asked to complete a pretest POMS and a Cravings Rating Form. Next, subjects were given the sucrose beverage or a placebo (aspartame drink), depending on the day. Subjects were given the ten ounce beverage and asked to drink the entire glass in 5 minutes. Nearly all adults can comfortably consume 10 ounces of liquid in 5 minutes. While the beverage was being consumed, the experimenter was out of the room so that a standard procedure was followed and so the subject could be allowed to drink the beverage at a comfortable pace.

After 5 minutes (from start of beverage consumption), the experimenter returned and asked the subject to fill out another POMS and Cravings Rating Form. These measurements were taken at this time to determine if visual cues, orosensory effects, or expectancies had an immediate impact on mood state and/or cravings. At this time, there should have been minimal changes in blood glucose, insulin or neurotransmitter levels. Once the measures were completed, the experimenter again left the room, but returned 45 minutes later to administer these measures again. By this time, glucose, insulin, and neurotransmitter levels should have been maximally affected by sugar ingestion (Blouin et al., 1993). Subjects were instructed to remain in the room during this time, but they were
free to do any work they may have brought along. Magazines were also provided for the subject.

After this last measure, the subject was asked to complete an ice cream taste test. Some self-designated sugar addicts report the tendency to overeat sweet foods after the initial consumption of sugar. The purpose of this "taste test" was to determine whether sugar and aspartame affect subsequent amount of sweets eaten by the subject. The task was represented as a "taste test" to help provide a reasonable rationale to subjects. Each subject was given three different brands of sweet, chocolate ice cream, and was asked to rate each on a number of variables (however, the ratings were irrelevant to this study). A tape recording along with a written copy of the taste test directions were given to the subject to increase perception of "officiality" of the task and reduce suspicions of alternative motives. Chocolate ice cream was used because it is a popular flavor and represents a sweet food that sugar "addicted" persons are known to prefer to consume. Again, the subject was alone in the laboratory room during this time. In addition, she was encouraged to eat as much as she desired and then asked to throw away any ice cream she did not eat. When the subject completed this task, she was finished with all procedures for the day. After the subject left, the garbage can was reweighed in order to determine the exact amount the subject ate.

All procedures were repeated with each subject for four consecutive days; each received two "real" (sucrose) beverages ("A") and two placebo beverages ("B") according to an assigned sequence, that is, one of two counterbalanced conditions (ABAB or
BABA) (see Figure 2). At the end of the fourth day, each subject was asked debriefing questions and was fully informed of the purposes of the study. Specifically, the subject was asked if she noticed any differences in the procedures on different days of the study, if she noticed any differences in the quality of the brands used throughout the experiment, and what she believed was the purpose of the study. Responses to these questions helped determine whether the subject was successfully deterred from the major purpose of this study and whether each subject believed that the placebo drink actually contained sugar.

Study 2: Chocolate Versus Placebo

Subjects

There were eight female subjects in this study. Four believed they were addicted to chocolate (addicted chocolate group), and four matched controls. Solicitation, interview, and selection of subjects for the addicted and control groups were conducted in the same manner as noted above in Study I. Of the 20 women who responded to the ads, 13 met the study requirements for the addicted chocolate group. Of these, five women agreed to participate; those unwilling to participate stated lack of time, no transportation, or were moving as impediments to their participation. Four of the five individuals were selected to participate based on the closeness of a match with a control subject.

Participants ranged in age from 32 to 51 and weighed between 135 and 196 pounds. Specifically, chocolate addict subject #1 was 51 years old, weighed 180 pounds, and was 5'6" tall, while her matched control was 46 years old, weighed 185 pounds, and
was 5'7". Addict subject #2, who was 32 years old, weighed 150 pounds, and was 5'9", and her matched control was 34 years old, weighed 150 pounds, and was 5'8". The third addict subject weighed 135 pounds, was 5'7", and was 36 years of age, while her matched control weighed 150 pounds, was 5'4", and was 33 years old. Finally, addict subject #4 was 41 years old, weighed 196 pounds, and was 5'5" tall, while her matched control was 40 years of age, weighed 195 pounds, and was 5'3".

**Dependent Variable Measures**

All measures used in Study 1 were used in Study 2, except that the Cravings Rating Form listed questions concerning chocolate cravings rather than sugar cravings.

**Chocolate Substitute**

A chocolate substitute was used that has the same flavor and texture, but had none of the pharmacological ingredients of true chocolate. This product was developed by Universal Flavors® (product number 462160B). Carmel coloring (produced by D.D. Williamson & Co., Inc.®, product number 604) was used to alter the color of the milk so that it matched that of real chocolate milk. In addition, aspartame (Nutrasweet®) was added to the placebo so that the desired sweetness was achieved. The real chocolate milk was made using Nestle Quick® chocolate milk powder.

A pilot test was conducted to make certain that there was no meaningful taste difference between the real chocolate drink and the placebo. Again, several trials were run
involving different brands and combinations of ingredients. One problem encountered was that pilot subjects noted a smell differential between beverages that could not be remedied through changing ingredients. Therefore, it was decided that nose plugs would be worn in order to attenuate the effects of smell on taste discrimination. Subjects were asked to rate the chocolate and placebo drinks on four variables: (a) color, (b) chocolate flavor, (c) texture, and (d) overall quality. The final pilot test involving the two drinks used in the actual experiment involved 21 subjects. No statistically significant differences between drinks were found for color $t_{20} = .34, p = .74$; chocolate flavor, $t_{20} = 1.15, p = .26$; texture, $t_{20} = .78, p = .45$; or overall quality, $t_{20} = .06, p = .95$.

Procedures

With appropriate variation (due to substance), procedures used in Study 1 were used in Study 2. Subjects in Study 2 were given a list of 30 different foods and substances, and asked to check any items to which they were allergic or would be unwilling to eat. Embedded in this list was milk and the known ingredients contained in the chocolate substitute. The purpose of this procedure was the same as for that in Study 1. Subjects in Study 2 were given the same rationale for the purpose of this study. One important difference, however, was that subjects in this study were asked to wear nose plugs while consuming the beverage and were told that it was important that smell not play a role in this study. In this way, the chocolate substitute served as a valid placebo. All other procedures used in Study 2 followed those of Study 1.
CHAPTER IV

RESULTS

The results for Studies 1 and 2 will be presented separately. For both studies, however, there are two general questions that were addressed by these studies. The first is whether individuals who believe they are addicted to either sugar or chocolate and normal controls respond differently after consuming chocolate or sugar, versus a placebo. The second question is whether individuals who believe they are addicted to one of these substances differ from normal controls in their responses to these substances. Each of these questions was examined with regard to the following symptoms and behaviors (a) mood, (b) craving ratings, and (c) amount of ice cream eaten.

To examine these questions, the data from each pair of subjects ("designated addict" and matched control) were graphed and interpreted based on visual examination. In addition, effect sizes of the mean difference between (a) baseline and time 5 minutes and (b) baseline and time 45 minutes were calculated for mood and chocolate cravings. Effect sizes of the mean for amount of ice cream eaten were also calculated. Effect sizes, rather than inferential statistics, were used because of the appropriateness of this statistic (e.g., when using a small sample). By examining the effect sizes of differences between groups and conditions, the magnitude of group differences, taking into account sample variance, could be determined.
Study 1: Sugar

Mood

Sugar Versus Placebo

The first question in this study pertains to whether sugar versus placebo has differential effects on either designated addict subjects or control subjects. Figure 3 displays pairs of subjects’ and match controls’ self-reported ratings of overall mood (total score on the POMS) across times and conditions (subscale scores can be found in Appendix G). Means, standard deviations and effect sizes can be found in Tables 1 and 2. In general, there appear to be no consistent mood differences for these two substances, among either designated addict or control subjects.

Designated addict subjects. Designated sugar addict #1’s mood remained stable 5 minutes after both sugar and placebo drinks on all days. After 45 minutes, however, this subject’s mood worsened on sugar, but not placebo days. These results suggest that pharmacological properties of sugar may have impacted this subject’s mood.

Designated addict #2, however, did not show such differential effects of the two substances. On 3 of the 4 days (two sugar, one placebo day) mood remained stable after 5 minutes. At 45 minutes, the subject reported a worsened mood state on the two placebo days, an improved mood on one sugar day, and a stable mood on the other sugar day.

Addict subject #3 did not report significant variability in mood across times or conditions. She indicated a very slight improvement in mood at 5 minutes on all 4 days,
Figure 3. Individual data from study 1: Mood scores (total score on POMS). Note that higher scores reflect more negative mood states than lower scores.
### Table 1

**Designated Addict Group, Sugar Versus Placebo: Means, Standard Deviations, and Effect Sizes**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Time (min)</th>
<th>Mean (SD)</th>
<th>Mean difference (SD)</th>
<th>Mean (SD)</th>
<th>Mean difference (SD)</th>
<th>Effect size</th>
<th>sugar-placebo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mood</td>
<td>0</td>
<td>13.5 (22.1)</td>
<td>-1.1 (11.1)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>17.1 (47.9)</td>
<td>3.4 (11.9)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-.39</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+5</td>
<td>12.4 (31.4)</td>
<td>3.1 (12.7)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>20.5 (57.9)</td>
<td>7.9 (16.4)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-.33</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+45</td>
<td>16.6 (27.3)</td>
<td></td>
<td>25.0 (58.7)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cravings</td>
<td>0</td>
<td>6.0 (1.8)</td>
<td>-0.3 (2.7)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.0 (2.3)</td>
<td>0.9 (2.4)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-.44</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+5</td>
<td>5.7 (2.0)</td>
<td></td>
<td>5.9 (0.8)</td>
<td>1.1 (2.0)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-.56</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+45</td>
<td>5.7 (2.3)</td>
<td>-0.3 (3.0)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>6.1 (2.2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amount eaten (grams)</td>
<td>+45</td>
<td>231.1 (111.7)</td>
<td></td>
<td>209.7 (114.8)</td>
<td></td>
<td>.19</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> Mean difference and standard deviation for time +5 minus time 0.

<sup>b</sup> Mean difference and standard deviation for time +45 minus time 0. Higher mood scores reflect more negative mood states than lower scores. Craving ratings could possibly range between 3 and 15.
Table 2

Control Group, Sugar Versus Placebo: Means, Standard Deviations, and Effect Sizes

<table>
<thead>
<tr>
<th>Variable</th>
<th>Time (min)</th>
<th>Sugar</th>
<th>Placebo</th>
<th>Effect size sugar-placebo</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean difference (SD)</td>
<td>Mean (SD)</td>
<td>Mean difference (SD)</td>
</tr>
<tr>
<td>Mood</td>
<td>0</td>
<td>6.0 (16.6)</td>
<td>-0.3 (5.0)*</td>
<td>-0.2 (12.3)</td>
</tr>
<tr>
<td></td>
<td>+5</td>
<td>5.7 (18.2)</td>
<td>1.0 (8.9)*</td>
<td>-3.2 (10.6)</td>
</tr>
<tr>
<td></td>
<td>+45</td>
<td>7.0 (13.4)</td>
<td></td>
<td>6.8 (9.7)</td>
</tr>
<tr>
<td>Cravings</td>
<td>0</td>
<td>4.8 (2.2)</td>
<td>-0.5 (0.5)*</td>
<td>5.3 (2.9)</td>
</tr>
<tr>
<td></td>
<td>+5</td>
<td>4.3 (1.7)</td>
<td></td>
<td>4.5 (2.1)</td>
</tr>
<tr>
<td></td>
<td>+45</td>
<td>5.3 (2.7)</td>
<td>0.5 (1.9)*</td>
<td>4.7 (0.8)</td>
</tr>
<tr>
<td>Amount eaten (grams)</td>
<td>+45</td>
<td>288.7 (104.4)</td>
<td></td>
<td>250.8 (58.7)</td>
</tr>
</tbody>
</table>

a Mean difference and standard deviation for time +5 minus time 0.
b Mean difference and standard deviation for time +45 minus time 0. Higher mood scores reflect more negative mood states than lower scores. Craving ratings could possibly range between 3 and 15.
both conditions. Mood responses 45 minutes after beverage ingestion were inconsistent, as mood reverted back towards baseline levels on two sugar days and one placebo day, but mood continued to improve on the other placebo day.

Finally, designated addict subject #4 showed a slight trend for her mood to worsen immediately after consumption of the beverage, regardless of whether it was placebo or chocolate. On Day 1, this subject reported extremely negative mood states across all three measurement periods, and mood was more variable than on any of the following days. On all days, mood was more negative than any of the other subjects.

These data were also assessed using effect sizes (see Tables 1 and 2). The mean difference in mood score between baseline and 5 minutes, and baseline and 45 minutes were calculated for both the sugar and placebo condition for the designated sugar addict group. The effect size represents the magnitude of the difference between these two conditions.

The small effect size (-0.39) echoes the graphed data; there is not a substantial difference between sugar and placebo in immediate effects on mood. Likewise, the effect size for the difference between substances in mood change from baseline to 45 minutes is -0.33, suggesting that, as a group, the designated addicts did not experience differential mood changes based on type of drink consumed (though one addict did show differential effects).

**Control subjects.** The effects of sugar versus placebo on the mood of control subjects was also examined. Like the addict subjects, there was little evidence that control
subjects were differentially affected by sugar versus placebo.

Control subject #1 reported mood states that remained stable at 5 minutes on all 4 days, for both conditions. Forty-five minutes after consumption of beverage on one sugar and one placebo day, mood continued to remain stable. On the other 2 days, however, mood slightly worsened. No differential effects for sugar versus placebo were found.

Control subject #2, likewise, did not show changes in mood from baseline to 5 minutes on any of the days. By 45 minutes, mood had worsened on one placebo day, but continued to remain stable on the other 3 days. Again, there is no evidence that this subject was affected by the pharmacological properties of sugar.

Finally, control subject #4 reported that her mood was stable across times and conditions. Obviously then, there were no differential effects of sugar versus placebo.

Effect sizes for change in mood scores across measurement periods for sugar versus placebo, were also assessed. An effect size 0.64 (slightly larger than that found for the designated addict subjects) suggests that mood may have been affected differently by sugar than placebo, immediately after consumption. This finding is rather surprising, given that subjects reported being unable to distinguish between types of drink and because physiological effects of each beverage should not occur within 5 minutes of ingestion. Examination of means and standard deviations (see Table 2) shows that in both conditions, overall mood improved, but did so slightly more in the placebo condition. It is suspected that the effect size most likely represents random variability.

Similarly, an effect size of -0.57 represents a small differential change in mood
from baseline to 45 minutes for placebo versus sugar. Again, this finding is interesting, as control subjects previously reported being unaffected by sugar, and mood actually changed more after placebo consumption than sugar consumption. This may be reflective of either random variability, or it may indicate that sugar served to slightly moderate mood among the “nonaddict” individuals.

**Designated Addict Versus Control Subjects**

The next question being examined is whether there are differences in the way addicts versus controls responded in this study with respect to mood. Figure 3 and Tables 3 and 4 display data related to this question. As a group, control subjects’ mood was more positive than that of the designated addicts (though group means were heavily influenced by extreme scores of one addict subject). There was also more variability in the addicts’ mood as compared to the control subjects.

For the first pair of subjects (addict #1 and control #1), the designated addict reported having more negative moods than the control subject on 3 of the 4 days. There were few other differences between these subjects other than the addict subject had a larger mood change than the control subject on one sugar day, whereas the control subject showed a greater mood change than the addict on one placebo day.

Designated addict #2 and control #2 also differed. The control subject, in this case, reported worse mood than the designated addict on all four days. However, with the exception of Day 1, the addict displayed more variability across measurement periods than
Table 3

Sugar Condition, Designated Addict Versus Control Group: Means, Standard Deviations, and Effect Sizes

<table>
<thead>
<tr>
<th>Variable</th>
<th>Time (min)</th>
<th>Addict</th>
<th>Control</th>
<th>Effect size (addict-control)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean (SD)</td>
<td>Mean difference (SD)</td>
<td></td>
</tr>
<tr>
<td>Mood</td>
<td>0</td>
<td>13.5 (22.1)</td>
<td>-1.1 (11.1)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6.0 (16.0)</td>
</tr>
<tr>
<td></td>
<td>+5</td>
<td>12.4 (31.4)</td>
<td>3.1 (12.7)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>5.7 (18.2)</td>
</tr>
<tr>
<td></td>
<td>+45</td>
<td>16.6 (3.1)</td>
<td></td>
<td>7.0 (13.4)</td>
</tr>
<tr>
<td>Cravings</td>
<td>0</td>
<td>6.0 (1.8)</td>
<td>-0.3 (2.7)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.8 (2.2)</td>
</tr>
<tr>
<td></td>
<td>+5</td>
<td>5.9 (2.0)</td>
<td>-0.3 (3.0)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4.3 (1.7)</td>
</tr>
<tr>
<td></td>
<td>+45</td>
<td>5.7 (2.3)</td>
<td></td>
<td>5.3 (2.7)</td>
</tr>
<tr>
<td>Amount eaten</td>
<td>+45</td>
<td>231.1 (111.7)</td>
<td></td>
<td>288.7 (104.4)</td>
</tr>
</tbody>
</table>

* Mean difference and standard deviation for time +5 minus time 0.

<sup>a</sup> Mean difference and standard deviation for time +45 minus time 0. Higher mood scores reflect more negative mood states than lower scores. Craving ratings could possibly range between 3 and 15.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Time (min)</th>
<th>Addict Mean (SD)</th>
<th>Addict Mean difference (SD)</th>
<th>Control Mean (SD)</th>
<th>Control Mean difference (SD)</th>
<th>Effect size (addict - control)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mood</td>
<td>0</td>
<td>17.1 (47.9)</td>
<td>3.4 (11.9)</td>
<td>-0.2 (12.3)</td>
<td>-3.0 (3.3)</td>
<td>.78</td>
</tr>
<tr>
<td></td>
<td>+5</td>
<td>20.5 (57.9)</td>
<td>-3.2 (10.6)</td>
<td>7.0 (12.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>+45</td>
<td>25.0 (58.7)</td>
<td>6.8 (9.7)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cravings</td>
<td>0</td>
<td>5.0 (2.3)</td>
<td>0.9 (2.4)</td>
<td>5.3 (2.9)</td>
<td>-0.8 (1.5)</td>
<td>.85</td>
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<td>+5</td>
<td>5.9 (0.8)</td>
<td>4.5 (2.1)</td>
<td></td>
<td>-0.7 (2.4)</td>
<td>.83</td>
</tr>
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<td>+45</td>
<td>209.7 (114.8)</td>
<td></td>
<td>250.8 (58.7)</td>
<td>- .45</td>
<td></td>
</tr>
</tbody>
</table>

* Mean difference and standard deviation for time +5 minus time 0.

* Mean difference and standard deviation for time +45 minus time 0. Higher mood scores reflect more negative mood states than lower scores. Craving ratings could possibly range between 3 and 15.
the control subject. No other consistent differences were found.

Because designated addict subject #3 did not have a matched control, no comparison can be drawn. However, addict #4 reported substantially worse mood than the control on all 4 days. The addict was also more variable in mood states the first 2 days of the study. No other differences between these subjects were noted.

Effect sizes of the mean change in mood from baseline to 5 minutes and baseline to 45 minutes after ingestion of sugar drink for addicts versus controls were -0.09 and 0.19, respectively. These effect sizes suggest that there was little difference between addicts and controls in terms of degree of mood change across measurement periods after eating sugar.

In the placebo condition, however, mood changes from baseline to 5 minutes were in the opposite direction for the two subject groups, resulting in an effect size of 0.78. Since subjects could not differentiate between beverages and physiological changes are not believed to occur immediately after consumption of sugar, these results are, again, surprising. Either these differences occurred by chance, or there was some immediate physiological reaction to the sugar. The fact that changes in mood from baseline to 45 minutes did not differ between groups (effect size = .06) suggests the former rationale may be more likely.

Cravings

Sugar Versus Placebo

The next variable being examined is subject-reported craving ratings. The data
relating to differences between the effects of sugar versus placebo on cravings for addicts and controls can be found in Figure 4 and Tables 1 and 2. There was a modest, though inconsistent tendency for designated addict subjects to report cravings that increased immediately (5 minutes) after consumption of either sugar or placebo. However, it is important to emphasize that some addict subjects reported increases in cravings, whereas others reported decreases. Two subjects showed minor differential effects for sugar versus placebo, but again, because changes were in opposite directions, it seems doubtful that the changes were related to the specific chemical properties of sugar. Likewise, control subjects’ craving reports were quite variable. While one control subject displayed differential reactions to sugar versus placebo, the other two control subjects did not.

**Designated addict subjects.** Addict subject #1 reported sugar cravings that were quite high across times and conditions. On the first day, cravings increased immediately after ingestion of sugar, then continued to increase to time 45 minutes. On all other days, however, cravings immediately decreased after beverage consumption (one sugar and two placebo days). At 45 minutes, though, cravings increased to a level at or higher than baseline. No trends for type of beverage consumed were apparent.

On 3 of the 4 days, addict #2 reported an increase in sugar cravings immediately after ingestion of substances (two placebo, one sugar). On the two placebo days, cravings increased further by 45 minutes. On sugar consumption trials, craving ratings differed; cravings increased slightly from 5 minutes one day and decreased the other day. Craving ratings on both sugar days after 45 minutes were similar to baseline. Because of the great
Figure 4. Individual data from study 1: Craving ratings. Scores could range from 3 to 15.
change in cravings immediately after consumption of both types of substances, expectancies can be viewed as having a major influence on cravings. However, because cravings were stronger 45 minutes after ingestion of placebo than after sugar, there is some suggestion that sugar intake may have stabilized cravings for this subject.

Like subject #2, on 3 of 4 days addict #3 reported immediate increases in sugar cravings after consumption of both types of beverages (two placebo, one sugar). On these three days, craving ratings dropped 45 minutes later to a point at or below baseline. On the other sugar day, cravings dropped substantially at 5 minutes, then remained stable at 45 minutes. Examination of craving rating change from only baseline to 45 minutes shows that cravings dropped more after sugar than placebo intake. However, the great variability and immediate changes in cravings indicate that, again, expectations likely played a major role in craving ratings.

There did not appear to be differential effects of placebo versus sugar for addict #4. This subject’s cravings remained stable immediately after consumption of the beverage on three of four days (two sugar, one placebo). On the other placebo day, cravings reduced after 5 minutes. Forty-five minutes after ingestion, cravings remained relatively stable on all days.

Effect sizes of the mean change in craving ratings for sugar versus placebo were also examined. Effect sizes suggest that, although small (effect size = -0.44 at 5 minutes and -0.56 at 45 minutes), there may be a differential effect of sugar versus placebo on cravings of the addict subjects. However, a closer look at the data indicates that these
effect sizes were heavily influenced by an extreme score of one subject (#3) on one sugar
day. Because her craving ratings on this one day are in the opposite direction of cravings
ratings on the other sugar day (as well as the other two placebo days), it seems likely that
her ratings on this day are not typical. A recalculation of the effect sizes after removal of
this subject’s scores on one day would provide an effect size of -0.17 at 5 minutes and
-0.26 at 45 minutes. These effect sizes seem more reflective of overall group changes in
cravings.

Control subjects. The control subjects’ craving ratings were also examined.
Control subject #1 showed no differential effects of sugar versus placebo on cravings. On
all days, cravings remained stable after 5 minutes, then increased at 45 minutes. This
increase was most substantial on Day 1 (sugar) and Day 4 (placebo).

The second control subject (#2) displayed immediate decreases in cravings on all
four days, both conditions. On 2 days (one placebo, one sugar), cravings did not change
from 5 to 45 minutes, on 1 day (placebo) cravings dropped at this time, and on the other
day (sugar), cravings increased. Examination of craving change from baseline to 45
minutes, however, indicates that cravings did tend to go down after placebo but not sugar
drink.

Control subject #4 showed little consistency in her craving ratings. For example,
cravings at 5 minutes increased slightly on one placebo day, decreased slightly on one
placebo and one sugar day, and remained stable on the other sugar day. Likewise, there
were no trends for 45 minutes or differential effects of sugar versus placebo.
Effect sizes for the change in mean craving ratings for sugar versus placebo were 0.33 at 5 minutes and 0.55 at 45 minutes. As a group, it appears that cravings slightly increased after sugar consumption, but slightly decreased after placebo consumption. A closer inspection of the individual data indicates that this difference was based mainly on scores from one subject (control #2), who did experience a large decrease in cravings 45 minutes after placebo but not the sugar drink.

**Designated Sugar Addicts Versus Control Subjects**

The next issue in this study is whether addict subjects differed from controls in their reported sugar cravings. As a group, the addict subjects reported somewhat higher overall levels of sugar craving across time and conditions than control subjects. Addicts also reported more variable levels of cravings within experimental sessions than the control group. These results can be found in Figure 4 and Tables 3 and 4.

More specifically, the first pair of subjects (addict #1 and control #1) did not appear to be differentially affected by sugar or placebo; however, the addict’s cravings were much higher overall. Both subjects experienced increases in cravings at time 45 on the majority of days.

Conversely, in the second pair of subjects, it was the control subject (#2) who reported significantly greater sugar cravings than the addict subject. The two subjects also had contrary initial reactions to both substances. The control subject reported a decrease in cravings at 5 minutes on all 4 days, whereas the addict subject reported increases on 3
of 4 days. Overall variability of craving ratings were approximately equal for the pair of subjects.

Finally, for the fourth pair of subjects, it was observed that the addict subject reported higher levels of cravings across measurement periods and conditions. However, the degree of craving change was equal between these two subjects. No similarities were noted between their reaction to type of beverage consumed.

Indeed, effect sizes for the sugar condition indicate that overall degree of change in cravings did not substantially differ between groups (effect size for mean change at 5 minutes = 0.14, and at 45 minutes = -0.30). For the placebo condition, however, the effect sizes were larger (0.85 for change at 5 minutes and 0.83 for change at 45 minutes). After placebo drink, cravings went up for the addict group, whereas they went down for the control group. Again, inspection of the individual data suggests that these effect sizes were largely impacted by the second pair of subjects who reported quite contrary and strong reactions to the placebo drink. For the remaining two pairs of subjects, however, there does not appear to be any difference in reaction to the placebo drink.

Amount of Ice Cream Consumed

Sugar Versus Placebo

This study also addressed the question of whether designated addict subjects or control subjects tend to eat more chocolate ice cream 45 minutes after sugar versus placebo ingestion. The data suggest that subsequent ice cream consumption among the
addict and control subjects was generally unaffected by initial ingestion of sugar versus placebo. Also, addict subjects tended to consume slightly more ice cream day by day as the study progressed. These results are presented in Figure 5 and Tables 1 and 2.

**Designated addict subjects.** Addict subject #1 displayed no tendency to eat more ice cream after consuming one type of beverage than another. This subject did, however, eat considerably more ice cream on the latter 2 days than the first 2 days.

Similarly, addict subject #2 ate approximately the same amount of ice cream on the first 3 days, then ate significantly more on the fourth day. Again, there was no differential effect of sugar versus placebo. Addict subject #3 ate approximately the same amount each day, regardless of condition, though there was a trend to eat slightly more as the experiment progressed.

Likewise, addict subject #4 also ate more ice cream as the study progressed (though much more so than subject #3). When averaged, this subject ate more ice cream on sugar days than placebo days. However, this seems more a function of the condition order (BABA) than any effects of sugar versus placebo.

An effect size of the mean difference between amount of ice cream eaten 45 minutes after consuming sugar versus sugar drink was calculated. An effect size of 0.19 indicated that, as a group, addicts did not eat more or less ice cream after the sugar drink than placebo.

**Control subjects.** The amount of ice cream eaten by control subjects was also analyzed. Control subject #1 showed a slight trend to eat less ice cream over the first 3
Figure 5. Individual data from study 1: Amount of ice cream eaten (grams). Subjects were offered a total of 600 grams of ice cream.
days, but did not show different reactions based on type of beverage.

Conversely, control subject #2 ate approximately the same amount of ice cream the first three days of the experiment, then significantly more on the final day. Again, no differential effects of sugar versus placebo were evident.

Finally, control subject #4 ate approximately the same amount of ice cream every day, regardless of condition.

An effect size of 0.46 suggests a small differential effect of these two drinks on amount of ice cream eaten may exist. However, this effect size seems unduly affected by control subject #1 and #2 who each ate more on one sugar day than any other day. It should be noted that on the other sugar day, both subjects ate approximately the same amount as on the two placebo days, so there does not seem to be a general effect of sugar. In addition, for one subject, this difference occurred on the first day, and for the other subject, the last day. It is on these days when subjects appeared most likely to eat more, regardless of condition.

Designated Addict Versus Control

The final question in Study 1 is whether differences exist in amount of ice cream eaten by addict subjects versus controls. The first pair of subjects ate approximately the same amount, but showed opposite patterns. The addict subject ate more as the study progressed while the control ate less. For the second pair of subjects, the control subject ate more ice cream than the addict, and the overall pattern across days and conditions was almost identical. Similar to the first pair, addict subject #3 and control subject #3 displayed
an interaction in amount eaten; the control subject initially ate more ice cream (on Days 1 and 2), while the addict subject ate more on the latter 2 days of the experiment.

Effect sizes of -0.53 for the sugar condition and -0.45 for the placebo condition (see Tables 3 and 4) indicate that, as a group, control subjects tended to eat more ice cream than addict subjects, regardless of whether sugar or placebo had been previously consumed. Again, this difference was largely due to one control subject (#2); otherwise, groups were approximately equal.

**Summary**

In summary, there appear to be no consistent differences for the effects of sugar versus placebo on mood, sugar cravings or amount of ice cream eaten for either the addict or control subjects. There were, however, individual subjects who displayed minor differential mood and craving responses to the two types of beverages. It is important to note, though, that even among these subjects, responses tended to be inconsistent, and therefore, it appears unlikely that pharmacological properties of sugar affected ratings.

What is most significant about the data, are however, differences between addict subjects and controls. The results indicated that sugar addict subjects reported worse and more variable mood states than control subjects. In addition, two of the three addict subjects tended to report higher and more variable craving levels than their matched controls. The other major difference was that addict subjects tended to eat more ice cream on subsequent days of the experiment, while control subjects generally ate less.
Study 2: Chocolate

Mood

Chocolate Versus Placebo

The first question being addressed in this study was whether designated addicts and controls experience changes in moods differentially for chocolate versus placebo drinks. Figure 6 displays pairs of subjects' and match controls' self-reported ratings of overall mood (total score on the POMS) across times and conditions (scores on the POMS subscales can be found in Appendix G). Examination of the data for the addicts suggests that there is little between-subject consistency in self-reported mood states across time or conditions.

Designated addict subjects. Addict subject #1 reported an improvement in mood immediately after consumption of placebo (time 5 minutes) on both days of the experiment and after consuming the chocolate drink on 1 of 2 days. On all days, subject #1's mood states reverted back to or closer to baseline level after 45 minutes. These findings provide evidence that this subject's mood was likely affected primarily by her expectancies about chocolate effects.

Addict subject #2 showed no consistent changes in mood. For example, on Day 1, after consumption of the placebo, her mood remained stable when assessed 5 minutes later, but then dramatically improved after 45 minutes. However, this finding was not evident on the other placebo day, nor was there a trend for the chocolate condition;
Figure 6. Individual data from study 2: Mood scores (total score on POMS). Higher mood scores reflect more negative mood states than lower scores.
mood improved after 45 minutes on one chocolate day but slightly worsened on the other.

Addict subject #3 also displayed little consistency in her self-reported mood states, though it should be noted that her mood generally improved from one day to the next. On three of four days, the subject reported mild to significant worsening of mood immediately after consumption of the chocolate and placebo drinks. On two of those days (one placebo and one chocolate condition) mood at time 45 minutes improved back to baseline levels. On the other day (Day 1--chocolate condition), mood significantly improved at time 45 minutes. In general, these results indicate that changes in mood were unlikely the result of pharmacological properties of the substances.

In contrast to subject #3, addict subject #4 rated her mood as steadily worsening across days. On 3 of the 4 days, the subject reported noticeable mood changes immediately after both types of beverages, but her mood did not change in a consistent direction. On 2 days (one placebo and one chocolate), mood slightly improved at time 5 minutes, but on 2 days (one chocolate and one placebo), mood slightly worsened. At time 45 minutes mood declined to a level near baseline or worse on 3 of 4 days (two placebo, one chocolate), but continued to improved on one chocolate day. Except for the trend for mood to worsen across days, there does not appear to be any consistencies across times or conditions.

These data can also be assessed using effect sizes (see Tables 5 and 6). The mean difference in mood score between baseline and time 5 minutes, and baseline and time 45 minutes was calculated for both the chocolate and placebo conditions for the addict group.
The effect size represents the magnitude of the difference between these two conditions.

At the 5-minute point of assessment, one would expect that any observed changes in mood would be similar in both chocolate and placebo conditions. When all four designated addict subjects’ data were averaged, it was found that there was a slightly greater change in mood at 5 minutes for the placebo condition versus the chocolate condition. An effect size of 0.21 suggests that this change is small and rather insignificant, and that the difference was most likely due to random variability. Theoretically, there is no reason for these scores to differ.

Effect sizes indicate that there is a greater difference in reported mood state between chocolate and placebo conditions at 45 minutes than at 5 minutes. Group means show that while overall mood appeared to improve 45 minutes after chocolate consumption, it remained relatively stable 45 minutes after the placebo. An effect size of -0.41 indicates that although a difference exists, it is relatively small.

It should also be noted that when examining the actual data, it appears that the effect size may have been unduly affected by one outlying score. On Day 1 (chocolate condition), addict subject #3 reported a dramatic improvement in mood. Because a similar mood change was not reported on the other chocolate day, it is questionable whether the change on Day 1 was due to pharmacological properties of the substances. If the scores from addict subject #3 on that one day were dropped, the overall means for the addicts mood score on the POMS in the chocolate condition would be 8.6 for baseline, it would improve to 4.4 at time 5 minutes, and would revert back to 7.0 at time 45 minutes. The
Table 5

Designated Addicts, Chocolate Versus Placebo: Means, Standard Deviations, and Effect Sizes

<table>
<thead>
<tr>
<th>Variable</th>
<th>Chocolate</th>
<th>Placebo</th>
<th>Effect size chocolate-placebo</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Time (min)</td>
<td>Mean (SD)</td>
<td>Mean difference (SD)</td>
</tr>
<tr>
<td>Mood</td>
<td>0</td>
<td>11.9 (18.5)</td>
<td>-0.5 (14.5)&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>+5</td>
<td>11.4 (21.2)</td>
<td>-6.0 (16.1)&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>+45</td>
<td>5.9 (11.9)</td>
<td></td>
</tr>
<tr>
<td>Cravings</td>
<td>0</td>
<td>7.7 (1.9)</td>
<td>-2.1 (3.2)&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>+5</td>
<td>5.6 (1.9)</td>
<td>-3.6 (2.4)&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>+45</td>
<td>4.1 (1.1)</td>
<td></td>
</tr>
<tr>
<td>Amount eaten (grams)</td>
<td>+45</td>
<td>257.0 (163.0)</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> Mean difference and standard deviation for time +5 minus time 0.

<sup>b</sup> Mean difference and standard deviation for time +45 minus time 0. Higher mood scores reflect more negative mood states than lower scores. Craving ratings could possibly range between 3 and 15.
Table 6

Control Group, Chocolate Versus Placebo: Means, Standard Deviations, and Effect Sizes

<table>
<thead>
<tr>
<th>Variable</th>
<th>Time (min)</th>
<th>Chocolate</th>
<th></th>
<th>Placebo</th>
<th></th>
<th>Effect size chocolate-placebo</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean (SD)</td>
<td>Mean difference (SD)</td>
<td>Mean (SD)</td>
<td>Mean difference (SD)</td>
<td></td>
</tr>
<tr>
<td>Mood</td>
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<td>-1.4 (5.4)</td>
<td>-1.0 (5.1)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-.20</td>
</tr>
<tr>
<td></td>
<td>+5</td>
<td>-1.6 (13.3)</td>
<td>0.4 (10.8)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-2.4 (5.2)</td>
<td>-1.9 (6.0)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>.27</td>
</tr>
<tr>
<td></td>
<td>+45</td>
<td>0.6 (9.9)</td>
<td>-3.3 (9.7)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cravings</td>
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<td>5.3 (1.8)</td>
<td>2.3 (2.0)&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>.36</td>
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<tr>
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<td>7.5 (1.8)</td>
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<td>5.6 (1.3)</td>
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<td>Amount eaten (grams)</td>
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<td></td>
<td>212.0 (68.3)</td>
<td></td>
<td>.37</td>
</tr>
</tbody>
</table>

<sup>a</sup> Mean difference and standard deviation for time +5 minus time 0.

<sup>b</sup> Mean difference and standard deviation for time +45 minus time 0. Higher mood scores reflect more negative mood states than lower scores. Craving ratings could possibly range between 3 and 15.
mean differences would then closely resemble the addicts’ pattern of mood changes in the placebo condition. In fact, effect sizes for baseline to 5 minutes would be -0.13, and baseline to 45 minutes would be -0.11.

**Control subjects.** While the data from the addicts appear to indicate that there is little if any differential effects of consumption of chocolate versus placebo on mood, there appears to be some observable trends for two of the four control subjects. However, even for these two subjects, the trends are contradictory.

Control subject #1 reported mood states that remained relatively consistent across times and conditions. There were no identifiable trends in her self-reported mood states. For example, there was a slight improvement in mood at 45 minutes on one chocolate day, whereas mood slightly worsened at this time on the other chocolate day.

Interestingly, control subject #2 did display some evidence of being differentially affected by the chocolate versus the placebo. On both chocolate days, mood remained stable across time. On the two placebo days, however, this subject reported little mood change immediately after placebo consumption (i.e., no changes due to expectations), but reported a small improvement in mood after 45 minutes.

Control subject #3 did report small alterations in mood each day; however, no trends were apparent across times or conditions.

Similar to control subject #2, control subject #4 also reported slight mood changes which differed between chocolate and placebo conditions. On both chocolate days, mood remained stable immediately after beverage consumption, but then slightly worsened after
45 minutes. On one of the placebo days, there was no significant change across times, and on the other placebo day (Day 1), there was an immediate improvement in mood at the five minute measurement period, but then no change between the 5-minute and 45-minute periods. These findings provide some evidence that pharmacological properties of chocolate may have affected this control subject's mood, but the inconsistencies (i.e., the fact that mood changed on one placebo as well as chocolate days) leave much doubt.

Effect sizes comparing changes in mood immediately after and 45 minutes after chocolate versus placebo consumption were also calculated for the control group (see Table 6). Neither the effect size at 5 minutes (-0.20) nor the effect size at time 45 minutes (0.27) reflect significant changes in mood. Although visual observation of the data indicated there may have been a slight difference between the effects of chocolate versus placebo consumption on mood for two of the control subjects, these effect sizes do not indicate differences to be significant. Further, extreme outlying scores do not appear to have obscured functional changes in mood.

Designated Addict Subjects Versus Control Subjects

The next question addressed in this study is whether designated addicts differ from controls with respect to mood. Figure 6 displays each subject's and matched control's self-report ratings of overall mood (total score on the POMS) across times and conditions.

Visual inspection of the data suggests that three of the four addict subjects reported consistently poorer mood across time and conditions (chocolate and placebo)
than their matched controls. Addict subject #3, on the other hand, reported significantly poorer mood than the control subject on the first day. However, her overall mood appeared to improve and align more closely with the control subject on the remaining three days.

Overall means (see Tables 7 and 8) also indicate that addict subjects’ overall mood was poorer than that of the control subjects’. Another apparent trend is that the addicts’ mood ratings were more variable across days and conditions, compared to control subjects’ mood ratings. This finding seems most evident in the initial day or two of the experiment, but then becomes less variable over time. Because of the impact of outlying scores on some calculations, means and effect sizes need to be cautiously interpreted.

For both addict and control groups, mood tended to improve immediately, irrespective of whether chocolate or placebo was consumed. Also, mood changed approximately the same degree in both conditions. The effect size of the mean difference between baseline and time 5 minutes for addicts versus controls was -0.28 for the placebo condition and 0.15 for the chocolate condition. These effect sizes support the finding that addicts and controls (as a group) experienced a similar degree of mood change. After 45 minutes, however, the addict subjects’ mean mood ratings reverted back to baseline level in the placebo condition but continued to improve in the chocolate condition. On the other hand, for control subjects, mood continued to improve 45 minutes after placebo, but reverted back to baseline levels in the chocolate conditions. Again, it should be noted that the drop in the mean addict subjects’ mood score at time 45 minutes for the chocolate
# Table 7

**Chocolate Condition, Designated Addict Versus Control Group: Means, Standard Deviations, and Effect Sizes**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Time (min)</th>
<th>Addict</th>
<th>Addict-Addict Mean difference (SD)</th>
<th>Control</th>
<th>Control-Control Mean difference (SD)</th>
<th>Effect size (addict-control)</th>
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<td><strong>Mood</strong></td>
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<tr>
<td></td>
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<tr>
<td></td>
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<td>11.4 (21.2)</td>
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<td></td>
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<tr>
<td><strong>Cravings</strong></td>
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<td></td>
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</tr>
<tr>
<td></td>
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<td>7.7 (1.9)</td>
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<td>257.0 (163.0)</td>
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<td>247.3 (124.2)</td>
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<td>.07</td>
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<sup>a</sup> Mean difference and standard deviation for time +5 minus time 0.

<sup>b</sup> Mean difference and standard deviation for time +45 minus time 0. Higher mood scores reflect more negative mood states than lower scores. Craving ratings could possibly range between 3 and 15.
Table 8

Placebo Condition, Designated Addict Versus Control Group: Means, Standard Deviations, and Effect Sizes

<table>
<thead>
<tr>
<th>Variable</th>
<th>Addict</th>
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<td>Time</td>
<td>Mean (SD)</td>
<td>Mean difference (SD)</td>
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<td>Mood</td>
<td>Mean difference (SD)</td>
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<td>+45</td>
<td>15.5 (15.1)</td>
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<td>Cravings</td>
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<td>7.0 (1.9)</td>
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<td>5.4 (2.6)</td>
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<td></td>
</tr>
<tr>
<td>Amount eaten</td>
<td>(grams)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>+45</td>
<td>246.1 (165.5)</td>
<td>212.0 (68.3)</td>
<td></td>
</tr>
</tbody>
</table>

* Mean difference and standard deviation for time +5 minus time 0.

b Mean difference and standard deviation for time +45 minus time 0. Higher mood scores reflect more negative mood states than lower scores. Craving ratings could possibly range between 3 and 15.
condition may have been overly influenced by one subject’s score on one day.

As discussed previously, if the scores from addict subject #3 on that one day were dropped, the overall means for the addicts’ POMS score in the chocolate condition would be 8.6 at baseline, improve to 4.4 at time 5 minutes, and would decline to 7.0 at time 45 minutes. This closely resembles the control subjects’ pattern of mood changes.

Cravings

Chocolate Versus Placebo

The next question addressed in this study is whether addicts and normal controls respond to placebo versus chocolate drink differently with respect to their self-reported chocolate cravings. Figure 7 displays the results of each subjects’ craving ratings. In general, the findings indicate that craving ratings tended to be quite variable and unpredictable across measurement periods, especially for the addicts. Also, most changes occurred immediately after consumption of each beverage, rather than after 45 minutes. Further, regardless of whether placebo or chocolate was consumed, the overall slope for cravings across time (within sessions) is negative for the addict subject, suggesting a trend toward decreased craving over time. On the other hand, no consistent slope pattern is evident across control subjects, either for time or condition. Thus, these results suggest that cravings may be largely based on factors other than the biochemical effects of chocolate.

_Designated addict subjects_. Addict subject #1 reported an immediate decrease in
Designated Addict #1 & Control #1

Designated Addict #2 & Control #2

Designated Addict #3 & Control #3

Designated Addict #4 and Control #4

Figure 7. Individual data from study 2: Craving ratings. Scores could range from 3 to 15.
cravings after 5 minutes on all days, for both conditions. On Day 1 (chocolate condition) cravings decreased across measurement periods. However, on the remaining 3 days, reported cravings leveled off and did not change between 5 minutes and 45 minutes. There was also a great deal of variability in this subject’s reported cravings.

Designated addict subject #2 also reported an immediate decrease in cravings on all days, regardless of whether placebo or chocolate was consumed. On two of the days (one placebo, one chocolate), cravings then increased at 45 minutes, but on the other 2 days, cravings remained consistent from 5 minutes to 45 minutes. These findings suggest that the subject’s perceptions and expectations probably played a large role in her report of craving intensity.

Unlike the previous two subjects, addict subject #3 reported an immediate increase in cravings after 5 minutes on 3 of 4 days; this was followed by a more dramatic decrease after 45 minutes, however. This pattern occurred regardless of condition, though craving reductions after 45 minutes were slightly greater on chocolate days than on placebo days.

Finally, the addict subject #4 reported chocolate cravings that did not appear to vary in any systematic manner across days or conditions. Indeed, her reports of cravings were as variable across time and condition as those of control subjects.

Effect sizes for craving ratings (over time) for the chocolate condition versus the placebo condition were calculated for the designated addict group (see Table 5). Changes in craving ratings between baseline and 5 minutes did not meaningfully differ between placebo and chocolate conditions. Overall means show that chocolate cravings dropped
immediately after consumption of both beverages approximately to the same degree (effect size = -0.17). On the other hand, changes from baseline to the 45-minute assessment period indicate that while craving ratings continued to drop in both the chocolate and placebo condition, they dropped significantly more so after consumption of chocolate than placebo (effect size = -0.71). Although this aggregated difference is suggestive of some pharmacological effects of chocolate on cravings, such a conclusion is constrained by the data of other subjects.

The magnitude of this effect size appears mostly influenced by two subjects' scores. For addict subject #3, chocolate craving consistently went down more on both chocolate days than placebo days. However, for subject #2, craving ratings on one placebo day changed in exactly the same manner and to the same degree as ratings on the chocolate days. Because of this inconsistency and the fact that two subjects experienced no differences in craving ratings after chocolate versus placebo, it appears that this effect size may not accurately reflect the differential effects of chocolate versus placebo on cravings.

Control subjects. Similar to the designated addict subjects, the control subjects did not appear to display any consistent differences between placebo and chocolate conditions with respect to chocolate cravings. Control subject #1 displayed little consistency in self-reported cravings across times and conditions. On 2 days (one chocolate and one placebo), the subject experienced an immediate increase in cravings, but cravings remained stable at 5 minutes on the other 2 days.
Control subject #2 maintained relatively stable craving ratings across times and conditions. Under both conditions there was a slight change in cravings at time 5 minutes, but ratings returned to baseline level at time 45 minutes.

Control subject #3 reported experiencing an increase in chocolate cravings at time 5 minutes on all 4 days. At time 45 minutes, ratings either returned to baseline levels (one chocolate and one placebo day) or remained relatively stable from time 5 minutes.

Similarly, control subject #4 indicated an increase in cravings immediately after consumption of both chocolate and placebo on all 4 days. At time 45 minutes, cravings either reduced or stayed stable, but there were no consistent trends for chocolate versus placebo.

Effect sizes for the control group were also calculated (see Table 6). Changes in craving ratings did not substantially differ between chocolate and placebo condition immediately after beverage consumption (effect size = .36) or after 45 minutes (effect size = -0.29), suggesting that, as a group, control subjects did not respond differently to chocolate or placebo with respect to subsequent chocolate cravings.

Designated Addict Versus Control

The next question addresses differences between chocolate addicts and controls with respect to cravings after consuming chocolate or placebo. Figure 7, and Tables 7 and 8 depict these results.

Examination of the first set of subjects indicates that both the addict subject #1 and control subject #1 rated their chocolate cravings similarly with respect to degree of
intensity and variability across time and conditions. However, the addict subject reported cravings that decreased at time 5 minutes each day, whereas the control subject's cravings either increased or stayed the same at time 5 minutes on all days.

Similarly, with the second set of subjects, the addict subject reported a decrease in cravings after 5 minutes each day, whereas the control subject's cravings slightly increased on 3 of 4 days. The addict displayed greater variability in her ratings (i.e., addict ratings had a daily range of 3 to 7, whereas the control subject's ratings had a daily range between 1 and 2).

Designated addict subject #3 and control subject #3 rated cravings that were approximately equal in overall intensity, but the designate addict subject again reported cravings that were more variable than the control subject (range = 4 to 6 for designated addict; range = 2 to 4 for control). Both subjects reported cravings that tended to increase by the 5-minute assessment period, across conditions.

Finally, the fourth pair of subjects also displayed some differences from one another. There was actually greater variability in the control subject's craving ratings than in the addict subject's ratings. Also, the control subject's cravings increased on all 4 days at time 5 minutes, whereas for the addict subject, it increased 2 days, went down 1 day, and remained the same 1 day at time 5 minutes.

Overall means and standard deviations reveal that for the addict subjects, cravings steadily decreased across time in both the chocolate and placebo conditions. Conversely, overall means for the control subjects indicate that the control subjects rated cravings as
increasing immediately after consumption of drinks, and then decreasing to a level closer
to baseline at time 45 minutes. This finding occurred in both the chocolate and placebo
conditions. The effect sizes of the mean change in craving ratings from baseline to 5
minutes for addicts versus controls was -1.70 in the chocolate condition and -1.50 in the
placebo condition. This illustrates that the immediate responses to the chocolate were
vastly different (cravings were in opposite directions) for the two types of subjects. The
effect size of the mean change in craving ratings from baseline to 45 minutes was also very
large (-1.86 in the chocolate condition and -1.35 in the placebo condition). The fact that
these differences occurred in both the chocolate and placebo condition is highly
interesting. Examination of means and standard deviations also indicates greater overall
variability in addict subjects’ ratings, compared to those of control subjects.

Amount of Ice Cream Eaten

Chocolate Versus Placebo

The study next examined the question of whether chocolate addicts and normal
controls eat different amounts of ice cream 45 minutes after consumption of chocolate
versus a placebo. Figure 8 shows that first, control subjects tended to consume less ice
cream than addicts, irrespective of whether they had previously consumed a chocolate or
placebo drink. Second, and more importantly, it does not appear that addicts were affected
differentially by chocolate versus placebo with respect to how much ice cream they
subsequently ate. On the other hand, two of the control subjects appeared to show some
Figure 8. Individual data from study 2: Amount of ice cream eaten (grams). Subjects were offered a total of 600g of ice cream.
differential eating response to the type of drink consumed.

**Designated addict subjects.** Designated addict subject #1 ate considerably less on the last day (placebo) than on the previous 3 days, but no consistent differences between placebo and chocolate conditions were observed. Addict subject #2 steadily ate less the last 2 days, but there were also no consistent differences between placebo and chocolate conditions. As can be easily observed, addict subject #3 ate very little ice cream, and there were no consistent differences between chocolate and placebo. Finally, addict subject #4 displayed significant variability in the amount eaten across days. She steadily ate more ice cream for the first 3 days, but then ate less on Day 4. As with the other three addict subjects, this subject displayed no consistent differences between placebo and control conditions. An effect size of 0.07 (see Table 5) indicates that differences in amount of ice cream eating between chocolate and placebo conditions did not differ for the addict subject.

**Control subjects.** An examination of the control subjects’ results indicates that control subject #1 ate varying amounts of ice cream across days, but there were no trends with respect to prior consumption of chocolate versus placebo. Control subject #2, however, tended to eat more ice cream (approximately 3 to 5 tablespoons) after consuming chocolate versus the placebo. Control subject #3 ate considerably more ice cream on the first day than on the following 3 days. However, there were no consistent differences between chocolate and placebo. Finally, control subject #4 did not vary much in the amount of ice cream eaten each day, but there was a trend to eat slightly more (the
equivalent of approximately 2 and 4.7 tablespoons of ice cream) on chocolate days than on placebo days.

**Designated Addicts Versus Controls**

The final question being asked in this study pertains to the amount of food eaten by addict subjects versus controls 45 minutes after consumption of chocolate or placebo. Figure 8 and Tables 7 and 8 display the data related to this question.

The most notable finding is that three of the four addict subjects ate considerably more ice cream than the control subjects on almost every day, in both conditions. Designated addict subject #3, however, ate very little ice cream each day, while her matched control subject ate considerably more on three of the days.

Examination of the means and effect sizes of the differences between addicts and controls do not, however, reflect these differences. Most likely, the results from both addict #3 and control #3, which substantially differed from the other subjects, led to there being no noticeable differences in the aggregate statistics. Designated addict subject #3 ate very little ice cream, and therefore probably brought down the mean amount eaten considerably. Because of this, visual inspection of the data likely provides the most information.

In addition, the standard deviations indicate greater variability in amount eaten by the addict subjects than the control subjects. For addict subjects, standard deviations ranged from 163 in the chocolate condition to 165.5 in the placebo condition, whereas for
the control subjects, standard deviations ranged from 68.3 in the placebo condition to 124.2 in the chocolate condition.

Summary

Similar to the findings of Study 1, the data in Study 2 suggest that there are no consistent differences in either the chocolate addicts’ or controls’ responses to ingestion of chocolate versus placebo. For the most part, any observed differential responses between the two types of beverages were found at an individual subject level. Also, even among these subjects, responses tended to be inconsistent, both within and between subjects. However, it should be noted that half of the control subjects ate slightly more ice cream after consumption of chocolate drink than placebo beverage. This may indicate a small effect of chocolate on nonaddict subjects’ subsequent eating behavior.

Also, similar to the results found in Study 1, the most noticeable findings in Study 2 relate to differences between chocolate addicts and their matched controls. The chocolate addict subjects reported poorer mood states, which were also significantly more variable than that of the control subjects, especially on the initial day or two of the experiment. While craving ratings were variable for both groups, they were particularly so for the addict subjects. Cravings also tended to be highly affected by expectations for both groups, as the most noticeable changes in craving ratings were immediately after beverage consumption, especially for designated addicts. Finally, designated addicts tended to eat more chocolate ice cream than controls after consumption of either beverage.
CHAPTER V
DISCUSSION

This study attempted to discern whether symptoms associated with eating sugar and chocolate among self-avowed sugar and chocolate addicts is best explained by psychological factors (e.g., learning) or by key chemical components of these foods. The results provided little evidence that physiological responses to the chemical constituents of these substances are responsible for producing relevant postconsumption symptoms, such as changes in mood, cravings, or amount of ice cream subsequently eaten. Learning explanations, on the other hand, are consistent with the results.

In reviewing the results, it will first be considered whether designated addict subjects responded to sugar or chocolate in a manner consistent with their self-avowed reports of symptoms of an addiction. Then, the evidence consistent with learning versus biochemical explanations will be examined. Also, a more complete explanation regarding why some individuals compulsively eat sugar and chocolate will be explored. Finally, limitations of the present study will be discussed.

Symptomatic Response of Sugar and Chocolate "Addicts"

Mood

During screening interviews, both self-proclaimed sugar and chocolate addicts
reported that, in general, their mood is affected by consumption of the addictive substance. All of the designated addict subjects in this study avowed experiencing a more positive mood state, such as increased feelings of calm and relaxation, contentedness, increased energy, and happiness after eating sugar or chocolate. Many subjects, however, concurrently reported feelings of guilt, a more negative emotion. The results of this experiment suggest that, in fact, mood did change considerably for most addict subjects after consumption of sugar or chocolate. However, the direction of change within and between subjects suggests that these women generally failed to show a consistent, "typical" pattern of improved mood after consuming sugar or chocolate. This finding is compatible with the results of Hetherington and Macdiarmid's (1993) survey of self-identified chocolate addicts, in which 51% of their sample reported positive affective responses to eating chocolate while 49% said they felt negatively. Learning theory suggests that a negative response to eating an addictive substance should tend to reduce the likelihood of further repetition of the behavior. Thus, it may be more likely that these subjects experience, at least temporarily, reinforcing feelings (e.g., increased relaxation, decreased anxiety). It is also speculated that for many of these subjects, negative cognitions (e.g., "I should not have eaten this, I will gain weight.") may lead to subsequent negative mood states, such as guilt feelings.

In the present study, it is unclear why the designated addict subjects did not actually evidence the improved mood response to the sugar or chocolate beverage they reported during screening interview. Perhaps, these women actually experienced positive
changes in mood after consuming sugar or chocolate, but on some days, negative cognitions (which subjects may be more attuned to) may have also been present and more prominent. It may also have been that these subjects simply do not experience consistent changes in mood after consuming sugar or chocolate; it may be that for some reason, they merely believe that they do (i.e., they may pay more attention to or be more aware of instances when their mood changes in one direction). Another possible explanation may involve orosensory properties of the substance. In this study, subjects were asked to drink a liquid form of sugar or chocolate. It may be that subjects are actually addicted to the orosensory properties related to eating (chewing) the substance, such as the texture of the food, rather than (or in addition to) any pharmacological properties of the food. This explanation is consistent with Rozin et al. (1991) who found that chocolate cravers tend to seek out food that have sensory properties (rather than pharmacological properties) similar to chocolate, when chocolate is not available.

Cravings

Subjects also indicated during screening interviews that their cravings for sugar or chocolate were usually affected by consumption of these foods. Most subjects reported that their cravings usually intensified until they ate the preferred food. Also, for many subjects, cravings were associated with ingestion of large amounts of sugar or chocolate. However, the results of this study indicate considerable variability in actual craving responses. All designated addict subjects experienced immediate changes in cravings after
ingestion of sugar or chocolate: two reported increases in cravings on both days, two reported decreases and four reported contradictory responses on the two days. After 45 minutes, similar ratings occurred, though a greater proportion indicated reduced cravings. So, while subjects stated that they typically experience reductions in cravings after eating sugar or chocolate, their actual ratings of cravings in this experiment suggest that they may not experience a consistent pattern of craving responses following consumption.

Again, it is difficult to explain why such inconsistencies in craving responses occurred. One likely explanation would be that subjects’ change in cravings was largely dependent on level of cravings at the time they arrived at the laboratory each day. For example, if a subject was already experiencing substantial chocolate cravings when she arrived for the experiment, she may sense a reduction in cravings after consuming chocolate. On the other hand, if this same subject arrived at the laboratory relatively free from strong chocolate cravings on another day, she may experience little or no change in cravings after drinking the chocolate beverage. An addiction model, however, would predict that subjects’ cravings would significantly increase upon seeing or tasting sugar, regardless of initial craving levels. Close examination of the data does not reveal any such trends for degree of immediate level of craving.

Another possible reason for the inconsistencies of craving changes may involve the idiosyncratic nature of cravings and their resolution. In other words, these women may sometimes require considerable amounts of sugar or chocolate in order to satisfy the cravings, while at other times, small amounts of the substance may serve to relieve
cravings. In the present study, a moderate level of sugar or chocolate was consumed, which may or may not have been sufficient for reducing cravings, depending on the subject and the day.

As discussed previously, the results may also be related to orosensory factors. Perhaps, for some of these women, craving reduction is best related to the act of chewing and experiencing the taste and texture of the sugar or chocolate in solid, rather than liquid form. In their study of chocolate cravers, Michener and Rozin (1994) found that while pharmacological properties of chocolate appeared to play no role in the satisfaction of chocolate cravings, orosensory properties did.

Amount of Ice Cream Eaten

Finally, many individuals who claim to be addicted to sugar or chocolate state that they tend to eat more highly desirable food or treats, or have difficulty controlling their intake of treats after eating sugar or chocolate. In fact, during the screening interview, all designated addict subjects avowed eating considerably more sugar or chocolate than they would have liked, several times each week. The present study examined how much of a highly desirable food (ice cream) subjects ate after consuming sugar or chocolate versus placebo, and how much designated addict subjects ate compared to matched controls. However, it was not possible to compare how much each subject consumed with what she may typically consume, outside the laboratory (because these data were not collected). Therefore, it is difficult to identify whether subjects naturalistically “overate.”
In this study, there was great variability in ice cream consumption among designated addict subjects after eating sugar or chocolate. More importantly, only about half of the designated addict subjects ate more than their matched controls. Again, there appears to be little evidence that subjects' reports of overeating are congruent with their actual behavioral response to initial consumption of sugar or chocolate. Further, there was little evidence that addict subjects were cued to eat more than nonaddicted peers by drinking substances to which they are purportedly addicted.

Once again, it is unclear why the designated addict subjects did not eat more than control subjects. Perhaps these subjects, because of their general tendency to overeat sugar or chocolate, also tend to diet or restrict food intake more frequently than controls, and may have been careful about overeating during the experiment. The setting of the study (i.e., laboratory) may also have impacted the designated addict subjects' general tendency to overeat sweet foods. Although the study was designed in such a manner as to reduce inhibitions about eating and anxieties about being observed, these subjects may have been cued to monitor their own behavior more closely (by asking subject to attune to their mood and cravings) than is typical.

If either of these speculations are accurate, they, too, contradict the addiction model of excessive sugar or chocolate consumption, because these subjects appear to have some control over their food intake subsequent to eating sugar or chocolate. It would appear that if, in fact, the designated addict subjects were truly addicted to sugar or chocolate, they would not display variable and inconsistent moods, cravings, and
subsequent food intake after consuming the addictive substance that they displayed in this study. The results suggest that, most likely, these subjects frequently crave and overeat sugar or chocolate, but are not actually addicted in the qualitative manner outlined in descriptions of chemical syndromes (e.g., DSM-IV [1994] substance dependence).

A question then arises as to whether the present sample is typical of individuals who consider themselves addicted to sugar or chocolate. It may be that the screening procedures used in this study did not adequately detect actual sugar and chocolate addicts or failed to distinguish those individuals with a "real" addiction from those who merely overeat these foods.

However, compared to other published studies examining sweet cravings or addictions, the screening procedures in the present study were actually more extensive and stringent. In general, other studies using similar groups (e.g., "food addicts," "sweet cravers") have set subject inclusion criteria based on a single variable; the subject simply identified him/herself as a sugar/chocolate craver or addict versus merely "liking" the substance (e.g., Hill & Heaton-Brown, 1994; Kayloe, 1993; Michener & Rozin, 1994).

There have been a few studies that used screening procedures similar to those in the present study, which involved a telephone interview assessing chocolate addiction following prospective subjects' response to an advertisement (Hetherington & Macdiarmid, 1993; Macdiarmid & Hetherington, 1995).

It is more difficult, however, to adequately compare this study's sample selection methods to screening procedures used in studies examining individuals with other forms of
behavioral addiction (e.g., sex, pathological gambling, binge eating). In general, individuals in these types of studies have been selected from samples of individuals receiving treatment for the addiction (and thus, have likely been diagnosed by a professional therapist). In addition, such individuals are most likely suffering from serious maladaptive consequences of their behavior, and therefore may be a select sample of individuals with more severe forms of the behavioral excess. Of those few studies that selected subjects from a population not currently receiving treatment, various screening methods have been used. These have included use of self-report questionnaires (e.g., of pathological gambling, Briggs, Goodin, & Nelson, 1996; of binge eating, Antony, Johnson, Carr-Nangle, & Abel, 1994) and semistructured or structured interview based on DSM-IV (1994) criteria (e.g., of binge eating, Brody, Walsh, & Devlin, 1994). The screening procedures used in the present study appear parallel to those used in other studies examining excessive behaviors except for the fact that an existing, empirically validated measure was not used, as was the case in most studies on binge eating and pathological gambling. Because sugar and chocolate addictions are not diagnosable disorders, and because of the apparent, relative lack of maladaptive consequences experienced by individuals who are self-identified sugar or chocolate addicts, there are no standards for identifying these individuals. Given this limitation, it seems reasonable to conclude that the screening procedures used in the present study adequately assessed the behaviors of the potential subjects.

If a truly maladaptive form of sugar or chocolate addiction exists, it may be that
the base rate is so low that none of the subjects sampled in this study evidenced it.

Certainly, the idea of sugar and chocolate addictions have been popularized in the mass media in recent years, and many individuals may find an addiction model of excessive consumption of these substances an especially attractive way of rationalizing their behavior.

Consistency of Results with a Learning or a Physiological Explanation for Compulsive Sugar/Chocolate Consumption

If excessive sugar and chocolate consumption among purported addicts is maintained by the physiological effects of key ingredients in the sugar or chocolate, then certain results would be expected in this study. First, subjects should display little or no change in mood or cravings concomitant with, or immediately after consuming real chocolate or sugar. On the other hand, after 45 minutes (by which time physiological effects are maximized), designated addict subjects should experience changes in cravings and/or mood. Furthermore, these findings would occur only on days when the subjects consumed the true chocolate or sugar beverage, while mood and cravings would remain stable after ingesting a placebo. Findings to the contrary would be more consistent with other explanations, such as social learning mechanisms perpetuating excessive sugar and chocolate consumption. For example, if similar mood and cravings changes occurred immediately after drinking either sugar or placebo, one would speculate that learned expectancies about the effects of sugar led to the perceived change in mood and cravings.
In addition, lack of consistent differences between responses to placebo versus sugar or chocolate (when subjects believed placebo actually contained sugar or chocolate) would be more likely to be consistent with learning mechanisms, rather than biochemical causes.

In both the sugar and chocolate studies, there was evidence that nonpharmacological factors (e.g., learning factors) may be involved in self-identified sugar and chocolate addicts’ responses to consuming these substances. First, most designated addict subjects (though not all), experienced immediate changes in mood and cravings after consuming sugar or chocolate (as well as the placebo). Second, there were no consistent differences in subjects’ responses to sugar or chocolate versus the placebo, including mood and craving changes, and amount of ice cream subsequently eaten. This, again, indicates that pharmacological properties were not likely involved in these changes.

These findings are similar to the results of a study by Reid and Hammersley (1995) who examined normal subjects’ responses to sugar, and to Michener and Rozin’s (1994) experiment with chocolate cravers. Both of these studies used placebos (though only in the sugar study were subjects blind to what they were consuming). Also, in these studies, subjects did not show differential mood, cravings, or eating patterns after ingestion of sugar or chocolate versus a placebo.

What is interesting in the current study, however, is that a few of the control subjects appeared to show slight differential responses to the sugar or chocolate versus the placebo. Although the differences tended to be small and inconsistent, there were hints that changes reported by a few of the control subjects may have been impacted by
chemical properties of the sugar or chocolate. Thus, even if these chemical properties lead to physiological changes, designated addict subjects did not appear to be affected, or at least were not aware of the impact. Instead, other factors (e.g., learning, changes in their environment or routine) may have been more salient for these subjects.

Why Some Individuals Purport to Experience Maladaptive Consumption of Sugar or Chocolate While Others Do Not

If, as the results of this study suggest, so-called sugar and chocolate addictions have little or no physiological basis, why is it that some individuals complain that they develop this eating behavior, while others do not? Examining the results pertaining to differences between self-avowed addicts subjects and the control subjects should shed light on this question.

First, designated addict subjects in both studies reported mood states and craving ratings that varied within and across days, substantially more than control subjects'. In both studies, this finding was most apparent in the first day or two of the study. One hypothesis for these findings is that individuals who claim to be addicted to sugar or chocolate tend to be more “reactive” to any number of changes in stimuli in their environment. For example, these individuals may, in general, experience more pronounced changes than other people in their internal state when faced with more situations (e.g., being in a new place, meeting strangers) and changes in environmental conditions (e.g., different temperature, lighting, space, etc.). Perhaps, then, these individuals experience
greater internal arousal, which may be perceived as anxiety, tension, or other negative states, when facing more stimuli or change. In addition, these individuals may become classically conditioned to eat chocolate or sugar—substances with which they have associated positive, calming and generally rewarding effects—in order to feel better (positive reinforcement). Also, such consumption may become associated with escaping or avoiding negative emotive states (negative reinforcement). Indeed, in other populations (e.g., bulimics, dieters, sweet cravers), negative emotions have been related to desire to binge (Abraham & Beumont, 1982; Bruch, 1974; Cattanach et al., 1988; Moyer et al., 1993; Polivy et al., 1994; Schlundt et al., 1993).

Second, in both of the present studies, designated addict subjects reported more negative mood states and higher levels of craving than control subjects. Again, this difference was most notable on the first 2 days of the study. It may be that individuals who believe they are addicted to sugar or chocolate have a general tendency to experience negative mood states more frequently than nonaddicts. Because these self-identified addicts have previously come to pair sugar or chocolate with positive feelings states (or relief of negative mood states), consumption of these foods may come to be conditioned to feeling better. However, because mood tended to improve across days, it may be more likely that many of these individuals do not experience consistently poorer moods, but instead tend to be more sensitive to changes in their environment, as hypothesized above.
A Proposed Model of Excessive Sugar and Chocolate Consumption

Although a biochemical addiction model may not be most appropriate for explaining the behavior of excessively eating sugar or chocolate, learning and cognitive factors seem relevant to understanding why some individuals report that they crave and overeat these substances. While many women in this study did not respond to sugar or chocolate in a manner consistent with what was previous indicated, their reports of mood, craving, and food intake changes after consuming these substances should not be discounted. As noted by their food intake and changes in mood and craving ratings, it is clear that these subjects differed from controls. Most notable were the less positive mood states, higher level of cravings, and the greater variability in both mood and cravings among designated addict subjects than in controls. These findings suggest that, indeed, these women experience the consumption of sugar and chocolate (as well as placebos) differently than controls.

A multicause explanation of excessive consumption of sugar and chocolate may be most applicable. Likely, individuals who believe they are addicted to sugar or chocolate have been operantly conditioned to consume sugar or chocolate in certain situations because the act is associated with positive experiences. For most of our society, sweet foods accompany festive, happy events. Certainly, the taste of sweet foods is positively reinforcing and most children are rewarded from time to time with sweets foods for good behavior. If this pairing occurs frequently, individuals may be operantly conditioned to
consume sweet foods because it results in positive feelings.

Some individuals may also learn to consume sweet foods because it helps them avoid feeling negative emotions by way of distraction or enhancement of a more positive mood state. This tendency may be even more likely to occur in individuals who experience greater fluctuation in their internal states, such as being anxious in new situations or around new people. As a result of such repeated pairings, individuals may come to expect that future consumption of sweets will lead to positive outcomes and thus excessively eat sweets in order to feel better.

However, because the subjects did not consistently evidence the range of maladaptive responses (i.e., lack of control over consumption, consistent mood, and craving changes) associated with other, better recognized dependencies (e.g., cocaine addiction, pathological gambling), it would appear that other factors, such as cognitions and/or presentation of specific cues, may play a role in whether the subject engages in the eating behavior and/or experiences their “typical” response to eating these substances. For example, self-identified sugar and chocolate addicts may only overeat these foods and experience changes in mood and cravings when in certain types of situations (e.g., being around other people, being in new environments) or when experiencing some types of cognitions (e.g., “I have a lot of work to do tonight,” “I feel lousy about myself.”). In addition, these cues and cognitions may be quite idiosyncratic, and therefore difficult to identify. A visual model of the proposed explanation for excessive sugar and chocolate consumption is presented in Figure 9.
Figure 9. Proposed model for explaining excessive consumption of sugar and chocolate.

Limitations and Future Directions

The present study has several limitations. First, this study used a small sample, and therefore caution is encouraged when generalizing the results to all self-avowed chocolate and sugar "addicts." Also, only female subjects were included in this study, and all subjects volunteered to participate based on seeing or hearing the researcher's advertisements. Certainly, it would be valuable to replicate this study using a larger number of subjects of both sexes. It would also be appropriate to screen subjects from a much larger pool (e.g., a college campus), which may somewhat reduce the self-selective nature of this study.
In addition, this experiment was conducted in a laboratory setting. While self-identified addicts might typically evidence the responses to sugar or chocolate that they purport, the laboratory setting may have attenuated subjects' responses. For example, subjects may have felt inhibited to eat as much ice cream as they typically would in circumstances where they did not feel their behavior was being monitored. Also, boredom may have been a factor in subjects' responses, as they were asked to remain in a laboratory room for 45 minutes without any specified tasks to perform. This lack of directed behavior is likely atypical of what these subjects do after consuming sweet foods. In addition, by asking subjects to attend to and rate their mood states and craving levels, subjects may have been cued to moderate their responses. Still, the fact that these subjects did not respond consistently in the direction they indicated during the initial interview lends support to the notion that these subjects do not meet the strict diagnostic criteria outlined in diagnostic manuals (i.e., *DSM-IV* [1994]) for “addictive behaviors” such as chemical dependency, severe impulse control disorders (e.g., kleptomania, etc.). Future researchers examining individuals who excessively eat sugar and chocolate would be advised to develop even more stringent inclusion criteria, selecting only those subjects with the most severe and consistently compulsive form of the behavior.

Finally, another limitation of this study is that a liquid form of both sugar and chocolate was used. As previously indicated, some individuals who crave sweet foods and claimed to be “addicted,” report that the taste and texture are the most attractive aspect of these foods. On the one hand, if pharmacological properties are involved in the process of
excessively consuming these substances, the form it takes should be irrelevant. On the other hand, where addiction models of excessive sugar and chocolate intake allow for psychological dependence (without physiological dependence), then orosensory and conditioning factors may play a key role in the process of maintaining the behavior. Therefore, it would be important to replicate this study comparing liquid and solid forms of sugar and chocolate. Presently, it seems possible to do this with sugar, but there does not appear to be an adequate commercial chocolate substitute with the same orosensory properties of real chocolate.

Future studies may also want to consider examining personality traits of subjects who claim to be addicted to sweet foods. It would be valuable to determine whether such individuals fit the profile of what is often referred to as an “addicted personality.” In addition, it would be useful to more thoroughly examine the role that mood plays in this excessive eating behavior. For example, one might ask whether negative mood states lead to overeating, or whether overeating leads to changes in mood. Future studies may want to explore mood states and mood-related psychopathology in such individuals, and to replicate this study while matching addicts and controls on baseline mood levels.
REFERENCES


APPENDICES
Appendix A

Profile of Mood States
Below is a list of words that describe feelings people have. Please read each one carefully. Then fill in ONE circle under the answer to the right which best describes how you feel right now.

The numbers refer to these phrases:

0 = Not at all
1 = A little
2 = Moderately
3 = Quite a bit
4 = Extremely

### HOW YOU FEEL RIGHT NOW

<table>
<thead>
<tr>
<th>Number</th>
<th>Feeling</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>Hopeless</td>
<td>Desperate</td>
</tr>
<tr>
<td>22</td>
<td>Relaxed</td>
<td>Shuffled</td>
</tr>
<tr>
<td>23</td>
<td>Unworthy</td>
<td>Rebellious</td>
</tr>
<tr>
<td>24</td>
<td>Slight</td>
<td>Helpless</td>
</tr>
<tr>
<td>25</td>
<td>Sympathetic</td>
<td>Bewildered</td>
</tr>
<tr>
<td>26</td>
<td>Uneasy</td>
<td>Unworthy</td>
</tr>
<tr>
<td>27</td>
<td>Restless</td>
<td>Unhappy</td>
</tr>
<tr>
<td>28</td>
<td>Unable to concentrate</td>
<td>Clear-cut</td>
</tr>
<tr>
<td>29</td>
<td>Fatigued</td>
<td>Lively</td>
</tr>
<tr>
<td>30</td>
<td>Helpful</td>
<td>Confused</td>
</tr>
<tr>
<td>31</td>
<td>Annoyed</td>
<td>Done</td>
</tr>
<tr>
<td>32</td>
<td>Discouraged</td>
<td>Shaky</td>
</tr>
<tr>
<td>33</td>
<td>Resentful</td>
<td>Unhappy</td>
</tr>
<tr>
<td>34</td>
<td>Nervous</td>
<td>Lively</td>
</tr>
<tr>
<td>35</td>
<td>Lonely</td>
<td>Confused</td>
</tr>
<tr>
<td>36</td>
<td>Mischievous</td>
<td>Resentful</td>
</tr>
<tr>
<td>37</td>
<td>Muddled</td>
<td>Active</td>
</tr>
<tr>
<td>38</td>
<td>Cheerful</td>
<td>Active</td>
</tr>
<tr>
<td>39</td>
<td>Bitter</td>
<td>On edge</td>
</tr>
<tr>
<td>40</td>
<td>Exhausted</td>
<td>Grouchy</td>
</tr>
<tr>
<td>41</td>
<td>Anxious</td>
<td>Blues</td>
</tr>
<tr>
<td>42</td>
<td>Ready to fight</td>
<td>Blues</td>
</tr>
<tr>
<td>43</td>
<td>Good natured</td>
<td>Energetic</td>
</tr>
<tr>
<td>44</td>
<td>Gloomy</td>
<td>Panicky</td>
</tr>
</tbody>
</table>

### MAKE SURE YOU HAVE ANSWERED EVERY ITEM.
Appendix B

Semistructured Telephone Interview
SEMISTRUCTURED TELEPHONE INTERVIEW (Experimental Group)

My name is ____________ and I’m conducting a study at Utah State University about how women feel about sugar/chocolate. I was wondering if you would be willing to answer a few questions today?

1.) I’m curious to know what prompted you to respond to the ad.

2.) As you recall, the ad said, “The Department of Psychology at Utah State University is conducting research on women who believe they are addicted to chocolate or sugar. If you believe you are dependent on either of these substances and are willing to participate in a short confidential, telephone interview, please contact (me).”

   In what ways do you feel you meet the description of this ad?

3.) How often do you consume sugar/chocolate?

4.) How would you describe your thoughts and feelings when you desire to eat sugar/chocolate during the week?

5.) How many times each week do your cravings for or thoughts about sugar/chocolate lead to you eating more sugar/chocolate than you should have?

6.) Some people who eat sugar/chocolate have no trouble stopping themselves after just a small taste. Other people start eating sugar/chocolate and begin to feel that they have little or no control afterwards.

   On a scale of 1 to 9 (where 1 is no control and 9 is total control, how much control do you feel you have over your consumption of sugar/chocolate?

7.) Some people eat sugar/chocolate and find that it has no effect on how they think or feel afterwards. Others find it has a dramatic effect on how they think or feel. Do you find that your thoughts or feelings are affected or changed after eating sugar/chocolate. Is your mood affected when you do not satisfy your craving for sugar/chocolate?

6.) What is your age?

7.) What is your height?

8.) What is your weight?

9.) Are you diabetic or hypoglycemic?

10.) Do you have any food or chemical allergies?

11.) Is there any chance you could be pregnant at this time?
SEMISTRUCTURED TELEPHONE INTERVIEW
(Control Group)

My name is ____________ and I'm conducting a study at Utah State University about how women feel about sugar/chocolate. I was wondering if you would be willing to answer a few questions today?

1.) I'm curious to know what prompted you to respond to the ad.

2.) As you recall, the ad said, "The Department of Psychology at Utah State University is conducting research on women who enjoy eating chocolate or sugar. If you believe you fit this criteria, and are willing to participate in a short confidential, telephone interview, please contact [me]." In what ways do you feel you meet the description of this ad?

3.) How often do you consume sugar/chocolate?

4.) How would you describe your thoughts and feelings when you desire to eat sugar/chocolate during the week?

5.) How many times each week do your cravings for or thoughts about sugar/chocolate lead to you eating more sugar/chocolate than you should have?

6.) Some people who eat sugar/chocolate have no trouble stopping themselves after just a small taste. Other people start eating sugar/chocolate and begin to feel that they have little or no control afterwards.

   On a scale of 1 to 9 (where 1 is no control and 9 is total control, how much control do you feel you have over your consumption of sugar/chocolate?

7.) Some people eat sugar/chocolate and find that it has no effect on how they think or feel afterwards. Others find it has a dramatic effect on how they think or feel. Do you find that your thoughts or feelings are affected or changed after eating sugar/chocolate. Is your mood affected when you do not satisfy your craving for sugar/chocolate?

6.) What is your age?

7.) What is your height?

8.) What is your weight?

9.) Are you diabetic or hypoglycemic?

10.) Do you have any food or chemical allergies?

11.) Is there any chance you could be pregnant at this time?
Appendix C

Cravings Rating Forms
CRAVINGS RATING FORM
(Chocolate)

A **chocolate craving** is: a strong desire or impulse to eat chocolate. It is a state in which a person is restless and tends to be attentive only to sights, smells, and thoughts relating to chocolate. Most people find that the strength of their cravings change. That is, sometimes a person will have no cravings for chocolate, whereas at other times, their cravings will be especially strong.

1.) At this moment, how strong is your craving for chocolate?

1 = no craving
2 = slight craving
3 = moderate craving
4 = strong craving
5 = extremely strong craving

2.) If you were to leave this building right now, how likely would you be at this moment to go out of your way to obtain chocolate?

1 = not at all likely
2 = possibly
3 = moderately likely
4 = quite likely
5 = very likely

3.) How much are thoughts of chocolate on your mind right now?

1 = not at all
2 = a little bit
3 = a moderate amount
4 = a lot
5 = an extreme amount
CRAVINGS RATING FORM
(Sugar)

A sugar craving is: a strong desire or impulse to eat sugar. It is a state in which a person is restless and tends to be attentive only to sights, smells, and thoughts relating to sugar. Most people find that the strength of their cravings change. That is, sometimes a person will have no cravings for sugar, whereas at other times, their cravings will be especially strong.

1.) At this moment, how strong are your sugar cravings?

1 = no craving
2 = slight craving
3 = moderate craving
4 = strong craving
5 = extremely strong craving

2.) If you were to leave right now, how likely would you be at this moment to go out of your way to obtain sugar?

1 = not at all likely
2 = possibly
3 = moderately likely
4 = quite likely
5 = very likely

3.) How much are thoughts of sugar on your mind right now?

1 = not at all
2 = a little bit
3 = a moderate amount
4 = a lot
5 = an extreme amount
Appendix D

Instructions to Subjects
INSTRUCTIONS TO SUBJECTS
(Sugar Group)

The study you have chosen to participate in investigates the effects of sugar intake on mood state, cravings, and taste perception. Because these factors may change on a daily basis, it is important to obtain several samples over time. It is for this reason that we need subjects to participate for four consecutive days.

Each day, you will be asked to drink a sugary beverage, wait 45 minutes so that certain chemicals in your blood will stabilize, and then you will be asked to taste test different flavors of ice cream.

Each day, you will also be asked to complete two questionnaires. One questionnaire asks about your mood, while the other contains questions about your cravings. You will be asked to fill out these questionnaires three separate times each day.

It is important that during the course of this study, you eat normally, as you would during any day you were not in an experiment. It is also important that you feel physically well during the course of this study. Please try to get adequate sleep and report any signs of illness to me each day.

It is also important that you do not eat or drink anything for three hours prior to coming, as we do not want you to feel "full" when you arrive.

At this point, I would like you to read this consent form, which I will go over with you, and you may decide if you are willing to continue with the study.
INSTRUCTIONS TO SUBJECTS
(Chocolate Group)

The study you have chosen to participate in investigates the effects of chocolate intake on mood state, cravings, and taste perception. Because these factors may change on a daily basis, it is important to obtain several samples over time. It is for this reason that we need subjects to participate for four consecutive days.

Each day, you will be asked to drink a chocolatey beverage, wait 45 minutes so that certain chemicals in your blood will stabilize, and then you will be asked to taste test different flavors of ice cream.

Each day, you will also be asked to complete two questionnaires. One questionnaire asks about your mood, while the other contains questions about your cravings. You will be asked to fill out these questionnaires three separate times each day.

It is important that during the course of this study, you eat normally, as you would during any day you were not in an experiment. It is also important that you feel physically well during the course of this study. Please try to get adequate sleep and report any signs of illness to me each day.

It is also important that you do not eat or drink anything for three hours prior to coming, as we do not want you to feel “full” when you arrive.

At this point, I would like you to read this consent form, which I will go over with you, and you may decide if you are willing to continue with the study.
Appendix E

Consent Form
SUGAR STUDY

PERMISSION STATEMENT

As a participant in the study being conducted by Lara Schultz and David M. Stein, Ph.D. of Utah State University, I understand that:

The purpose of the study is to examine the effects of sugar intake on mood state, cravings, and taste perception. It is expected that there will be approximately 16 subjects in this study. While I may not benefit personally from participation in this study, it is expected that the results will be of great benefit to clinicians and researchers.

I understand that participation in this study involves coming to the lab on four consecutive days. During this time, I will be asked to drink a sugary beverage, fill out two questionnaires, and participate in an ice cream taste test (consuming and rating different flavors of ice cream). In addition, my height and weight will be measured and I will be asked questions about my current health. Each day, the entire procedure will take approximately 75 minutes.

I am aware that the researchers are not interested in the responses or data of individual subjects, but that of groups of people. Therefore, results from questionnaires will report only group data and will be used for research purposes only. Any information about my individual responses will be lost when data are analyzed as groups.

Further, I understand that there are no known risks associated with participating in the study. The beverages you will be asked to consume all consist of substances that are found in common foods people regularly eat and have been approved by the Food and Drug Administration. I also understand that my involvement is voluntary. I am free to withdraw my consent at any time during the study period, without consequence. There may also be certain circumstances in which my participation may be terminated without my consent. This situation could occur if I have certain health conditions (e.g., diabetes, pregnancy, general illness), if I am allergic to food used in this study, or if I fail to keep my appointments.

I understand that codes will be used in place of identifying information (e.g., name) to label all forms and questionnaires to protect my confidentiality. Additionally, I understand that all research materials will be kept locked in a safe place to further ensure my confidentiality, and will be destroyed six months after research is completed. Some details about the purposes of the present study will not be disclosed to me until after the entire study is completed, so as not to compromise the results. Upon my completion of this study, I will be fully debriefed about the study.

I understand that subjects are invited to inquire about study procedures at any time, and that results of the study will be available in about six months from Dr. Stein or Lara Schultz, Utah State University.

______________________________  _______________________
Name                                    Date

______________________________  _______________________
Signature                               Signature

P.I. David M. Stein, Ph.D.  Date

Any questions or concerns, please contact:
Lara Schultz at 752-4346 or
David M. Stein, Ph.D. at 797-3274
As a participant in the study being conducted by Lara Schultz and David M. Stein, Ph.D. of Utah State University, I understand that:

The purpose of the study is to examine the effects of chocolate intake on mood state, cravings, and taste perception. It is expected that there will be approximately 16 subjects in this study. While I may not benefit personally from participation in this study, it is expected that the results will be of great benefit to clinicians and researchers.

I understand that participation in this study involves coming to the lab on four consecutive days. During this time, I will be asked to drink a chocolatey beverage, fill out two questionnaires, and participate in an ice cream taste test (consuming and rating different flavors of ice cream). In addition, my height and weight will be measured and I will be asked questions about my current health. Each day, the entire procedure will take approximately 75 minutes.

I am aware that the researchers are not interested in the responses or data of individual subjects, but that of groups of people. Therefore, results from questionnaires will report only group data and will be used for research purposes only. Any information about my individual responses will be lost when data are analyzed as groups.

Further, I understand that there are no known risks associated with participating in the study. The beverages you will be asked to consume all consist of substances that are found in common foods people regularly eat and have been approved by the Food and Drug Administration. I also understand that my involvement is voluntary. I am free to withdraw my consent at any time during the study period, without consequence. There may also be certain circumstances in which my participation may be terminated without my consent. This situation could occur if I have certain health conditions (e.g. diabetes, pregnancy, general illness), if I am allergic to food used in this study, or if I fail to keep my appointments.

I understand that codes will be used in place of identifying information (e.g. name) to label all forms and questionnaires to protect my confidentiality. Additionally, I understand that all research materials will be kept locked in a safe place to further ensure my confidentiality, and will be destroyed six months after research is completed. Some details about the purposes of the present study will not be disclosed to me until after the entire study is completed, so as not to compromise the results. Upon my completion of this study, I will be fully debriefed about the study.

I understand that subjects are invited to inquire about study procedures at any time, and that results of the study will be available in about six months from Dr. Stein or Lara Schultz, Utah State University.

Name ___________________________________ Date ____________________

Signature ____________________________________________________________________________

Any questions or concerns, please contact:
Lara Schultz at 752-4346 or
David M. Stein, Ph.D. at 797-3274
Appendix F

Food Questionnaire
FOOD QUESTIONNAIRE

Below is a list of foods and chemicals that you may be asked to consume during the course of this study. Please check any items that you are allergic to or would not be willing to consume.

___ Milk
___ Cornstarch
___ Cottonseed oil
___ Lime
___ Yeast
___ Wheat
___ Annatto extract
___ Sugar
___ Carrageenan
___ Lecithin
___ Cocoa
___ Bread
___ Citric Acid
___ Banana
___ Nutmeg
___ Flour
___ Ice cream
___ Orange juice
___ Corn
___ Peanut butter
___ Eggs
___ Cheese
___ Butter
___ Folic acid
___ Aspartame
___ Vanilla extract
___ Vegetable oil
___ Cinnamon
___ Maltodextrin
___ Salt
Appendix G

POMS Subscale Scores
Figure 10. POMS subscale scores for designated sugar addict #1 and control #1. Higher scores reflect worse mood states than lower scores on all scales except vigor. On the vigor subscale, higher scores reflect more positive mood states than lower scores.
Figure 11. POMS subscale scores for designated sugar addict #2 and control #2. Higher scores reflect worse mood states than lower scores on all scales except vigor. On the vigor subscale, higher scores reflect more positive mood states than lower scores.
Figure 12. POMS subscale scores for designated sugar addict #3. Higher scores reflect worse mood states than lower scores on all scales except vigor. On the vigor subscale, higher scores reflect more positive mood states than lower scores.
Figure 13. POMS subscale scores for designated sugar addict #4 and control #4. Higher scores reflect worse mood states than lower scores on all scales except vigor. On the vigor subscale, higher scores reflect more positive mood states than lower scores.
Figure 14. POMS subscale scores for designated chocolate addict #1 and control #1. Higher scores reflect worse mood states than lower scores on all scales except vigor. On the vigor subscale, higher scores reflect more positive mood states than lower scores.
Figure 15. POMS subscale scores for designated chocolate addict #2 and control #2. Higher scores reflect worse mood states than lower scores on all scales except vigor. On the vigor subscale, higher scores reflect more positive mood states than lower scores.
Figure 16. POMS subscale scores for designated chocolate addict #3 and control #3. Higher scores reflect worse mood states than lower scores on all scales except vigor. On the vigor subscale, higher scores reflect more positive mood states than lower scores.
Figure 17. POMS subscale scores for designated chocolate addict #4 and control #4. Higher scores reflect worse mood states than lower scores on all scales except vigor. On the vigor subscale, higher scores reflect more positive mood states than lower scores.