

TOWARDS A SOCIO-CULTURAL MODEL OF FOOD CRAVINGS:  
EVIDENCE FROM THE CASE OF PERIMENSTRUAL CHOCOLATE CRAVING

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To my grandmothers,

Dr. Margret Albring

and

Margarethe Hormes,

two extraordinary women.

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## ABSTRACT

### TOWARDS A SOCIO-CULTURAL MODEL OF FOOD CRAVINGS: EVIDENCE FROM THE CASE OF PERIMENSTRUAL CHOCOLATE CRAVING

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Food cravings are a common, yet poorly understood phenomenon. Past attempts to explain them with a focus purely on physiological mechanisms have been unsuccessful. Four studies examine the hypothesis that food cravings are best conceptualized in terms of socio-cultural and psychological factors, looking specifically at the example of perimenstrual chocolate craving. Study 1 demonstrates that the word “craving” does not lexicalize in a majority of foreign languages, calling into question the idea that craving is a universally relevant concept. Instead, the notion of craving appears fundamentally culture-bound. Study 2 characterizes chocolate cravers in the United States, and finds that women who link craving temporally to their menstrual cycle are unique in several attributes, most notably in significantly more disordered eating attitudes and behaviors. Differences between menstrual and other cravers and non-cravers hint at possible psychological characteristics associated with perimenstrual chocolate craving. Study 3 assesses the fate of perimenstrual chocolate craving in women post-menopause and finds that cravings remain prevalent, but in the absence of regular menstrual cycles are attributed in self-reports to stressors in the environment. This provides further

evidence against a direct causal role of hormones in the etiology of perimenstrual chocolate craving, and gives rise to the hypothesis that cravings are a culturally sanctioned response to stress, and that menstruation is simply one highly salient stressor. Study 4 tests this stress-hypothesis by assessing the affective and physical correlates of chocolate craving in women diagnosed with premenstrual syndrome. Premenstrual chocolate craving, along with a range of affective symptoms, is shown to decrease significantly with the onset of menstruation, in the absence of significant changes in levels of hormones. It is furthermore reduced effectively with placebo treatment. This strongly suggests that perimenstrual chocolate craving is part of a cluster of affective symptoms that emerge prior to menstruation, probably in response to the subjective experience of stress. Results from these four studies constitute compelling new evidence against a physiological basis of food cravings. They provide the basis for a novel model of food cravings that emphasizes socio-cultural and psychological factors, including dietary restraint, ambivalence and culturally-promoted ways of coping with stress.

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## CHAPTER 1

### GENERAL INTRODUCTION

Cravings are strong desires or urges that are difficult to resist. The notion of craving – though lacking a clear, agreed-upon definition - has been central to our conceptualization of addiction, including addictions to drugs and alcohol, tobacco, gambling or sex. In the context of addiction, craving is often seen as a critical precursor to relapse, and thereby as an important obstacle to successful recovery (Drummond, 2001). Aside from its centrality in our understanding of addiction, the notion of craving has garnered widespread attention in a domain of life largely unrelated to addictive pathology, namely food and eating. Among the first 40 links generated by a Google search for the term “craving” were a mere six references to drug and alcohol cravings, eight sites dealing with gambling, but a total of 17 sites that mention cravings for food. Clearly, the notion of food cravings has entered the lay person’s vocabulary. From the perspective of the researcher, however, food cravings and their causes and effects so far have remained somewhat of a puzzle.

#### *1. What are Food Cravings?*

A food craving is defined as “a desire so strong that an individual will go out of his or her way to satisfy it” (Rozin, Levine, & Stoess, 1991), or “an intense, periodic

motivation aimed at gaining the craved substance” (Bruinsma & Taren, 1999). Food cravings differ from hunger in that only a specific food will satisfy a craving, whereas hunger is alleviated by any number of foods. Food cravings have been found to occur in 94% of female and 75% of male undergraduate students in the United States (U.S.) (Zellner, Garriga-Trillo, Rohm, Centeno, & Parker, 1999). In another study 82% of a sample of U.S. women ages 20 to 37 reported experiencing food cravings (Rodin, Mancuso, Granger, & Nelbach, 1991).

Though numerous theories of the basis of food cravings have been proposed, there have been few experimental studies of mechanisms (Pelchat, 1997). As a result, as of now there is little definitive knowledge about processes involved in either the etiology or in the satisfaction of food cravings. Thus, there remains much to be accomplished in terms of experimentally testing existing theories and deriving comprehensive models of food cravings. The present investigation is an attempt at broadening the traditional approach to the study of food cravings by examining the phenomenon from a different angle, employing novel methodologies, and examining socio-cultural and psychological factors.

The focus of this series of studies is on food cravings only. Cravings for drugs, alcohol and tobacco have been studied quite extensively, and a review of the relevant literature is beyond the scope of this investigation. Though work on craving in other domains can inform and guide research on food cravings, cravings for specific foods are substantially different from cravings for addictive substances, for example in the fact that the notions of tolerance and withdrawal are central to drug and alcohol addiction,

but difficult to apply to food and eating. Broadening our understanding of food cravings thus requires a unique research approach.

## *II. Why Chocolate Craving?*

Chocolate is the most commonly and intensely craved food in North America (Rozin et al., 1991). Chocolate is a unique food in terms of its ingredients and sensory properties. Its high fat and sugar content make it an innately palatable substance, and its numerous potentially pharmacologically active ingredients have garnered much attention and speculation. Chocolate melts at body temperature, which gives it an unusual melt-in-your mouth feel and texture, and it has an especially attractive aroma, at least for North Americans and Europeans. Chocolate is one of the few substances easily identifiable based only on its odor. It is in large part for these reasons that chocolate craving has received a relatively high degree of attention, and has arguably become the most studied of all food cravings.

Chocolate craving has been studied from two distinct angles, namely in terms of factors involved in the *causation* of chocolate craving, and from the perspective of the possible mechanisms underlying the *satisfaction* of cravings through the consumption of chocolate. So far both these approaches have been focused on physiological processes, such as hormonal fluctuations (as causes) and the chemical and pharmacological properties of chocolate (as effects). As discussed in more detail below, studies of this kind have yielded disappointing results and fail to provide an adequate explanation of

the etiology or the satisfaction of food cravings in general, and chocolate craving in particular.

More recently efforts have been made to study chocolate craving in a cross-cultural fashion, looking beyond North America and investigating the prevalence and nature of cravings in countries such as Spain (Zellner et al., 1999) and Egypt (S. Parker, Kamel, & Zellner, 2003). Findings from these studies – though preliminary at best – are largely incompatible with a purely “biological” explanation of food cravings. These cross-cultural studies form the basis and motivation for the present investigation and effort to understand food cravings in terms of social, cultural and psychological factors.

### *III. The Physiology of Chocolate Craving*

Both scientists and lay people alike tend to show a strong preference for biological accounts of various psychological phenomena. The study of chocolate and other cravings has been no exception. So far, a vast majority of research conducted on the issue of food cravings has focused on identifying causal physiological mechanisms. One major area of work has looked at the role of hormones in *causing* chocolate craving, and especially chocolate craving associated with the perimenstrum, the time period lasting from approximately four days prior to and four days into the onset of menstruation, when chocolate craving tends to increase in frequency and intensity. The second set of studies has focused on the pharmacology of chocolate and the role of its

ingredients in *satisfying* cravings. These two lines of investigation and their findings and limitations, are briefly reviewed below.

*The Role of Hormones in Chocolate Craving.* Women who experience regular menstrual periods undergo hormonal fluctuations such that there is an increase in levels of estrogen and progesterone during the periovulatory (i.e. just prior to ovulation) and midluteal (i.e. about midway through the cycle) phase, with estrogen levels peaking at the time of ovulation. This increase is followed by a drop in levels of both hormones during the luteal phase and lasting into menstruation (Figure 1-1). Evidence points to a general link between the menstrual cycle and the occurrence of cravings in women. For example, research on nicotine addiction suggests a possible effect of hormonal fluctuations on abstinence-related symptoms, with studies finding evidence for a heightened experience of withdrawal and increased cue-induced craving during the luteal and ovulatory phases of the menstrual cycle (Carpenter, Upadhyaya, LaRowe, Saladin, & Brady, 2006; Franklin et al., 2004). Similarly, alcohol-dependent women report increased frequency of drinking during the premenstrum, and they specifically identify this time of the menstrual cycle as a drinking cue (Epstein et al., 2006).

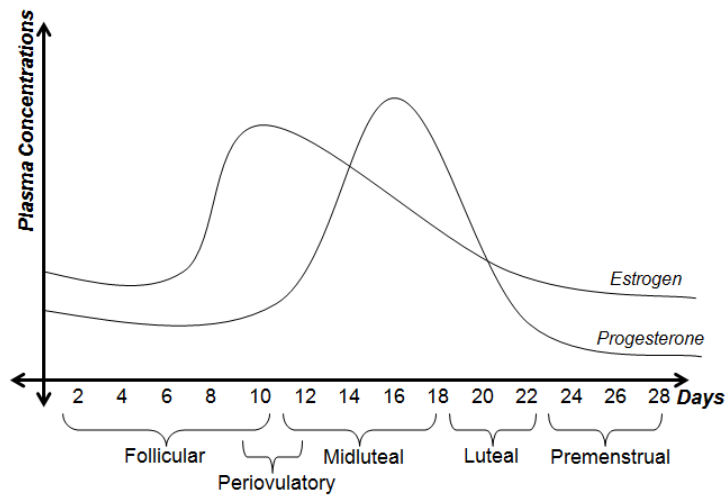


Figure 1-1: Levels of estrogen and progesterone throughout the menstrual cycle (day 1 is the first day of menstruation)

Food cravings in women have also been shown to occur in a cyclical pattern (Bancroft, Cook, & Williamson, 1988; Dye, Warner, & Bancroft, 1995). This is not surprising since in many mammalian species food intake in females is generally influenced by the menstrual cycle, and especially by levels of the ovarian hormone estrogen, with progesterone playing a secondary role primarily as an inhibitor of estrogen's effects (Gong, Garrel, & Calloway, 1989). Food intake in women is generally lower in the late follicular phase of ovulation, when levels of estrogen are relatively high and levels of progesterone are low (Gong et al., 1989). Conversely, when estrogen levels are low food intake tends to be higher (Gong et al., 1989). The perimenstrum, the time spanning several days prior to and into the onset of menstruation, is a period of

particularly low levels of estrogen and progesterone, and a time during which food intake increases by an estimated average of 215-500 kcal per day (Dalvit, 1981; Gong et al., 1989). Carbohydrate consumption especially increases in the time after ovulation, leading up to the onset of menstruation (Dalvit-McPhillips, 1983). Based on this observation it has been speculated that a general increase in hunger could contribute to more frequent food cravings in women during the perimenstrum, though this hypothesis has not received any empirical support.

Numerous studies present evidence for a particularly prominent link between chocolate craving and the menstrual cycle, and specifically a perimenstrual peak in the intensity and frequency of craving for chocolate (Bruinsma & Taren, 1999; Hill & Heaton-Brown, 1994; Mercer & Holder, 1997; Rozin et al., 1991; Zellner, Garriga-Trillo, Centeno, & Wadsworth, 2004). Prevalence estimates vary, but a recent study reports the occurrence of perimenstrual chocolate craving in as many as 49% of American women surveyed (Osman & Sobal, 2006), though – as discussed in some detail in the studies presented here - prevalence rates are much lower in other cultures, including in European (Zellner et al., 1999) and African countries (S. Parker et al., 2003). “Specific food cravings” are included as a criterion in the diagnosis of premenstrual dysphoric disorder (APA, 2000), just one illustration of the strong perceived link between changes in hormonal status and changes in food intake in women in the U.S.

It was at one point hypothesized that there is a direct link between hormonal changes and chocolate craving, such that a cyclic fall in progesterone plays a role in inducing perimenstrual chocolate craving. However, it has been shown that there is no



significant link between levels of the estrogen estradiol and the number, frequency, or types of cravings (Rodin et al., 1991). It has also been demonstrated that exogenous administration of progesterone, an inhibitor of estradiol and its effects, during the premenstrual days does not effectively reduce cravings at the time of the perimenstrum (Michener, Rozin, Freeman, & Gale, 1999). In spite of an obvious temporal connection between the menstrual cycle and craving, there is thus no clear evidence for any causal physiological link between cyclical fluctuations in levels of hormones and perimenstrual chocolate craving.

*The Pharmacology of Chocolate Craving.* With strong evidence against a direct link between hormonal fluctuations and perimenstrual chocolate craving there are two remaining arguments for a role of physiological factors in perimenstrual chocolate craving. One is that physiological changes (other than hormonal fluctuations) during menses induce a negative state that is relieved by an ingredient or combination of ingredients in chocolate (Michener et al., 1999; Zellner et al., 2004). This need state could involve specific nutritional and physiological deficits, or more generally overall caloric depletion. The second explanation points to the psychoactive ingredients in chocolate, and proposes that their physical effects are involved in craving (Di Marzo et al., 1998; Smit, Gaffan, & Rogers, 2004). It is important here to distinguish between potential physiological triggers of craving and physiological effects that reduce it. Just like headaches are not caused by low levels of blood aspirin but can be treated with aspirin, chocolate craving may not be triggered by the absence of a certain nutrient in

the system, but may be satisfied by the consumption of that nutrient. Thus, even if ingredients in chocolate can be shown to play a causal role in relieving cravings, the question of what triggered the craving in the first place will remain unanswered (Michener et al., 1999).

The claim that chocolate craving occurs in response to some nutritional or physiological deficiency - such as a lack in magnesium or the serotonin-precursor tryptophan - is based on two observations. First, evidence suggests that levels of magnesium drop significantly during menstruation, especially in women with premenstrual syndrome (Rosenstein, Elin, Hosseini, & Grover, 1994). This magnesium deficiency has been linked to a variety of affective and physical symptoms, including depressed mood, migraines and fluid retention (Facchinetti et al., 1991; Quaranta, Buscaglia, Meroni, Colombo, & Cella, 2007). Second, it has been found that consumption of carbohydrates can increase the availability of tryptophan, increasing levels of mood-enhancing neurotransmitters in the brain (Benton, 2002). However, though once proposed as a plausible explanation, there is currently no evidence to suggest that chocolate craving occurs in response to nutritional or neurotransmitter deficiencies (Pelchat & Schaeffer, 2000). If craving was in fact caused by the body's attempts to restore some form of nutritional homeostasis in the face of deficits, cravings would be expected to be less specific, but include a variety of foods of similar nutritional composition as chocolate (H. Weingarten & Elston, 1991), including those high in tryptophan – such as peanuts or bananas - or magnesium – such as cashews or spinach. Instead, even though chocolate and non-chocolate cravings may overlap to

some extent (Henderson, Rozin, Gale, & Freeman, 2009), a great percentage of chocolate craving are very specific and there seems to be no substitute when chocolate is craved (Michener & Rozin, 1994; Polivy, Coleman, & Herman, 2005).

Related to the nutritional deficiency hypothesis it has been argued that mere caloric depletion can increase craving frequency in general, and more specifically cause an enhancement of the pleasure of sweet taste (Cabanac, 1971), leading to cravings for foods high in sugar. Evidence, however, generally does not support the assumption that mere caloric depletion increases the frequency or intensity of cravings (Martin, O'Neil, & Pawlow, 2006; Pelchat & Schaeffer, 2000). Instead, it has been shown that consuming a supplement-based very low-calorie liquid diet actually decreases the frequency of food cravings (Martin et al., 2006). It has furthermore been demonstrated that responsiveness to bitter and sweet tastes decreases when estrogen is low (Gong et al., 1989), providing evidence against the assumption that the sweet taste of chocolate is enhanced during the perimenstrum. Based on the latter finding it could instead be speculated that decreased sensitivity to the two most salient tastes in chocolate – bitter and sweet – may yield increased intake in an attempt to achieve the same sensory effects of chocolate ingested at other times of the cycle. The main problem with this modified explanation of how changes in taste sensitivity may affect craving is the fact that it once again does not provide any good reason why such a large percentage of perimenstrual cravings are specifically for chocolate, and not more generally for sweets or other similar foods.

The cacao fraction of chocolate contains a number of potentially pharmacologically active ingredients (Smit et al., 2004; Smit & Rogers, 2001). Based on this observation it has been suggested that chocolate craving is somehow related to the psychoactive effects of the ingredients in chocolate, including changes in mood and physical well-being. The most widely studied of these possibly pharmacologically active ingredients in chocolate are the sympathomimetic amines tyramine and phenylethylamine (Michener et al., 1999) and the cannabinoid anandamide (Smit et al., 2004). Chocolate is also one of the principal dietary sources of stimulating methylxanthines (Smit et al., 2004). Though chocolate contains only a small amount of the methylxanthine caffeine, it does have a lot of theobromine, which is a close relative with similar effects (Weil & Rosen, 2004). With tyramine, phenylethylamine, caffeine and theobromine all having stimulating properties, their effects could potentially summate to produce significant arousal following the consumption of chocolate.

Tyramine and phenylethylamine are thought to be similar in structure to several neurotransmitters, including dopamine, epinephrine and norepinephrine, and to have activating and arousing effects (Michener et al., 1999). However, large quantities – and significantly higher doses than found in the average-sized serving of chocolate - need to be ingested to achieve these effects. Furthermore, phenylethylamine is rapidly metabolized by the enzyme MAO-B, preventing significant concentrations from reaching the brain following oral ingestion of chocolate.

Caffeine is known to affect cognitive and psychomotor function (Smit & Rogers, 2000), to increase mental alertness, and to produce small changes in feelings of well-

being at low doses (Smit & Rogers, 2002). Theobromine has been shown to increase energy, motivation to work, as well as alertness (Mumford et al., 1994). The methylxanthines in chocolate could thus provide some psychostimulant effects, and specifically increase energetic arousal (Smit et al., 2004). Studies show that only theobromine and caffeine are present in close to high enough doses in normal serving sizes of chocolate to possibly have any psychoactive effects (Smit et al., 2004; Weil & Rosen, 2004). Hershey's chocolate bars – among the most popular candy bars sold in the U.S. – weigh between 41g (“Hershey's Special Dark”) and 60g (“Hershey's Milk Chocolate”). An average 50g portion of dark chocolate contains 237-519mg of theobromine<sup>1</sup>, which is somewhat below the lowest reliable placebo-discriminable dose of 560mg (Mumford et al., 1994), and has significant effects on only a small number of very sensitive consumers (Mumford et al., 1994). Furthermore, the average 50g serving of dark chocolate contains only 17-36mg of caffeine, which is considerably less than the amount of caffeine found in a typical serving of coffee or tea, which is about 40-130mg (James, 1991)<sup>2</sup>. There is no evidence for a dose-response difference between dark and milk chocolate (Smit et al., 2004), which further suggests that the effects of caffeine and theobromine – as well as any other potentially arousing agents in chocolate - are small at best. In addition – unlike coffee – anecdotally, chocolate is rarely described as or considered an arousing or energizing food. It can be concluded with some certainty

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<sup>1</sup> Ministry of Agriculture, Fisheries and Food (1998). Survey of caffeine and other methylxanthines in energy drinks and other caffeine-containing products (updated). Food Surveillance Information Sheet (144, no.103, revised).

<sup>2</sup> Ibid.

that even methylxanthines are not present in high doses in average portions of chocolate to have any noticeable effects in the majority of consumers.

The lipid anandamide and its analogs, N-oleoylethanolamine and N-linoleoylethanolamine, which have recently been discovered in chocolate, are thought to bind to cannabinoid receptors to mimic the effects of plant-derived cannabinoid drugs, heighten sensitivity, induce euphoria (Di Tomaso, Beltramo, & Piomelli, 1996), and exert calming and anxiolytic effects (Michener et al., 1999). Again, it is unclear if – but unlikely that – chocolate contains high enough concentrations of anandamide to produce these effects to any noticeable degree (Di Tomaso et al., 1996).

Some of the most compelling evidence against a pharmacological basis for chocolate craving comes from data on the effects of ingesting the pharmacologically active contents of an average serving of chocolate in the form of capsulated cocoa powder, and in isolation of its orosensory properties, including its sight, smell, texture, and taste. Though consumption of the capsulated cocoa has the same physiological effects as ingested chocolate, it has been shown to be largely ineffective at reducing chocolate craving as measured over a 45-minute period, which is adequate time to allow for full absorption (Michener & Rozin, 1994). White chocolate, on the other hand, which – with the possible exception of the fat-soluble lipid anandamide – contains none of the active ingredient of dark and milk chocolate, but shares its creamy, melt-in-your-mouth properties and high caloric density was found to reduce chocolate craving with about half the potency of regular chocolate (Michener & Rozin, 1994). These findings

very clearly suggest that it is not the pharmacologically active ingredients – but instead possibly the sensory experience of eating chocolate - that satisfies cravings.

Overall evidence thus demonstrates that even though chocolate contains pharmacologically active compounds, the mere presence of these ingredients – whether or not they have any significant psychoactive effects – is unlikely to be involved in chocolate ingestion in response to craving (Di Marzo et al., 1998; Gibson & Desmond, 1999; Smit & Rogers, 2001), or to play a causal role in the phenomenon of perimenstrual or other chocolate craving. Studies that attempt to isolate orosensory from pharmacological effects of chocolate suggest that it is more likely to be the sensory experience of consuming chocolate, and not the pharmacology of its ingredients, that are implicated in craving (Michener & Rozin, 1994; Smit et al., 2004).

In summary there are four main arguments against a role of physiology in perimenstrual chocolate craving. One, craving is generally uncorrelated with absolute levels of and changes in hormones related to the menstrual cycle. Second, chocolate for the most part does not contain psychoactive ingredients at high enough doses to have a noticeable impact, and other foods and beverages would be a much better source of many of these ingredients than chocolate. Third, consumption of the active ingredients in chocolate in isolation of its orosensory properties does not produce the same reduction in perimenstrual craving derived from the consumption of actual chocolate (Michener & Rozin, 1994). Fourth, there is no reason why the psychoactive ingredients in chocolate should affect men and women differently in a way that would uniquely link

chocolate to perimenstrual craving (Weil & Rosen, 2004). These findings suggest a need for an alternative explanation to strictly biological causes of chocolate craving.

#### *IV. The Psychology of Chocolate Craving*

Instead of focusing on the at most minimal psychopharmacological effects of chocolate as playing a role in craving it is worth paying attention to psychological mechanisms that are involved in the experience of craving as an alternative explanation to purely physiological processes (Osman & Sobal, 2006). Four such psychological mechanisms can be hypothesized to be of particular relevance to our understanding of perimenstrual chocolate craving, namely 1. chocolate as a trigger of ambivalence, 2. links between dietary restraint and overeating, 3. the use of chocolate to regulate emotions, and 4. cue-induced craving.

*Ambivalence.* The high sugar and fat contents of chocolate contribute to making it one of the most palatable foods available (Drewnowski & Greenwood, 1983; Drewnowski, Krahn, Demitrack, Nairn, & Gosnell, 1992). Based on the innate palatability of chocolate it has been suggested that chocolate craving is motivated - if not exclusively, then primarily - by its orosensory properties (Benton, 2004; Hetherington, 2001; Michener & Rozin, 1994). Perhaps largely due to its palatability, chocolate is highly emotionally charged and is known to evoke powerful and oftentimes conflicting feelings. It is perceived as being simultaneously desirable and forbidden, as



pleasant but unhealthy (Grogan, Bell, & Conner, 1997). Women in the U.S. in particular seem to conceptualize chocolate as a very ambivalent food. This is strikingly illustrated by the finding that 14% of American women surveyed in one study reported feeling embarrassed when buying a chocolate bar at the store (Rozin, Bauer, & Catanese, 2003). A link between feelings of ambivalence and craving is supported by findings from a diary study in which subjects recorded their mood state as tied to the occurrence and satisfaction of food cravings in general (Hill, Weaver, & Blundell, 1991). Those subjects who gave in to a craving immediately after they experienced it reported an increase in positive mood, while those who resisted the craving before finally giving in to it reported an increase in negative mood (Hill et al., 1991; Rogers & Smit, 2000), suggesting that there are conflicting responses at work in the evaluation of a food cue. It has furthermore been shown that exposing self-described “chocoholics” to the smell and taste of chocolate inhibits their salivary response, which is in stark contrast to the normal physiological reaction to a palatable food (Wooley & Wooley, 1981). This suggests that frequent cravers may experience significant anxiety when confronted with chocolate (Rogers & Hill, 1989; Rosen, 1981).

*Dietary Restraint.* Chocolate is a calorically dense food, containing between 35% (for semisweet chocolate) and 55% fat (for unsweetened chocolate), and between

460 (dark) and 535 calories (milk) per 100 grams of solid Hershey's chocolate<sup>3 4</sup>. As a result, chocolate is stigmatized as lacking in nutritional value and associated with weak willpower and overeating. Restrained intake of chocolate is valued – especially in women in Western cultures - and failure to maintain restraint is a sign of weakness and a trigger for feelings of guilt (Macdiarmid & Hetherington, 1995). Many women attempt to restrict their intake of chocolate and other calorically dense foods, and such dietary restraint has been shown to be at least weakly correlated with food cravings (Hill et al., 1991). For example, exposure to visual stimuli of desired foods, such as images of chocolate, increases desire for that food specifically in dieters (Fletcher, Pine, Woodbridge, & Nash, 2007). Though most studies so far have focused on external stimuli that elicit cravings, recent theories propose that mere thoughts about the craved food can strengthen and maintain cravings over extended periods of time (Kavanagh, Andrade, & May, 2005). The link between restraint and craving may thus in part be due to the fact that during times of restraint, even fleeting thoughts and weak desires for a specific food become more salient and are subsequently labeled as cravings (Rogers & Smit, 2000).

*Emotion Regulation.* Restraint has been shown to interact with mood, with restrained eaters consuming more food when in an experimentally induced dysphoric

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<sup>3</sup> Cacaoweb: Nutrition facts for cocoa and chocolate. <http://www.cacaoweb.net/nutrition.html>, retrieved 04-12-09.

<sup>4</sup> [www.calorieking.com](http://www.calorieking.com), retrieved 04-12-09

mood, compared to a non-dysphoric mood, while non-restrained eaters' consumption is unaffected by their current mood state (Ruderman, 1985). Numerous studies have attempted to establish general links between craving and mood states. For example, cravers were found to report more boredom and anxiety than non-cravers on days on which cravings occurred (Hill et al., 1991). Furthermore, dysphoric mood appears to frequently precede craving episodes (Hill et al., 1991). Chocolate craving has been shown to occur in response to psychological triggers, including depressed mood (Benton, 2002; Willner et al., 1998) and stress (Benton, Greenfield, & Morgan, 1998). Based on these findings it has been argued that women use carbohydrates in general, and specifically sweets, to "self-medicate" during times of perimenstrual dysphoria (Smith & Saunder, 1969; Wurtman, Brzezinski, Wurtman, & Laferrere, 1989), either with some psychoactive ingredient contained in chocolate, or with the sensory aspects of chocolate as a pleasant and rewarding treat. Those women who usually attempt to restrict their intake of chocolate could be particularly susceptible to craving at this time.

In spite of a possible theoretical link between restraint, dysphoric mood during the perimenstrum, and craving, however, a number of empirical findings speak against a significant role of changes in mood in perimenstrual or other chocolate craving. First, the timing and severity of food cravings have been found to be unrelated to mood states (Bancroft et al., 1988), with perimenstrual cravings for any type of food - and for chocolate specifically - occurring in women who do not report any mood changes at that time (Bancroft et al., 1988; Tomelleri & Grunewald, 1987). Depression in particular has been found to be unrelated to food craving (Dye et al., 1995). Second, exogenous

administration of the anxiolytic drug alprazolam has been shown to have no significant effect in decreasing perimenstrual chocolate craving, providing evidence against the hypothesis that chocolate is craved because of its anti-anxiety effects (Michener et al., 1999). Third, it has been demonstrated that even when chocolate consumption decreases craving, it does not only fail to alleviate concurrent negative mood states, but in fact tends to prolong dysphoria (G. Parker, Parker, & Brotchie, 2006).

Taken together, findings suggest that even if chocolate is used to regulate mood states, any positive effects are likely outweighed by the experience of guilt induced by negative food-related cognitions (Macht & Dettmer, 2006). The association between craving and mood is thus likely to be bidirectional. While cravings have been shown to be frequently preceded by negative mood states, there is also evidence to suggest that food cravings in general, and chocolate craving specifically, cause an increase in negative mood states, including guilt, anxiety and depression (Fletcher et al., 2007).

*Cue-Induced Eating.* Eating has reliably been shown to be elicited by external cues, such as time of day or place (Birch, McPhee, Sullivan, & Johnson, 1989; H. P. Weingarten, 1984). It has therefore been argued that cue-induced eating plays a role in chocolate craving (Cornell, Rodin, & Weingarten, 1989; Zellner & Edwards, 2001), such that certain cues that are present when eating chocolate become associated with chocolate, and trigger cravings on future occasions (Zellner et al., 2004). It is possible that chocolate comes to be linked to the perimenstrum as the only acceptable time to indulge in an otherwise forbidden food (Rogers & Jas, 1994), possibly cued by the

presence of a number of psychological or physical symptoms that uniquely occur perimenstrually - such as fluid retention, cramps or headaches - or by some culturally-prescribed norm. An interesting finding in this context is the fact that women who crave chocolate in a cyclical fashion give chocolate a higher hedonic rating than men or women who crave chocolate, but in a non-cyclical fashion (Rozin et al., 1991). This can be interpreted as evidence for mechanisms of conditioning in which the perimenstrum cues chocolate as a reward.

There is thus preliminary evidence that several psychological factors play an important role in craving etiology and in the satisfaction of chocolate craving. More work is needed to fully assess the influence of ambivalence, restraint, emotion regulation and self-reward, and cue-induced eating on craving for chocolate and other foods. It is clear at this point already, however, that any comprehensive model of chocolate craving must take these mechanisms into account.

#### V. *The Socio-Cultural Context of Chocolate Craving*

Culture is known to be a major determinant of people's food choices (Rozin, 1988, 1996) and it has been argued that the best predictor of food preferences, habits and attitudes of any particular human would be information about his ethnic group (and hence, native cuisine), rather than any biological measure that one might imagine (Rozin, 1982a). Conversely, the choice, consumption, display and representation of foods are necessarily tied to the formation and reformation of identities – cultural, class,

ethnic, racial and national (Terrio, 2000). Considering the close ties between cultural identity and food choice it should come as no surprise that we are beginning to realize that culture plays a significant role in understanding food cravings as well.

Chocolate craving is a predominantly American phenomenon, and it seems that while the notions of “chocolate addiction” and chocolate craving have become part of American cultural vocabulary (Hetherington, 2001), they remain largely unknown concepts in most other countries. Sweet cravings - while extremely prominent in Western cultures - are virtually absent in other countries. For example, only 1% of young Egyptian men and 6% of young Egyptian women reported cravings for chocolate (S. Parker et al., 2003). Not only was chocolate rarely craved in this sample of young Egyptian adults, but they were also far more likely to indicate craving savory foods than sweet foods (S. Parker et al., 2003).

Though gender differences in the prevalence and objects of food cravings are visible to some extent in other cultures, they are far less pronounced than they are in the U.S. For example, it has been shown that 29% of Spanish women report experiencing regular chocolate craving, but 22% of Spanish men do the same (Zellner et al., 1999). This gender difference of 7% in the prevalence of craving is significantly lower than the 28% difference in chocolate craving between American women and men reported in the same study (Zellner et al., 1999). The link between being female and craving chocolate appears engrained in American culture, with Americans being 15% more likely than Spaniards to report believing that chocolate craving occur more frequently in women than in men (Osman & Sobal, 2006). By comparison, 31% of

Spanish males thought that chocolate craving is a largely gender neutral experience (Osman & Sobal, 2006).

Cultural differences are not limited to the prevalence of chocolate craving in women versus men, but extend to the patterns of chocolate craving reported by women. Specifically, it seems that American women are significantly more likely to link chocolate craving to the menstrual cycle than Spanish women. A recent study found 49% of American women reporting perimenstrual chocolate craving, compared to only 28% of Spanish women surveyed (Osman & Sobal, 2006). Considering that there are no cultural differences in hormonal and other physiological changes associated with different stages of the menstrual cycle, this finding provides strong evidence in favor of the assumption that chocolate craving is largely a culture-specific phenomenon.

Over 90% of Americans associate chocolate with holidays (Osman & Sobal, 2006). As noted above, chocolate is also a highly emotionally charged food. This particular perception of chocolate is however not universal, but instead very much culturally bound. Somewhat ironically, the culture that considers chocolate an acceptable antidote for negative mood states, a special treat (Dye, 2001; Rogers & Smit, 2000), and a fixture in celebrations and special occasions at the same time condemns its consumption. American women have been shown to be significantly more likely to report feelings of guilt after eating chocolate than Spanish women, who reported mostly positive or neutral mood states following consumption (Osman & Sobal, 2006).

Chocolate craving has been shown to increase in frequency with age in American women (Osman & Sobal, 2006). This could suggest that with increased

socialization into and exposure to American culture and its ideas about chocolate comes increased compliance with culturally-driven expectations about the role of chocolate in women's lives. Assuming that there is in fact an underlying cultural mechanism that drives the nature and prevalence of chocolate craving in the U.S. it is expected that the frequency and temporal pattern of chocolate craving in other cultures should vary depending on the degree of exposure to American culture (Osman & Sobal, 2006). As of now, studies looking at the impact of cultural involvement in chocolate craving report only weak evidence for a relationship between the two (Osman & Sobal, 2006); however, this may in part be due to difficulties in accurately defining and measuring the construct of socialization into American culture.

Existing findings overall strongly suggest that culture plays a role in the processes underlying chocolate craving in general, and perimenstrual chocolate craving specifically. More research is needed to fully establish the nature of the influence of culture on craving prevalence.

## VI. *Overview of the Dissertation*

As illustrated by the above overview, past attempts to develop models of food craving have focused primarily on physiological mechanisms thought to underlie craving, and have been largely fruitless. This tendency towards physiological explanations is probably best understood as being influenced by work on craving in the context of drug and alcohol addiction, which has been focused almost entirely on identifying biological



substrates of craving. In work on drug and alcohol craving the consensus is that craving remains an elusive concept and “an enduring puzzle” (Drummond, Litten, Lowman, & Hunt, 2000). Recently there has been a shift away from the traditional emphasis on purely biological factors, and towards the recognition that qualitative, anthropological and cross-cultural methods could serve as a way to gain a better understanding of an otherwise poorly understood phenomenon (Drummond et al., 2000). It seems appropriate to take cues from trends in this closely related field of research on drug and alcohol craving and attempt new methods in the study of food cravings as well.

The focus of the series of studies presented here is on the social, cultural and psychological factors thought to play a role in food cravings that have been largely neglected in previous research. The goal is to present further evidence against a primary role of physiology in chocolate craving, with an eye on developing alternative explanations. The aim is to derive a more comprehensive model of chocolate and other food cravings that is based in socio-cultural and psychological mechanisms, and that has sufficient explanatory power without needing to draw on physiological processes. Broadly speaking, it is hypothesized here that chocolate craving is a culture-specific and culture-bound construct, and a conditioned or normed response in American women to the perimenstrum as a time of stress.

Study 1 (Chapter 2) picks up where past cross-cultural studies of craving prevalence left off in answering the question of whether craving is culturally and – in so far as language is a reflection of culture – language-bound, or if it is a universal human experience (Drummond et al., 2000). The study does so by assessing the lexicalization

of the word “craving” in a wide range of languages, using dictionaries and native speaker reports. The idea behind this approach is that the presence of a word for “craving” in other languages is an important indicator as to the relevance and importance of the concept represented by that word in other cultures.

Study 2 (Chapter 3) seeks to characterize chocolate cravers in the U.S., with a specific focus on characteristics that distinguish women who report cravings that are temporally linked to the menstrual cycle from those who crave, but report no such temporal patterns, and those who do not crave at all. It is thought that differences between these groups of cravers in their relationship to food and eating, and in eating-related and other pathology can provide valuable indications about possible mechanisms underlying perimenstrual chocolate craving.

Studies 3 and 4 (Chapters 4 and 5) take a look at perimenstrual chocolate craving in two special populations: women past menopause, who no longer undergo cyclical fluctuations in hormones and ceased menstruation (Study 3), and women who experience severe premenstrual symptoms, as reflected in a diagnosis of premenstrual syndrome (Study 4). Study 3 seeks to determine the fate of perimenstrual chocolate craving in the absence of menstruation and any of the physiological mechanisms that were in the past believed to be causally involved in the etiology of these cravings. Study 4 aims to determine if the stress associated with the unpleasant symptoms of the perimenstrum is related to more severe chocolate craving during that time. It looks specifically at the effects of the onset of menstruation itself on the reported severity of affective versus physical symptom clusters. It furthermore seeks to assess whether the

stress associated with the perimenstrum - which is believed to be psychologically as opposed to physiologically driven - and the craving hypothesized to be related to that stress, can be alleviated with the simple administration of a placebo pill.

The conclusion (Chapter 6) integrates findings from these four studies, evaluates the evidence presented, and derives a new model of chocolate craving that reflects the results presented here, and forms the basis for the generation and testing of new hypotheses about the mechanisms involved in chocolate and other food cravings.

## CHAPTER 2

### DOES “CRAVING” CARVE NATURE AT THE JOINTS? ABSENCE OF A SYNONYM FOR CRAVING IN MOST LANGUAGES

#### Introduction

A craving is an “urgent desire, longing, [or] yearning.”<sup>5</sup> To crave is to want or need something with such a strong sense of urgency that it is difficult to keep thoughts focused on anything other than the object of the craving. An individual in the midst of a craving episode will go out of his or her way to obtain that which is craved. A drug addict craves the next hit, a smoker craves cigarettes, an alcoholic craves another drink, and the self-proclaimed “chocoholic” craves a candy bar.

The use of the word “craving” in the English language dates back to at least the 1300s. Its original meaning was an “accusation [or] persecution,” or an “earnest or urgent asking, begging,” but the word has been used more specifically to refer to intense desires or urges since the early 1600s (Simpson & Weiner, 1989). The etymology of “craving” is not entirely clear, though it is generally assumed that it is derived from the Old Icelandic or Norse word “krefja,” and in turn the Old English word “crafian” and Middle English term “craven,” meaning “to beg” or “to demand” (Various, 2000, 2007).

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<sup>5</sup> “craving, *vbl. n.*” *The Oxford English Dictionary*. 2nd ed. 1989. [OED Online](http://proxy.library.upenn.edu:2192/cgi/entry/50053387). Oxford University Press. 15 Jan. 2008 <<http://proxy.library.upenn.edu:2192/cgi/entry/50053387>>.

The word “craving” is relatively common, ranked at 21,998 in the list of 86,800 most frequently used words in the English language according to WordCount<sup>6</sup>, an online database based on the British National Corpus<sup>®</sup>, a 100 million word collection of samples of written and spoken language, designed to represent current English use.<sup>7</sup> Related words, such as “want” (rank 151), “need” (158), “like/liking” (67 and 9584), “love” (384), “desire” (1869), “urge” (5720), “addiction” (10,307), and “compulsion” (12,627) tend to be used somewhat more frequently. This suggests that “craving” – though fairly common - is also a rather specific term, possibly with restricted use in certain contexts. Indeed, though the meaning of “craving” may have been broader in the past, today it appears to be used almost exclusively in reference to strong urges, including addictions to drugs, alcohol and tobacco, as well as in reference to specific foods. Virtually all of the targets of craving are potential ingestants, with the exception of drugs administered by injection (though injection could of course be considered just another way of “ingesting” or taking in a substance). In spite of a narrowing of the use of the word over time, as of now there still appears to be no clear, agreed-upon definition of the term in English (Drummond, 2001).

Much like cravings for drugs, a food craving is defined as “a desire so strong that an individual will go out of his or her way to satisfy it” (Rozin et al., 1991), or “an intense, periodic motivation aimed at gaining the craved substance” (Bruinsma & Taren, 1999). Very common and largely benign, cravings for specific foods are generally not

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<sup>6</sup> <http://wordcount.org/>, retrieved 08-02-08

<sup>7</sup> It should be noted that WordCount rankings represent language use in all English-speaking countries and not specifically in the U.S.

considered facets of true addictive behaviors, since they are not associated with tolerance or withdrawal (Rogers & Smit, 2000). In the U.S. food cravings have been found to occur in 94% of female and 75% of male undergraduate students (Zellner et al., 1999). In another study 82% of a sample of U.S. women ages 20 to 37 reported experiencing food cravings (Rodin et al., 1991). Prevalence of food cravings in Canada has been shown to parallel that in the U.S., with 97% of women and 68% of men in a sample of Canadian undergraduate students reporting having experienced any food cravings (H. P. Weingarten & D. Elston, 1990). A survey of 18 to 45 year-old women in New Zealand, on the other hand, found only 58% had experienced any food cravings, and 50% had experienced food cravings in the past three months (Gendall, Joyce, & Sullivan, 1997). This suggests varying prevalence rates of food cravings in Anglophone countries, with the highest incidence occurring in North America.

Chocolate craving is a type of food craving that has been studied in some detail, partly because chocolate is the most commonly craved foods in the U.S. (Rozin et al., 1991). A recent study found that 91% of American undergraduate women reported having experienced any chocolate craving, compared to only 59% of American undergraduate men (Osman & Sobal, 2006). Regular chocolate cravings were reported by 45% of U.S. undergraduate women and 17% of American undergraduate men (Zellner et al., 1999). These figures suggest high prevalence among women, and significant and consistent gender differences in the occurrence of chocolate craving in the U.S.

Research on food cravings in non-English speaking countries has been minimal. A survey of Spanish college students found that 89% of women and 86% of men

experience food cravings (though it should be noted that it is unclear how exactly “craving” was translated into Spanish in this particular study) (Zellner et al., 1999), pointing to a high overall incidence, but a striking absence of the gender differences in craving prevalence that is commonly observed in North American countries.

Chocolate and sweet cravings - while very common in the U.S. – have been found to be essentially absent in other, non-English speaking countries. For example, young Egyptian respondents were much less likely to indicate cravings for sweet as opposed to savory foods, and only 1% of young Egyptian men and 6% of young Egyptian women reported cravings for chocolate (S. Parker et al., 2003). This difference cannot simply be explained by a lack of exposure to sweets, which are readily available in Egypt, just as they are in the U.S. (S. Parker et al., 2003). On the other hand, in Spain 29% of undergraduate women reported regular chocolate cravings, but 22% of Spanish undergraduate men did the same (Zellner et al., 1999). In Japan, women indicated rice as their most craved food, followed by chocolate in second place (Komatsu, 2008), suggesting a strong influence of culinary tradition on the perceived desirability of foods in specific countries. These differences in the types of food cravings reported, overall chocolate craving prevalence, and the absence in other countries of the gender differences in craving that are characteristic of the U.S. are findings that have yet to be addressed theoretically. Existing models of food cravings, which oftentimes attribute craving to physiological mechanisms, cannot readily explain what has been observed about the nature of chocolate and other food cravings in cross-cultural studies.

In some instances the authors of these cross-cultural studies cite difficulties translating the term “craving” from English to the language of interest (S. Parker et al., 2003). They note differences in meaning between the wording used in translated versions of the study questionnaires and the meaning of the word in English. In the apparent absence of precise synonyms they often have to resort to the use of a phrase to try and describe the phenomenon of craving to subjects in non-English speaking countries (Cepeda-Benito, Gleaves, Fernandez et al., 2000; S. Parker et al., 2003).

Based on the puzzling findings of varying prevalence rates of craving, and from the methodological difficulties in studies involving translated materials one can postulate that the concept of food and perhaps drug craving does not translate easily into languages other than English. The possible implications of the hypothesized absence of lexicalization of a common English term in other languages – including its effects on research findings - so far has received little attention, even though it has clear implications in determining in how far “craving” is a natural, important and universal category of life within and outside of the U.S.

The idea that one feature of important and legitimate concepts is that they are widely lexicalized has been proposed previously, for example in Wierzbicka’s (Wierzbicka, 1999) writing on “emotions” versus “feelings,” and the way in which terms from each category are expressed in different languages. Her analysis casts some doubt on the validity of the category suggested by the word “emotion”(Wierzbicka, 1999). Of



course there are other criteria besides lexicalization to establish validity, but clearly one should be skeptical of a category that is lexicalized in relatively few languages.

There are certain legitimate categories of life or in psychology that are known not to be lexicalized in many languages, including English. For example, unlike Hindi (“samdhi/samdhan”) or Yiddish (“mekhutanim”), English does not lexicalize the relationship between a person, and his or her daughter-in-law’s or son-in-law’s family. Similarly, English does not lexicalize the idea of pride in the success of one’s children or other close individuals (unlike Yiddish “naches”). On the other hand, while we know in psychology that there is a fundamental difference between flavor (which is the mixture of oral and of olfactory sensations) and taste (the output of oral taste buds only), many languages do not make this distinction (Rozin, 1982b). So exceptions to the widespread lexicalization of universal concepts exist, however, they appear to be quite rare.

As illustrated by the examples given here, the degree of lexicalization of any term may provide an indication as to what aspects of life are especially important in a given culture. Hindi and Jewish families traditionally form close ties even with more distant relatives – such as one’s children’s in-laws – and this necessitates descriptive words, which may not be “culturally relevant” in other countries. Thus, the extent of their lexicalization in various languages should correlate highly with the legitimacy, importance and universality of certain ideas.

In summary, in reviewing the literature on craving and the lexicalization of concepts in different languages three important issues emerged:

1. Prevalence and nature of food cravings across cultures differ significantly and often without any obvious explanation.
2. Studies of cross-cultural differences in the prevalence of cravings report difficulties translating the term “craving” from English into different languages.
3. Lexicalization of concepts matters as an indication of their legitimacy and universality. Linguistic differences can point to cultural differences in aspects of life that are considered relevant and important.

It is our sense that the English word “craving” refers to periodic strong desires, but is more specific than that, being restricted almost entirely to potential ingestants or injected drugs. In other words, it singles out a set of substances or activities subject to strong desires, and lexicalizes this subset. It is not at all clear that this subset of strong desires singled out by “craving” have any unique psychological or physiological properties.

Based on existing findings we here postulate that craving is a culture-specific and culture-bound phenomenon, principally characteristic of the U.S. or North America. We test this hypothesis by assessing the degree of lexicalization of “craving” and the existence of appropriate translations in a wide range of languages. We do so in two ways. First, we look up dictionary synonyms for the English word “craving” in various languages online, and note if the back translation of these words (using the same online

dictionary) refers back to the English word “craving.” Second, we discuss the existence of a synonym for “craving” and a number of related words and concepts with native speakers of non-English languages who are also fluent in English.

## Study 1

### *Methods*

We selected 28 different languages to represent a range of linguistic origins (Table 1), in part based on languages considered in a previous study employing similar methods (Rozin, Berman, & Royzman, 2009). In that study, languages were selected according to two criteria, 1. representation of most of the groups of languages in the world and the languages spoken by the great majority of human beings, and 2. availability in the local University community of native speakers of these languages who were also fluent in English.

There were no dictionaries available online for three of the languages selected (Malayam, Oriya, and Sinhalese). For each of the remaining 25 languages we located an online dictionary in which we could look up target words in English, and find their equivalent in the language in question. We always chose the first dictionary generated by a search using the Google online search engine (entering the search terms “English Amharic Dictionary,” “English Cantonese Dictionary,” and so on). In cases where the

first dictionary did not provide the opportunity for back-translation into English we then went to the next dictionary and so on. We always took the first word offered as a translation by the dictionary, unless the dictionary suggested that there were two or more words of equal status, in which case we considered several translations for one language. We then back-translated all the words suggested as initial synonyms into English, using the reverse search mechanism in the same dictionary.

The target word for translation was “craving.” In addition we translated three “control” words to provide a basis for comparison when assessing the translations of “craving.” These control words were “addiction,” chosen because of the similarity of context with craving, “desire,” chosen because of the similarity of meaning with “craving,” and “hope” as a control word comparable in type (i.e. designating an internal, affective state), but unrelated in meaning. The percent of languages which offered translations of the English terms that in turn yielded the original word anywhere in the back-translation was calculated. For example, entering “craving” into an English-French online dictionary yielded one word - “soif” - as a translation. Back-translating “soif” generated “appetite (for something),” which indicates an unsuccessful back-translation (because “craving” was not part of the back-translation), coded as “0=no.” The English-Spanish Dictionary yielded three equivalent translations: “antojo” (back-translation “whim, craving”), “anhelo” (“longing, desire”), and “ansias” (“yearning, longing”), or a successful “1=yes” back-translation rate.

## Results

Among the 25 languages assessed, the online dictionaries yielded on average 1.5 ( $SD=1.2$ , range: 0-4) translations for “craving,” 1.6 ( $SD=1.8$ , range: 0-8) for “addiction,” 4.3 ( $SD=3.2$ , range: 1-13) for “desire,” and 1.9 ( $SD=1.4$ , range: 0-6) for “hope.” Six dictionaries each did not generate any translation for “craving” (Amharic, Danish, Latin, Tagalog, Turkish, and Uzbek) and “addiction” (Danish, Finnish, Latin, Tagalog, Thai, and Uzbek); three did not yield translations for the term “hope” (Cantonese, Latin and Tagalog). The absence of some or all of these translations could of course be a function of the automated nature of an online dictionary and should be interpreted cautiously. We are less interested in absolute findings in regards to the existence of translations of these words as we are in relative differences between the four words assessed.

Across the 25 languages, 64% of the dictionaries included the term “craving” in the back-translations generated. In the case of “addiction” the rate was 68%, and 88% for “hope” and 96% for “desire” (Figure 2-1). A chi-square comparing the four groups was significant ( $\chi^2=10.79$ ,  $p=0.01$ ), as were a chi-square tests comparing the rates of back-translations for “craving” versus the three other groups combined ( $\chi^2=4.52$ ,  $p=0.05$ ), and “craving” versus “desire” and “hope” only ( $\chi^2=9.12$ ,  $p=0.004$ ), indicating significantly lower rates of successful back-translation in the case of “craving.”

## *Discussion*

Back-translation rates generated by online dictionaries were taken as an indicator of the degree to which initial translations offered truly corresponded to the meaning of the target words. It was assumed that the more equivalent in meaning the initial translation, the more likely it would be that the original term would be generated in the back-translation. It is demonstrated here that “craving” yielded a notably lower (by 24 to 32 percentage points) back-translation rate than two of the control terms, “desire” and “hope.” This then suggests that whatever translations of “craving” were offered initially were somehow inadequate at capturing the true meaning of the word in the other language, and were likely generated in the absence of a truly synonymous translation. Of note, “addiction” yielded similarly low back-translation rates as “craving.” This is consistent with the fact that addiction and craving are used in similar contexts and refer to related phenomena. It can be concluded that “craving” does not translate easily into a range of foreign languages.

## Study 2

In assessing the lexicalization of “craving” in various languages we felt it was important to not only rely on dictionaries and their automated translations, but to also interview native speakers of a range of foreign languages who are familiar with their native language and culture, as well as with the English language and – to varying degrees - with American culture. These native speakers’ intuitions give valuable insight

into the extent to which the notion of “craving” is considered empirically a relevant and valid concept in other languages and cultures.

### *Methods*

Twenty-seven native speakers of languages other than English were recruited for 30 minute semi-structured interviews (conducted by JMH) via announcements in a large introductory psychology class in the fall of 2008 and spring 2009. These native speakers represented a total of 20 different languages (Table 2-1). We specifically recruited more than one native speaker of a subset of the languages selected in order to assess consistency in responses across several informants. To this end we interviewed three native speakers each of French and Korean, and two native speakers each of Portuguese, Russian and Spanish. For the main analyses only one native speaker of each of the 20 languages was included; in the case of multiple informants the first person interviewed for each language was selected.

Participants were screened to determine that they were native speakers of a foreign language (as defined by having learned that language before adolescence, and having exclusively or at least primarily spoken that language at home while growing up), and with sufficient fluency in English to conduct the interview. In surveying native speakers of foreign languages we were primarily interested in how they would translate “craving” into their native language, and the degree to which they would consider the translation offered truly synonymous with what they know about the meaning of the

term “craving” in English. We furthermore questioned the native speakers about synonyms for words related to the concept of “craving” in English, including “desire,” “urge,” “addiction,” “love,” “like,” and “adore.” For each of these words we queried about translations into the native language, and level of equivalence of that translation in capturing the meaning of the English term.

We then asked about uses of the different terms in the native language across 16 domains, assessing which of the words could be appropriately applied in the context of drug, tobacco and alcohol use, in reference to food and non-alcoholic beverages, food in pregnant women, when speaking about romantic partners, good friends or family members, and with respect to domains such as clothing, hobbies, art, music, literature, locations, buildings, or a field of study (“Could you use the term [word in native language respondent indicated] in reference to [domain of interest]?”).

### *Results*

Of the 20 native speakers (65%,  $n=13$  female), all but one (95%,  $n=19$ ) had been born outside of the U.S. The respondents who had not been born there reported having lived in the U.S. on average four years ( $M=4.2$  years,  $SD=4.7$ , range: 1 month – 19 years). Respondents indicated on average having spoken English for 14 years ( $M=13.7$ ,  $SD=5.3$ , range: 3-24 years). They reported a high mean fluency in speaking English ( $M=87.4$ ,  $SD=11.3$ , range: 58-100, on a scale of 0=“no English at all” to 100=“perfect native speaker fluency”).



Of the 20 respondents two indicated not knowing the meaning of the word “craving” in English and were thus unable to provide a proper definition or translation. Of the remaining 18 respondents all gave a definition of the term in English that correctly captured the meaning of “craving.” Only about a quarter (22%,  $n=4$ ) indicated that they believed there to be a proper synonym of the term in their native language (Albanian, Filipino, Vietnamese and Spanish), while the remaining 78% ( $n=14$ ) thought there was no adequate translation.

When asked for their best effort at translating the term “craving” into their native language seven respondents (39%) provided a descriptive phrase, while 11 respondents (61%) generated a single word. When asked about the appropriateness of the translation they had provided, 83% ( $n=15$ ) of the respondents felt that their translation was not equivalent to the meaning of “craving” in English, and only three (17%) still believed the translation provided appropriately captured the concept of “craving” in English (Albanian, Vietnamese and Spanish). By comparison, 100% ( $n=20$ ) of respondents were able to provide what they considered equivalent translations of the terms “like” and “love,” 85% ( $n=17$ ) of the words “desire” and “addiction,” and 70% ( $n=14$ ) of the term “adore.” The only other word queried that proved difficult for respondents was “urge,” with only 20% ( $n=4$ ) able to generate what they considered to be a proper translation in their native language (Bengali, Hindi, Greek, and Spanish) (Figure 2-2).

Asked about common uses of the translated terms, most respondents reported that the equivalent (or approximate) translation of “craving” (if there was one) is used

primarily in the context of consummatory behaviors, including drugs and alcohol, tobacco, food, and sex. A similar pattern emerged in the reported uses of “addiction” and “urge.” “Love” was said by most respondents to be used in an equally constrained context, and to be applicable almost exclusively to people, including romantic partners, family members and good friends. “Desire” and “adore” had reported uses that were much broader in scope, while “like” emerged as the most widely applicable term, essentially spanning all context queried during the interview. Figure 2-3 represents the reported domains of use of four of the words assessed in those languages that provided any translation, illustrating the wide applicability of “like,” in contrast to the specificity of the words “love” (as referring primarily to people), “addiction” (as referring mostly to substances known to have the potential for physical dependence), and “craving” (referring to a range of substances commonly ingested or otherwise consumed). The similarities in reported use of “craving” and “addiction” across domains is noteworthy, as it suggests that “craving” enters language in connection with the concept of addiction.

In terms of consistency of reports between several native speakers of the same language, agreement between the two Portuguese, Russian and Spanish respondents was perfect (with the exception of one of the Russian informants who could not think of a translation for either “desire” or “urge”). In the case of the three French and three Korean native speakers there was some level of disagreement in self-reports. Again, this was in large part due to some of the respondents not generating any translations

for some of the words. Of note, however, two of the French and all three Korean respondents agreed that there was no equivalent translation of the word “craving.”

### *Discussion*

Findings are consistent with results of study 1 in that they point to consistent difficulties in translating “craving” into a range of languages, compared to several control words. These difficulties were clearly recognized by the respondents in this study who believed the translation task to be challenging, and almost all agreed that whatever translation they provided did not feel fully adequate in capturing the meaning of the English word. The translations – equivalent or merely approximate – that were offered suggest that respondents appropriately attempted to capture the sense that “craving” in English refers almost exclusively to desires related to consummatory or ingestive behaviors.

Of note, the word “urge” also proved difficult for study participants. The most likely reason for this is the fact that in spite of its dual meaning (as a verb and noun) it is used relatively rarely in the English language (as noted above), and non-native speakers may have very little to no experience with the word. Another possible explanation is the fact that “urge” and “craving” are quite similar in meaning (in fact, many studies – including ours – use “urge” in the definition of “craving” provided in questionnaires). When respondents are unable to translate “craving” because the concept it is not a natural category in their native language, the same may be true for “urge.”

## General Discussion

In two studies we demonstrate a striking absence of truly equivalent translations of “craving” in a wide range of languages, representing a diverse set of cultures. Study 1 illustrates this fact using electronic dictionaries; study 2 corroborates the finding using native speaker reports. Prior research suggests that the absence of a synonym for a specific word in a particular language indicates that this word does not correspond to what would be considered a natural category. Our results thus indicate that “craving” does not in fact carve nature at its joints, but instead designates a subcategory of strong periodic desires that appears to be a culture-specific notion, prevalent primarily or almost exclusively in English-speaking countries. Of note, it includes some but not all ingestants (e.g. individuals would rarely or never report craving water).

Our results suggest strongly that we should not assume that “craving” designates a natural or even important category. This finding has important implications for the way in which we view major psychological processes, including food choice and addiction. Our results also support the previously raised possibility that the lexicalization of craving is in fact a useful statement about categories of life that are particularly important in any given culture.

<b>Study 1 (Dictionaries)</b>	<b>Study 2 (Native Speakers)</b>
Amharic	Albanian
Bulgarian	Bulgarian
Cantonese	Bengali
Czech	Cantonese
Danish	French (x3)
Dutch	German
Finnish	Greek
French	Hindi
German	Japanese
Greek	Korean (x3)
Gujarati	Mandarin
Hebrew	Nepali
Italian	Tagalog/Filipino
Japanese	Polish
Latin	Portuguese (x2)
Mandarin	Romanian
Polish	Russian (x2)
Portuguese	Spanish (x2)
Russian	Tamil
Spanish	Vietnamese
Tagalog/Filipino	
Thai	
Turkish	
Uzbek	
Vietnamese	

Table 2-1: List of languages used in studies 1 and 2

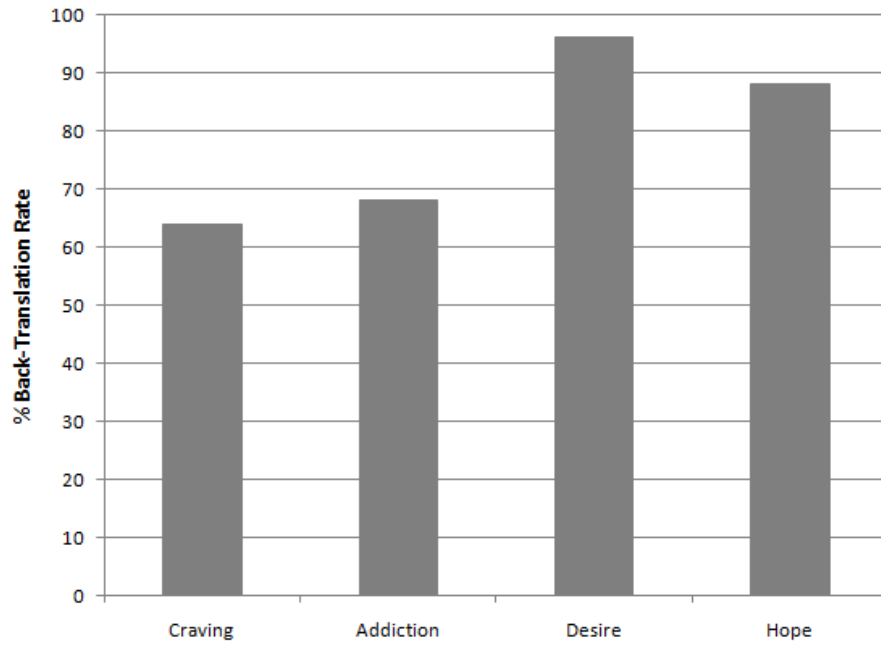


Figure 2-1: Percent back-translation rate obtained for each of four words using electronic dictionaries (study 1)

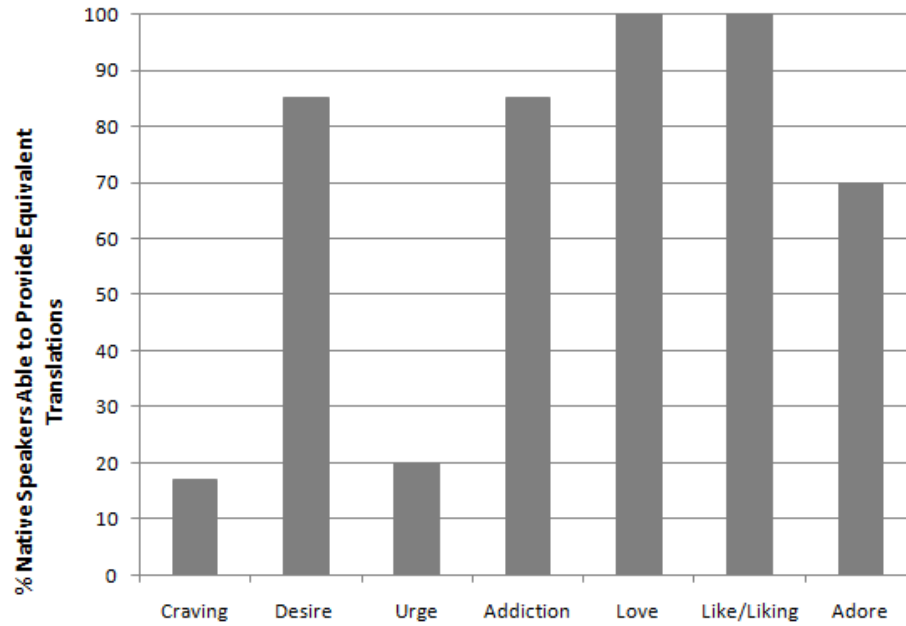


Figure 2-2: Percent of native speakers of 20 foreign languages indicating the presence of an equivalent translation for each of seven words (study 2)

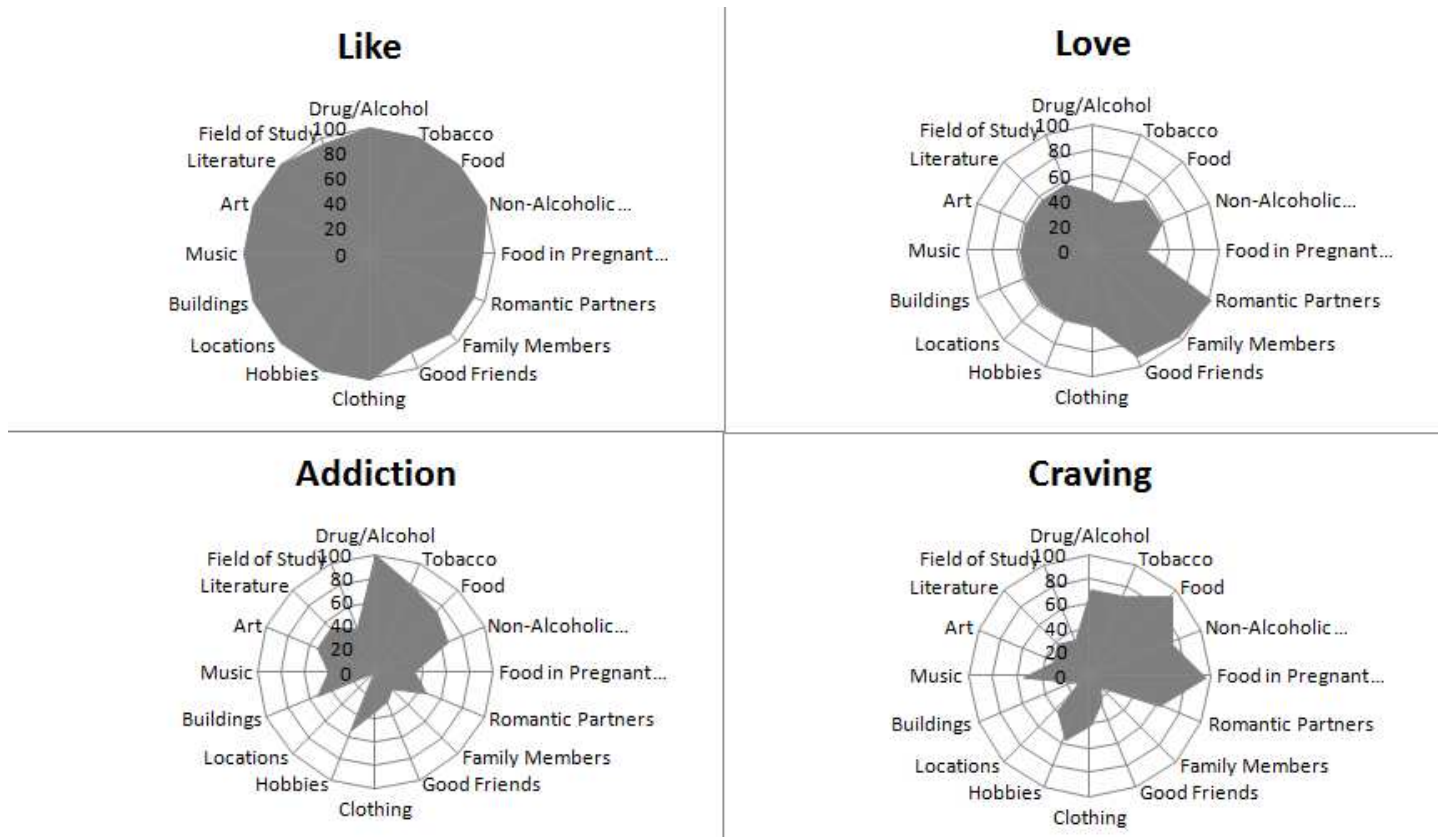


Figure 2-3: Percent of respondents indicating appropriate use of the word “like,” “love,” “addiction,” and “craving” across domains (% are valid percent calculated for sample of respondents who indicated any translation of the target word) (study 2)



## CHAPTER 3

### ALL CRAVINGS ARE NOT CREATED EQUAL: EVIDENCE FOR TWO DIMENSIONS OF CHOCOLATE

#### CRAVING

##### Introduction

A food craving is defined as a desire “so strong that it will cause a person to go far out of his or her way to satisfy the craving” (Rozin et al., 1991), or as “an intense, periodic motivation aimed at gaining the craved substance” (Bruinsma & Taren, 1999) that leads to the subjective experience of a compulsive urge to eat. Food cravings are a common phenomenon, with 82 to 100% of women and 70 to 75% of men reporting any food or drink cravings (Pelchat, 1997; Rodin et al., 1991; Zellner et al., 1999). Food cravings tend to be very specific, and if a certain food is craved usually no other substance can satisfy the craving.

Craving for chocolate has received special attention for three reasons. First, chocolate is one of the most commonly and intensely craved foods among young adults in North American countries (Rozin et al., 1991; H. Weingarten & Elston, 1991), but does not stand out in other countries as a food that is craved more than any other (Osman & Sobal, 2006; Zellner et al., 1999). The exact reasons for these cultural differences are as of yet unknown. Second, there are striking gender differences in the prevalence of chocolate craving in the U.S., with women consistently reporting significantly higher rates of craving than men (Osman & Sobal, 2006; Rozin et al., 1991; Zellner et al., 1999). Third, in about half of female chocolate cravers in the U.S., chocolate craving is linked specifically to the menstrual cycle. This has been established

repeatedly in studies using retrospective respondent self-report, and was confirmed in a recent analysis of daily ratings of chocolate craving intensity across six menstrual cycles (Henderson et al., 2009). The gender differences in chocolate craving prevalence in the U.S. appear to be due directly to the added presence of menstrual cravings in women.

A majority of menstrual cravings occur primarily or solely perimenstrually, with a pronounced increase in craving beginning several days before the onset of and lasting several days into menstruation (Bruinsma & Taren, 1999; Hill & Heaton-Brown, 1994; Mercer & Holder, 1997; Rozin et al., 1991; Zellner et al., 2004). Somewhat fewer women report experiencing chocolate craving at other times of the cycle, most notably ovulation (unpublished observation). In spite of a clear temporal association between chocolate craving and the menstrual cycle there seems to be no obvious causal link such that hormonal changes associated specifically with ovulation or menstruation somehow directly eliciting cravings. The exact mechanisms involved in the etiology of these cravings thus remain to be determined (Hormes & Rozin, 2009; Michener et al., 1999; Rodin et al., 1991).

While chocolate craving and other food cravings are for the most part harmless – especially compared to cravings for cigarettes, alcohol and drugs of abuse - they have been shown to lead to binge eating episodes in bulimic patients (Kales, 1990) and obese women (Bjoervell, Roennberg, & Roessner, 1985), and to increased food consumption in restrained eaters (Fedoroff, Polivy, & Herman, 1997). Even in non-pathological populations chocolate craving can elicit powerful feelings of ambivalence and guilt (Macdiarmid & Hetherington, 1995). A better understanding of the mechanisms underlying chocolate craving and the potential

relationship between craving and problematic attitudes and behaviors thus has immediate clinical relevance.

In addition, knowing about the correlates of cyclically occurring chocolate craving – as opposed to cravings without any specific temporal pattern – is a first step toward understanding the potential mechanisms involved in the phenomenon of menstrual craving. A question of interest is what – if anything - distinguishes perimenstrual and other menstrual chocolate craving from chocolate craving that is unrelated to the menstrual cycle, chocolate craving as it occurs in men, and other food cravings in general. Do women who crave chocolate at specific times of the menstrual cycle exhibit any particular characteristics that make them more likely to experience these cyclically occurring cravings?

Menstrual craving might differ from other kinds of chocolate craving primarily because menstrual cravers come to associate chocolate craving specifically with those times of the menstrual cycle frequently characterized by unpleasant “symptoms,” such as mid-cycle and perimenstrual pain and cramps, increased hunger, bloating, and weight gain (Altabe & Thompson, 1990; O'Herlihy, Robinson, & de Crespigny, 1980; Stubbs & Costos, 2004; Yonkers, O'Brien, & Eriksson, 2008). It is postulated here that based on such learned associations, craving in menstrual cravers will be linked to more negative correlates with regards to weight and dieting, enjoyment of food, and eating and weight-related pathology, compared to women who experience craving in the absence of any temporal associations with the menstrual cycle, even if this non-menstrual craving is frequent or intense.

## Methods

All methods were approved by the Institutional Review Board of the University of Pennsylvania.

Participants were 115 women recruited from a department subject pool who participated in the study in exchange for research participation credit. Respondents completed a laboratory test of the effects of sensory-specific satiety on disinhibited eating described elsewhere (Hormes & Timko, 2009b), followed by a battery of questionnaires completed anonymously online via a secure server up to one week after the laboratory portion of the study. Specific measures were included in order to test the assumption that menstrual chocolate craving differs from chocolate craving that occurs non-cyclically, by assessing the relationship between chocolate craving, depression, anxiety and stress, food cravings in general, attitudes to chocolate, dietary restraint, disordered eating, and other eating-related pathology.

Participants were asked to provide demographic information, including age and ethnicity, their weight and height (to determine Body Mass Index), ideal weight, self-identified dieting status (“Are you currently on a diet to lose weight?”), other dieting habits, and nature and patterns of chocolate and other food cravings (“Do you have any cravings for food or drink? If you do crave something, what is your strongest craving for?”). They were asked to indicate the frequency (on a scale of “0=never crave” to “5=crave chocolate more than once a day”) and intensity (on a scale of “0=no cravings” to “4=extreme cravings;” these items were adopted from previous studies where they were rated on scales with these different endpoints) of their chocolate craving. The two ratings were multiplied to yield a measure of overall craving severity (ranging from 0=no craving to 20=highest craving frequency and intensity). Participants also

provided ratings of the positive aspects of chocolate on a rating scale ranging from 1="not at all positive" to 10="extremely positive." They were then asked if they believed there to be a link between their chocolate craving and menstrual cycle, such that cravings are more frequent or intense at specific points during the cycle. If respondents thought such a link existed they were asked to indicate the times at which cravings tend to peak by checking off boxes corresponding to 28 days of the menstrual cycle, ranging from day 1 "onset of menstruation" to day 28 "day before menstruation." Respondents then completed the following well-established, validated and widely used measures:

*The Power of Food Scale (PFS)* (Lowe et al., 2008): an 18-item measure of the susceptibility to the psychological influence of the mere presence or availability of food.<sup>8</sup> The PFS has been shown to have acceptable levels of internal consistency (Cronbach's  $\alpha=0.93$ ) and adequate convergent and divergent validity (Didie, 2003)

*The Restraint Scale (RS)* (Herman & Polivy, 1980): a ten-item measure assessing restrained eating that contains two subscales, measuring "Weight Fluctuation" and "Concern for Dieting." The RS has good test-retest reliability ( $r=0.95$ ) and adequate internal consistency ( $\alpha=0.82$ ) (Allison, Kalinsky, & Gorman, 1992).

*The Attitudes to Chocolate Questionnaire (ACQ)* (Benton et al., 1998): a 24-item, three-factor questionnaire assessing attitudes to chocolate. The first factor ("Craving") measures craving for chocolate and the tendency to seek comfort from chocolate under emotionally

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<sup>8</sup> This study used an early version of the Power of Food scale that contains 18 items. It correlates highly with the current 15-item and alternate 21-item versions of the scale. (M.R. Lowe, personal communication, August 19, 2008).

stressful conditions, the second factor (“Guilt”) assesses negative feelings associated with eating chocolate and dissatisfaction with weight and body image, and the third factor (“Functional”) reflects a functional approach, such as using chocolate to gain energy when exercising or if missing a meal. The split-half reliability of the “Craving” (0.91), “Guilt” (0.91) and “Functional” (0.51) factors of the ACQ has been shown to be adequate (Benton et al., 1998); less is known about the internal consistency and convergent and divergent validity of the scale in English-speaking samples, but a translated version of the scale has been shown to have satisfactory psychometric properties (Mueller, Dettmer, & Macht, 2007)

*The Eating Attitude Test (EAT-26)* (Garner & Garfinkel, 1979): a 26-item measure of symptoms and concerns characteristic of eating disorders. It contains three factors assessing “Dieting,” “Oral Control” and “Bulimia and Food Preoccupation” The EAT-26 is widely used and has been shown to have good internal consistency ( $\alpha=0.87$ ) and test-retest reliability ( $r=0.89$ ) in female adolescents comparable to the present sample (Banasiak, Wertheim, Koerner, & Voudouris, 2001)

*The Depression Anxiety Stress Scales-21 (DASS-21)* (Lovibond & Lovibond, 1995): a 21-item self-report instrument measuring the three related negative emotional states of depression, anxiety and tension/stress. The Depression ( $\alpha=0.96$ ), Anxiety ( $\alpha=0.89$ ) and Stress ( $\alpha=0.93$ ) subscales have all been shown to have good internal consistency, and the scale is considered to have excellent discriminatory validity in discriminating between various anxiety and mood disorders (Brown, Chorpita, Korotitsch, & Barlow, 1997)

*The Eating Inventory (EI) with Rigid (RC) and Flexible Control (FC)* (Stunkard & Messick, 1985; Westenhoefer, Stunkard, & Pudel, 1999): a 51-item measure assessing “Cognitive

Restraint of Eating,” “Disinhibitor” and “Hunger.” The EI has high internal consistency ( $\alpha=0.90$ ) and test-retest reliability ( $r=0.91$ ) (Allison et al., 1992)

*The Food Craving Questionnaires Trait and State (FCQ-T, FCQ-S)* (Cepeda-Benito, Gleaves, Williams, & Erath, 2000): two self-report measures of the typical manifestation of craving in the individual (FCQ-T), and of craving as a psychological state in response to specific situations, such as stress (FCQ-S). The FCQ-T has excellent internal consistency ( $\alpha=0.98$ ) and good test-retest reliability (ranging from  $r=0.72 - 0.88$  for the different subscales); the FCQ-S has equally high internal consistency ( $\alpha=0.96$ ) but – as is to be expected with a state measure – lower test-retest reliability ( $r=0.40 - 0.63$  for the different subscales) (Cepeda-Benito, Gleaves, Williams et al., 2000).

The first (and largely unrelated) laboratory part of the study consisted of a standard pre-load design in which the effects of eating a calorically dense pre-load on subsequent consumption were assessed. Participants were all women who consumed a pre-load (chips or chocolate), followed by either chips or chocolate as a test food. A portion of the participants in the control group did not consume a pre-load. By virtue of this design a subsample of 18 participants consumed a pre-load of chocolate and then engaged in a taste test of chocolate to measure the degree of disinhibited eating (Hormes & Timko, 2009b). Though otherwise not connected to the present investigation, data from this subset of participants allowed for the assessment of the behavioral effects of menstrual and other craving on disinhibited eating in addition to the self-report measures collected in the entire sample.

## Statistical Analyses

High (51.3%,  $n=59$ ) and low severity chocolate cravers (48.7%,  $n=56$ ) were defined by a median split on the craving severity (i.e. frequency x intensity) variable at the score of 4.0. Respondents whose scores fell at the median were included in the “high” craving severity group. Six subjects (5.2%) who reported a craving frequency and intensity of 0 were included in the “low” craving severity group. Menstrual craving was determined by an individual’s positive answer to the question of whether cravings tend to peak at a specific time each month. Thus, four distinct groups were created: menstrual cravers with high severity cravings, menstrual cravers with low severity cravings, non-menstrual cravers with high severity cravings, and non-menstrual cravers with low severity cravings.

In order to explore both main effects of craving severity (high versus low) and menstrual versus non-menstrual craving, as well as the interaction between the two on measures of dietary restraint, disordered eating, depression, anxiety and stress, general food cravings, attitudes to chocolate, and other eating-related pathology, a series of multivariate analysis of variance (MANOVAs, for the Food Craving Questionnaire Trait and State, given the larger number of factors in this measure, as well as for the Attitudes to Chocolate Questionnaire, given the three factors of this measure) and analyses of variance (ANOVAs, for the remainder of the variables, see Table 1) was conducted. Given that sample sizes were uneven in the MANOVAs, Box’s  $M$  was used as a measure of heterogeneity of variance-covariance matrices; heterogeneity was assumed if  $p < 0.001$ . Levene’s tests were conducted for the ANOVAs and the appropriate non-parametric tests are reported when heterogeneity of variance was found. Significance



criteria for the univariate analyses were corrected using a modified, sequential Bonferroni correction.

It was initially hypothesized that BMI could potentially be a significant covariate in these analyses, particularly given that a portion of the sample was overweight (11.3%,  $n=13$  with a BMI at or above 25). Body mass index was not correlated with craving severity ( $r=-0.13$ ,  $p = 0.16$ ); however, it was significantly correlated with menstrual craving ( $r=.28$ ,  $p=0.002$ ). Due to this correlation, BMI was initially included in all analyses, and found not to be a significant covariate. Therefore, BMI was removed as a covariate from all other analyses.

## Results

### *Sample Characteristics*

Respondents were on average 20 years old ( $M=19.63$ ,  $SD=2.92$ ) and self-identified as Caucasian (49.6%,  $n=57$ ), Asian (34.8%,  $n=40$ ), African-American (4.3%,  $n=5$ ), Hispanic (4.3%,  $n=5$ ), and “other” (7.0%,  $n=8$ ). On average, respondents reported BMIs in the normal range ( $M=22.09$ ,  $SD=3.52$ ), but indicated a discrepancy between their current and lower perceived ideal weight of nine pounds ( $M=8.67$ ,  $SD=8.75$ ). About one third of respondents (27.0%,  $n=31$ ) self-identified as being on a diet to lose weight at the time of the study, hoping to lose an average of 13.25 pounds ( $SD=9.80$ ). Neither menstrual/non-menstrual nor high/low cravers were more or less likely to self-identify as dieting to lose weight.

### *Chocolate Craving*

Almost all respondents (96.5%,  $n=111$ ) indicated ever having experienced any chocolate craving, as indicated by self-report of a frequency of craving of at least “once a month,” and at least a “mild” craving intensity. Twenty-seven respondents (23.5%) spontaneously (i.e. prior to any other questions about chocolate craving) indicated chocolate as their most craved food. Respondents on average reported craving “a few times a month” ( $M=2.20$ ,  $SD=1.22$  on a scale of 0=“never crave” to 5=“crave more than once a day”), and described their cravings as “mild” to “moderate” in intensity ( $M=1.83$ ,  $SD=0.99$  on a scale of 0=“no cravings” to 4=“extreme cravings”). Chocolate craving frequency and intensity ratings were significantly and positively correlated ( $r = 0.75$ ,  $p \leq 0.001$ , Spearman’s rho = 0.72,  $p \leq 0.001$ ). Respondents on average felt very positively about chocolate ( $M = 7.25$ ,  $SD = 2.28$ , range: 0-10).

### *High versus Low Severity Craving*

High severity chocolate cravers reported craving significantly more frequently [ $M = 3.04$ ,  $SD = 1.00$  versus  $M = 1.32$ ,  $SD = 0.72$ ;  $t(113) = -10.60$ ,  $p \leq 0.001$ ] and more intensely [ $M = 2.61$ ,  $SD = 0.67$  versus  $M = 1.02$ ,  $SD = 0.49$ ;  $t(113) = -14.64$ ,  $p \leq 0.001$ ] than low severity cravers, supporting the cut-off point for the median split. High severity chocolate cravers were not significantly more likely to report a link between their cravings and menstrual cycle than low severity cravers [54.3%,  $n = 19$  versus 45.7%,  $n = 16$ ;  $\chi^2 = 0.01$ ,  $p = 0.55$ ].

### *Menstrual versus Non-Menstrual Craving*

A third of respondents (30.4%,  $n = 35$ ) indicated that their chocolate craving was linked to their menstrual cycle. Of these menstrual cravers, 24 (68.6% of all menstrual cravers) reported perimenstrual cravings beginning four days before and lasting four days into menstruation; 11 women (31.4% of all menstrual cravers) believed their cravings to occur primarily at some other point during the menstrual cycle, most notably around ovulation. Seventy-nine participants (68.7% of the entire sample) did not report any link between their cravings and the menstrual cycle and are referred to as “non-menstrual” cravers.

### *Phenomenology of Craving Severity and Menstrual Craving*

*Attitudes toward Chocolate.* A 2 x 2 MANOVA was conducted to assess significant differences in scores on the ACQ between high/low and menstrual/non-menstrual cravers. There was a significant multivariate main effect for craving severity [ $F(3, 109) = 8.53, p \leq 0.01$ , Wilks'  $\lambda = 0.81, \eta_p^2 = 0.19$ ]. Post-hoc analyses indicated significant univariate effects for severity on the “Craving” [ $F(1, 111) = 16.74, p \leq 0.01, \eta_p^2 = 0.13$ ] and “Functional” [ $F(1, 111) = 10.27, p \leq 0.01, \eta_p^2 = 0.09$ ] factors of the ACQ. Differences between high and low severity cravers on the “Guilt” factor were marginally significant [ $F(1, 111) = 3.66, p = 0.06, \eta_p^2 = 0.03$ ]. These results suggest that high severity cravers experience more craving, a tendency to use chocolate for emotional comfort, as well as for energy and similar purposes, but only marginally more guilt than low severity cravers. There were no multivariate main effects for menstrual craving on the

ACQ [ $F(3, 109) = 1.51, p \leq 0.21, \text{Wilks}' \lambda = 0.96, \eta_p^2 = 0.04$ ], and no interaction between menstrual craving and craving severity [ $F(3, 109) = 0.35, p \leq 0.79, \text{Wilks}' \lambda = 0.99, \eta_p^2 = 0.01$ ].

*Trait and State Craving.* There was a main multivariate effect for craving severity on trait craving (FCQ-T) [ $F(9, 89) = 3.92, p \leq 0.21, \text{Wilks}' \lambda = 0.72, \eta_p^2 = 0.28$ ]. Post-hoc analyses indicated significant effects of craving severity on factors 1: "Intentions and plans to consume food" [ $F(1,101) = 15.20, p \leq 0.01, \eta_p^2 = 0.14$ ], 2: "Anticipation of positive reinforcement that may result from eating" [ $F(1,101) = 25.99, p \leq 0.01, \eta_p^2 = 0.21$ ], 3: "Anticipation of relief from negative states and feelings as a result of eating" [ $F(1,101) = 11.83, p \leq 0.001, \eta_p^2 = 0.11$ ], 4: "Lack of control over eating" [ $F(1,101) = 5.55, p = 0.02, \eta_p^2 = 0.05$ ], 6: "Craving as a physiological state" [ $F(1,101) = 6.44, p = 0.01, \eta_p^2 = 0.06$ ], 7: "Emotions that may be experienced before or during food cravings or eating" [ $F(1,101) = 14.25, p \leq 0.01, \eta_p^2 = 0.13$ ], and 8: "Cues that may trigger food cravings" [ $F(1,101) = 7.62, p \leq 0.01, \eta_p^2 = 0.07$ ], of the FCQ-T. High severity cravers scored significantly higher on all these measures. There was no significant difference between high and low severity cravers on the sub-scales that assessed "Thoughts or preoccupation with food" [ $F(1,101) = 3.11.20, p = 0.08, \eta_p^2 = 0.03$ ] and "Guilt from cravings and/or giving in to them" [ $F(1,101) = 0.72, p = 0.40, \eta_p^2 = 0.01$ ]. There was no multivariate main effect for menstrual craving [ $F(9, 89) = 0.75, p = 0.66, \text{Wilks}' \lambda = 0.93, \eta_p^2 = 0.07$ ], and no significant interaction between the two dimensions [ $F(9, 89) = 0.99, p = 0.45, \text{Wilks}' \lambda = 0.91, \eta_p^2 = 0.09$ ].

In terms of state craving (FCQ-S), Box's M was significant at  $p \leq 0.001$ , indicating heterogeneity of variance-covariance matrices. Therefore, a series of 2 (craving severity) x 2 (menstrual craving) ANOVAs were conducted. Levene's test was significant for the first state factor ("Intense desire to eat"), but not for the remaining four. In order to test for effects of

craving severity and menstrual craving on desire to eat, four groups were constructed (high/low severity menstrual cravers and high/low severity non-menstrual cravers) and a Kruskal Wallis analysis of variance indicated that there were no significant differences between groups [ $\chi^2(3, N = 115) = 3.91, p = 0.27$ ]. There were no main effects for craving severity, menstrual craving, or an interaction between the two on the second (“Anticipation of positive reinforcement that may result from eating”) or third factor (“Anticipation of relief from negative affect”). In terms of factor 4 (“Lack of control over eating”), there were no main effects for craving severity [ $F(1, 111) = 0.24, p = 0.63, \eta_p^2 = 0.002$ ] or menstrual craving [ $F(1, 111) = 1.88, p = 0.17, \eta_p^2 = 0.02$ ]. There was a significant interaction between the two [ $F(1, 111) = 5.95, p = 0.02, \eta_p^2 = 0.05$ ] with low severity non-menstrual cravers having the most control over eating ( $M = 4.88, SD = 1.95$ ) and low severity menstrual cravers having the least control over eating ( $M = 6.88, SD = 3.03$ ). Finally, using a less stringent criterion for significance, there was a significant interaction [ $F(1, 111) = 3.59, p = 0.06, \eta_p^2 = 0.03$ ] between craving severity and menstrual craving on factor 5 (“Craving as a physiological state”), with high severity menstrual cravers having the lowest scores ( $M = 5.85, SD = 2.56$ ) and low severity menstrual cravers having the highest scores ( $M = 7.75, SD = 3.90$ ). There were no main effects for craving severity [ $F(1, 111) = 1.16, p = 0.28, \eta_p^2 = 0.01$ ] or menstrual craving [ $F(1, 111) = 0.03, p = 0.86, \eta_p^2 = 0.00$ ].

*Eating Pathology.* Due to significant Levene’s tests, non-parametric tests were used to determine whether or not there were differences between the groups of cravers in terms of weight status. In order to determine whether or not there was an interaction between craving severity and menstrual craving, a Kruskal-Wallis was conducted using the four previously constructed groups. This was significant [ $\chi^2(1, N = 115) = 9.58, p = 0.02$ ], with low-severity

menstrual cravers on average having the highest BMI ( $M = 25.09$ ,  $SD = 5.91$ ) and high severity non-menstrual cravers having the lowest mean BMI ( $M = 21.29$ ,  $SD = 2.15$ ). Menstrual cravers were also significantly more likely to be dissatisfied with their weight than non-menstrual cravers ( $z = -2.47$ ,  $p = 0.01$ ), reporting being on average 11.69 ( $SD = 11.02$ ) pounds higher than their ideal weight, whereas non-menstrual cravers reported being only 7.29 ( $SD = 7.16$ ) pounds higher than their ideal weight. There was no significant difference between high and low severity craving ( $z = -0.47$ ,  $p = 0.81$ ) and no interaction between the two [ $\chi^2(3, N = 115) = 6.31$ ,  $p = 0.10$ ].

There were no main effects of craving severity [ $F(1, 111) = 1.92$ ,  $p = 0.17$ ,  $\eta_p^2 = 0.02$ ] or menstrual craving [ $F(1, 111) = 0.02$ ,  $p = 0.90$ ,  $\eta_p^2 < 0.01$ ] on eating disorder symptomatology, as measured by the EAT-26, nor was there an interaction between the two dimensions [ $F(1, 111) = 1.67$ ,  $p = 0.20$ ,  $\eta_p^2 < 0.02$ ]. In terms of susceptibility to the food environment, as assessed by the PFS, there was a significant effect for craving severity [ $F(1, 111) = 8.80$ ,  $p = 0.004$ ,  $\eta_p^2 = 0.07$ ], but not for menstrual craving [ $F(1, 111) = 0.001$ ,  $p = 0.98$ ,  $\eta_p^2 < 0.01$ ] and there was no interaction [ $F(1, 111) = 0.52$ ,  $p = 0.47$ ,  $\eta_p^2 < 0.01$ ]. Women who reported higher severity craving tended to be more susceptible to elements of the food environment ( $M = 53.10$ ,  $SD = 15.21$ ) than low severity cravers ( $M = 43.91$ ,  $SD = 12.50$ ). Women who identified primarily as menstrual cravers tended to have higher scores on the RS ( $M = 15.86$ ,  $SD = 6.53$ ) than non-menstrual cravers [ $M = 12.19$ ,  $SD = 5.51$ ,  $F(1, 111) = 10.08$ ,  $p < 0.01$ ,  $\eta_p^2 = 0.08$ ]. There was no significant difference between high/low craving severity [ $F(1, 111) = 0.12$ ,  $p = 0.73$ ,  $\eta_p^2 = 0.01$ ] and no interaction [ $F(1, 111) = 1.21$ ,  $p = 0.27$ ,  $\eta_p^2 = 0.13$ ]. Most of the difference between menstrual cravers on the RS appears to be accounted by the “Weight Fluctuation” Scale as there was a main effect for

menstrual cravings [ $F(1, 111) = 16.88, p < 0.01, \eta_p^2 = 0.13$ ] (but not for severity and no interaction) on this sub-scale, but not on the “Current Dieting” subscale [ $F(1, 111) = 2.94, p = 0.09, \eta_p^2 = 0.03$ ].

The interaction effect of craving severity and menstrual craving on levels of disinhibition as assessed by the EI approached the modified Bonferroni-corrected significance level of  $p \leq 0.02$  [ $F(1,111) = 4.29, p=0.04; \eta_p^2 = 0.04$ ], such that low severity menstrual cravers reported the highest susceptibility to overeating. This self-report was confirmed in the laboratory test of actual disinhibited eating of chocolate following a chocolate pre-load, where low severity menstrual cravers engaged in more disinhibited eating following a pre-load than high severity menstrual and non-menstrual cravers, with significance levels approaching the modified Bonferroni-corrected level of  $p \leq 0.03$  [ $F(1,14)=5.40, p=0.04; \eta_p^2 = 0.28$ ] for the laboratory subset of the sample of  $n=18$ . There were no main effects of craving severity and menstrual craving on any of the subscales of the EI, and there was no interaction on the restraint or hunger subscales (all  $ps > 0.05$ ).

*General Pathology.* There were no significant differences between high and low severity cravers or menstrual and non-menstrual cravers on measures of overall depression, stress or anxiety, or self-esteem (all  $ps > 0.05$ ), indicating that differences between high/low severity and menstrual/non-menstrual are rather specific to weight- and eating-related measures.

## Discussion

Findings presented here suggest the existence of two distinct dimensions of craving, namely craving severity, as defined by self-reported frequency and intensity of craving, and menstrual craving, as defined by a self-reported temporal association between chocolate craving and the menstrual cycle, such that craving peaks at a specific time each month. These two dimensions are independent in that menstrual chocolate cravers were no more likely than non-menstrual cravers to experience chocolate craving of high versus low severity.

The two dimensions were furthermore related to distinct sets of behaviors and attitudes. Higher craving severity was associated significantly with increased general responsiveness to food cues, craving in response to internal cues, including stress, and use of chocolate as a source of energy, to relieve negative mood states, and to gain comfort. In spite of marginally higher guilt in high severity cravers, overall, high severity cravers reported positive attitudes towards chocolate and its consumption, anticipating positive effects and a reduction of negative mood states. They reported normal weight and generally did not give any indication of attempts to reduce chocolate intake. They did not report elevated levels of restraint or significant weight dissatisfaction. Chocolate, therefore, remains an appetitive stimulus for high severity chocolate cravers, as any guilt experienced upon chocolate consumption is seemingly not enough to outweigh the reinforcing aspects of chocolate consumption, or to lead to disordered attitudes or behaviors in regards to food. Menstrual chocolate craving, on the other hand, was associated with more maladaptive patterns of behavior. Women who felt their cravings occurred cyclically reported significantly elevated levels of restraint, more pronounced weight fluctuations, higher BMIs, and significantly higher weight dissatisfaction.



The interaction of craving severity and menstrual craving was uniquely associated with susceptibility to disinhibition, including self-reported disinhibited overeating and lack of control over eating, as well as actual disinhibited eating in the laboratory, as measured by the amount of chocolate consumed following a chocolate pre-load in a subset of the study sample. This suggests that craving severity and temporal patterns interact to directly impact food intake in potentially dysfunctional ways. Interestingly, it was the low severity menstrual cravers who reported the most “pathology,” including more susceptibility to disinhibited overeating and significantly higher BMIs than the other three groups.

Findings suggest that chocolate craving in and of itself is not an inherently negative experience, even if it occurs frequently and with high intensity. Instead, women who frequently and intensely crave chocolate report largely positive behaviors and attitudes related to chocolate. Chocolate craving that occurs specifically at times of the menstrual cycle that are marked by unpleasant symptoms, however, appears to take on those negative connotations and comes to be seen as a rather unpleasant occurrence. This is particularly true when craving severity is otherwise low. The associations between menstrual craving and maladaptive eating- and weight-related attitudes and behaviors reported here is likely best understood by thinking about women who experience cyclically occurring cravings as coming to associate chocolate craving very specifically with the menstrual cycle. For many women certain times of the menstrual cycle, such as ovulation, the perimenstrum and menstruation itself carry negative associations, as they can evoke unpleasant and even painful symptoms, such as weight gain, bloating, cramps, and increased hunger (Stubbs & Costos, 2004; Yonkers et al., 2008). Cravings

that occur exclusively at specific and identifiable times of the menstrual cycle may thus come to be associated with these negative aspects of the menstrual cycle.

Based on the findings presented here it is not possible to determine the exact mechanisms or direction of causality of the association between craving and the menstrual cycle. It can be speculated that women who experience particularly unpleasant menstrual symptoms are more likely to view specific times of their cycle as a rare time in which the consumption of “forbidden” treats is acceptable. Over time chocolate may thereby come to be associated with the menstrual cycle as the only time at which it is acceptable – or even culturally sanctioned - to experience and give in to cravings, and indulge in chocolate as a rare treat. Women who experience particularly unpleasant symptoms associated with the menstrual cycle may also engage in behaviors that somehow make them more likely to crave chocolate. For example, hunger and food intake have been shown to increase in the days following ovulation and preceding the onset of menstruation (Dalvit, 1981), and women who are especially susceptible to weight gain shortly before menstruation may be more likely to restrict their intake specifically in regards to high-fat, high-calorie foods such as chocolate in an effort to counteract the anticipated weight gain. They could thereby set themselves up to desire exactly those foods they are denying themselves, an experience that may subjectively be experienced and subsequently be labeled as “menstrual craving.”

More research is needed to assess the ways in which links between the menstrual cycle and chocolate craving and their negative correlates identified here come to be established. More work is needed to explore the interesting finding that it is the low severity menstrual cravers who appear to experience the most problematic behaviors. There are some limitations

inherent in the present study that should be addressed in future work. For example, findings are based exclusively on retrospective self-report. Future studies should attempt to track chocolate craving and the correlates identified here longitudinally, possibly in the form of daily ratings. Based on the evidence discussed in the present study it is recommended that future research on chocolate craving differentiate between menstrual and non-menstrual chocolate cravers.

	<b>Non-Menstrual Cravers (n=79)</b>	<b>Menstrual Cravers (n=36)</b>	<b>Low Craving Severity (n=56)</b>	<b>High Craving Severity (n=59)</b>
<b>Body Mass Index</b>	M=21.42, SD=2.79	M=23.54, SD=4.55	M=22.56, SD=4.47	M=21.64, SD=2.24
<b>Current minus Ideal Weight</b>	M=7.29, SD=7.16	M=11.69, SD=11.02	M=9.07, SD=11.05	M=8.29, SD=5.87
<b>Power of Food Scale</b>	M=48.47, SD=14.14	M=48.97, SD=15.89	M=43.91, SD=12.05	M=53.10, SD=15.21
<b>Restraint Scale</b>				
<b>Total Score</b>	M=12.19, SD=5.51	M=15.86, SD=6.53	M=13.20, SD=6.65	M=13.47, SD=5.50
<b>Weight Fluctuation</b>	M=4.56, SD=2.82	M=6.92, SD=3.25	M=5.48, SD=3.56	M=5.12, SD=2.71
<b>Concern for Dieting</b>	M=7.63, SD=3.56	M=8.94, SD=4.20	M=7.71, SD=4.05	M=8.36, SD=3.57
<b>Attitudes to Chocolate Questionnaire</b>				
<b>Factor 1: Craving</b>	M=2.85, SD=0.97	M=2.98, SD=1.19	M=2.47, SD=1.01	M=3.29, SD=0.92
<b>Factor 2: Guilt</b>	M=2.69, SD=0.93	M=3.03, SD=1.21	M=2.59, SD=1.10	M=3.00, SD=0.93
<b>Factor 3: Functional</b>	M=2.36, SD=1.06	M=2.54, SD=1.19	M=2.04, SD=1.02	M=2.78, SD=1.09
<b>Eating Attitudes Test-26</b>				
<b>Total Score</b>	M=8.59, SD=-9.05	M=11.11, SD=10.33	M=8.96, SD=9.04	M=9.78, SD=9.97
<b>Factor 1: Dieting</b>	M=4.35, SD=4.79	M=6.00, SD=5.93	M=4.54, SD=5.23	M=5.19, SD=5.20
<b>Factor 2: Oral Control</b>	M=0.72, SD=1.00	M=0.47, SD=0.81	M=0.77, SD=1.01	M=0.53, SD=0.88
<b>Factor 3: Bulimia and Food Preoccupation</b>	M=1.03, SD=2.16	M=1.44, SD=2.60	M=1.00, SD=2.19	M=1.31, SD=2.42
<b>Depression Anxiety Stress Scales-21</b>				
<b>Depression</b>	M=8.08, SD=8.19	M=9.22, SD=9.55	M=8.57, SD=8.56	M=8.31, SD=8.73
<b>Anxiety</b>	M=6.00, SD=6.66	M=5.44, SD=7.39	M=5.04, SD=6.04	M=6.58, SD=7.55
<b>Stress</b>	M=11.67, SD=9.12	M=12.06, SD=9.63	M=11.07, SD=9.71	M=12.47, SD=8.81

<b>Eating Inventory</b>				
<b>Disinhibition</b>	M=19.82, SD=2.42	M=20.50, SD=2.10	M=20.14, SD=2.32	M=19.93, SD=2.37
<b>Hunger</b>	M=18.04, SD=1.71	M=18.22, SD=1.97	M=18.13, SD=1.64	M=18.07, SD=1.94
<b>Cognitive Restraint</b>	M=21.43, SD=3.15	M=22.25, SD=2.93	M=21.86, SD=3.07	M=21.53, SD=3.14
<b>Rigid Control</b>	M=20.00, SD=1.80	M=19.28, SD=2.11	M=19.80, SD=2.06	M=19.75, SD=1.87
<b>Flexible Control</b>	M=14.91, SD=1.66	M=14.03, SD=1.98	M=14.64, SD=1.80	M=14.62, SD=1.82
<b>Food Craving Questionnaire – Trait</b>				
<b>Factor 1</b>	M=8.91, SD=2.96	M=8.97, SD=3.48	M=7.72, SD=2.54	M=10.04, SD=3.21
<b>Factor 2</b>	M=14.30, SD=3.82	M=14.63, SD=4.73	M=12.49, SD=3.54	M=16.19, SD=3.80
<b>Factor 3</b>	M=7.66, SD=2.67	M=7.83, SD=2.75	M=6.79, SD=2.53	M=8.59, SD=2.55
<b>Factor 4</b>	M=14.53, SD=5.39	M=16.14, SD=6.68	M=13.73, SD=5.57	M=16.27, SD=5.88
<b>Factor 5</b>	M=16.69, SD=7.02	M=18.13, SD=7.89	M=15.59, SD=5.77	M=18.69, SD=8.33
<b>Factor 6</b>	M=12.04, SD=3.62	M=13.06, SD=3.83	M=11.23, SD=3.48	M=13.37, SD=3.62
<b>Factor 7</b>	M=11.05, SD=3.09	M=11.56, SD=4.69	M=9.84, SD=3.63	M=12.53, SD=4.22
<b>Factor 8</b>	M=12.77, SD=3.79	M=13.42, SD=4.25	M=11.98, SD=3.66	M=13.91, SD=3.98
<b>Factor 9</b>	M=7.17, SD=2.98	M=8.53, SD=3.56	M=7.41, SD=3.42	M=7.78, SD=3.04
<b>Food Craving Questionnaire – State</b>				
<b>Factor 1</b>	M=7.22, SD=3.47	M=7.53, SD=2.98	M=7.07, SD=3.32	M=7.54, SD=3.32
<b>Factor 2</b>	M=7.23, SD=3.16	M=7.64, SD=2.88	M=6.75, SD=3.06	M=7.93, SD=2.98
<b>Factor 3</b>	M=6.70, SD=2.93	M=7.08, SD=2.21	M=6.27, SD=2.66	M=7.34, SD=2.69
<b>Factor 4</b>	M=5.63, SD=2.62	M=6.31, SD=2.79	M=5.45, SD=2.46	M=6.22, SD=2.84
<b>Factor 5</b>	M=6.68, SD=3.13	M=6.69, SD=3.32	M=6.80, SD=3.26	M=6.58, SD=3.12

Table 3-1: Means and standard deviations on all dependent measures for menstrual/non-menstrual cravers and those with low/high craving severity.

## CHAPTER 4

### PERIMENSTRUAL CHOCOLATE CRAVING: WHAT HAPPENS AFTER MENOPAUSE?

#### Introduction

Food cravings are a common phenomenon and occur in 94% of female and 75% of male undergraduate students in the U.S. (Zellner et al., 1999). In a sample of U.S. women ages 20 to 37, 82% reported experiencing food cravings (Rodin et al., 1991). Cravings are generally more prevalent in women than men and decrease somewhat with age, with 100% of young women and 70% of young men craving any food or drink, compared to 66% of older women and 62% of older men (Pelchat, 1997).

Chocolate is the most commonly and intensely craved food in North American countries (H. Weingarten & D. Elston, 1990). There are marked gender differences in the prevalence of chocolate craving, with approximately 90% of American women having craved chocolate at some point, compared to about 60% of men (Osman & Sobal, 2006), and 45% of American undergraduate women but only 17% of American undergraduate men craving chocolate regularly (Zellner et al., 1999). Gender differences prevail across generations, with a survey of undergraduates and their parents finding 54% of daughters and 60% of mothers, but only 20% of sons and 24% of fathers craving chocolate (Rozin et al., 1991).

In American women, about half of cravings for chocolate occur perimenstrually (Bruinsma & Taren, 1999; Henderson et al., 2009; Hill & Heaton-Brown, 1994; Mercer & Holder, 1997; Rozin et al., 1991; Zellner et al., 2004), with a marked increase in craving beginning a few days before and extending into the first few days of menses. Since the incidence of chocolate craving in women is about twice that of men, and since about half of women crave chocolate perimenstrually, the striking gender difference in chocolate craving in the U.S. may be attributable primarily to the added presence of perimenstrual craving in women.

It has been suggested that hormonal factors lead directly to an increase in the frequency and intensity of chocolate craving specifically at the time of the perimenstrum. Women who have regular menstrual periods undergo hormonal fluctuations such that there is an increase in levels of estrogen and progesterone during the periovulatory and midluteal phase, with estrogen levels peaking at the time of ovulation. This increase is followed by a drop in levels of both hormones during the luteal phase and lasting into menstruation. A natural hypothesis is that there is a direct link between hormonal changes and chocolate craving, such that a cyclic fall in the estrogen estradiol and/or progesterone induces perimenstrual chocolate craving. However, it has been demonstrated that there is no significant link between levels of estradiol and the number, frequency, or types of cravings (Rodin et al., 1991), and exogenous administration of progesterone does not significantly reduce perimenstrual cravings (Michener et al., 1999).

There is no doubt that chocolate contains many biologically active compounds, including the arousing substances caffeine, theobromine, tyramine and phenethylamine. It is interesting that unlike the case of coffee, where pharmacological effects are pronounced and often referred

to by coffee users, the typical lay account for chocolate consumption is based on its sensory appeal, and not any of its pharmacological effects. Chocolate is extremely appealing in its unique sensory properties, including its melt-in-your-mouth texture, sweetness and fragrant aroma. For scientists, the presence of undoubted pharmacological activity in chocolate is a strong temptation to account for its use in these terms. However, there is evidence that reduction of chocolate craving when chocolate is ingested results from the sensory experience of chocolate, and not its post-ingestive effects (Michener and Rozin, 1994). Of course, even if satisfaction of chocolate craving is sensory, it is possible that the initiation of the craving has a pharmacological origin.

We believe that the preponderance of evidence favors a sensory account for the popularity of chocolate. The sensory appeal allows chocolate to serve as a form of self-reward or indulgence, and/or as a means of coping with stress by inducing pleasure.

A reasonable next step in exploring pharmacological/physiological versus sensory causes of chocolate craving is to evaluate the presence (or absence) and nature of chocolate craving in women who no longer experience a regular menstrual cycle. If hormonal changes associated with ovulation and menstruation are somehow directly and causally involved with the 50% of chocolate craving in women that occur perimenstrually, then the prevalence of chocolate craving should drop markedly post-menopause.

Following irregular production of estrogen, progesterone and testosterone during perimenopause, in menopause a woman's ovaries cease production of the estrogen hormones and progesterone altogether, resulting in the absence of cyclical hormonal fluctuations. Hormone replacement therapy is sometimes prescribed to peri- and postmenopausal women



experiencing adverse symptoms. This therapy consists of artificially boosting levels of estrogen, progesterone or progestin, in part to maintain the presence of a cyclic drop in progesterone (i.e. when progesterone pills are discontinued periodically), much like what is experienced by women with a regular menstrual cycle.

To our knowledge chocolate craving has not been looked at specifically in women post-menopause to determine if these women continue to experience chocolate craving, and if so, what the temporal patterns and perceived triggers of their cravings are. Based on previous findings that suggest no direct link between perimenstrual hormone levels and chocolate craving in women pre-menopause it is hypothesized that women post-menopause continue to experience chocolate craving even without menstruation. The link between menstruation and chocolate craving may result from the fact that for many women, menstruation is a stress, and that chocolate craving is stimulated by any form of stress. A link between craving and stress might also account for other cyclically occurring cravings, including sweet (Henderson et al., 2009; Rozin et al., 1991; H. Weingarten & D. Elston, 1990), alcohol (Epstein et al., 2006) and cigarette cravings (Carpenter et al., 2006; Franklin et al., 2004).

## Methods

University of Pennsylvania female alumnae, selected randomly from pre-specified graduating classes to include women pre- and post-menopause clustered around the ages of 45, 65, and 80, were sent an anonymous questionnaire. The return rate was 35.0%, yielding a total of 280 respondents (93.9% Caucasian), aged approximately 45 ( $M=45.81$ ,  $SD=0.93$ ;  $n=89$ , 31.8%

of sample), 65 ( $M=63.35$ ,  $SD=2.49$ ;  $n=154$ , 55.0%) and 80 years ( $M=81.76$ ,  $SD=1.80$ ;  $n=37$ , 13.2%). None of the 65 and 80 year-old women and 82% ( $n=73$ ) of the 45 year-old respondents reported regular monthly periods, supporting the appropriateness of the sample selection for the purpose of this study.

Participants provided demographic information, including age and ethnicity, weight and height, ideal weight, and dieting habits (“Are you currently on a diet to lose weight?”), regularity of periods (“Do you have regular monthly periods?”), menopause status (“If you do not have regular monthly periods, are you (please circle one): In menopause, past menopause, or other?”), and use of hormonal birth control or hormone replacement therapy (“Are you currently using hormonal birth control, such as the pill or the patch?” and “If you are in menopause, are you on any form of hormone replacement therapy? If yes, which?”). They were asked to rate their liking for chocolate (on a 0-9 Likert scale, ranging from “0=dislike extremely” to “9=like extremely”), occurrence of food and drink cravings (“Do you crave any food or drink?” and “If so, what is your strongest craving for”), and frequency and intensity of chocolate craving (rated on two separate Likert scales, ranging from “0=never crave chocolate” to “5=crave chocolate more than once a day,” and from “0=no cravings” to “4=extreme cravings”). These rating scales have been used previously in our laboratory to identify chocolate cravers and to gauge overall severity of the craving experience.

Participants indicated any temporal patterns in their cravings, including whether or not they found their chocolate craving to be (or to have been in the past) related to the menstrual cycle. Women who reported such a connection were asked to indicate the times during the cycle at which cravings peak(ed), by checking of boxes corresponding to the days of the

menstrual cycle, starting with 1="first day of menstruation" to 28="day before menstruation." If participants did not think there is or was any link but still craved chocolate they were asked to describe any other temporal patterns and triggers for their chocolate craving in an open-ended question format ("If you experience/d any chocolate craving, do you feel that they occur/red at any specific point in time, i.e. time of year, month, day, etc.?"). These responses were coded according to types of patterns and triggers identified (e.g. "time of day" or "mood states").

## Results

### *Chocolate Liking and Craving*

Respondents on average indicated liking chocolate "very much" ( $M=8.08$ ,  $SD=1.06$ , on a scale of 0="dislike extremely" to 9="like extremely"), and there were no significant differences or age-related trends in liking for chocolate between women age 45 ( $M=8.22$ ,  $SD=1.04$ ), 65 ( $M=7.95$ ,  $SD=1.10$ ), and 80 [ $M=8.24$ ,  $SD=0.86$ ;  $F(2,277)=2.50$ ,  $p=0.08$ ,  $\eta^2=0.02$ ]. There were significant differences between women in the different age groups in the reported prevalence of *any* chocolate craving (i.e. a rating of at least "once a month or less" on the chocolate craving frequency scale) ( $\chi^2=7.18$ ,  $p=0.03$ ). Respondents age 45 had the highest prevalence of any chocolate craving (89.8%,  $n=79$ ), followed by the 80 year-old women (81.1%,  $n=30$ ), and the 65 year-old respondents (75.7%,  $n=115$ ) (Figure 4-1). Combining all postmenopausal women, 76.7% ( $n=145$ ) reported any chocolate craving, compared to 89.8% ( $n=79$ ) of premenopausal women ( $\chi^2=6.61$ ,  $p=0.01$ ). Thus, in support of the hormonal hypothesis, there is evidence for a

very modest but statistically significant reduction in cravings after menopause. There was no significant difference by age in the percentage of women spontaneously (i.e. without any prompting and prior to any other questions about chocolate) indicating chocolate as their most craved food (26.1%,  $n=23$  in 45, 22.9%,  $n=35$  in 65, and 24.3%,  $n=9$  in 80 year-olds;  $\chi^2=0.33$ ,  $p=0.85$ ). Comparing self-reported prevalence of any non-chocolate “sweet,” “salty” and “other” food or drink cravings, there were no significant differences by age ( $\chi^2=3.05$ ,  $p=0.22$ ).

Respondents indicated “mild” to “moderate” cravings ( $M=1.56$ ,  $SD=0.99$  on the 0 to 5 intensity scale) occurring “a few times a month” ( $M=2.14$ ,  $SD=1.39$  on the 0 to 4 frequency scale). A one-way analysis of variance (ANOVA) comparing the frequency of chocolate craving in 45 ( $M=2.31$ ,  $SD=1.29$ ), 65 ( $M=1.93$ ,  $SD=1.45$ ), and 80 year-olds ( $M=2.61$ ,  $SD=1.22$ ) was significant [ $F(2,257)=4.18$ ,  $p=0.02$ ,  $\eta^2=0.15$ ], with women age 80 reporting significantly more frequent cravings than women age 65 (Tukey HSD  $p=0.03$ ). A one-way ANOVA comparing the intensity of chocolate craving was also significant [ $F(2,226)=5.34$ ,  $p=0.01$ ,  $\eta^2=0.26$ ], with 45 year-old women reporting significantly more intense cravings ( $M=1.81$ ,  $SD=1.00$ ) than 65 year-old respondents ( $M=1.38$ ,  $SD=0.98$ ,  $p=0.01$ ). Women age 80 did not differ significantly from the other two age groups in the self-reported intensity of chocolate craving ( $M=1.79$ ,  $SD=0.88$ ) (Figure 4-2).

#### *Prevalence of Current or Past Perimenstrual Chocolate Craving*

There was a significant difference in the number of women in each age group who perceived their current or past (i.e. premenopausal) chocolate craving as being related to their menstrual cycle ( $\chi^2=48.80$ ,  $p\leq 0.001$ ). Women age 45 were most likely to report a link between

their chocolate craving and their menstrual cycle (47.2%,  $n=42$ ); only 13.6% ( $n=21$ ) of 65 year-old women and none of the 80 year-old women saw their past chocolate craving as having been related in some way to their menstrual cycle pre-menopause (Figure 4-1).

Of all women who perceived a link between their chocolate craving and the menstrual cycle (22.5%,  $n=63$ ) either currently or in the past, 81.0% ( $n=51$  of 63) reported that these cravings occur or occurred perimenstrually, i.e. several days before and several days into the onset of menses. The remaining 19.0% ( $n=12$ ) either perceived cravings to be strongest at some other time of the cycle (most notably around ovulation), or did not specify a particular time at which cravings increased. There was a significant difference in prevalence specifically of current or past (i.e. premenopausal) perimenstrual chocolate craving, with women age 45 reporting a much higher incidence (39.3%,  $n=35$ ), compared to memories of women age 65 (10.4%,  $n=16$ ) and 80 (none) ( $\chi^2=41.20$ ,  $p\leq 0.001$ ). Note that the 45-year-olds are confirming the previously established incidence of perimenstrual craving (about 50% of adult American women chocolate cravers), and that the anomaly here comes from the *remembered* link for the older women.

Thirty-six women (12.9% of the entire sample) reported craving triggers or temporal patterns unrelated to the menstrual cycle. A marginally higher percentage of women age 65 (16.9%,  $n=26$ ) and 80 (10.8%,  $n=4$ ) believed their current and past chocolate craving to follow a cyclical pattern or to be caused by triggers unrelated to the menstrual cycle, compared to only 6.7% ( $n=6$ ) of women age 45 ( $\chi^2=5.34$ ,  $p=0.07$ ;  $\chi^2=4.36$ ,  $p=0.03$  when comparing 45 year-old women to the two groups of postmenopausal women combined). The temporal patterns and triggers unrelated to the menstrual cycle reported by women included craving during particular mood states (e.g. “when I’m stressed”) (34.3% of the 36 women who reported other triggers,

$n=12$ ), at specific times of day (e.g. “right before bedtime”) (28.6%,  $n=10$ ), other seasonal patterns (e.g. “I crave most during the winter”) (14.3%,  $n=5$ ), craving after a meal (11.4%,  $n=4$ ), and other factors (5.7%,  $n=2$ ).

### *Chocolate Craving and Hormone Supplements*

Only 14.1% ( $n=12$ ) of the premenopausal women reported currently using hormonal birth control (one woman received depo injections, four had hormonal intra-uterine devices, and the other seven used a variety of hormonal birth control pills) and 13.1% ( $n=25$ ) of the postmenopausal women were currently using hormone replacement therapy. In the absence of sufficient statistical power neither group differed significantly from women in their age group who were not using hormone supplements in self-reported perimenstrual chocolate craving, other chocolate craving, mean chocolate liking, mean frequency of chocolate craving, or mean intensity of chocolate craving. Similarly the 18.0% ( $n=16$ ) of premenopausal women who reported not having regular periods for various reasons - including hysterectomies or polycystic ovary syndrome - did not differ from the women with a regular menstrual cycle in prevalence of chocolate craving, mean chocolate liking, and mean frequency and intensity of chocolate craving. There were no clear trends in either direction in these comparisons between those using and those not using hormonal supplements, and between those pre-menopausal women with and without regular menstrual periods.

## Discussion

There were no significant differences by age in overall prevalence and type of food or drink cravings, though women age 45 reported a somewhat higher prevalence, compared to women age 65 and women age 80, who reported the lowest craving incidence. Women age 45 reported a significantly higher prevalence of chocolate craving, compared to their older counterparts, though importantly not high enough to support a “physiological” explanation for these cravings. These findings are consistent with prior evidence that suggest a general decline in the occurrence of any cravings with age (Pelchat, 1997). The fact that a sizeable proportion of women in all age groups report chocolate and other cravings, however, indicates that the notion of “craving” is not a generation-specific phenomenon, but rather an experience that is familiar to women at any age. Furthermore, chocolate is not just seen by younger women as a food that is to be craved more than any other; instead chocolate was the most craved food in women at all ages. Similarly there were no significant differences by age in liking for chocolate which rules out a significant impact of generational factors, such as limited access to chocolate or experiences with chocolate of lower quality in older women who grew up in the depression and post-war eras. Instead chocolate is and remains a highly palatable food in American women at any age.

The most notable differences by age were in the self-reported patterns of and triggers for chocolate craving identified by women. The prevalence of self-reported perimenstrual craving (current in premenopausal women and past in postmenopausal women) was highest and in the expected range in the 45 year-old women. In women post-menopause on the other hand, there were very few reports of prior, pre-menopause chocolate craving that was thought

to be related to the menstrual cycle. This could be due either to an actual absence or to a lack of recall of any perimenstrual cravings premenopausally. The latter assumption is supported by the fact that reports of past perimenstrual cravings are low in the 65 year-old women but absent entirely in the 80 year-old women.

Regardless of which explanation is accurate it is important to note that even though the perceived triggers for cravings changed as a function of menopause status, the anticipated 50% of chocolate craving that would be expected to disappear at menopause, if hormonally caused, did not materialize. Craving prevalence did not decrease simply by the approximate proportion of premenopausal perimenstrual cravers (i.e. leaving only the women who craved non-perimenstrually prior to menopause). Instead, the drop in prevalence from pre- to post-menopause reported here was a mere 13.1%, and most of the women post-menopause (76.7%) continued to crave chocolate and attributed these cravings to a variety of triggers, including negative mood states and seasonal factors. Furthermore, women using hormonal birth control or on hormone replacement therapy did not differ from women not taking any hormonal supplements in the frequency, intensity or patterns of chocolate craving. Though the number of women using these hormonal therapies was small, these findings do provide further evidence against a direct role of hormonal factors in causing chocolate craving.

Chocolate craving is prevalent in all women, regardless of age and menopause status. The most notable change that occurs over time is a shift in the perceived triggers for these cravings. Findings thus provide substantial new evidence against any direct causal link between chocolate craving and physiological events specifically associated with the menstrual cycle. Instead strong urges for chocolate experienced regularly by a significant proportion of women



seemingly come to be attributed to the most salient stressor(s) in the current environment. The menstrual cycle with its very salient “symptoms” – e.g. perimenstrual increase in hunger, cramps, water retention, and menstruation itself – is likely to be one of the more noticeable and perhaps stressful series of events in a woman’s life, and women pre-menopause appear to identify the menstrual cycle as a likely cause for chocolate craving. This assumption is supported by the fact that women diagnosed with premenstrual syndrome experience more chocolate craving than controls (Henderson et al., 2009). Postmenopausal women do not cease to crave chocolate, but instead identify new stressors or notable events in their lives to which they attribute their cravings. These events include specific mood states – such as stress and fatigue – and temporal and seasonal patterns, and may be just the type of triggers that are salient enough to present themselves as plausible explanations for chocolate craving. A stress coping response for chocolate craving is consistent with reports from women in a number of studies that they use chocolate as a pleasant reward when under pressure.

It would be important to demonstrate that the stronger the stress of menstruation for a woman, the more intense her chocolate craving, and similarly for non-menstrual stressors. It also remains to be determined if stress is actually the direct *cause* of cravings, and if so, what the exact mechanisms underlying this relationship might be.

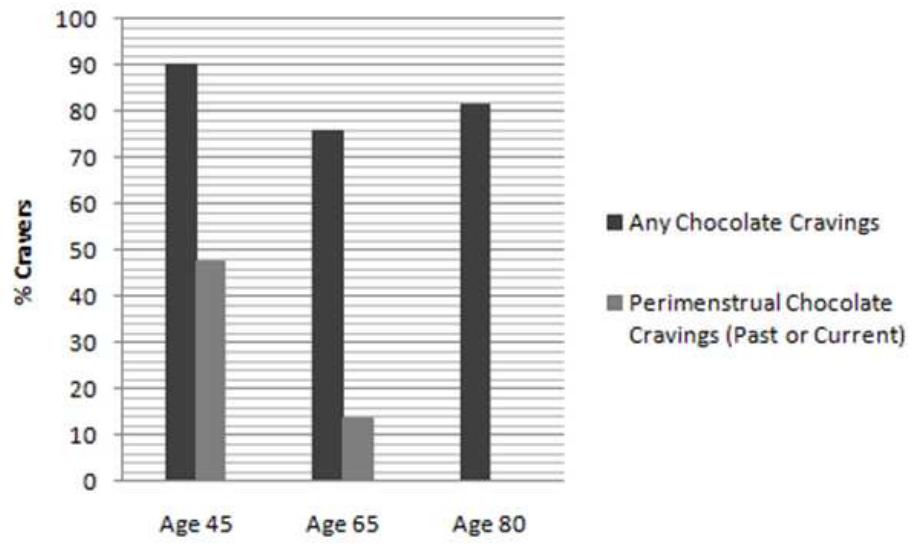


Figure 4-1: Prevalence (%) of any chocolate craving and perimenstrual chocolate craving (past or current) in women age 45, 65, and 80

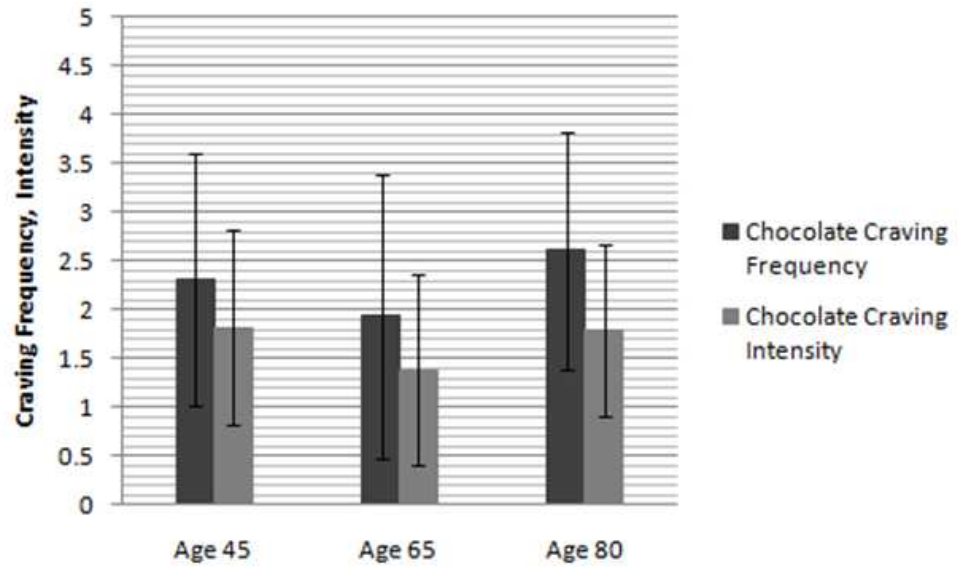


Figure 4-2: Mean frequency (scale 1-5) and intensity (scale 1-4) of chocolate craving in women Age 45, 65, and 80 (S.D. error bars)

## CHAPTER 5

### PERIMENSTRUAL CHOCOLATE CRAVING AND THE AFFECTIVE AND PHYSICAL SYMPTOMS OF MENSTRUATION: AN EMPIRICAL STUDY

#### Introduction

Chocolate craving is a common phenomenon that occurs regularly in approximately half of all women in the U.S. (Rozin et al., 1991). In about half of female chocolate cravers the incidence of craving is linked temporally to the menstrual cycle, such that cravings peak perimenstrually, meaning in the days right before the onset of and lasting several days into menstruation (Bruinsma & Taren, 1999; Henderson et al., 2009; Hill & Heaton-Brown, 1994; Mercer & Holder, 1997; Osman & Sobal, 2006; Rozin et al., 1991; Zellner et al., 2004). In part based on the observed temporal associations between craving and the menstrual cycle it has been speculated that chocolate craving is triggered directly or indirectly by physiological processes (Michener & Rozin, 1994). However, studies so far have failed to provide clear evidence for such a biological basis of chocolate craving. For example, the hypothesis that hormonal changes across the menstrual cycle are causally involved in perimenstrual craving has not received support in studies looking at the effects of exogenous administration of progesterone, which found no relationship between levels of hormones and intensity of chocolate craving (Michener et al., 1999).

With physiological studies yielding largely disappointing findings, attention can be turned towards non-biological factors that may be involved in the etiology of chocolate craving.

Cross-cultural studies have assessed overall prevalence rates of, and gender differences in chocolate craving in countries outside of North America (Osman & Sobal, 2006; S. Parker et al., 2003; Zellner et al., 1999). Findings from these studies show that chocolate craving, and perimenstrual chocolate craving in particular, is characteristic primarily of American women. Among these women in the U.S., chocolate cravers who link craving to the menstrual cycle differ from those who crave at other times, and from non-cravers in several psychological and behavioral measures, including higher levels of dietary restraint, weight dissatisfaction and fluctuation, and higher body mass index (Hormes & Timko, 2009a). A study of the nature of chocolate craving in women after menopause finds that craving prevalence does not decrease as anticipated with the absence of regular menstrual periods, but instead comes to be attributed to a variety of perceived external stressors (Hormes & Rozin, 2009). Based on this finding it has been proposed that craving is a learned responses to stressful triggers in the environment, and that menstruation may simply be one such stressful event in women's lives (Hormes & Rozin, 2009). The link between perceived stress and craving may be due either to stress as a culturally sanctioned permission to indulge in an otherwise forbidden food, or to chocolate as a means of coping with stress, either due to its pharmacological or – more likely – its uniquely appealing oro-sensory properties. This stress hypothesis does not take into account (and considers minor) direct physiological links between the menstrual cycle and craving, but leaves open the possibility of an influence of the physical effects of stress itself on craving incidence, for example via elevated levels of cortisol.

Taken together, existing findings strongly suggest that chocolate craving – and especially perimenstrual chocolate craving – is a phenomenon driven primarily by psychological factors, as

opposed to direct effects of hormonal variables. However, as of now no study has looked at chocolate craving as it relates to the various psychological and physical symptoms associated with menstruation across the menstrual cycle. This is a necessary step in order to begin to identify mechanisms by which craving might come to be associated temporally with menstruation in a significant proportion of American women.

The present study assesses symptoms of the perimenstrum in a sample of women diagnosed with premenstrual syndrome (PMS), a chronic mood disorder characterized by a cluster of affective and physical symptoms that typically emerge during the luteal phase of the menstrual cycle and subside following the onset of menstruation (Freeman, Rickels, Sondheimer, & Polansky, 1999). Though perhaps not fully representative of the experience of the average woman, women with PMS are a suitable sample because they are likely to be more aware of the symptoms they experience as related to the menstrual cycle. Menstrual effects on chocolate craving may be exaggerated in these women, but this can be considered a virtue at least in early studies on links between menstruation and craving. Measures in this particular sample of women can help identify more easily associations between chocolate craving and other symptoms that may also be present in women without PMS.

Daily ratings of craving and other symptoms provided by this sample of women allow for an assessment of the subjective experience of affective and physical concerns at different points during the menstrual cycle, and specifically in anticipation of, versus following the onset of menstruation. Changes in reported symptom severity can be related in an objective manner to what is known to occur in terms of hormonal changes at that time. For example, it is common to refer to the “premenstrual” period and to consider menstruation an event that marks a

significant change in physical status. However, after peaking in the periovulatory (estrogen) and midluteal (progesterone) phases, levels of estrogen and progesterone remain relatively constant at their lowest levels in the three to four days prior to and following the onset of menstruation (Figure 1-1). It is therefore more appropriate to speak about the “perimenstrum” - designating the time period spanning the days prior and lasting into menstruation - as a natural unit of time, since menstruation itself is not accompanied by significant hormonal changes. Any premenstrual symptoms should thus extend well into the onset of menstruation, however, it has not been established if this is in fact the case for either the affective or physical symptoms of the perimenstrum, or for perimenstrual chocolate craving. In support of the stress-hypothesis of perimenstrual chocolate craving it is postulated that chocolate craving severity will increase, along with the other affective symptoms associated with the perimenstrum, in response to the subjectively stressful experience of the anticipation of the onset of menstruation. It is expected that the increase in affective symptoms and craving severity will occur in a manner that is inconsistent with the absence of any hormonal fluctuations occurring at the same time.

## Methods

Data used was archival data, collected in 1999 as part of a clinical trial of treatments for PMS. Data had previously been analyzed to test for the effects of three treatment conditions – Alprazolam, progesterone and placebo – on the severity of premenstrual symptoms reported by the 164 women enrolled in the clinical trial (Freeman et al., 1999). The effects of these treatments on self-reported chocolate craving have also been reported (Michener et al., 1999).

The temporal changes in levels of symptom severity with the anticipation and onset of menstruation investigated here have not been previously assessed.

The clinical trial spanned the course of approximately six months, with two menstrual cycles of baseline ratings, one cycle of single/participant-blind placebo treatment for all participants, and three cycles of random assignment to drug treatment versus placebo conditions. Placebo and medications were administered beginning on day 18 of cycle 3 (placebo), and cycles 4 through 6 (placebo and medication). The details and results of this clinical trial are described in more detail elsewhere (Freeman et al., 1999; Michener et al., 1999). The present study sought to track chocolate craving and other perimenstrual symptoms during the perimenstrual period, comparing severity prior to and following the onset of menstruation. Furthermore, perimenstrual chocolate craving was assessed under medication-free conditions in cycles 1 and 2, and compared to placebo administration during the last ten days (18 through 28) of cycle 3.

Participants were 18-45 year-old women with regular menstrual cycles of 22 to 35 days. Cycles were standardized to 28 days by discarding or adding mid-cycle days for longer or shorter cycles. Day 14 – as the approximate day of ovulation – was used as an anchor; for cycles shorter than 28 days, day 13 was repeated, and for cycles longer than 28 days the appropriate number of days just prior to day 14 was removed (Freeman et al., 1999). Exclusion criteria for the clinical trial included major physical or psychiatric disorders, pregnancy, nursing, and certain types of medication. Symptoms of PMS were assessed using the Daily Symptom Rating Scale (DSR), a self-report measure listing 17 common premenstrual symptoms. These 17 symptoms have been used as a standard indicator in a series of clinical trials (Freeman et al., 1999;



Freeman et al., 2001; Michener et al., 1999), and as such, for purposes of data simplification, have been factor-analyzed. Treatment effects in studies using the Daily Symptom Rating Scale are typically described in terms of scores on four factors of “Mood” (anxiety/tension, irritability/persistent anger, depression, nervous tension, mood swings, and feeling out of control/overwhelmed), “Behavior” (poor coordination, insomnia/hypersomnia, confusion, headache, crying, and fatigue), “Pain” (aches, cramps and breast tenderness) and “Physical” (food cravings/increased appetite and swelling/bloating/weight gain) (Freeman, DeRubeis, & Rickels, 1996). Respondents rated each of these symptoms daily on a five-point scale (from 0=“Not present at all” to 4 = “Severe: symptom is overwhelming and/or unable to carry out daily activities”), for a maximum total Daily Symptom Rating Scale score of 85.

The Daily Symptom Rating Scale is widely used to identify individuals with PMS and those meeting criteria for a DSM-IV diagnosis of premenstrual dysphoric disorder (PDD). A score of 70 on the scale is commonly considered the cut-off point for a clinical diagnosis (Freeman et al., 1996), and this score was used here to determine eligibility for inclusion in the clinical trial. For the purpose of the assessment of the relationship between chocolate craving and other symptoms, two items were added to the daily questionnaires, namely “craving for chocolate” and “craving for non-chocolate sweets.” These additional items were rated on the same 0 to 4 scale; only respondents who completed the two additional items are included in the following analyses ( $n=137$ ,  $n=147$ , and  $n=146$  of 164 participants in cycles 1, 2 and 3, respectively).

## Statistical Analyses

Changes in the severity of chocolate craving and affective and physical symptoms with the onset of menstruation were assessed by comparing symptom ratings on days 28 versus 1 in the consecutive cycles 1 and 2, and cycles 2 and 3. This was done first using independent-samples t-tests of the mean symptom ratings on the two days in each comparison for each individual symptom, the four factors, and the total Daily Symptom Rating Scale scores. Second, a one-way repeated measures ANOVA was conducted, comparing mean increase or decrease in symptom severity from the last (day 28) to the first days (day 1) of each cycle between the four factors of the DSR. The four factors were modified slightly by adding ratings of swelling to the “Pain” factor (to go along with ratings of aches, cramps and breast tenderness), and by creating a fourth symptom cluster containing the three craving measures employed here (general food cravings, chocolate craving and cravings for non-chocolate sweets). The “Mood” and “Behavior” factors and the variables loading onto them were maintained in their original form.

Changes in symptom severity with the daily administration of a placebo in the last five days of cycle 3 were assessed by comparing mean ratings on the modified factors in the premenstrual periods in cycles 1, 2 and 3, using a series of one-way repeated measures ANOVA.

## Results

### *Symptom Changes with the Onset of Menstruation*

Mean symptom ratings on the day before menstruation (day 28 in cycles 1 and 2) were compared to ratings on the first day of menstruation (day 1 in cycles 2 and 3, respectively) to assess the effects of the onset of menstruation on self-reported severity of chocolate and other cravings, and ratings of physical and mood symptoms, keeping in mind that hormonally speaking the onset of menstruation is not a significant event.

In the transition from day 28 in cycle 1 to day 1 in cycle 2 there was a statistically significant drop in ratings of chocolate craving and general food cravings (see Table 5-1 for all means, standard deviations and statistics, Figure 5-1) ( $p \leq 0.05$ ). Ratings of depression, feeling out of control, mood swings, crying, irritability, and nervous tension decreased significantly as well. There was a statistically significant reduction in only one physical symptom, namely breast tenderness, while ratings of another physical symptom, cramps, increased significantly. In terms of overall factor ratings and Daily Symptom Rating Scale scores, mean ratings on factors 1 “Mood,” 2 “Behavior,” and 4 “Physical,” and total DSR score decreased significantly, while there was a statistically significant increase in scores on factor 3 “Pain” with the onset of menstruation in the transition from cycle 1 to cycle 2.<sup>9</sup>

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<sup>9</sup> Differences between days 28 and 1 in ratings of general food craving and depression (decrease) as well as cramps (increased) remained significant when applying a more stringent, traditional Bonferroni-

From day 28 of cycle 2 to day 1 of cycle 3 there was again a significant ( $p \leq 0.05$ ) drop in ratings of chocolate craving and general food cravings, as well as in cravings for non-chocolate sweets (Table 5-1, Figure 5-1). There was a simultaneous significant decrease in feeling out of control, mood swings, anxiety, irritability, nervous tension, depression, and insomnia. Breast tenderness was again the only physical symptom that decreased significantly with the onset of menstruation, while ratings of cramps again increased significantly. Taken together, individual symptom ratings yielded a significant decrease in scores on factors 1 “Mood,” 2 “Behavior” and 4 “Physical.”<sup>10</sup>

One-way repeated measures ANOVAs comparing mean increases/decreases on factors 1 “Mood” (anxiety, irritability, depression, nervous tension, mood swings, and feeling out of control), factor 2 “Behavior” (poor coordination, insomnia, confusion, headache, crying, and fatigue), modified factor 3 “Pain” (aches, cramps, breast tenderness and added ratings of swelling), and the cluster of craving measures (general food cravings, chocolate craving, and cravings for non-chocolate sweets) showed a significant effect for factor in the transitions from cycle 1 to 2 [Wilk’s Lambda=0.77;  $F(3,117)=11.70$ ,  $p \leq 0.001$ ; partial  $\eta^2=0.23$ ], and cycle 2 to 3 [Wilk’s Lambda=0.71;  $F(3,123)=16.70$ ,  $p \leq 0.001$ ; partial  $\eta^2=0.29$ ].

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corrected criterion for significance ( $p \leq 0.002$ ), as well as when using a modified, sequential Bonferroni technique.

<sup>10</sup> Applying a traditional Bonferroni-corrected significance criterion of  $p \leq 0.002$ , decreases in general food cravings, mood swings, anxiety, irritability, depression, factor 4 “Physical,” and total DSR score remained statistically significant, as did the increase in ratings of cramps. Using the modified, sequential Bonferroni technique, differences in total DSR scores, Factors 1 “Mood” and 4 “Physical,” general food cravings, cramps, mood swings, nervous tension, irritability, and anxiety remained statistically significant.

In the cycle 1/2 transition the greatest mean decrease in symptom ratings occurred for the “Mood” factor ( $M=2.18$ ,  $SD=7.17$ ) and craving ratings ( $M=1.09$ ,  $SD=3.09$ ). Scores on the “Behavior” factor on average decreased by 0.98 points ( $SD=4.56$ ), while “Pain” ratings increased ( $M=-0.74$ ,  $SD=3.69$ ). A series of post-hoc paired-samples t-tests (with a Bonferroni-corrected significance level of  $p=0.01$ ) indicated significant differences between changes on the “Mood” factor and changes in “Behavior” ( $p=0.01$ ) and “Pain” ( $p\leq 0.001$ ), and significant differences between change in scores on the “Pain” factor and “Behavior” ( $p\leq 0.001$ ) and “Craving” ( $p\leq 0.001$ ). Of note, differences in changes in “Mood” and “Craving” were not significant.

Similarly, in the transition from cycle 2 to cycle 3, ratings of “Mood” ( $M=3.77$ ,  $SD=6.56$ ) decreased the most, followed by change scores on the “Behavior” factor ( $M=1.47$ ,  $SD=4.34$ ) and cravings ( $M=1.37$ ,  $SD=2.86$ ), and very small decreases in ratings of “Pain” ( $M=0.22$ ,  $SD=3.07$ ). Post-hoc paired-samples t-tests (with a Bonferroni-corrected significance level of  $p=0.01$ ) indicated significant differences in mean change scores between mood symptoms, behavior ( $p\leq 0.001$ ), pain ( $p\leq 0.001$ ), and craving ratings ( $p\leq 0.001$ ), as well as between behavior and pain symptom ratings ( $p\leq 0.001$ ), and craving and pain symptom ratings ( $p\leq 0.001$ ). Results suggest a significant reduction in severity of craving and mood symptoms – but not physical concerns – with the onset of menstruation.

### *Symptom Severity in Baseline Cycles 1 and 2 versus Placebo Cycle 3*

The effects of placebo administration on premenstrual symptoms were assessed by comparing mean sums of symptom ratings during the premenstrual days 23-28, using a series of

one-way repeated measures ANOVAs. One-way analyses of variance comparing mean symptom ratings in baseline cycles 1 and 2 and placebo cycle 3 were statistically significant for Factor 1 “Mood” [Wilk’s Lambda=0.80;  $F(2,135)=17.28$ ,  $p\leq 0.001$ ; partial  $\eta^2=0.20$ ], Factor 2 “Behavior” [Wilk’s Lambda=0.90;  $F(2,135)=7.22$ ,  $p=0.001$ ; partial  $\eta^2=0.10$ ], modified Factor 3 “Pain” [Wilk’s Lambda=0.91;  $F(2,135)=6.68$ ,  $p=0.002$ ; partial  $\eta^2=0.09$ ] and the cluster of “Craving” measures [Wilk’s Lambda=0.90;  $F(2,128)=6.79$ ,  $p=0.002$ ; partial  $\eta^2=0.10$ ] (see Table 5-2 for all means and statistics, Figure 5-2). Post-hoc analyses (paired-samples t-tests) indicated significant differences (Bonferroni-corrected  $p\leq 0.02$ ) between cycles 1 and 3 and cycles 2 and 3 in ratings on Factor 1 “Mood” and “Craving,” and between cycles 2 and 3 on Factors 2 “Behavior” and 3 “Pain.” Results indicate significantly lower ratings of a range of symptoms in the premenstrual placebo phase of cycle 3, compared to the same time periods in baseline cycles 1 and 2.

Of note, for the same analyses in the post-menstrual (days 5-10) and menstrual time periods (days 1-3) there were no significant differences between cycles 1, 2 and 3 in mean ratings on any of the four factors (Table 5-2).

## Discussion

Findings presented here provide evidence against perimenstrual chocolate craving as a hormonally-driven phenomenon, and in support of the assumption that chocolate craving during the perimenstrum is a response to the subjective experience of stress during this time of the cycle. It appears that what is experienced as stressful or unpleasant in particular is the anticipation of the onset of menses, as opposed to menstruation itself. A range of affective

symptoms and craving severity increased in response to this subjectively experienced stress, and decreased rapidly with the onset of menstruation. The increase and decrease in mood and craving symptoms take place independently of co-occurring hormonal fluctuations (or absence thereof), or self-reported severity of physical concerns related to the perimenstrum.

If chocolate craving and the related mood symptoms were caused directly by the hormonal processes underlying menstruation as a biological event, the onset of menses itself should not produce such drastic changes in symptom ratings over the course of a mere 24 hours. Instead, the most dramatic changes in symptoms should occur in conjunction with the most marked fluctuations in levels of hormones, which occur during the periovulatory, midluteal and luteal phases mid-cycle, when estrogen and progesterone first increase markedly, and then drop rapidly. The fact that menstruation itself – a psychologically rather than physiologically notable event – correlates with such significant changes in self-reported symptoms suggests a strong influence of psychology, rather than physical processes on the subjective experience of the perimenstrual symptom cluster that includes chocolate craving. It seems that the expectation of the onset of menstruation is a stressful time, and that women respond to this stress by developing a range of affective symptoms that include chocolate craving.

Administration of a placebo during the premenstrual period is highly effective in “treating” chocolate craving, as well as other affective and physical symptoms associated with the impending onset of menstruation. The placebo effect is a well-documented, if poorly understood, phenomenon. The fact that an impact of a placebo pill is observable here strongly suggests that perimenstrual chocolate cravings and associated complaints are primarily

subjective experiences, possibly related to the stress of the perimenstrum, and largely unrelated to the physiological or hormonal processes occurring at the same time.

In summary, it is demonstrated here that chocolate craving, along with the affective symptoms associated with menstruation, fluctuates in a manner that is largely uncoupled from the hormonal changes taking place at the same time. More specifically, after a premenstrual increase, the onset of menstruation leads to drops in symptom severity not expected based on the absence of any significant hormonal changes taking place during that time. Secondly, administration of a placebo pill significantly reduced the severity of a range of symptoms occurring premenstrually, including chocolate craving and affective symptoms. Taken together findings support the view of chocolate craving as part of a cluster of psychologically-driven symptoms that arise, likely as a response to the stress of the perimenstrum or of the anticipated onset of menstruation itself. With the onset of menstruation, these symptoms subside independently of hormonal levels and severity of any co-occurring physical symptoms, which tend to stay stable or increase at the same time. Finding support a role of stress in the etiology of perimenstrual chocolate craving and associated symptoms, with craving potentially being a culturally-promoted way of coping with subjectively experienced stress.



	Cycle 1 – Cycle 2			Cycle 2 - Cycle 3		
	Cycle 1-28	Cycle 2-1	Statistic	Cycle 2-28	Day 3-1	Statistic
<b>Anxiety</b>	1.86 (1.40)	1.57 (1.39)	t(278)=1.77, p=0.08	2.20 (1.33)	1.74 (1.42)	t(289)=5.46, p<0.001
<b>Irritability</b>	2.42 (1.24)	2.01 (1.44)	t(278)=2.55, p=0.01	2.73 (1.18)	1.91 (1.38)	t(289)=5.46, p<0.001
<b>Depression</b>	2.00 (1.49)	1.45 (1.45)	t(278)=3.11, p=0.002	1.81 (1.33)	1.34 (1.38)	t(289)=2.96, p=0.003
<b>Nervous Tension</b>	2.09 (1.43)	1.64 (1.42)	t(278)=2.65, p=0.01	2.12 (1.35)	1.47 (1.36)	t(289)=4.09, p<0.001
<b>Mood Swings</b>	2.15 (1.42)	1.75 (1.56)	t(277)=2.24, p=0.03	2.29 (1.40)	1.54 (1.40)	t(289)=4.54, p<0.001
<b>Out of Control</b>	1.71 (1.60)	1.30 (1.47)	t(277)=2.24, p=0.03	1.60 (1.50)	1.08 (1.40)	t(289)=3.04, p=0.003
<b>Poor Coordination</b>	1.09 (1.34)	0.85 (1.34)	t(278)=1.54, p=0.13	1.15 (1.33)	0.92 (1.28)	t(289)=1.52, p=0.13
<b>Insomnia</b>	1.13 (1.48)	0.91 (1.40)	t(278)=1.29, p=0.19	1.18 (1.43)	0.74 (1.24)	t(287)=2.83, p=0.01
<b>Confusion</b>	1.07 (1.38)	0.82 (1.30)	t(277)=1.54, p=0.12	1.11 (1.30)	0.90 (1.28)	t(289)=1.36, p=0.17
<b>Headache</b>	1.26 (1.34)	1.18 (1.42)	t(277)=0.46, p=0.65	1.35 (1.40)	1.13 (1.40)	t(289)=1.35, p=0.18
<b>Crying</b>	1.19 (1.43)	0.85 (1.34)	t(278)=2.07, p=0.04	1.07 (1.36)	0.91 (1.28)	t(288)=1.02, p=0.31
<b>Fatigue</b>	2.30 (1.32)	2.10 (1.37)	t(277)=1.22, p=0.22	2.49 (1.24)	2.28 (1.32)	t(289)=1.42, p=0.16
<b>Aches</b>	1.64 (1.45)	1.64 (1.50)	t(277)=-0.21, p=0.98	1.84 (1.40)	1.65 (1.36)	t(289)=1.18, p=0.24
<b>Cramps</b>	1.26 (1.33)	2.12 (1.43)	t(278)=-5.23, p<0.001	1.29 (1.36)	2.06 (1.41)	t(289)=-4.74, p<0.001
<b>Breast Tenderness</b>	1.80 (1.39)	1.38 (1.33)	t(277)=2.55, p=0.01	1.73 (1.41)	1.27 (1.36)	t(289)=2.81, p=0.01
<b>Swelling</b>	1.98 (1.40)	1.78 (1.45)	t(278)=1.19, p=0.24	2.10 (1.42)	1.81 (1.42)	t(289)=1.74, p=0.08
<b>Craving Foods</b>	1.85 (1.45)	1.30 (1.46)	t(277)=3.12, p=0.002	1.86 (1.41)	1.24 (1.38)	t(289)=3.83, p<0.001
<b>Chocolate Craving</b>	1.37 (1.40)	0.97 (1.34)	t(262)=2.37, p=0.02	1.17 (1.35)	0.85 (1.28)	t(278)=2.05, p=0.05
<b>Craving Non-Chocolate Sweets</b>	1.26 (1.37)	1.01 (1.35)	t(262)=1.51, p=0.13	1.38 (1.41)	0.94 (1.24)	t(271)=2.75, p=0.01
<b>Factor 1 “Mood”</b>	12.27 (6.97)	9.72 (7.23)	t(277)=3.00, p=0.003	12.76 (6.19)	9.09 (6.70)	t(289)=4.84, p<0.001
<b>Factor 2 “Behavior”</b>	8.02 (5.25)	6.68 (5.50)	t(276)=2.09, p=0.04	8.35 (4.92)	6.79 (5.12)	t(286)=2.65, p=0.01
<b>Factor 3 “Pain”</b>	4.70 (3.40)	5.13 (3.28)	t(277)=-1.09, p=0.28	4.86 (2.94)	4.98 (3.03)	t(289)=-0.35, p=0.73
<b>Factor 4 “Physical”</b>	3.82 (2.42)	3.08 (2.52)	t(277)=2.52, p=0.01	3.97 (2.35)	3.05 (2.26)	t(289)=3.40, p=0.001
<b>DSR Total Score</b>	28.82 (14.75)	24.63 (16.01)	t(276)=2.27, p=0.02	29.93 (13.03)	23.65 (14.05)	t(286)=3.93, p<0.001

Table 5-1: Mean symptom ratings on day 28 (day before menstruation) versus day 1 (first day of menstruation) in cycles 1, 2, and 3

	Premenstrual (Days 23-28)				Menstrual (Days 1-3)				Post-Menstrual (Days 5-10)			
	Cycle 1	Cycle 2	Cycle 3	Statistic	Cycle 1	Cycle 2	Cycle 3	Statistic	Cycle 1	Cycle 2	Cycle 3	Statistic
<b>Factor 1 "Mood"</b>	62.97 (34.00)	68.92 (29.10)	49.92 (28.75)	F(2,135)=17.28, p<0.001 <sup>1-3, 2-3</sup>	9.12 (18.10)	21.88 (18.48)	21.05 (17.43)	F(2,427)=0.87, p=0.42	15.35 (18.31)	14.75 (18.59)	17.51 (20.32)	F(2,134)=0.82 , p=0.44
<b>Factor 2 "Behavior"</b>	40.77 (25.91)	44.07 (23.21)	34.90 (21.00)	F(2,135)=7.22, p=0.001 <sup>2-3</sup>	15.24 (13.55)	15.90 (13.49)	16.56 (13.13)	F(2,427)=0.34, p=0.71	12.99 (13.30)	13.41 (14.48)	14.79 (15.20)	F(2,134)=0.35 , p=0.71
<b>Factor 3 "Pain" (modified)</b>	31.42 (18.90)	33.46 (19.16)	26.80 (17.30)	F(2,135)=6.68, p=0.002 <sup>2-3</sup>	13.74 (10.61)	15.72 (11.09)	14.80 (9.95)	F(2,135)=1.18, p=0.31	3.98 (6.41)	4.57 (6.74)	5.17 (7.03)	F(2,134)=1.28 , p=0.28
<b>Cluster "Cravings"</b>	23.42 (17.80)	23.20 (16.42)	17.42 (14.91)	F(2,126)=6.79, p=0.002 <sup>2-3</sup>	6.04 (7.56)	7.08 (8.46)	6.82 (8.41)	F(2,128)=0.52, p=0.60	3.85 (7.53))	4.31 (8.52)	4.19 (7.15)	F(2,127)=0.10 , 0.90

Table 5-2: Mean symptom ratings during premenstrual, menstrual and post-menstrual phases in cycles 1, 2, and 3 (Superscript indicates

significant post-hoc results, e.g. <sup>1-3</sup> indicates significant differences between cycles 1 and 3 at Bonferroni-corrected  $p \leq 0.02$ )

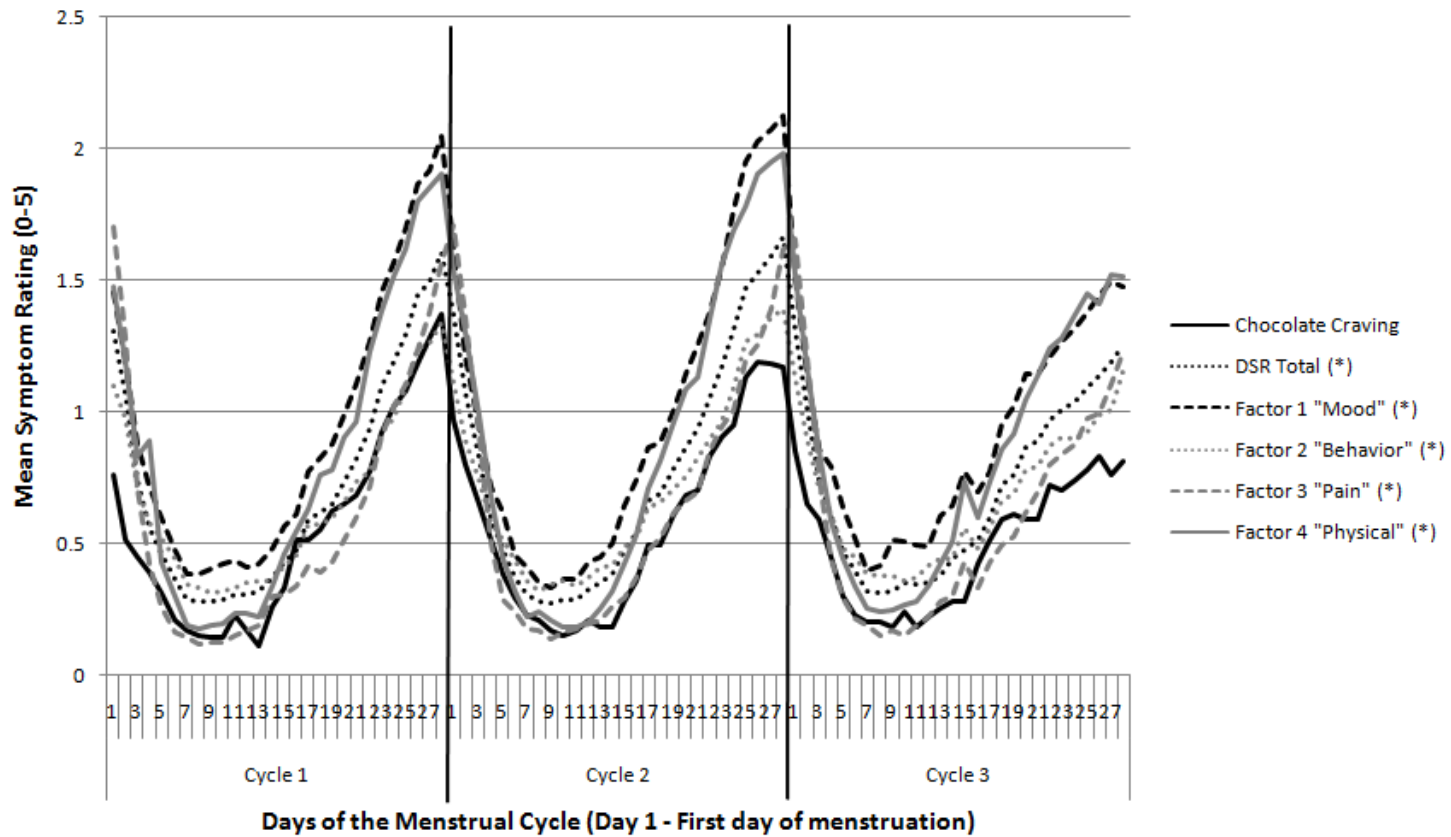


Figure 5-1: Mean symptom ratings across the 28 days of three consecutive menstrual cycles (cycle 3 with placebo administration) (\* denotes adjusted ratings: factor and DSR scores divided by the number of symptoms loading on that factor)

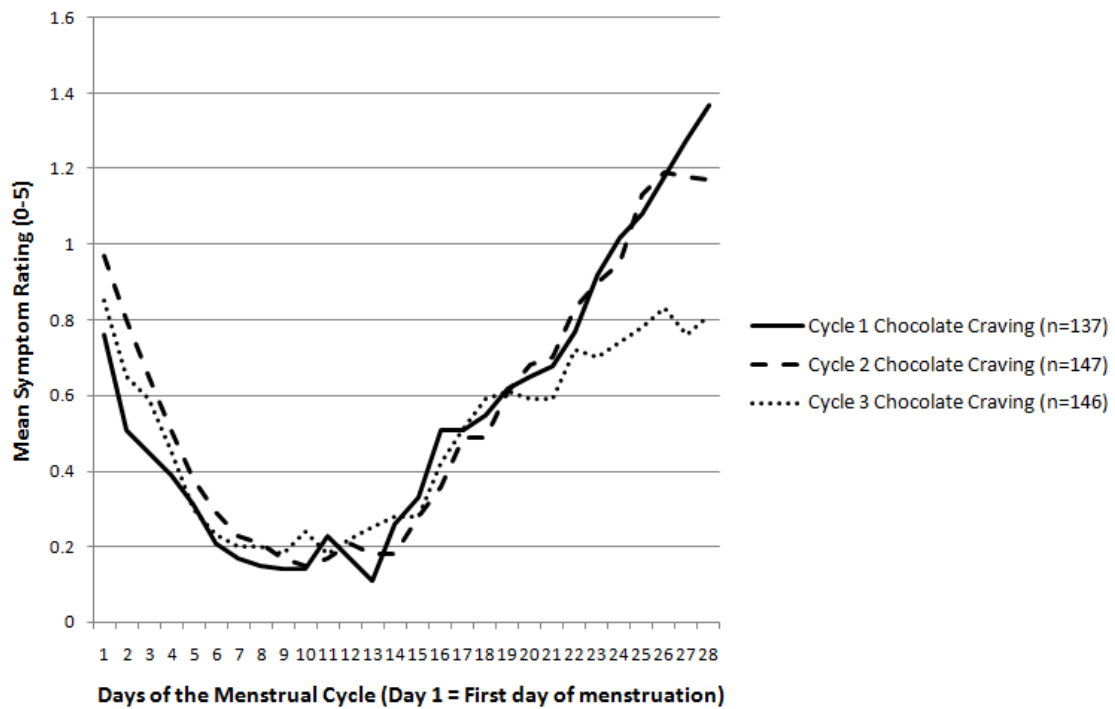


Figure 5-2: Mean chocolate craving ratings across the 28 days of three consecutive menstrual cycles (cycle 3 with placebo administration)

## CHAPTER 6

### GENERAL DISCUSSION

#### *I. Summary of Findings*

Food cravings have been somewhat of a puzzle to psychologists working in the field of food choice and preference. Previous research has yielded few findings that give insight into causal mechanisms underlying these cravings. The novelty of the approach presented here lies primarily in the choice of different methodologies that focus on social, cultural and psychological factors. Using these approaches the four studies discussed here present compelling new evidence against a physiological basis of chocolate craving. They furthermore give important indications about socio-cultural and psychological mechanisms involved in the etiology of craving. Specifically, they indicate that the perimenstrum and the anticipation of the onset of menses are a source of stress, and that craving is a culturally supported response to that stress.

Study 1 (Chapter 2) illustrates the extent to which the notion of craving is culture-bound, by demonstrating the very limited extent to which the word “craving” lexicalizes in languages other than English. In light of this finding it is evident that processes specific to North American culture foster the perceived relevance and importance of the notion of chocolate (and possibly other food) craving. Any model of the etiology of craving must account for this fact.

With craving emerging as a predominantly North American phenomenon, study 2 (Chapter 3) sought to characterize cravers in the U.S., with a specific focus on the most common - and in many ways most puzzling - of all food cravings, namely chocolate craving in women, and specifically craving as associated temporally with the menstrual cycle. Important differences in psychological characteristics emerged between menstrual cravers, other cravers and non-chocolate cravers, suggesting that menstrual cravers have more disordered relationships to food. The direction of causality between heightened dietary restraint, more pronounced weight fluctuations, higher body mass index and menstrual chocolate craving cannot yet be established based on the data presented here. It is clear, however, that a comprehensive understanding of food cravings must take into consideration the unique psychological and behavioral traits of cravers.

Having characterized perimenstrual and other menstrual craving, study 3 (Chapter 4) sought to track the fate of these cravings in the absence of regular menstrual periods. Findings constitute another piece of evidence against a physiological basis specifically for perimenstrual chocolate craving, by showing that craving prevalence does not decrease as expected in the absence of cyclic hormonal fluctuations in women past menopause. Importantly, results from women post-menopause instead clearly point to a role of stress in the etiology of craving, since respondents tended to cite a range of stressors in their environment as the perceived cause of their current chocolate craving. A model of craving etiology needs to incorporate stress as a plausible trigger of cravings.

Study 4 (Chapter 5) pursued the stress-hypothesis of chocolate craving that was formulated based on findings in study 3 by assessing the affective versus physical correlates of

perimenstrual chocolate craving, and changes in the severity of these symptoms in anticipation of, versus following the onset of menstruation. Craving, along with the other affective symptoms, dropped substantially with the onset of menstruation, with no obvious physical basis for this decrease. This finding is new, but in fact very consistent with the widespread perception of menstruation as a major life event, especially in non-Western cultures such as India, where menstruating women cannot touch their children or cook food. In addition, a placebo, administered premenstrually, was highly effective at reducing the entire cluster of perimenstrual symptoms. Taken together these results strongly support the assumption that chocolate craving is a predominantly psychologically driven response to the subjective stress experienced by women in anticipation of the onset of menstruation.

## *II. A New Model of Craving*

The findings presented here call for the formulation of a new model of chocolate and other food cravings, one that relies to a greater extent on socio-cultural and psychological explanations. The following is an attempt at such a model (Figure 6-1). It takes into account the findings discussed here and unites them with additional factors believed to play a role in bringing about the phenomenon termed “craving.”

The proposed model postulates that our innate preference for sweet and fatty tastes and for chocolate’s unique oro-sensory properties and melt-in-your-mouth feel makes it a highly palatable and appealing food. Living in a culture that values slim physiques, or the so-called “thin-ideal,” however, American women in particular feel significant pressure to closely monitor

their food intake, and to stay away from calorically dense foods such as chocolate. This conflict between a biological drive towards and the culturally imposed avoidance of chocolate results in a state of **ambivalence**, in which chocolate becomes simultaneously positively and negatively charged.

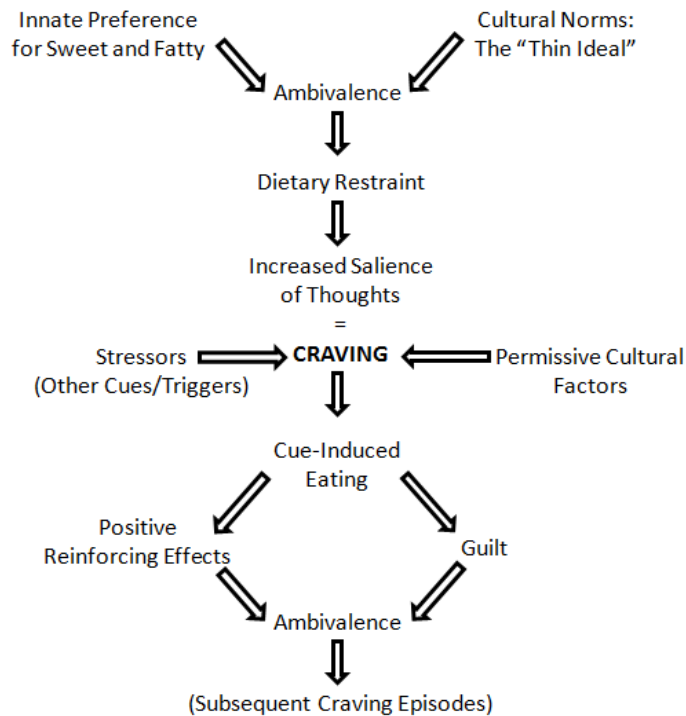


Figure 6-1: A new model of chocolate craving

In an effort to conform to socio-cultural standards many women in the U.S. engage in high levels of **dietary restraint**, oftentimes specifically cutting out “forbidden foods,” such as chocolate. It has long been known that heightened dietary restraint, which is largely cognitively mediated, has an influence on how information in the environment is processed. Specifically, in times of high dietary restraint there is an **increase in the salience of thoughts** and stimuli



related to the food that one purposefully avoids (Green & Rogers, 1993). In other words, a dieter who specifically cuts out chocolate is significantly more likely to notice a television advertisement about chocolate than a woman who is not purposefully avoiding chocolate. More recently it has been demonstrated that intrusive thoughts and cognitions about highly appealing objects – such as craved foods – often become increasingly elaborated upon in the form of the construction of mental images that simulate the sensory and emotional qualities of the target object (Kavanagh et al., 2005). This thought elaboration occupies significant cognitive capacities, is generally only momentarily rewarding, and results in the experience of strong desires. This process of thought elaboration may well correspond to what is commonly termed “craving.”

American culture prescribes the “thin ideal” and the dietary rules associated with adherence to it, but at the same time sends powerful messages about circumstances under which it is acceptable to break these rules. These *permissive cultural factors* define occasions when going against the otherwise strictly observed social norms is not just forgivable, but in many ways even expected. For example, everyone will understand that when upset about a break-up, or when getting fired from her job, a woman eats chocolate. Inherent in these socially sanctioned exceptions to the rules are specific triggers that signal permission to break dietary restraint and indulge in the consumption of otherwise forbidden foods. These triggers are thought to be mostly negatively valenced, and can generally be termed “*stressors*.” Going through a break-up and getting fired are two examples of potential stressors. The oftentimes highly salient physical and affective “symptoms” of the perimenstrum or the uncertainty of the anticipation of the onset of menstruation represent another type of stressor that American

culture has declared an acceptable condition for the temporary suspension of restraint. Women declare that they are “premenstrual, bloated, and moody” during “that time of the month” – and nobody is surprised or even judgmental if they treat themselves by indulging in highly palatable foods.

In situations when stressors coincide with times of high dietary restraint, increased salience of food-related stimuli, and the subjective experience of craving in an individual who has internalized the permissive cultural factors, ***cue-induced eating*** of the forbidden food is likely to occur. A woman who has cut out chocolate from her diet for weeks in an effort to lose or maintain her weight will notice the chocolate on display at the coffee shop she visits each day on her way to work and it takes effort and discipline not to purchase this chocolate. She will probably think about the chocolate throughout the day, remember what it looks like, imagine what it would smell and taste like. She will label these elaborated thoughts and resulting desire “craving.” On the days leading up to her period, when the woman feels sluggish, retains water and experiences painful cramps, she will no longer have to resist her cravings but can actually reach for the chocolate at the check-out, purchase and consume it, knowing that she will be able to “justify” her actions – to herself and others - in a socially acceptable manner afterwards.

Once the cue-induced eating has occurred, two things will happen as a result. Biologically destined to enjoy sweet, fatty and calorically dense food, the individual will experience the ***positive reinforcing effects*** of consuming a highly palatable food, probably even more so if it occurs after an extended period of abstinence. In the case of chocolate, she will enjoy the smell, feel and taste of chocolate – and according to some accounts may additionally experience some benefits from the pharmacologically active ingredients in chocolate (though

these effects are likely to be weak to non-existent). At the same time, however, she will experience significant **guilt** as a result of breaking her self-imposed dietary rules and going against social norms that prescribe restraint. Taken together, these positive rewarding effects and negative affective responses interact to once again increase levels of **ambivalence**, setting the stage for future craving episodes to occur.

### *III. Limitations and Future Directions*

The proposed model incorporates what is known about chocolate craving up to this point, and provides a useful basis for the generation of hypotheses that continue to address causal factors in the etiology of food cravings. Future studies should formulate and test predictions that emerge from this model and adapt it to a wider range of contexts.

The model as it is presented here is based on research conducted specifically on the phenomenon of perimenstrual chocolate craving in American women. It is believed that the model is broad enough to explain other types of food cravings, and is furthermore not limited to addressing craving in women. There is no reason why a man attempting to cut out pizza from his diet could not undergo a similar “craving” experience as the one described above, and give into his craving on a day when he is under particularly great pressure at work. The model is based to a large extent on social norms specific to the U.S., a necessary feature when it comes to accounting for the unusually high prevalence of chocolate and other cravings in North America. It is however possible that the model can be adapted to incorporate social norms specific to other cultures, and modified to predict their effects on the nature and prevalence of

cravings. The extent to which the model applies to a broader range of contexts should be explored systematically through studies on cravings for foods other than chocolate in more diverse populations.

An important obstacle to being able to draw more definitive conclusions with regards to the mechanisms underlying food craving is the fact that studies discussed here are largely correlational, and rely to some extent on retrospective reports (with the important exception of study 4, which utilized daily reports and the experimental manipulation of placebo administration). Unlike many physiological mechanisms, which lend themselves to manipulation, socio-cultural factors are not easily studied under controlled conditions in the laboratory. Logical next steps in testing the predictions of the proposed model involve assessing the nature of ambivalence, since it is hypothesized to play a critical role in craving etiology. This should be accomplished by measuring simultaneous positive and negative responses to the controlled exposure to a food stimulus in cravers versus non-cravers, and determining if elevated levels of attitudinal conflict are in fact related to a higher incidence of craving. Similarly, the exact role of subjectively experienced stress in triggering cue-induced eating in response to a craving should be evaluated, possibly by inducing craving in the laboratory, and then exposing subjects to stressors to see if self-reported cravers are more likely to respond with consumption of the craved food under these conditions than non-cravers or cravers in the absence of stress.

Finally, it must be noted that the research and model presented here address the possible *causes* of cravings only. They do not directly speak to the processes by which cravings are satisfied. More research is needed to determine the mechanisms involved in the

satisfaction of cravings, and the characteristics of chocolate that makes it stand out as a food that effectively alleviates cravings. It is possible that two distinct pathways are involved in the etiology and satisfaction of craving. The exact nature of these pathways and their interplay merit further assessment.

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