

9. Perimenstrual chocolate craving: from pharmacology and physiology to cognition and culture

J.M. Hormes

Department of Psychology, College of Arts and Sciences, University at Albany, State University of New York, Social Sciences 399, 1400 Washington Avenue, Albany, NY 12222, USA, jhormes@albany.edu

Abstract

Chocolate craving is a common phenomenon, but only in some cultures. Americans are much more likely to report chocolate craving than individuals in other cultures that have been surveyed. Furthermore, in the United States, women are about twice as likely to experience chocolate craving, compared to men. In about half of female US chocolate cravers, craving fluctuates cyclically with a well-defined peak in frequency and intensity beginning approximately four days prior to and lasting until about four days after the onset of menstruation. Though the phenomenon of cyclically fluctuating chocolate craving has been called 'premenstrual', it is thus more appropriately termed perimenstrual craving. The pattern of cyclically occurring chocolate cravings has raised questions about a possible causal role of the menstrual cycle in eliciting cravings. This chapter reviews existing accounts of mechanisms underlying perimenstrual chocolate craving, including pharmacological, physiological, cognitive, and socio-cultural explanations. Evidence generally does not support a causal role of the active ingredients in chocolate in either the etiology or the satisfaction of craving. Cyclic fluctuations in hormones do not appear to directly elicit chocolate craving. The interplay of several cognitive factors, including ambivalent attitudes to chocolate, dietary restraint, and thought elaboration, on the other hand, may play a role in the etiology of craving in general, and perimenstrual chocolate craving in particular. A growing body of literature also suggests that perimenstrual chocolate craving is a culture-bound syndrome, limited to North America. Based on these findings it is hypothesized that perimenstrual chocolate craving arises as the result of women's efforts to restrict consumption of a highly ambivalent food, along with a culturally-driven view of the perimenstrum as a cue signalling permission to engage in an otherwise prohibited indulgence.

Keywords: perimenstrual, premenstrual, food, sweets, ambivalence, cultural differences

Summary points

- Perimenstrual chocolate craving, an increase in the frequency and intensity of craving for chocolate beginning around four days prior to and lasting until about four days after the onset of menstruation, is reported by around 50% of female chocolate cravers in North America.
- In countries outside of North America, chocolate craving is far less prevalent, commonly reported about equally by men and women, and rarely or not at all linked to the menstrual cycle.
- Evidence does not support a role of the pharmacologically active ingredients of chocolate in either the etiology or satisfaction of cravings, but instead points to a primary role of the sensory properties of chocolate.
- Mechanisms associated with the menstrual cycle, such as cyclic fluctuations in levels of hormones, do not appear to directly cause perimenstrual chocolate craving.
- A number of cognitive processes have been implicated in the etiology of perimenstrual chocolate craving, including conflicting attitudes towards chocolate, cue reactivity, and thought elaboration.
- Cultural differences in the nature of craving, including an absence of fully equivalent translations of the word 'craving' in most languages outside of English, suggest that any causal mechanisms underlying the etiology of perimenstrual chocolate craving are likely culture-bound.
- It appears that culturally defined chocolate-related attitudes and behaviours, along with socially sanctioned circumstances under which it is acceptable to indulge in otherwise forbidden foods, drive the high prevalence of perimenstrual chocolate craving specifically in North America.

9.1 Introduction

As illustrated throughout this volume, food intake is tied to the menstrual cycle in a myriad of complex ways. This chapter discusses a very specific link, namely the temporal association between craving for chocolate and the perimenstrual period, which includes the premenstrum and the first few days of menstruation. Perimenstrual chocolate craving is a well-documented phenomenon, but its etiology remains poorly understood. This review discusses a number of mechanisms hypothesized to underlie perimenstrual chocolate craving, roughly in the chronological order in which they were examined by the field. It closes with a discussion of recent research on cognitive and cultural factors, integrated into a proposed new model of perimenstrual chocolate craving, and suggestions for future research.

9.1.1 Food cravings

A food craving is an intense urge that occupies an individual's thoughts and motivates them to go out of their way to satisfy it (Hormes and Rozin, 2010). Craving differs from the physiological state of hunger, which can be alleviated by any number of foods, in that a craving is typically only satisfied by one specific food (Pelchat, 2002) (Table 9.1).

Food cravings are common phenomena in some countries. For example, in a survey of United States undergraduate students, 94% of women and 75% of men reported ever having experienced a craving for a specific food (Zellner *et al.*, 1999). Similarly, in Canada, 97% of female and 68% of male college students endorsed food cravings (Weingarten and Elston, 1990).

Individuals who crave foods experience on average one to two craving episodes per week, and most result in the consumption of the desired food (Hill and Heaton-Brown, 1994; Weingarten and Elston, 1991) (Table 9.1). Cravings are most common in younger individuals, and prevalence decreases with age (Pelchat, 1997).

Table 9.1. Facts about craving.

Definition	A craving is an intense urge that motivates an individual to go out of his or her way to satisfy it (e.g. Hormes and Rozin, 2010)
Specificity	Craving differs from the physiological state of hunger, which can be alleviated by any number of foods, in that it is typically only satisfied by one specific food (Pelchat, 2002)
Frequency	Individuals, who crave foods experience an average of one or two craving periods per week (Weingarten and Elston, 1990)
Prevalence	94% of female and 75% of male US undergraduates have experienced a craving for a specific food (Zellner <i>et al.</i> , 1999)
Language	The word 'craving' does not lexicalize in most languages other than English (Hormes and Rozin, 2010)

Research points to a common neuroanatomical substrate for food and drug cravings (Pelchat *et al.*, 2004). Cravings for cigarettes, alcohol, and drugs of abuse are potent triggers for relapse and major obstacles to sustained abstinence (Bottlender and Soyka, 2004; Evren *et al.*, 2012; Ferguson and Shiffman, 2009; Sinha *et al.*, 2006). By comparison, food cravings are mostly harmless; however, they have been shown to be associated with binge eating episodes in bulimic and obese women (Bjoervell *et al.*, 1985; Kales, 1990; Mitchell *et al.*, 1985). Even in non-pathological populations, cravings can elicit strong feelings of guilt (Macdiarmid and Hetherington, 1995). A better understanding of craving etiology therefore has broad clinical importance.

9.1.2 Chocolate craving and the menstrual cycle

Chocolate is the most commonly and intensely craved food in Western cultures (Rodin *et al.*, 1991; Rogers and Smit, 2000; Rozin *et al.*, 1991; Weingarten and Elston, 1990), and it is unique in many ways. Chocolate has a highly attractive aroma and melts at body temperature, producing extremely pleasant tactual dynamics in the mouth. Cacao beans, the seeds of the *Theobroma cacao* tree (Lopez, 2002), contain high levels of lipids, making chocolate a relatively high-fat food. In its pure form, cacao is bitter and rather unpalatable. A variety of processing techniques, including roasting, fermentation, and the addition of sugar, bring out the aroma of chocolate not readily apparent in the raw beans.

Dark chocolate contains the highest concentrations of cacao, while milk chocolate usually has extra fat and sugar added to it. White chocolate is not a 'true chocolate', but is simply cocoa butter mixed with sugar and flavours (Table 9.2). As a result it contains few, if any, of the active ingredients of pure cacao, with the possible exception of fat-soluble components, such as trace levels of the cannabinoid anandamide (Bruinsma and Taren, 1999; Parker *et al.*, 2006).

More than half of Americans rate chocolate as their favourite flavour, and a majority prefer milk to dark or white chocolate.¹ A strong preference for chocolate is experienced as something more than mere liking by many: in a survey of American undergraduates, 91% of women and 59% of

Table 9.2. Requirements for ingredients in cacao products (FDA, 2011).

	Chocolate liquor	Milk solids	Cocoa butter	Sweetener
Semi-/bitter-sweet	≥30-35%			
Milk	≥10%	≥12%		
White		≥14%	≥20%	≤55%

¹ Survey conducted by the National Confectioners Association: <http://www.candyusa.com/FunStuff/FunFactsDetail.cfm?ItemNumber=976>.

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men had experienced a craving for chocolate (Osman and Sobal, 2006) (Figure 9.1). Chocolate is the most frequently craved food among sweet cravers in the US (Zellner *et al.*, 1999). Roughly 20% of women, but less than 10% of men rated chocolate as their most intensely craved food in a survey of undergraduate students and their parents (Rozin *et al.*, 1991).

These figures suggest that chocolate craving is common in the US, and also highlight the pronounced gender differences consistently observed in studies of craving prevalence, with women up to twice as likely as men to report strong urges for chocolate (Osman and Sobal, 2006; Rozin *et al.*, 1991; Weingarten and Elston, 1991; Zellner *et al.*, 1999). Perimenstrual chocolate craving appears to fully account for these gender differences: across multiple studies, about half of women surveyed report a well-defined craving peak for chocolate in the perimenstrual period, beginning from a few days before the onset and extending into the first few days of menses (Hill and Heaton-Brown, 1994; Rozin *et al.*, 1991; Zellner *et al.*, 2004) (Figure 9.2).

Over the course of several decades, numerous hypotheses have been proposed to explain the etiology of perimenstrual chocolate craving. Studies examining the pharmacology of chocolate, the physiological basis of menstruation, cognitive factors, and the cultural context of craving paint a picture of a complex phenomenon.

9.2 The pharmacology of craving

Cacao contains a number of pharmacologically active ingredients (Bruinsma and Taren, 1999; Rogers and Smit, 2000), including the sympathomimetic amines tyramine and phenylethylamine (Michener *et al.*, 1999), the cannabinoid anandamide (Di Tomaso *et al.*, 1996), and methylxanthines (Smit *et al.*, 2004) (Table 9.3).

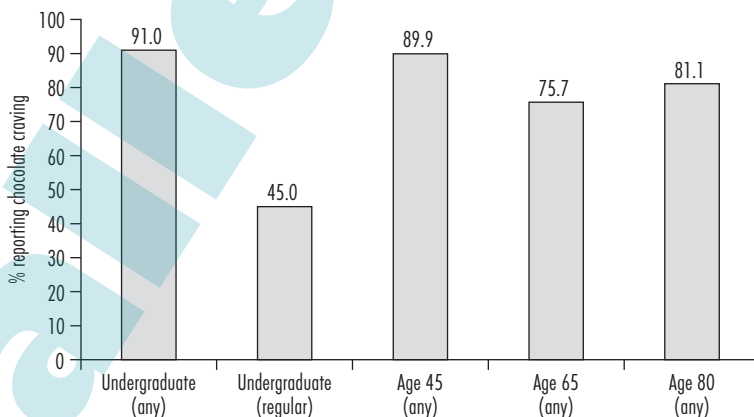


Figure 9.1. Prevalence of chocolate craving ('any' or 'regular' craving) in US women at different ages (Hormes and Rozin, 2009; Osman and Sobal, 2006; Zellner *et al.*, 1999).

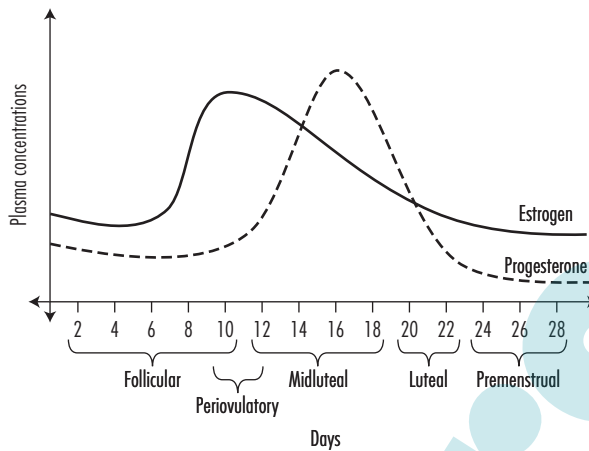


Figure 9.2. Approximate plasma concentrations of oestrogen and progesterone throughout the menstrual cycle (day 1 = onset of menstruation) (Hormes, 2010).

Table 9.3. Examples of chocolate ingredients with hypothesized pharmacological effects (Bruinsma and Taren, 1999; Di Tomaso *et al.*, 1996; Michener and Rozin, 1994; Rogers and Smit, 2000; Smit *et al.*, 2004).

Type	Chocolate ingredient	Hypothesized effect
Methylxanthine	theobromine caffeine	hypothesized to exert stimulant effects
Cannabinoid	anandamine	thought to mimic effects of cannabinoid drugs and induce euphoria, etc.
Sympathomimetic amine	tyramine phenylethylamine	hypothesized to exert stimulant effects
Other	tryptophan casomorphin	serotonin precursor with wide range of hypothesized effects opiod agonist with wide range of hypothesized effects

Two hypotheses implicate the psychoactive effects of chocolate in perimenstrual craving (Figure 9.3):

1. Physiological changes during the perimenstrum induce a deficit state, which is relieved by one or more ingredients in chocolate.
2. Ingredients in chocolate exert positive effects, which are most salient during the perimenstrum.

The claim that perimenstrual chocolate craving occurs in response to a nutritional or physiological deficiency was motivated by observations such as a menstrual drop in levels of magnesium, which has been linked to a variety of affective and physical premenstrual symptoms (Facchinetti *et*

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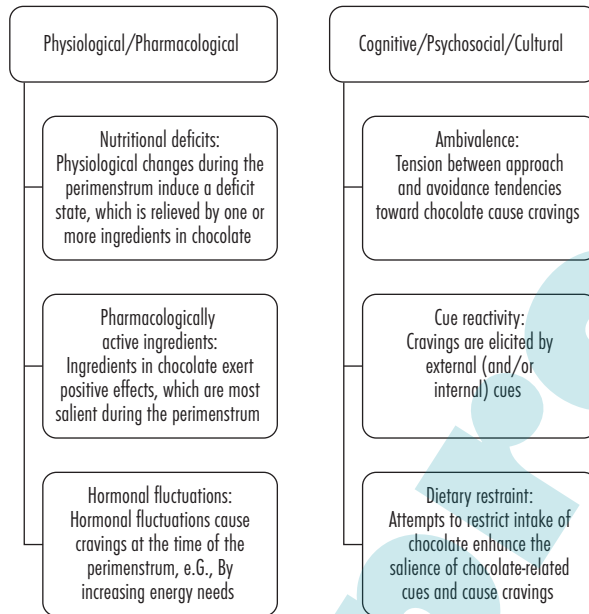


Figure 9.3. Summary of mechanisms hypothesized to play a role in the etiology of perimenstrual chocolate craving.

al., 1991; Quaranta *et al.*, 2007; Rosenstein *et al.*, 1994). Research generally does not support a nutritional or pharmacological deficiency explanation of perimenstrual craving (Pelchat and Schaeffer, 2000). If the body's attempts to restore homeostasis in the face of deficits caused craving it should be rather non-specific and include strong urges for foods of similar nutritional composition as chocolate, for example, those high in magnesium (e.g. cashews or spinach) or tryptophan (e.g. peanuts or bananas). Instead, most craving episodes are highly specific, with few or no apparent substitutes for chocolate to satisfy them (Pelchat, 2002).

It has been speculated that mere caloric depletion increases the frequency of cravings for foods high in sugar, for example, by enhancing the pleasure of sweet taste. Evidence generally does not support this assumption. Responsiveness to both sweet and bitter tastes is attenuated when oestrogen is low (Gong *et al.*, 1989), and consuming a very low-calorie liquid diet tends to decrease, rather than increase, the frequency of food cravings (Martin *et al.*, 2006). A caloric depletion hypothesis fails to account both for the unique perimenstrual pattern of many craving episodes, as well as for the specificity of most cravings: assuming a causal role of a negative energy balance, perimenstrual craving should be more generally for sweet, fatty, or other calorically dense foods.

When considering the pharmacology of cacao, it is important to distinguish between potential physiological triggers of craving and the 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 a deficiency in a certain substance, but may be satisfied by the consumption of that substance. It can thus be hypothesized that instead of alleviating a negative state, chocolate is craved because its consumption results in positive experiences, such as enhanced mood or alertness.

Studies examining links between craving and mood states have had mostly mixed results. Mood states were once reported to be unrelated to food cravings across the menstrual cycle (Bancroft *et al.*, 1988). Subsequent studies found that depressed individuals consume more chocolate (Rose *et al.*, 2010), and identified depressed and dysphoric moods as triggers for chocolate craving (Hill *et al.*, 1991; Willner *et al.*, 1998).

It has been argued that women, who suffer from depression at greater rates than men, use carbohydrates to self-medicate during times of perimenstrual dysphoria, and a dysphoric mood induction has been shown to induce a general preference for foods rich in carbohydrates specifically in women (Corsica and Spring, 2008). Evidence suggests that consumption of carbohydrates increases the availability of tryptophan and mood-enhancing neurotransmitters in the brain (Benton, 2002). Tyramine and phenylethylamine, two ingredients in chocolate, are similar in structure to endogenous neurotransmitters with activating and arousing effects (Michener *et al.*, 1999). However, significantly higher doses than those found in average sized servings of chocolate would need to be ingested to achieve these effects (Rogers and Smit, 2000). Furthermore, recent studies report that consumption of chocolate can lead to significant negative food-related cognitions (Macht and Dettmer, 2006), guilt, anxiety, and depression (Fletcher *et al.*, 2007), suggesting that at least in some, chocolate may not only fail to alleviate dysphoria, but could in fact prolong it (Parker *et al.*, 2006).

The methylxanthines caffeine and theobromine in chocolate increase energetic arousal and well-being and have been hypothesized to alleviate unpleasant physical symptoms associated with the perimenstrum (Rossignol *et al.*, 1991; Smit *et al.*, 2004). However, milk chocolate contains on average only 0.2 mg/g of caffeine and 2 mg/g of the less potent theobromine (Michener and Rozin, 1994; Shivley and Tarka, 1984). The 120 mg of theobromine found in a 60 g portion of milk chocolate are far below what is generally considered a reliable placebo-discriminable dose (Mumford *et al.*, 1994). The same 60 g serving of milk chocolate contains only around 12 mg of caffeine, which is considerably less than the 40-130 mg found in a typical serving of coffee or tea (James, 1991). There is no evidence for a dose-response difference between dark and milk chocolate (Smit *et al.*, 2004), and anecdotally, unlike coffee, chocolate is rarely described as or considered an arousing or energizing food. The effects of any potentially arousing agents in chocolate are thus small at best and unlikely to play a significant role in causing cravings, in general, or perimenstrual craving, specifically.

Chocolate contains the lipid anandamide and its analogues, which have been hypothesized to bind to cannabinoid receptors to heighten sensitivity, induce euphoria, and exert calming and anxiolytic effects (Di Tomaso *et al.*, 1996). It remains unclear if chocolate contains high enough concentrations of anandamide to produce these effects to any noticeable degree (Rogers and

Smit, 2000), and if and why effects would be particularly salient during the perimenstrum. Of note, exogenous administration of the anxiolytic drug alprazolam does not significantly decrease perimenstrual chocolate craving, suggesting that it is unlikely that chocolate is craved specifically for its anti-anxiety effects (Michener *et al.*, 1999).

Compelling evidence against a pharmacological basis of chocolate craving in general comes from a study isolating the orosensory from the pharmacological properties of chocolate (Michener and Rozin, 1994). Consumption of the equivalent of an average serving of chocolate in the form of capsulated cocoa powder was largely ineffective at reducing chocolate cravings. 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 aroma, creamy, melt-in-your-mouth texture, and high caloric density, reduced craving with about half the potency of regular chocolate.

9.3 The physiology of perimenstrual craving

The notion of craving has become so closely tied to the perimenstrum that ‘specific food cravings’ are included as a criterion in the diagnosis of premenstrual dysphoric disorder (APA, 2000). Of note, the link between the menstrual cycle and craving appears to extend to a variety of non-food substances as well. Smokers are more likely to experience craving during the luteal phase of the menstrual cycle (Carpenter *et al.*, 2006); similarly, alcohol-dependent women identify the premenstrum as a drinking cue (Epstein *et al.*, 2006) (Figure 9.2).

Based on the pronounced cyclic pattern of chocolate and other cravings in many women, it was once widely suggested that hormonal fluctuations, or other mechanisms associated specifically with the menstrual cycle, play a causal role in perimenstrual chocolate craving. An early study found no significant association between levels of the oestrogen estradiol and the frequency or types of cravings (Rodin *et al.*, 1991). The hypothesis that a cyclic fall in progesterone (Figure 9.2) induces perimenstrual chocolate craving was not supported in subsequent research that demonstrated that exogenous administration of progesterone, an inhibitor of estradiol and its effects, does not effectively reduce craving at the time of the perimenstrum (Michener *et al.*, 1999).

If cyclic fluctuations in levels of hormones were to play a causal role in approximately half of the incidence of chocolate craving observed among US women, one would expect craving prevalence to drop by about 50% in post-menopausal women. However, a survey of three groups of women ages 45, 65, and 80 found that a significant proportion of women at all ages crave chocolate regularly (Hormes and Rozin, 2009) (Figure 9.1). Most importantly, there was a striking absence of a drop in craving prevalence post-menopause that was high enough (i.e. about 50%) to support a causal role of cyclic fluctuations in hormones in the etiology of perimenstrual chocolate craving in women pre-menopause (Hormes and Rozin, 2009). In spite of the temporal association

between the menstrual cycle and chocolate craving, the two do not appear to be causally linked such that perimenstrual changes in levels of hormones directly bring about cravings.

9.4 Craving and cognition

Since the actual onset of menstruation is triggered not by hormonal changes, but rather by localized events, including increased coiling of spiral arteries, ischemia, and shedding of the endometrium, it is an occurrence of psychological rather than systemic significance. Furthermore, the typical pattern of craving reported by many female chocolate cravers in the US is characterized by peaks in frequency and intensity beginning some days prior to menstruation. As such, perimenstrual chocolate craving may well be driven by psychological, rather than physiological, factors (Figure 9.3).

9.4.1 Ambivalence to chocolate

Chocolate is widely, though incorrectly, stigmatized as lacking in nutrients and its consumption is associated with weak willpower. Since it is simultaneously very palatable and high in caloric density, chocolate can evoke powerful conflicting thoughts and feelings (Cartwright and Stritzke, 2008; Rogers and Smit, 2000). Women in particular hold ambivalent views of sweet snacks as being both unhealthy and pleasant (Grogan *et al.*, 1997). In a survey of female American college students, 14% reported feeling embarrassed when buying a chocolate bar at the store (Rozin *et al.*, 2003). More than a quarter of US women include both positive and negative words when giving three free associations to 'chocolate' (Rozin, unpublished observation). In some normal-weight women, consumption of a bar of chocolate elicited both elevated mood and feelings of guilt (Macht and Dettmer, 2006). Exposing women to calorically dense foods has been shown to inhibit their salivary response, suggesting that they experience significant anxiety when faced with palatable foods that are perceived as 'forbidden' (Rogers and Hill, 1989; Rosen, 1981; Wooley and Wooley, 1981).

Several studies have begun to examine the role of attitudinal and affective ambivalence in the experience of craving. Data supports a three-factor ambivalence model of chocolate craving, with three components reflecting underlying approach and avoidance inclinations, along with guilt (Cartwright and Stritzke, 2008). In US undergraduates surveyed while presented with a bar of chocolate, the degree of ambivalent affect reported was significantly and positively associated with their desire to eat the chocolate, but significantly and inversely correlated with the amount of chocolate subsequently consumed (Hormes and Rozin, 2011). In other words, the more conflicted they felt, the more respondents wanted to eat the chocolate, but the less likely they were to actually do so. Giving in to a craving as it emerges tends to enhance positive mood, whereas resisting before eventually giving in to it triggers increases in negative mood (Hill *et al.*, 1991). Based on these preliminary findings, the role of ambivalence in craving, and perimenstrual craving, in particular, should be examined further.

9.4.2 Cue-reactivity and thought elaboration

Eating is elicited by external non-food cues, such as time of day or place (Weingarten, 1984). It has been argued that cue-induced eating plays a role in chocolate craving, such that certain cues that are present when eating chocolate become associated with chocolate and trigger cravings on future occasions (Zellner and Edwards, 2001). 'Incentive sensitization' theory postulates that repeated activation of mesolimbic dopamine neurotransmission enhances the salience and motivational value of drug rewards and drug-related cues, thereby transforming mere 'wanting' (which is thought to be distinct from 'liking', based on separate underlying neural systems) into craving (Berridge, 2009; Robinson and Berridge, 1993). The way in which the notion of incentive sensitization may apply to perimenstrual chocolate craving in particular remains to be determined.

Chocolate cravers show a strong attentional bias for chocolate-related cues (Kemps and Tiggemann, 2009; Smeets *et al.*, 2009), and cue-elicited craving appears to interfere with limited cognitive resources (Kemps and Tiggemann, 2010). Acute chocolate craving specifically impairs visuo-spatial aspects of working memory performance, suggesting that in terms of underlying cognitive processes, craving is largely visual in nature (Tiggemann *et al.*, 2010). Indeed, when people crave, they report experiencing vivid images of the desired substance (May *et al.*, 2004), and visuo-spatial tasks have been shown to effectively reduce craving for chocolate and cigarettes (Andrade *et al.*, 2012; May *et al.*, 2010). Recent research demonstrates that mere thoughts about a craved food can strengthen and maintain cravings over extended periods of time. The 'Elaborated intrusion' theory postulates that craving is the result of cue-elicited intrusive thoughts about the craved substance and elaborative processes that increase the salience of thoughts and mental images related to the craved substance (Kavanagh *et al.*, 2005; May *et al.*, 2012). As is the case with most theories of craving, more work is needed to apply the construct of elaborated intrusion specifically to perimenstrual craving.

9.4.3 Dietary restraint

As noted previously, 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. Many women attempt to resolve their ambivalence in favour of abstinence from chocolate. Levels of dietary restraint have been shown to be positively associated with food cravings (Hill *et al.*, 1991), and deprivation triggers craving and overeating specifically in restrained eaters (Polivy *et al.*, 2005). Successful maintenance of dietary restraint requires cognitive effort and attention-demanding tasks, which necessitate allocation of cognitive resources, increase the likelihood of disinhibited eating in highly restrained eaters (Ward and Mann, 2000). Of note, women who link chocolate craving to the menstrual cycle reported significantly higher levels of dietary restraint than those who did not perceive any temporal association (Hormes and Timko, 2011). The possibility that dietary restraint plays a particularly important role in the etiology of perimenstrual craving should be examined in future research.

9.5 Culture and craving

Food choice is closely tied to cultural identity. For example, most Americans associate the consumption of chocolate with culture-specific holidays, such as Easter or Valentine's Day (Osman and Sobal, 2006). Somewhat ironically, American culture, which promotes chocolate as a special treat and antidote for negative mood states, is characterized by the presence of significant conflict around its consumption. It appears that this ambivalent view of chocolate is not universal, but rather culturally bound. For example, American women are likely to report feeling bad after eating chocolate, while Spanish women experience mostly positive or neutral mood states (Osman and Sobal, 2006).

As noted previously, food cravings are extremely common in the US and Canada. However, in New Zealand, which is another English-speaking country, a survey of 18 to 45 year-old women found that only 52% had ever experienced any food cravings unrelated to pregnancy (Gendall *et al.*, 1997). Sweet cravings are virtually absent in other regions: craving for chocolate represented a mere 1% and 6% of cravings reported by young Egyptian men and women (Parker *et al.*, 2003). Rice was the most commonly craved food in a survey of Japanese women (Komatsu, 2008).

Interestingly, in any given country there is an inverse relationship between the amount of raw cacao produced and the amount of chocolate consumed: Belgian and Luxembourgish per capita consumption of chocolate is about 5.9 kg a year, but in the world's two leading cacao producing countries, the Ivory Coast and Indonesia, annual consumption of chocolate is only about 454 and 36 g per capita, respectively (Richardson, 2003). Furthermore, many non-chocolate sweets are an important part of local food culture in countries such as Egypt, yet most Egyptians desire primarily savoury foods (Parker *et al.*, 2003). While access to cacao does not appear to be a primary factor in determining the nature or prevalence of chocolate cravings, the extent to which regional availability of processed chocolate products may play a role remains to be determined.

Even in countries that report cravings for specific foods, there is a striking absence of the marked gender differences that characterize chocolate craving in the US (Zellner *et al.*, 1999). The link between being female and craving chocolate appears uniquely engrained in American culture: American men and women believe that chocolate craving occurs more frequently in women than in men, while Spanish men generally feel that craving is gender neutral (Osman and Sobal, 2006). While half of American women link chocolate craving to the menstrual cycle, only 28% of Spanish women did the same (Osman and Sobal, 2006).

The notion of chocolate craving has become part of American cultural vocabulary, but marked cultural differences in the perception and use of chocolate raise questions about the extent to which 'craving' is an important construct outside of North America. Using a linguistic approach, a recent study found that the term 'craving' does not lexicalize in a majority of languages other than English (Hormes and Rozin, 2010). When a rough translation is available, it often refers to strong desires for food specifically during pregnancy (e.g. 'antojo' in Spanish). Indeed, the cross-cultural studies described here note the use of descriptive phrases such as 'what food or drink do

you want very intensely?’ in place of equivalent translations (Osman and Sobal, 2006; Parker *et al.*, 2003). Assuming that lexicalization reflects the universality of certain concepts (Wierzbicka, 1999), findings suggests that the notion of craving may be limited in its importance to the US or North America (Hormes and Rozin, 2010). The role of cultural factors in the high prevalence of perimenstrual chocolate craving in the US merits further study.

9.6 Conclusions

A number of attempts have been made to explain the phenomenon of perimenstrual chocolate craving (Figure 9.3). More work remains in to be done, but there is sufficient evidence to rule out some hypotheses and to begin to integrate others into a new, testable model. Research to date speaks strongly against a direct role of the pharmacology of chocolate or the physiological mechanisms involved in regulating menstruation in the etiology of perimenstrual chocolate craving. Though still preliminary, evidence instead suggests that complex cognitive processes and cultural context play a key role: in North America, where chocolate is a source of much ambivalence, women in particular seek to resolve this ambivalence in favour of abstinence, exerting significant cognitive effort in an attempt to maintain dietary restraint. Under these circumstances, chocolate-related cues increase in salience, and otherwise fleeting thoughts about chocolate are elaborated upon to the point at which they are experienced as ‘craving.’ In this context, the perimenstrum comes to serve as an easily recognizable, socially acceptable, and culturally sanctioned excuse for women to break restraint and indulge in otherwise forbidden treats (Rogers and Smit, 2000).

It must be noted that many theories and studies discussed here focus on chocolate craving in general and more work is needed to examine if and how they can help elucidate the phenomenon of perimenstrual chocolate craving. In turn, it also remains to be determined if a better understanding of perimenstrual chocolate craving may shed light on non-menstrual chocolate craving and craving in men. Similarly, since there is evidence to suggest that cravings for non-food substances such as tobacco and alcohol may be more prevalent or pronounced perimenstrually, a better understanding of the etiology of perimenstrual chocolate craving may potentially generalize to other ingested substances.

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