Appetite 91 (2015) 256–265

Contents lists available at ScienceDirect

Appetite

journal homepage: www.elsevier.com/locate/appet

Research report

Chocolate versions of the *Food Cravings Questionnaires*. Associations with chocolate exposure-induced salivary flow and ad libitum chocolate consumption ☆

Adrian Meule [a,b,*], Julia M. Hormes [c]

[a] *Institute of Psychology, University of Würzburg, Würzburg, Germany*
[b] *Hospital for Child and Adolescent Psychiatry, LWL University Hospital, Ruhr University Bochum, Hamm, Germany*
[c] *Department of Psychology, University at Albany, State University of New York, Albany, NY, USA*

ARTICLE INFO

Article history:
Received 28 January 2015
Received in revised form 21 March 2015
Accepted 15 April 2015
Available online 23 April 2015

Keywords:
Food craving
Chocolate
Food Cravings Questionnaires
Salivation
Salivary flow
Hunger

ABSTRACT

The *Food Cravings Questionnaires* are the most commonly used instruments for the assessment of trait and state food craving. Chocolate is the most frequently craved food in Western societies. In the current studies, the *Food Cravings Questionnaire-Trait-reduced* (FCQ-T-r) and the *Food Cravings Questionnaire-State* (FCQ-S) were adapted to capture strong urges for chocolate. In study 1, students ($n = 492$; 81.3% female) completed chocolate versions of the FCQ-T-r and FCQ-S among other measures online. The FCQ-T-r ($\alpha = .94$) comprised two subscales representing *lack of control* ($\alpha = .91$) and *thoughts about chocolate* ($\alpha = .91$). The FCQ-S ($\alpha = .87$) comprised two subscales representing *chocolate craving* ($\alpha = .90$) and *hunger* ($\alpha = .85$). FCQ-T-r scores were significantly and positively correlated with self-reported frequency of consuming chocolate and with scores on the *Attitudes to Chocolate Questionnaire*, indicating good convergent validity. In study 2, students ($n = 76$; 73.7% female) underwent a chocolate exposure in the laboratory. FCQ-S scores increased during chocolate exposure and increases in momentary chocolate craving were significantly positively correlated with increases in salivary flow. Higher momentary chocolate craving was positively correlated with higher laboratory chocolate consumption. Exploratory analyses revealed that increases in salivary flow were only associated with increased chocolate consumption in participants scoring high, but not low on trait chocolate craving. The chocolate versions of the FCQ-T-r and FCQ-S represent reliable and valid self-report measures for the assessment of trait and state chocolate craving.

Introduction

Food craving refers to an intense desire to eat a specific food (Hormes & Rozin, 2010). In Western societies, the most commonly craved food is chocolate, particularly in women (Rozin, Levine, & Stoess, 1991; Weingarten & Elston, 1991). Food craving is usually measured with self-report questionnaires, of which two of the most frequently used are the *Food Cravings Questionnaires* (FCQs; Cepeda-Benito, Gleaves, Fernández et al., 2000; Cepeda-Benito, Gleaves, Williams, & Erath, 2000).

The FCQs consist of a trait version (FCQ-T) and a state version (FCQ-S), designed to capture stable aspects of the craving experience and dynamic changes in craving, respectively. The FCQ-T assesses the frequency of food craving experiences with 39 items, response categories of which range from *never/not applicable* to *always*. The original English and Spanish versions consist of nine subscales representing the multiple dimensions of food craving: (1) having intentions and plans to consume food, (2) anticipation of positive reinforcement that may result from eating, (3) anticipation of relief from negative states and feelings as a result of eating, (4) lack of control over eating, (5) thoughts or preoccupation with food, (6) craving as a physiological state, (7) emotions that may be experienced before or during food cravings or eating, (8) cues that may trigger food cravings, and (9) guilt from cravings and/or for giving into them (Cepeda-Benito, Gleaves, Fernández et al., 2000). However, this factorial structure could not be replicated in several subsequent studies (Crowley et al., 2012, 2014; Meule, Lutz, Vögele, & Kübler, 2012a; Rodríguez-Martín & Molerio-Pérez, 2014; Vander Wal, Johnston, & Dhurandhar, 2007). Moreover, internal consistency of the FCQ-T is very high (usually $\alpha > .90$) and, therefore, researchers often report FCQ-T total scores only.

In order to address these issues, a reduced version of the FCQ-T (FCQ-T-r) was developed recently, which consists of 15 items and has a one-factorial structure (Meule, Hermann, & Kübler, 2014). The FCQ-T-r was initially validated in German, but its psychometric

☆ *Acknowledgments:* The authors would like to thank Sophia Backhaus, Katrin Beck, Ursula Becker, Julia Fischer, Marie Friedmann, Christian Ganster, Johannes Goldschmitt, Tina Hermann, Nina Pfrommer, Stephen Pfrommer, Julia Semineth, Nina Vierheilig, and Pauline Zahn for collecting the data.
* Corresponding author.
E-mail address: adrian.meule@rub.de (A. Meule).

http://dx.doi.org/10.1016/j.appet.2015.04.054
0195-6663/

properties and correlates have since been replicated in Spanish, Italian and English as well (Hormes & Meule, submitted; Innamorati et al., 2015; Rodríguez-Martín & Molerio-Pérez, 2014).

The FCQ-S assesses momentary food craving with 15 items, response categories of which range from *strongly disagree* to *strongly agree*. The original English and Spanish versions consist of five subscales representing (1) an intense desire to eat, (2) anticipation of positive reinforcement that may result from eating, (3) anticipation of relief from negative states and feelings as a result of eating, (4) lack of control over eating, and (5) craving as a physiological state (i.e., hunger; Cepeda-Benito, Gleaves, Fernández et al., 2000; Cepeda-Benito, Gleaves, Williams et al., 2000). Like for the trait version, however, the proposed factor structure could only be partially replicated in recent studies (Meule et al., 2012a; Vander Wal et al., 2007) and internal consistency is usually very high ($\alpha > .90$), leading many researchers to report its total score only.

The wording of the FCQs simply asks respondents to indicate agreement with the items of the scale and does not specify a specific food they should think of when completing the questionnaires. While this is commonly considered an advantage of the FCQs over other food craving questionnaires that are restricted to one or more specific foods (cf. Martin, McClernon, Chellino, & Correa, 2011), the general nature of the FCQs may be disadvantageous in some instances, depending on the question of research. Rodriguez et al. (2007) developed an adaptation of the FCQ-T for the assessment of chocolate craving in British and Spanish women. They concluded that the FCQ-T can be adapted successfully to assess specific food cravings in addition to foods in general and that the chocolate-adapted version is well suited to investigate chocolate craving in English- and Spanish-speaking populations. To date, no study has examined chocolate-adapted versions of the FCQ-T-r and FCQ-S. Thus, the aim of the present studies was to develop and validate these versions using the German versions of the FCQ-T-r and FCQ-S.

Study 1

Study 1 was a questionnaire-based study in which factor structure and correlates of the chocolate-adapted FCQ-T-r and FCQ-S were investigated. Based on the one-factorial structure of the FCQ-T-r, we hypothesized that its chocolate version would also show a one-factorial structure. However, as no study has used such a version before, we used exploratory factor analysis for testing factor structure. As the FCQ-S contains three items assessing hunger (i.e., without any reference to one or more specific foods; see method section), we expected that its chocolate-adapted version would consist of two factors, representing *chocolate craving* and *hunger*. Although trait and state food craving can be clearly differentiated with the FCQs, scores on the FCQ-T/FCQ-T-r and the FCQ-S have been shown to be weakly and positively correlated (Meule, Beck Teran et al., 2014). Hence, we expected that trait chocolate craving would be positively correlated with state chocolate craving, but not with state hunger.

Studies using the FCQ-T/FCQ-T-r consistently show that women and current dieters have higher trait food craving scores than men and non-dieters, respectively, and that higher trait food craving scores are associated with higher body mass index (BMI) and lower dieting success (e.g., Cepeda-Benito, Fernandez, & Moreno, 2003; Hormes, Orloff, & Timko, 2014; Meule, Hermann et al., 2014; Meule et al., 2012a; Meule, Westenhöfer, & Kübler, 2011). Accordingly, we expected to find similar associations between these variables and the chocolate version of the FCQ-T-r in the present study.

The *Attitudes to Chocolate Questionnaire* (ACQ; Benton, Greenfield, & Morgan, 1998) measures trait chocolate craving and guilt associated with chocolate craving and consumption (see methods). Scores on its craving subscale have been found to be associated with self-reported frequency of consuming chocolate (Benton et al., 1998; Van Gucht, Soetens, Raes, & Griffith, 2014). As the FCQ-T-r does not contain any items of the FCQ-T's guilt subscale (Meule, Hermann et al., 2014), we expected that scores on the chocolate version of the FCQ-T-r would be highly, positively correlated with scores on the craving subscale of the ACQ and to a lesser extent with scores on the guilt subscale of the ACQ. Moreover, similar to what has been found with the ACQ, we expected that scores on the chocolate version of the FCQ-T-r would be positively correlated with self-reported frequency of consuming chocolate.

Scores on the FCQ-S have typically been found to be positively correlated with current food deprivation, that is, the time since participants' last meal (Cepeda-Benito et al., 2003; Meule, Hermann et al., 2014; Meule et al., 2012a). Accordingly, we hypothesized that current general food deprivation would be positively correlated with scores on the chocolate version of the FCQ-S and that this association would be particularly pronounced for its hunger subscale, but smaller for its craving subscale.

Methods

Participants and procedure

A link to the online survey was distributed via e-mail to student mailing lists at several universities in Germany. Participation was voluntary and participants did not receive any compensation. Study duration was two weeks. Every question required a response in order to continue. The website was visited 833 times and $n = 612$ participants started questionnaire completion. Of these, $n = 498$ participants completed the entire set of questions. The website's (https://www.soscisurvey.de) data quality check, which is based on the time participants spent on each page, was used to exclude participants who answered the questions carelessly (i.e., spent little time on each page). As a result, data of $n = 6$ participants were excluded from analyses, leaving a final sample size of $n = 492$.

Most participants were women (81.3%, $n = 400$), students (86.8%, $n = 427$), and had German citizenship (92.9%, $n = 457$). Mean age was $M = 24.58$ years ($SD = 5.05$, Range: 18–56). Mean BMI was $M = 22.05$ kg/m^2 ($SD = 3.27$; Range: 14.13–42.83; $n = 39$ [7.9%] underweight [BMI < 18.50 kg/m^2], $n = 395$ [80.3%] normalweight [BMI = 18.50–24.99 kg/m^2], $n = 48$ [9.8%] overweight [BMI = 25.00–29.99 kg/m^2], $n = 10$ [2.0%] obese [BMI ≥ 30.00 kg/m^2]). Note that this sample is not representative of the general population in Germany, where in a comparable age group (18–29 years) mean BMI is higher (approximately 24 kg/m^2) and only around 65% are in the normalweight range (Mensink et al., 2013). Mean latency since the last meal consumed was $M = 2.79$ hours ($SD = 3.73$, Range: 0–24). One-hundred and seventy-seven participants (36.0%) reported to be current dieters.

Measures

Chocolate version of the Food Cravings Questionnaire-Trait-reduced (FCQ-T-r)

The term 'chocolate' was incorporated into each item of the general version of the German FCQ-T-r (Table 1). Response categories were the same as in the original version, that is, responses were scored 1–6 ranging from *never/not applicable* to *always*.

Chocolate version of the Food Cravings Questionnaire-State (FCQ-S)

References to 'one or more specific foods' in the general version of the German FCQ-S were substituted with 'chocolate' (Table 2). As the FCQ-S contains three items for the measurement of hunger, which do not allow for a reference to specific foods, these items were not changed (items 13–15, Table 2). Response categories were the same as in the original version, that is, responses were scored 1–5 ranging from *strongly disagree* to *strongly agree*.

Table 1
Factor loadings and item statistics of the chocolate version of the *Food Cravings Questionnaire-Trait-reduced* in study 1.

Item	Factor		*M*	*SD*	r_{itc}
	Control	Thoughts			
1. When I crave chocolate, I know I won't be able to stop eating once I start. [Wenn ich ein starkes Verlangen nach Schokolade verspüre, weiß ich, dass ich nicht mehr aufhören kann zu essen, wenn ich erst mal angefangen habe.]	.96		2.88	1.45	.75
2. If I have a chocolate craving, I often lose control and eat too much. [Wenn ich ein starkes Verlangen nach Schokolade verspüre, verliere ich oft die Kontrolle und esse zu viel davon.]	.95		3.03	1.51	.76
3. Chocolate cravings invariably make me think of ways how to get chocolate. [Wenn ich ein starkes Verlangen nach Schokolade verspüre, denke ich ausnahmslos darüber nach, wie ich Schokolade bekomme.]		.66	2.28	1.28	.76
4. I feel like I have chocolate on my mind all the time. [Ich habe das Gefühl, dass ich die ganze Zeit nur Schokolade im Kopf habe.]		.87	1.56	0.87	.71
5. I find myself preoccupied with chocolate. [Ich ertappe mich dabei, wie ich mich gedanklich ständig mit Schokolade beschäftige.]		.89	1.57	0.84	.67
6. Whenever I have chocolate cravings, I find myself making plans to eat chocolate. [Immer wenn ich ein starkes Verlangen nach Schokolade verspüre, merke ich, dass ich gleich plane welche zu essen.]		.61	2.83	1.40	.63
7. I crave chocolate when I feel bored, angry, or sad. [Ich verspüre ein starkes Verlangen nach Schokolade, wenn ich mich gelangweilt, wütend oder traurig fühle.]		.45	2.96	1.42	.63
8. I have no will power to resist my chocolate crave. [Ich habe nicht die Willensstärke, um meinen Schokoladengelüsten widerstehen zu können.]	.50		2.60	1.35	.65
9. Once I start eating chocolate, I have trouble stopping. [Wenn ich einmal anfange Schokolade zu essen, fällt es mir schwer wieder aufzuhören.]	.97		3.10	1.53	.75
10. I can't stop thinking about chocolate no matter how hard I try. [Ich kann nicht aufhören über Schokolade nachzudenken, wie sehr ich mich auch bemühe.]		.87	1.53	0.85	.73
11. If I give in to a chocolate craving, all control is lost. [Wenn ich dem starken Verlangen nach Schokolade nachgebe, verliere ich jegliche Kontrolle.]	.56	.33	1.84	1.28	.75
12. Whenever I have a chocolate craving, I keep on thinking about eating chocolate until I actually eat it. [Immer wenn ich ein starkes Verlangen nach Schokolade verspüre, denke ich so lange weiter ans Schokolade essen, bis ich diese tatsächlich esse.]		.81	2.15	1.27	.73
13. If I am craving chocolate, thoughts of eating it consume me. [Wenn ich ein starkes Verlangen nach Schokolade verspüre, verzehren mich die Gedanken daran diese zu essen geradezu.]		.85	1.69	1.09	.71
14. My emotions often make me want to eat chocolate. [Meine Emotionen bringen mich oft dazu Schokolade essen zu wollen.]		.56	2.47	1.35	.61
15. It is hard for me to resist the temptation to eat chocolate that is in my reach. [Wenn sich Schokolade in meiner Reichweite befindet, fällt es mir schwer der Versuchung zu widerstehen sie zu essen.]	.75		3.28	1.45	.69

Notes: German item wording in square brackets. Only factor loadings >.30 are displayed.

Table 2
Factor loadings and item statistics of the chocolate version of the *Food Cravings Questionnaire-State* in study 1.

Item	Factor		*M*	*SD*	r_{itc}
	Craving	Hunger			
1. I have an intense desire to eat chocolate. [Ich verspüre den intensiven Wunsch Schokolade zu essen.]	.77		2.28	1.17	.70
2. I'm craving chocolate. [Ich verspüre ein starkes Verlangen nach Schokolade.]	.81		2.14	1.12	.73
3. I have an urge for chocolate. [Ich verspüre den Drang Schokolade zu essen.]	.78		2.13	1.12	.68
4. Eating chocolate would make things seem just perfect. [Schokolade zu essen, würde mir alles einfach perfekt erscheinen lassen.]	.74		1.71	0.96	.61
5. If I were to eat chocolate, I am sure my mood would improve. [Wenn ich Schokolade essen würde, würde sich sicher meine Stimmung verbessern.]	.70		2.59	1.23	.63
6. Eating chocolate would feel wonderful. [Schokolade zu essen würde sich großartig anfühlen.]	.72		2.78	1.26	.63
7. If I ate chocolate, I wouldn't feel so sluggish and lethargic. [Wenn ich Schokolade essen würde, würde ich mich nicht so träge und antriebslos fühlen.]	.56		1.82	0.95	.52
8. Satisfying my chocolate craving would make me feel less grouchy and irritable. [Wenn ich mein Verlangen nach Schokolade stillen könnte, würde ich mich weniger schlecht gelaunt und gereizt fühlen.]	.69		1.97	1.09	.59
9. I would feel more alert if I could satisfy my chocolate craving. [Wenn ich mein Verlangen nach Schokolade stillen könnte, würde ich mich munterer fühlen.]	.66		1.99	1.02	.60
10. If I had chocolate, I could not stop eating it. [Wenn ich Schokolade hätte, könnte ich nicht aufhören davon zu essen.]	.54		2.71	1.43	.38
11. My desire to eat chocolate seems overpowering. [Mein Verlangen Schokolade zu essen scheint überwältigend zu sein.]	.72		1.64	0.97	.55
12. I know I'm going to keep on thinking about chocolate until I actually have it. [Ich weiß, dass ich solange an Schokolade denken werde, bis ich sie tatsächlich habe.]	.67		1.78	1.08	.53
13. I am hungry. [Ich habe Hunger.]		.91	2.20	1.29	.28
14. If I ate right now, my stomach wouldn't feel as empty. [Wenn ich jetzt etwas essen würde, würde sich mein Magen nicht mehr so leer anfühlen.]		.90	2.36	1.37	.32
15. I feel weak because of not eating. [Ich fühle mich schwach, weil ich nichts gegessen habe.]		.79	1.55	0.89	.25

Notes: German item wording in square brackets. Only factor loadings >.30 are displayed.

Perceived Self-Regulatory Success in Dieting (PSRS)

The PSRS (Fishbach, Friedman, & Kruglanski, 2003; Meule, Papies, & Kübler, 2012) consists of three items and measures how successful participants are in watching their weight or losing weight and how easy it is for them to stay in shape. Responses are scored on a scale ranging from 1 (=*not successful/not difficult*) to 7 (=*very successful/very difficult*). Internal consistency was $\alpha = .72$ in the current study.

Attitudes to Chocolate Questionnaire (ACQ)

The ACQ (Benton et al., 1998) consists of 24 items and was originally proposed to measure craving for chocolate and eating chocolate for emotional reasons (*craving*), negative feelings associated with eating chocolate (*guilt*), and eating chocolate for functional reasons (*functional*). Responses were recorded on a 10 cm visual analog scale anchored *not at all like me* and *very much like me*. However, subsequent studies revealed that a 22-item, two-factor solution representing *craving* and *guilt* ought to be preferred over the original factor structure (Cramer & Hartleib, 2001; Müller, Dettmer, & Macht, 2008; Van Gucht et al., 2014). Thus, we calculated those two subscales in the current study. Participants indicated their responses using a slider bar that were scored 1–10. Internal consistency was $\alpha = .85$ for the craving subscale and $\alpha = .90$ for the guilt subscale in the current study.

Sociodemographic, anthropometric and other information

Participants were asked to report their age (in years), sex (male/female), body height (in m), body weight (in kg), occupation (student/other), citizenship (German/other), and time since their last meal (in hours). Current dieting status (yes/no) was determined with a single question ("Are you currently restricting your food intake to control your weight [e.g. by eating less or avoiding certain foods]?"; cf. Meule, Lutz, Vögele, & Kübler, 2012b). Chocolate consumption was assessed with the question "How often do you eat chocolate?", responses of which were recorded on a four-point scale (*never/rarely*, *once or several times a month*, *once or several times a week*, *almost daily/daily*).

Data analyses

Sample size far exceeded the minimum 5:1 subjects-to-item ratio necessary for exploratory factor analysis (Costello & Osborne, 2005). Factor analyses of FCQ-T-r and FCQ-S data were carried out with the program FACTOR Version 9.2 (Lorenzo-Seva & Ferrando, 2013). Principal Component Analysis was chosen as extraction method and Promax ($\kappa = 4$) was selected as rotation method. The number of factors was determined by Minimum Average Partial (MAP) test. Pearson's product moment correlation coefficients were used to examine associations between trait and state chocolate craving, BMI, food deprivation, chocolate consumption, ACQ scores, and dieting success. Independent *t*-tests were used to examine associations between trait and state chocolate craving WITH sex and dieting status. Exact *p*-values (two-tailed) are reported in case of significance ($p \leq .05$), except for $p < .001$. *P*-values >.05 are denoted as *ns*.

Results

Factor structure and reliability

FCQ-T-r

The Kaiser–Meyer–Olkin Measure of Sampling Adequacy (KMO = 0.94) and statistically significant Bartlett's Test of Sphericity ($\chi^2_{(105)} = 5640.7$, $p < .001$) indicated that the data were adequate for conducting an exploratory factor analysis. The MAP test indicated two dimensions (lowest averaged partial .03), which explained 65.6% of variance (component 1: 56.0%, component 2: 9.6%). Items

of the first factor (3, 4, 5, 6, 7, 10, 12, 13, 14) included items of the original version's subscales *thoughts or preoccupation with food* (5 items), *intentions and plans to consume food* (2 items) and *emotions* (2 items) (Cepeda-Benito, Gleaves, Williams et al., 2000). Thus, we termed this the *thoughts* subscale. Items of the second factor (1, 2, 8, 9, 11, 15) included items of the original version's subscales *lack of control over eating* (5 items) and *cues that may trigger food cravings* (1 item) (Cepeda-Benito, Gleaves, Williams et al., 2000). Thus, we termed this the *control* subscale. Internal consistencies were $\alpha = .91$ (*control* subscale), $\alpha = .91$ (*thoughts* subscale), and $\alpha = .94$ (total scale). Items, factor loadings, and item statistics are displayed in Table 1.

FCQ-S

The Kaiser–Meyer–Olkin Measure of Sampling Adequacy (KMO = 0.87) and Bartlett's Test of Sphericity ($\chi^2_{(105)} = 4254.4$, $p < .001$) indicated that the data were adequate for conducting an exploratory factor analysis. The MAP test indicated two dimensions (lowest averaged partial .04), which explained 55.4% of variance (component 1: 39.9%, component 2: 15.4%). Items of the first factor (12, 13, 14) were the items of the original version's subscale *craving as a physiological state* (Cepeda-Benito, Gleaves, Williams et al., 2000). Thus, we termed this the *hunger* subscale. Items of the second factor (1–12) included items of the original version's subscales *intense desire to eat*, *anticipation of positive reinforcement*, *anticipation of negative reinforcement*, and *lack of control over eating* (Cepeda-Benito, Gleaves, Williams et al., 2000). Thus, we termed this the *craving* subscale. Internal consistencies were $\alpha = .90$ (*craving* subscale), $\alpha = .85$ (*hunger* subscale), and $\alpha = .87$ (total scale). Items, factor loadings, and item statistics are displayed in Table 2.

Correlates of trait and state chocolate craving

Higher trait chocolate craving was strongly correlated with higher scores on the craving subscale of the ACQ, moderately correlated with higher scores on the guilt subscale of the ACQ, higher chocolate consumption, lower dieting success, and higher state chocolate craving, and weakly correlated with higher BMI (Table 3). Higher state chocolate craving was also positively associated with ACQ *craving* and *guilt* scores, frequency of chocolate consumption, and perceived dieting success, but not with BMI (Table 3). Only FCQ-S *hunger* subscale scores were significantly correlated with current food deprivation (Table 3). Women reported higher trait and state chocolate craving than men, but did not differ in current hunger (Table 4). Current dieters reported higher trait chocolate craving than non-dieters, but did not differ in state chocolate craving or hunger (Table 4).

Conclusion of study 1

The chocolate versions of the FCQ-T-r and FCQ-S had good to excellent internal consistencies. Contrary to our initial hypotheses, the FCQ-T-r contained two subscales assessing (1) a lack of *control* over eating chocolate and (2) *thoughts* about and preoccupation with chocolate. In line with expectations, the FCQ-S combined the subscales assessing momentary (1) chocolate *craving* and (2) *hunger*. Higher levels of trait chocolate craving were associated with higher BMI, more frequent chocolate consumption, higher scores on the ACQ, and lower dieting success. Current dieters and women had higher FCQ-T-r scores than non-dieters and men. Higher scores on the FCQ-S *hunger* subscale, but not on its *craving* subscale were

Table 3
Descriptive statistics of and correlations between continuous study variables in study 1.

$n = 492$	*M* (*SD*)	Range	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. FCQ-T-r – control	16.73 (7.19)	6–36	–	.73***	.92***	.48***	–.12*	.40***	.14**	–.08	.34***	.70***	.52***	–.30***
2. FCQ-T-r – thoughts	19.03 (8.03)	9–49		–	.94***	.54***	–.05	.47***	.06	–.03	.42***	.79***	.40***	–.31***
3. FCQ-T-r – total	35.76 (14.15)	15–82			–	.55***	–.09	.47***	.11*	–.06	.41***	.80***	.49***	–.33***
4. FCQ-S – craving	25.52 (9.32)	12–54				–	.15**	.95***	.00	–.03	.42***	.59***	.24***	–.12**
5. FCQ-S – hunger	6.11 (3.15)	3–15					–	.44***	–.05	.39***	–.01	–.06	–.08	.01
6. FCQ-S – total	31.63 (10.28)	15–65						–	–.01	.10*	.38***	.52***	.19***	–.11*
7. Body mass index (kg/m^2)	22.05 (3.27)	14.13–42.83							–	.04	–.06	.06	.14**	–.41***
8. Food deprivation (hours)	2.79 (3.73)	0–24								–	–.05	–.06	–.07	–.05
9. Chocolate consumption frequency	3.05 (0.88)	1–4									–	.52***	.00	–.05
10. ACQ – craving	4.02 (1.60)	1.00–8.75										–	.41***	–.28***
11. ACQ – guilt	3.87 (2.01)	1.00–9.30											–	–.39***
12. PSRS	12.98 (3.58)	3–21												–

Notes: FCQ-T-r = Food Cravings Questionnaire-Trait-reduced, FCQ-S = Food Cravings Questionnaire – State, ACQ = Attitudes to Chocolate Questionnaire, PSRS = Perceived Self-Regulatory Success in Dieting Scale.
* $p < .05$, **, $p < .01$, ***$p < .001$.

Table 4
Comparison of trait and state chocolate craving between women and men and between current dieters and non-dieters in study 1.

	Sex		$t_{(490)}$	*p*	Current dieting status		$t_{(490)}$	*p*
	Women ($n = 400$) *M* (*SD*)	Men ($n = 92$) *M* (*SD*)			Dieters ($n = 177$) *M* (*SD*)	Non-dieters ($n = 315$) *M* (*SD*)		
FCQ-T-r								
Control	17.20 (7.31)	14.70 (6.29)	3.04	.003	18.53 (7.61)	15.72 (6.75)	4.22	<.001
Thoughts	20.03 (8.19)	14.70 (5.54)	5.94	<.001	20.58 (8.71)	18.17 (7.49)	3.23	.001
Total	37.23 (14.41)	29.39 (10.88)	4.90	<.001	39.10 (15.31)	33.89 (13.10)	3.98	<.001
FCQ-S								
Craving	26.02 (9.43)	23.33 (8.58)	2.52	.01	25.88 (9.11)	25.31 (9.45)	0.65	*ns*
Hunger	6.01 (3.14)	6.55 (3.18)	1.50	*ns*	6.18 (3.24)	6.08 (3.11)	0.33	*ns*
Total	32.03 (10.36)	29.88 (9.78)	1.82	*ns*	32.06 (10.38)	31.39 (10.23)	0.69	*ns*

Notes: FCQ-T-r = Food Cravings Questionnaire-Trait-reduced, FCQ-S = Food Cravings Questionnaire – State.

related to longer food deprivation. Trait and state chocolate craving were positively associated with each other, whereby this association was driven by the FCQ-S craving, but not its hunger subscale. To conclude, study 1 provided initial support for validity of both chocolate adapted versions of the FCQs. Interrelationships between and correlates of the chocolate versions of the FCQ-T-r and FCQ-S were comparable to those found in prior studies using the general versions (Meule, Beck Teran et al., 2014; Meule, Hermann et al., 2014; Meule et al., 2012a). It appears, however, that current *craving* vs. *hunger*, as measured with the FCQ-S, can be more clearly differentiated when specifically assessing chocolate craving, as compared to the general version of the FCQ-S.

Study 2

In study 2, changes in FCQ-S scores during chocolate exposure were investigated in the laboratory. Furthermore, associations with salivary flow and ad libitum chocolate intake were tested. There are different techniques for the measurement of salivary flow, all of which are intercorrelated (Nederkoorn, Smulders, & Jansen, 1999; White, 1977). The most common technique for measuring salivation in the context of food and eating is the use of cotton dental rolls (Wooley & Wooley, 1981), often referred to as the Strongin–Hinsie–Peck Test (Peck, 1959). This method was chosen in the current study as well, because it is easier to apply than counting the number of swallows (which requires recording of electromyography; Nederkoorn et al., 1999) and it is more comfortable for both the experimenter and the participant than collecting saliva in a cup (White, 1977).

Salivary flow increases during exposure to palatable foods as compared to baseline measurement (e.g., Nederkoorn, Smulders, & Jansen, 2000; Nirenberg & Miller, 1982; Sahakian, 1981; Wooley & Wooley, 1981) and this increase may be related to increased desire for these foods. For example, there are few studies in which self-reported hunger or desire to eat correlated with salivary response as measured with dental rolls during food exposure (e.g., Booth & Fuller, 1981; Legenbauer, Vögele, & Rüddel, 2004). However, note that although salivary flow increases during food exposure (as measured either with dental rolls or with other techniques such as the number of swallows), it did not correlate with subjective craving or food intake in the majority of studies (e.g., Legenbauer et al., 2004; Nederkoorn et al., 2000; Nirenberg & Miller, 1982; Sahakian, 1981; Wooley & Wooley, 1981).

Given that the FCQ-S was developed to capture dynamic changes in craving intensity, we expected that scores on the FCQ-S *craving* subscale would remain stable during a baseline period, increase during chocolate exposure, and decrease after chocolate exposure when participants were allowed to eat the chocolate. Regarding the FCQ-S *hunger* subscale, we expected that scores would not change throughout the experiment. Salivary flow was expected to be higher during chocolate exposure, as compared to baseline, and this increase was hypothesized to be correlated with increases in state chocolate craving. As higher FCQ-T/FCQ-T-r scores have previously been found to predict increases in state food craving in response to food-cue exposure (Meule, Hermann et al., 2014; Meule & Kübler, 2014; Meule, Skirde, Freund, Vögele, & Kübler, 2012), both increases in salivation and chocolate craving were expected to be positively correlated with trait chocolate craving, that is, FCQ-T-r scores.

Similar to study 1, we expected that trait and state chocolate craving would be positively correlated with chocolate intake. In addition, higher salivation was also hypothesized to be related to higher chocolate intake. On an exploratory basis, we also examined if trait chocolate craving was a moderator of the relationships between increases in state chocolate craving or salivation and chocolate consumption.

Methods

Participants

Participants were $n = 76$ students (73.7% female, $n = 56$) at the University of Würzburg (Würzburg, Germany). Mean age was $M = 23.59$ years ($SD = 3.92$, Range: 18–37). Mean BMI was $M = 21.82$ kg/m^2 ($SD = 2.89$, Range: 16.65–36.88). Participants were asked to estimate the time that elapsed since their last meal: mean food deprivation was $M = 3.54$ hours ($SD = 4.09$, Range: 0–16). Eighteen participants (23.7%) reported to be current dieters. Three participants (3.9%) reported to be smokers. Participants received course credits for compensation.

Measures and materials

Chocolate versions of the FCQ-T-r and FCQ-S

The chocolate-adapted German versions of the FCQ-T-r and FCQ-S, which were used in study 1, were also used in study 2. As the two subscales of the FCQ-T-r were highly correlated with each other in study 1 and in this study ($r = .81$, $p < .001$), only its total score was used in the current analyses. Internal consistency was excellent (Cronbach's $\alpha = .94$). Participants completed the FCQ-S four times and internal consistencies ranged from good to excellent for both the *craving* ($\alpha = .89$–$.92$) and *hunger* ($\alpha = .88$–90) subscales, as well as the total scale ($\alpha = .88$–90).

Chocolate bars

Five different types (crunchy cookie, crunchy flakes, yogurt, nougat, alpine milk) of 100 g chocolate bars (Ritter Sport, Alfred Ritter GmbH & Co. KG, Waldenbuch, Germany, a brand that is popular and widely available in Germany) were used for the chocolate exposure.

Salivation

Two cotton dental rolls (10×38 mm) were used each for measuring baseline salivary flow and salivary flow during chocolate exposure.

Weighing scales and body height

A micro scales (0.01 g precision; DIPSE/SSR-Produkt GmbH & Co.KG, Oldenburg, Germany) was used for weighing the dental rolls and the chocolate. A personal scale (PS 22, Beurer GmbH, Ulm, Germany) was used for determining body weight of participants. Body height was measured with a body height meter.

Procedure

Participants were tested individually. After participants were welcomed by the experimenter, they completed the informed consent process. They were asked to take at least one sip of water or as many as needed to quench their thirst. Participants then completed a paper-and-pencil version of the FCQ-S for the first time. Next, the experimenter handed out two dental rolls and instructed participants to place these between their lower gums and cheeks. After one minute, the experimenter removed the dental rolls with tweezers and put them in a small plastic bag. Participants then completed the FCQ-S for the second time. Following this, five sorts of chocolate bars were placed in front of the participants and they were instructed to choose the one they liked the most at that moment. Participants were then again instructed to place two dental rolls between their lower gums and cheeks, and, subsequently, to unwrap the chocolate, to snap off one piece with their fingers, and to smell it. After one minute, the experimenter again removed the dental rolls with tweezers and put them in a small plastic bag. Participants then completed the FCQ-S for the third time. Participants were then told that they could now eat as much of the remaining

chocolate bar as they wished during completion of the final set of questionnaires, which assessed sociodemographic information, time since participants' last meal, and included the chocolate versions of the FCQ-T-r and FCQ-S, and additional measures. During questionnaire completion, the experimenter unobtrusively left the room and returned after ten minutes. Finally, participants' body weight and height were measured and the dental rolls and the remaining chocolate were weighed.

Data analyses

Changes in current chocolate craving and current hunger were examined via repeated measures analyses of variance of the respective subscale scores of the FCQ-S. Analyses were followed-up with paired samples *t*-tests. For subsequent correlation analyses, change scores were computed by subtracting FCQ-S scores prior to chocolate exposure from FCQ-S scores after chocolate exposure, that is, higher values indicate an increase in current chocolate craving and hunger, respectively, during chocolate exposure.

Baseline salivation was computed by subtracting the weight of the dental rolls prior to baseline measurement from the weight of the dental rolls after baseline measurement. Chocolate exposure salivation was computed by subtracting the weight of the dental rolls prior to the chocolate exposure from the weight of the dental rolls after the chocolate exposure. Change in salivation between baseline and chocolate exposure was tested with a paired *t*-test. For subsequent correlation analyses, a change score was computed by subtracting baseline salivation from chocolate exposure salivation, that is, higher values indicate an increase in salivary flow from baseline to chocolate exposure.

Regarding chocolate consumption, the weight of the remaining chocolate after the experiment was subtracted from the initial weight, that is, higher values indicate a higher amount of chocolate consumed. Pearson product moment correlation coefficients were computed to examine the strength of the relationships between food deprivation (i.e., hours since the last meal), current chocolate craving, current hunger, trait chocolate craving (i.e., FCQ-T-r scores), salivary flow, and chocolate consumption.

Finally, we explored if possible relationships between changes in chocolate craving and salivation with chocolate consumption were moderated by individual differences in trait chocolate craving. For this, a linear regression analysis was calculated with chocolate craving change score, FCQ-T-r scores, and the interaction of chocolate craving change score × FCQ-T-r as predictor variables and consumed chocolate as dependent variable. Similarly, a linear regression analysis was calculated with salivation change score, FCQ-T-r scores, and the interaction of salivation change score × FCQ-T-r as predictor variables and consumed chocolate as dependent variable. Sex, dieting status and food deprivation were initially included as predictors but did not change results as neither variable was associated with chocolate consumption or salivation and, thus, results are presented without these variables. All regression analyses were computed using the program *Interaction!* Version 1.7.2211 (Freeware available at http://www.danielsoper.com/interaction). Exact *p*-values (two-tailed) are reported in case of significance ($p \leq .05$), except for $p < .001$. *P*-values >.05 are denoted as *ns*.

Results

Changes in current chocolate craving and hunger

Current chocolate craving changed over the course of the experiment ($F_{(3,225)} = 28.12$, $p < .001$, $\eta_p^2 = .27$; Fig. 1). Craving did not change between the first and second measurement ($t_{(75)} = 0.41$, *ns*), but was significantly higher after chocolate exposure ($M = 31.00$, $SD = 9.39$) than before ($M = 26.82$, $SD = 8.75$, $t_{(75)} = 6.81$, $p < .001$). At the end of the experiment ($M = 24.36$, $SD = 8.81$), craving decreased significantly, that is, was lower as compared to after chocolate exposure ($t_{(75)} = 7.46$, $p < .001$; Fig. 1).

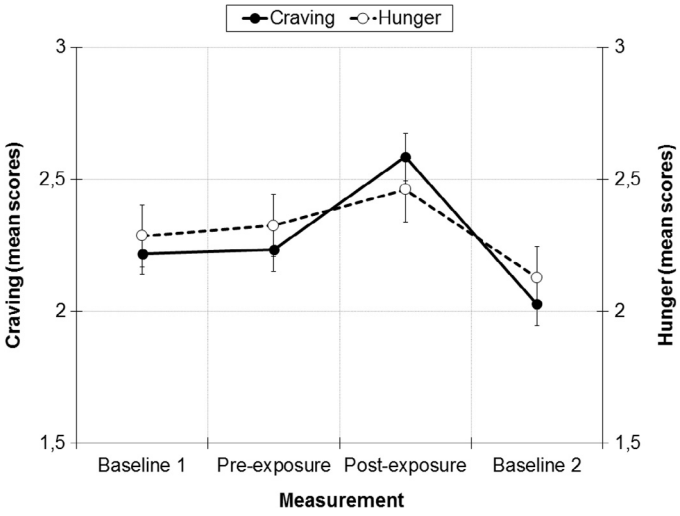

Fig. 1. Mean scores of the *craving* and *hunger* subscales of the chocolate version of the *Food Cravings Questionnaire-State* in study 2. Both chocolate craving and hunger scores remained stable during baseline salivation measurement, increased during chocolate exposure, and decreased afterwards. Note that analyses are based on sum scores, but mean scores are used for presentation purposes here. Error bars indicate the standard error of the mean.

Current hunger changed over the course of the experiment ($F_{(3,225)} = 8.53$, $p < .001$, $\eta_p^2 = .10$; Fig. 1). Hunger did not change between the first and second measurement ($t_{(75)} = 0.76$, *ns*), but was higher after chocolate exposure ($M = 7.38$, $SD = 3.22$) than before ($M = 6.97$, $SD = 3.08$, $t_{(75)} = 3.31$, $p < .001$). At the end of the experiment ($M = 6.38$, $SD = 3.09$), hunger decreased, that is, was lower as compared to after chocolate exposure ($t_{(75)} = 4.17$, $p < .001$; Fig. 1).[1]

Changes in salivary flow

Salivation during chocolate exposure ($M = 0.49$ g, $SD = 0.35$) was significantly higher than baseline salivation ($M = 0.38$ g, $SD = 0.22$, $t_{(75)} = 3.57$, $p = .001$).

[1] We also conducted these analyses with sex as between-subject factor. For state chocolate craving, there was main effect of sex, indicating that men had lower scores than women ($F_{(1,74)} = 3.89$, $p = .05$). However, there was no significant interaction of sex × measurement ($F_{(3,222)} = 1.44$, *ns*), indicating that although men and women differed in absolute state chocolate craving, changes in state chocolate craving throughout the experiment were not different for men and women. For hunger, there was neither a main effect of sex ($F_{(1,74)} = 0.50$, *ns*) nor an interaction of sex × measurement ($F_{(3,222)} = 1.25$, *ns*). Replicating findings of study 1, men reported lower trait chocolate craving than women ($t_{(74)} = 2.76$, $p = .009$). However, men and women did not differ in current food deprivation, salivary flow, or chocolate consumption (all $t_{(74)}$s < 1.08, *ns*). Accordingly, controlling for sex in the subsequent correlational and regression analyses did not affect results.

Including dieting status as between-subject factor in the analysis of variance for state chocolate craving did neither reveal a main effect of dieting status ($F_{(1,74)} = 0.56$, *ns*) nor an interaction of dieting status × measurement ($F_{(3,222)} = 1.41$, *ns*). Similarly, for hunger, there was neither a main effect of dieting status ($F_{(1,74)} = 0.01$, *ns*) nor an interaction of dieting status × measurement ($F_{(3,222)} = 0.45$, *ns*). Replicating findings of study 1, dieters reported higher trait chocolate craving than non-dieters, although this difference was not statistically significant ($t_{(74)} = 1.69$, *ns*). Dieters and non-dieters did not differ in current food deprivation, salivary flow, or chocolate consumption (all $t_{(74)}$s < 1.42, *ns*). Accordingly, controlling for dieting status in the subsequent correlational and regression analyses did not affect results.

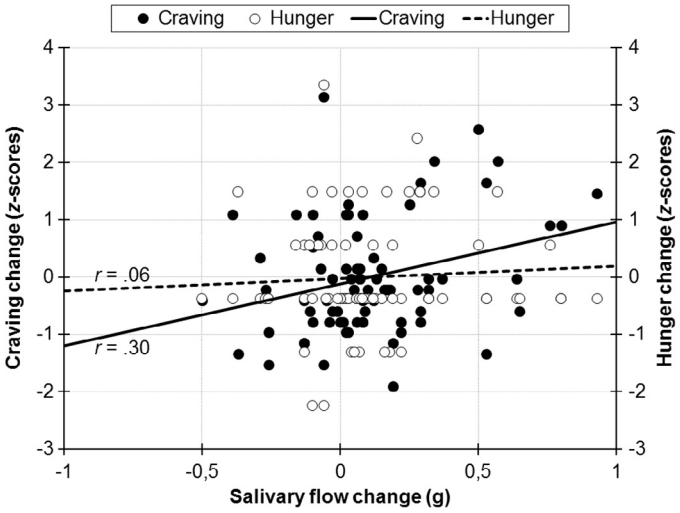

Fig. 2. Scatterplot showing associations between changes in salivary flow and scores on the chocolate version of the *Food Cravings Questionnaire-State* in study 2. Increases in salivary flow from baseline to chocolate exposure were correlated with increasing *craving* scores from pre- to post-exposure, but not with changes in *hunger* scores from pre- to post-exposure. Note that analyses are based on differences of sum scores, but *z*-scores are used for presentation purposes here.

Fig. 3. Simple slopes showing the moderating effect of scores on the chocolate version of the *Food Cravings Questionnaire-Trait-reduced* on the relationship between changes in salivary flow and chocolate consumption in study 2. Increases in salivary flow from baseline to chocolate exposure were associated with higher chocolate intake at the end of the experiment in participants scoring high on trait chocolate craving, but not in those scoring low on trait chocolate craving.

Correlations between study variables

Food deprivation was positively correlated with all four measurements of current hunger (*rs* = .38-.48, *ps* ≤ .001), but not with current chocolate craving. Vice versa, trait chocolate craving was positively correlated with all four measurements of current chocolate craving (*rs* = .42-.50, *ps* < .001), but not with current hunger. Changes in salivary flow were positively correlated with changes in chocolate craving during chocolate exposure (*r* = .30, *p* = .008), but not with changes in hunger during chocolate exposure (*r* = .06, *ns*; Fig. 2).

Participants consumed on average *M* = 25.76 g (*SD* = 23.46) of chocolate (or *M* = 140.49 kcal, *SD* = 127.06). Chocolate intake was positively correlated with all four measurements of current chocolate craving (*rs* = .42–.50, *ps* < .001), but not with current hunger.

Predictors of chocolate intake

In the regression analysis including chocolate craving, neither trait chocolate craving (β = .15, *ns*), chocolate craving change score (β = –.02, *ns*), nor the interaction term (β = –.02, *ns*) were significant predictors of chocolate intake. In the regression analysis including salivation, trait chocolate craving (β = .18, *ns*) and salivation change score (β = .23, *ns*) were non-significant predictors of chocolate intake. However, there was a significant interaction between trait chocolate craving and salivation change score (β = .37, *p* = .005). Increases in salivary flow from baseline to chocolate exposure were only related to higher chocolate intake in individuals scoring high on trait chocolate craving (+1 *SD*, β = .68, p = .007), but not in individuals scoring low on trait chocolate craving (–1 *SD*, β = –.22, *ns*; Fig. 3).

Conclusion of study 2

As expected, state chocolate craving as measured with the chocolate version of the FCQ-S remained stable across the baseline period, increased during chocolate exposure, and decreased afterwards. Unexpectedly, hunger ratings followed the same pattern of dynamic change, although effect size was smaller than for the craving ratings. Furthermore, additional analyses showed a clear differentiation between current chocolate craving and hunger: similar to study 1, length of food deprivation was positively correlated with hunger (but not chocolate craving), while trait chocolate craving was positively correlated with state chocolate craving (but not hunger). Furthermore, only increases in current chocolate craving (but not hunger) were correlated with increases in salivation and current chocolate craving (but not hunger) was correlated with higher chocolate consumption.

Contrary to hypotheses, trait chocolate craving was unrelated to increases in state chocolate craving, increases in salivary flow, and chocolate consumption. However, trait chocolate craving was found to be a moderator of the relationship between increases in salivation and chocolate consumption. Increased salivary flow was only associated with higher chocolate intake in individuals with high trait chocolate craving scores, but not in those with low trait chocolate craving scores. To conclude, study 2 replicated and extended the findings from study 1, providing further support for the validity of the chocolate adapted FCQs by demonstrating associations with objective measures such as salivary flow and ad libitum chocolate intake.

Discussion

In the current studies, the FCQ-T-r and FCQ-S were adapted to refer to chocolate, their factor structures were explored and their correlates examined. Both versions had good to excellent internal consistencies. Contrary to hypotheses and findings from prior validation studies, however, the chocolate version of the FCQ-T-r contained two factors representing (1) a lack of control over eating chocolate and (2) thoughts about and preoccupation with chocolate. However, both subscales were highly correlated with each other. Thus, future research may investigate if use of the two subscales in the assessment of correlates of trait cravings has significant advantages over the use of FCQ-T-r total scores.

Between-group differences and correlates of the chocolate version of the FCQ-T-r were largely similar to those of the general versions of the FCQ-T/FCQ-T-r, indicating construct validity. For example,

women had higher trait chocolate craving scores than men. While there are marked gender differences in chocolate craving in North America, cultural differences have been found. For example, it appears that this gender effect is less pronounced in Spain (Osman & Sobal, 2006) and Spanish women reported less frequent chocolate craving than British women (Rodriguez et al., 2007). In Germany, it has been previously found that women had higher scores than men on the ACQ (Müller et al., 2008). In the current studies, a clear gender effect was found and, thus, results suggest that the relationship between chocolate craving and gender may be more similar between Germany and North America as opposed to other European countries. Interestingly, it has been found recently that there is a positive relationship between chocolate craving and disordered eating behavior in women, but not in men in the US (Hormes et al., 2014). Future research may investigate if such interactive effects are culture-specific or if similar findings can be obtained in (at least some) European countries.

Trait chocolate craving was higher in current dieters than in non-dieters and scores were weakly and positively correlated with BMI and negatively correlated with dieting success, similar to findings from studies in which the general version of the FCQ-T-r was used (Innamorati et al., 2015; Meule, Hermann et al., 2014; Rodríguez-Martín & Molerio-Pérez, 2014). Moreover, trait chocolate craving scores were highly correlated with a conceptually similar measure (the ACQ) and were related to more frequent chocolate consumption, similar to what has been found using the ACQ (Benton et al., 1998; Van Gucht et al., 2014). Although FCQ-T-r scores were positively correlated with FCQ-S scores in both studies, FCQ-T-r scores were, unexpectedly, neither associated with increases in state chocolate craving or salivation during chocolate exposure nor with ad libitum chocolate consumption in the laboratory. This may be due to ceiling effects as chocolate craving increased during chocolate exposure in most participants and state chocolate craving was associated with chocolate consumption independent of trait chocolate craving. However, we found that trait chocolate craving was a significant moderator of the relationship between increases in salivation during chocolate exposure and subsequent chocolate intake. Specifically, increased salivation was only associated with higher chocolate intake in those with high trait craving scores, but not in those with low trait craving scores. Hence, increased salivation, which prepares the body for ingestion and was associated with increased desire to eat chocolate, only results in chocolate intake in those who report habitual strong chocolate craving, but not in those who report having a higher level of control over their chocolate consumption.

As expected, the chocolate version of the FCQ-S combined two subscales representing chocolate craving and hunger. Although scores on the hunger subscale also changed as a function of chocolate exposure, it appears that craving and hunger can be more clearly differentiated when there is a specific food specified in the wording of the craving-related items, compared to the general version of the measure. For example, food deprivation was exclusively related to scores on the hunger subscale, but not to scores on the craving subscale in both studies. Vice versa, trait chocolate craving was exclusively related to scores on the craving subscale, but not to scores on the hunger subscale in both studies. Moreover, only increases in state chocolate craving, but not increases in current hunger were related to increased salivary flow and only state chocolate craving, but not hunger, was related to laboratory chocolate intake.

Interpretation of results is limited by the fact that most participants were normal-weight, female university students. Future studies should extend the present findings to larger samples of men or to clinical samples, for example, individuals with eating disorders or obesity. Such research appears to be particularly worthwhile given the differential relationships between chocolate craving and disordered eating as a function of gender (Hormes et al., 2014). Moreover, we only had one experimental condition in study 2 (namely chocolate exposure) and, thus, future research on chocolate craving and salivation may include additional conditions such as a control group with no chocolate exposure or an imaginal craving induction protocol (Kemps & Tiggemann, 2007). Finally, we used German versions of the chocolate adapted FCQs and, thus, it is yet to be demonstrated that they can be equally used in other languages, particularly given the cultural differences in chocolate craving (Hill, 2007; Osman & Sobal, 2006; Rodriguez et al., 2007). If proven successful, the chocolate versions of the FCQ-T-r and FCQ-S may be useful instruments for the transcultural investigation of chocolate craving. As has been demonstrated in the current studies, we conclude that the chocolate versions of the FCQ-T-r and FCQ-S represent reliable and valid self-report measures for the assessment of trait and state chocolate craving.

References

Benton, D., Greenfield, K., & Morgan, M. (1998). The development of the attitudes to chocolate questionnaire. *Personality and Individual Differences*, *24*, 513–520.

Booth, D. A., & Fuller, J. (1981). Salivation as a measure of appetite. A sensitivity issue. *Appetite*, *2*, 370–372.

Cepeda-Benito, A., Fernandez, M. C., & Moreno, S. (2003). Relationship of gender and eating disorder symptoms to reported cravings for food. Construct validation of state and trait craving questionnaires in Spanish. *Appetite*, *40*, 47–54.

Cepeda-Benito, A., Gleaves, D. H., Fernández, M. C., Vila, J., Williams, T. L., & Reynoso, J. (2000). The development and validation of Spanish versions of the state and trait food cravings questionnaires. *Behaviour Research and Therapy*, *38*, 1125–1138.

Cepeda-Benito, A., Gleaves, D. H., Williams, T. L., & Erath, S. A. (2000). The development and validation of the state and trait Food-Cravings Questionnaires. *Behavior Therapy*, *31*, 151–173.

Costello, A. B., & Osborne, J. W. (2005). Best practices in exploratory factor analysis. Four recommendations for getting the most from your analysis. *Practical Assessment, Research & Evaluation*, *10*(7), 1–9.

Cramer, K. M., & Hartleib, M. (2001). The attitudes to chocolate questionnaire. A psychometric evaluation. *Personality and Individual Differences*, *31*, 931–942.

Crowley, N., LePage, M. L., Goldman, R. L., O'Neil, P. M., Borckardt, J. J., & Byrne, T. K. (2012). The food craving questionnaire-trait in a bariatric surgery seeking population and ability to predict post-surgery weight loss at six months. *Eating Behaviors*, *13*, 366–370.

Crowley, N., Madan, A., Wedin, S., Correll, J. A., Delustro, L. M., Borckardt, J. J., et al. (2014). Food cravings among bariatric surgery candidates. *Eating and Weight Disorders*, *19*, 371–376.

Fishbach, A., Friedman, R. S., & Kruglanski, A. W. (2003). Leading us not unto temptation. Momentary allurements elicit overriding goal activation. *Journal of Personality and Social Psychology*, *84*, 296–309.

Hill, A. J. (2007). The psychology of food craving. *Proceedings of the Nutrition Society*, *66*, 277–285.

Hormes, J. M., & Meule, A. (submitted). Psychometric properties of the English Food Cravings Questionnaire-Trait-reduced (FCQ-T-r).

Hormes, J. M., Orloff, N. C., & Timko, C. A. (2014). Chocolate craving and disordered eating. Beyond the gender divide? *Appetite*, *83*, 185–193.

Hormes, J. M., & Rozin, P. (2010). Does "craving" carve nature at the joints? Absence of a synonym for craving in many languages. *Addictive Behaviors*, *35*, 459–463.

Innamorati, M., Imperatori, C., Meule, A., Lamis, D. A., Contardi, A., Balsamo, M., et al. (2015). Psychometric properties of the Italian Food Cravings Questionnaire-Trait-reduced (FCQ-T-r). *Eating and Weight Disorders*, *20*, 129–135.

Kemps, E., & Tiggemann, M. (2007). Modality-specific imagery reduces cravings for food. An application of the Elaborated Intrusion Theory of Desire to food craving. *Journal of Experimental Psychology. Applied*, *13*, 95–104.

Legenbauer, T., Vögele, C., & Rüddel, H. (2004). Anticipatory effects of food exposure in women diagnosed with bulimia nervosa. *Appetite*, *42*, 33–40.

Lorenzo-Seva, U., & Ferrando, P. J. (2013). *Manual of FACTOR v.9.20*. Tarragona, Spain: Universitat Rovira i Virgili.

Martin, C. K., McClernon, F. J., Chellino, A., & Correa, J. B. (2011). Food cravings. A central construct in food intake behavior, weight loss, and the neurobiology of appetitive behavior. In V. R. Preedy, R. R. Watson, & C. R. Martin (Eds.), *Handbook of behavior, food and nutrition* (pp. 741–755). New York: Springer.

Mensink, G. B. M., Schienkiewitz, A., Haftenberger, M., Lampert, T., Ziese, T., & Scheidt-Nave, C. (2013). Overweight and obesity in Germany. Results of the German Health Interview and Examination Survey for Adults (DEGS1). *Bundesgesundheitsblatt*, *56*, 786–794.

Meule, A., Beck Teran, C., Berker, J., Gründel, T., Mayerhofer, M., & Platte, P. (2014). On the differentiation between trait and state food craving. Half-year retest-reliability of the *Food Cravings Questionnaire-Trait-reduced* (FCQ-T-r) and the *Food Cravings Questionnaire-State* (FCQ-S). *Journal of Eating Disorders*, *2*(1), 25. doi:10.1186/s40337-014-0025-z.

Meule, A., Hermann, T., & Kübler, A. (2014). A short version of the *Food Cravings Questionnaire – Trait*. The FCQ-T-reduced. *Frontiers in Psychology*, *5*, 190. doi:10.3389/fpsyg.2014.00190.

Meule, A., & Kübler, A. (2014). Double trouble. Trait food craving and impulsivity interactively predict food-cue affected behavioral inhibition. *Appetite*, *79*, 174–182.
Meule, A., Lutz, A., Vögele, C., & Kübler, A. (2012a). Food cravings discriminate differentially between successful and unsuccessful dieters and non-dieters. Validation of the Food Craving Questionnaires in German. *Appetite*, *58*, 88–97.
Meule, A., Lutz, A., Vögele, C., & Kübler, A. (2012b). Self-reported dieting success is associated with cardiac autonomic regulation in current dieters. *Appetite*, *59*, 494–498.
Meule, A., Papies, E. K., & Kübler, A. (2012). Differentiating between successful and unsuccessful dieters. Validity and reliability of the Perceived Self-Regulatory Success in Dieting Scale. *Appetite*, *58*, 822–826.
Meule, A., Skirde, A. K., Freund, R., Vögele, C., & Kübler, A. (2012). High-calorie food-cues impair working memory performance in high and low food cravers. *Appetite*, *59*, 264–269.
Meule, A., Westenhöfer, J., & Kübler, A. (2011). Food cravings mediate the relationship between rigid, but not flexible control of eating behavior and dieting success. *Appetite*, *57*, 582–584.
Müller, J., Dettmer, D., & Macht, M. (2008). The Attitudes to Chocolate Questionnaire. Psychometric properties and relationship to dimensions of eating. *Appetite*, *50*, 499–505.
Nederkoorn, C., Smulders, F. T. Y., & Jansen, A. (1999). Recording of swallowing events using electromyography as a non-invasive measurement of salivation. *Appetite*, *33*, 361–369.
Nederkoorn, C., Smulders, F. T. Y., & Jansen, A. (2000). Cephalic phase responses, craving and food intake in normal subjects. *Appetite*, *35*, 45–55.
Nirenberg, T. D., & Miller, P. M. (1982). Salivation. An assessment of food craving? *Behaviour Research and Therapy*, *20*, 405–407.
Osman, J. L., & Sobal, J. (2006). Chocolate cravings in American and Spanish individuals. Biological and cultural influences. *Appetite*, *47*, 290–301.
Peck, R. E. (1959). The SHP test. An aid in the detection and measurement of depression. *AMA Archives of General Psychiatry*, *1*, 35–40.
Rodríguez-Martín, B. C., & Molerio-Pérez, O. (2014). Exploring the factor structure of the Food Cravings Questionnaire-Trait in Cuban adults. *Frontiers in Psychology*, *5*, 214. doi:10.3389/fpsyg.2014.00214.
Rodriguez, S., Warren, C. S., Moreno, S., Cepeda-Benito, A., Gleaves, D. H., Fernandez, M. D., et al. (2007). Adaptation of the food-craving questionnaire trait for the assessment of chocolate cravings. Validation across British and Spanish Women. *Appetite*, *49*, 245–250.
Rozin, P., Levine, E., & Stoess, C. (1991). Chocolate craving and liking. *Appetite*, *17*, 199–212.
Sahakian, B. J. (1981). Salivation and appetite. Commentary on the forum. *Appetite*, *2*, 386–389.
Van Gucht, D., Soetens, B., Raes, F., & Griffith, J. W. (2014). The Attitudes to Chocolate Questionnaire. Psychometric properties and relationship with consumption, dieting, disinhibition and thought suppression. *Appetite*, *76*, 137–143.
Vander Wal, J. S., Johnston, K. A., & Dhurandhar, N. V. (2007). Psychometric properties of the State and Trait Food Cravings Questionnaires among overweight and obese persons. *Eating Behaviors*, *8*, 211–223.
Weingarten, H. P., & Elston, D. (1991). Food cravings in a college population. *Appetite*, *17*, 167–175.
White, K. D. (1977). Salivation. A review and experimental investigation of major techniques. *Psychophysiology*, *14*, 203–212.
Wooley, O. W., & Wooley, S. C. (1981). Relationship of salivation in humans to deprivation, inhibition and the encephalization of hunger. *Appetite*, *2*, 331–350.