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Research report

Food cravings discriminate differentially between successful and unsuccessful dieters and non-dieters. Validation of the Food Cravings Questionnaires in German [☆]

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ABSTRACT

Food cravings have been strongly associated with triggering food consumption. However, definitions and measurements of food cravings are heterogeneous. Therefore, *Cepeda-Benito and colleagues (2000)* have suggested the Food Cravings Questionnaires (FCQs) to measure food cravings as a multidimensional construct at trait- and state-level. In the current study, we validated a German version of the FCQs in an online study ($N = 616$). The factor structure of the state and trait versions could partially be replicated, but yielded fewer than the originally proposed factors. Internal consistencies of both versions were very good (Cronbach's $\alpha > .90$), whereas retest reliability of the state version was expectedly lower than that of the trait version. Construct validity of the trait version (FCQ-T) was demonstrated by high correlations with related eating behavior questionnaires and low correlations with questionnaires unrelated to eating. Most importantly, FCQ-T-subcales were able to discriminate between successful and unsuccessful dieters and non-dieters. Validity of the state version was supported by positive relations with food deprivation and current negative affect. Taken together, the German version of the FCQs has good psychometric properties. Moreover, this study provided first evidence that distinct dimensions of food cravings are differentially related to success and failure in dieting.

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Introduction

Craving is an intense desire or longing for particular substances (*Weingarten & Elston, 1990*), for example alcohol, tobacco, and other drugs, but also food (*Hormes & Rozin, 2010*). Food cravings are characterized by both appetitive and aversive components (*Rodríguez, Fernández, Cepeda-Benito, & Vila, 2005*). Accordingly, it has been suggested that food cravings can be viewed analogous to emotions as they have motivational significance for the organism (*Shiffman, 2000*). In this respect, craving and hunger are closely related and indeed show many similarities (*Shiffman, 2000*). However, cravings differ from hunger as they tend to be more intense and specific for the kind of food desired (*Hill, 2007*). Furthermore, although nutritional deprivation can increase food cravings, it is not necessary to elicit them. For instance, *Pelchat and Schaefer (2000)* could show that a monotonous diet – and therefore sensory rather than nutritional deprivation – is sufficient to stimulate food cravings in young adults. Moreover, psychological factors like

external and emotional eating are stronger related to food cravings than dietary restraint or daily caloric intake (*Hill, Weaver, & Blundell, 1991*).

Attempts to measure craving objectively, e.g. based on physiological data, have been criticized for being unspecific (*Shiffman, 2000*). Until now, “subjective self-report seems the only viable assessment modality” (*Shiffman, 2000, p. S172*). The term craving is somewhat vague and often subjects are asked to indicate on a one-item rating scale how strong they crave or desire a specific object (*Weingarten & Elston, 1990*). Therefore, there is a need to assess craving as a multidimensional construct with standardized questionnaires instead of single questions. This is particularly important in non-English speaking countries because there is no simple equivalent expression for craving (*Hormes & Rozin, 2010*).

To assess craving multidimensional, different measures have been developed such as the Food Cravings Questionnaires (FCQs, including a state and a trait version; *Cepeda-Benito, Gleaves, Williams, & Erath, 2000; Cepeda-Benito et al., 2000*), the Attitudes to Chocolate Questionnaire (ACQ; *Benton, Greenfield, & Morgan, 1998*), the Orientation towards Chocolate Questionnaire (OCQ; *Cartwright & Stritzke, 2008*), and the Food Craving Inventory (FCI; *White, Whisenhunt, Williamson, Greenway, & Netemeyer, 2002*). Each of these measures represents different approaches to

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the craving construct. Both the ACQ and OCQ are designed to measure cravings specifically related to chocolate and emphasize the relationship between craving and feelings of guilt (Benton et al., 1998) or the conflict between approach and avoidance inclinations during the experience of craving (ambivalence model; Cartwright & Stritzke, 2008). The FCI measures cravings related to different classes of food (high fats, sweets, carbohydrates/starches, fast-food fats; White et al., 2002). Therefore, all of these instruments assess habitual cravings related to specific kinds of food and are restricted to certain dimensions of food cravings. As opposed to these questionnaires, the FCQs were constructed to assess craving for a variety of foods, without confining them to certain categories or specific foods, e.g., chocolate. Furthermore, the FCQs cover behavioral, cognitive and physiological aspects of food cravings. Finally, the FCQs combine two versions that measure current and habitual food cravings. Therefore, the FCQs are the only currently available food craving instruments that (1) do not refer specifically to chocolate or similar, (2) assess food cravings on a multidimensional level, and (3) measure food cravings as trait and state. Moreover, there is evidence that the FCQs can be used easily as a measure for specific cravings, e.g. by replacing references to food with references to chocolate (Rodríguez et al., 2007).

The FCQs are arguably the most extensively validated food craving measures and are available in Dutch (Franken & Muris, 2005; modified version from Nijs, Franken, & Muris, 2007), English (Cepeda-Benito, Gleaves, Williams et al., 2000) and Spanish (Cepeda-Benito, Gleaves, Fernández et al., 2000). Excellent psychometric properties could be demonstrated for healthy participants (Cepeda-Benito, Fernández, & Moreno, 2003; Cepeda-Benito, Gleaves, Fernández et al., 2000; Cepeda-Benito, Gleaves, Williams et al., 2000) and patients with eating disorders (Moreno, Rodríguez, Fernández, Tamez, & Cepeda-Benito, 2008). However, the factor structure could only be partially replicated in a sample of overweight and obese persons (Vander Wal, Johnston, & Dhurandhar, 2007). The trait version of the FCQs (FCQ-T) has been positively associated with disinhibited eating behavior, habitual hunger ratings, eating disorder symptoms, sensitivity to reward, and body-mass-index (BMI) in healthy participants (Cepeda-Benito, Gleaves, Williams et al., 2000; Cepeda-Benito et al., 2003; Franken & Muris, 2005). Moreover, female participants had higher FCQ-T-scores than male participants (Cepeda-Benito et al., 2003). In patients with eating disorders, FCQ-T-subcales have been found to discriminate between anorexia and bulimia nervosa subtypes (Moreno, Warren, Rodríguez, Fernández, & Cepeda-Benito, 2009). However, only cravings that were associated with a lack of control over eating, preoccupation with food, negative affect, and guilty feelings were predictive of bulimic symptomatology (Moreno et al., 2008). Morbidly obese patients consistently reported higher food cravings than controls, except for cravings associated with positive reinforcement that result from eating (Abilés et al., 2010).

Based on these findings, we expected the FCQ-T to be associated with a loss of control in eating behavior as an indicator of convergent validity. Specifically, we expected food cravings to be highly correlated with self-reported binge eating, food addiction symptoms, low perceived self-regulatory success in dieting, and dieting strategies that have been previously connected to low dieting success or high eating-related psychopathology (*rigid control*; Shearin et al., 1994; Stewart, Williamson, & White, 2002; Timko & Perone, 2005; Westenhoefer, 1991; Westenhoefer, Stunkard, & Pudel, 1999).

Relevant, but not directly eating-related constructs were used as an indicator of divergent validity. Substance craving and impulsivity have been positively, but weakly associated with BMI (Meule, Nakovics, & Kübler, submitted for publication; Meule, Vögele, & Kübler, 2011). Furthermore, impulsivity was weakly correlated with food addiction symptoms (Meule, Vögele, & Kübler,

in press). Accordingly, we expected small positive correlations between food craving and both, substance craving and impulsivity. Sensitivity to reward or punishment has been inconsistently linked to dysfunctional eating behavior (see Bijttebier, Beck, Claes, & Vandereycken, 2009 for a review). For instance, while sensitivity to reward was positively correlated with the FCQ-T (Franken & Muris, 2005), the *Behavioral Inhibition System* (BIS), but not the *Behavioral Activation System* (BAS), was positively correlated with food addiction symptoms (Gearhardt, Corbin, & Brownell, 2009; Meule et al., in press). Therefore, we expected no or small positive correlations between food craving and BIS/BAS-reactivity.

We further expected an association between food craving and dietary restraint. However, evidence for such a relationship is ambiguous. For instance, Polivy and colleagues (2005) found restrained eaters – as measured with the *Restraint Scale* (RS) – to experience more food cravings than unrestrained eaters. Restrained eating as measured with the *Dutch Eating Behavior Questionnaire* (DEBQ) and the *Three-Factor Eating Questionnaire* (TFEQ), however, was not correlated with craving frequency (Hill et al., 1991). These contradictory findings could be due to the different questionnaires used, because the RS has been found to measure unsuccessful restrained eaters while the DEBQ and TFEQ identify successful restrained eaters (Heatherton, Herman, Polivy, King, & McGree, 1988; Williamson et al., 2007). Yet, another study using the RS did not find an association between restraint status and food cravings (Rodin, Mancuso, Granger, & Nelbach, 1991). Furthermore, using restraint scales is critical because the population of restrained eaters consists of unsuccessful and successful ones (Van Strien, 1997; Van Strien, 1999). Most recently, attempts have been made to distinguish more explicitly between successful and unsuccessful restrained eaters (Papies, Stroebe, & Aarts, 2008; Van Koningsbruggen, Stroebe, & Aarts, 2011; Van Koningsbruggen, Stroebe, Papies, & Aarts, 2011). In those studies, the subscale *concern for dieting* of the RS is used to identify dieters and non-dieters. Additionally, the *Perceived Self-Regulatory Success in Dieting Scale* (PSRS; Fishbach, Friedman, & Kruglanski, 2003) is used to evaluate successful or unsuccessful dietary restraint. We adapted this procedure to classify participants as non-dieters and successful and unsuccessful dieters and explored food cravings in these subpopulations. Specifically, we expected food cravings to be increased in unsuccessful dieters compared to successful ones who in turn were expected to experience more food cravings than non-dieters.

The state version of the FCQs (FCQ-S) has been found to be sensitive to meal consumption in normal-weight (Cepeda-Benito, Gleaves, Williams et al., 2000) and overweight (Vander Wal, Marth, Khosla, Jen, & Dhurandhar, 2005; Vander Wal et al., 2007) participants. State cravings decreased after breakfast and increased afterwards during the first 3 h (Cepeda-Benito, Gleaves, Williams, et al., 2000; Vander Wal et al., 2007). Accordingly, length of food deprivation uniquely and exclusively predicted state cravings (Cepeda-Benito et al., 2003).

Thus, we expected the FCQ-S to be positively correlated with the hours that have elapsed since the last meal. Furthermore, we also predicted current cravings to be associated with less positive and more negative current affect because mood has been suggested as a possible antecedent to or consequence of craving (Hill et al., 1991).

Methods

Procedure

Student councils of several German universities were contacted by e-mail. Then, the internet address of the online study was sent using the student councils' mailing lists. As an incentive, five

×50 Euro were raffled among participants who completed the entire set of questions. Questionnaire completion took approximately 25 min. Every question required a response in order to continue. Study period lasted four weeks. Participants who entered their e-mail-address and agreed to be contacted again, were asked to participate in retesting one week after closure of the website.

Participants

The study-website was visited 1615 times. The entire set of questionnaires was completed by $N = 617$ participants (38.2%). The majority of participants were women (75.8%). Data from one participant was excluded from further analyses because of implausible statements. Mean BMI was $M = 22.3 \text{ kg/m}^2$ ($SD = 3.3$), mean age was $M = 24.5$ years ($SD = 4.0$). Almost all participants were students (89.0%) and had German citizenship (95.5%). The retest was completed by $n = 237$ participants. However, data of only $n = 197$ participants could be used because individual codes of some participants did not correspond to the ones specified in the primary data collection.

Food Cravings Questionnaires (FCQs)

The FCQs measure the intensity of food cravings on a multidimensional level. The trait version (FCQ-T) has 39 items and consists of the subscales *intentions and plans to consume food* (INTENTIONS), *anticipation of positive reinforcement that may result from eating* (POS REINFORCEMENT), *anticipation of relief from negative states and feelings as a result of eating* (NEG REINFORCEMENT), *lack of control over eating* (LACK OF CONTROL), *thoughts or preoccupation with food* (THOUGHTS), *craving as a physiological state* (HUNGER), *emotions that may be experienced before or during food cravings or eating* (EMOTIONS), *cues that may trigger food cravings* (CUES), and *guilt from cravings and/or giving into them* (GUILT). The 15-item state version (FCQ-S) assesses momentary food cravings on the dimensions *intense desire to eat* (DESIRE), *anticipation of positive reinforcement that may result from eating* (POS REINFORCEMENT), *anticipation of relief from negative states and feelings as a result of eating* (NEG REINFORCEMENT), *lack of control over eating* (LACK OF CONTROL), and *craving as a physiological state* (HUNGER). Both versions of the FCQs have internal consistencies of $\alpha > .90$ (Cepeda-Benito, Gleaves, Fernández et al., 2000; Cepeda-Benito, Gleaves, Williams et al., 2000).

The English version of the FCQs was translated into German by the first and second authors of the current manuscript. In case of ambiguities, the Spanish version was also taken into account. A bilingual speaker, who did not have any knowledge about the original FCQs, translated the first draft of the German version back into English. Discrepancies between the back-translation and the original form were discussed and adjusted.

Measures to establish convergent validity

Yale Food Addiction Scale (YFAS)

The YFAS measures addictive eating behavior and consists of 27 items. The questionnaire is based on the diagnostic criteria for substance dependence of the DSM-IV (American Psychiatric Association, 1994). Scoring of the YFAS enables the calculation of a symptom count as well as a diagnosis of food addiction. Internal consistencies range between $\alpha = .81-.86$ (Gearhardt et al., 2009; Meule et al., in press), which could be confirmed in the present study ($\alpha = .83$).

Restraint Scale-Subscale Concern for Dieting (RS-CD)

The RS (Herman & Polivy, 1980) consists of two subscales that measure *concern for dieting* (RS-CD) and *weight fluctuations* (RS-

WF; Dinkel, Berth, Exner, Rief, & Balck, 2005). However, it has been suggested to disregard RS-WF due to confounding with BMI and overweight (Stroebe, 2008). Furthermore, RS-CD has been found to have higher internal consistency than RS-WF ($\alpha = .82$ vs. $.69$, Dinkel et al., 2005). In the present study, we thus used the RS-CD only and internal consistency was $\alpha = .79$.

Perceived Self-Regulatory Success in dieting (PSRS)

This three-item scale developed by Fishbach and colleagues (2003) asks participants to rate on 7-point scales how successful they are in watching their weight or losing extra weight and how difficult it is for them to stay in shape. The scale was translated into German from the Dutch version used by Papies and colleagues (2008). In our study, participants were able to choose *not applicable* if they were not concerned with their weight. If this option was chosen in at least one question, total PSRS scores were excluded from analysis ($n = 135$). For the remaining $n = 480$ participants, internal consistency of the PSRS was $\alpha = .74$, which is higher than previously reported ($\alpha = .66$; Van Koningsbruggen, Stroebe, & Aarts, 2011).

Flexible and rigid control of eating behavior

These scales were originally developed by Westenhoefer (1991) who found that the *cognitive restraint* subscale of the TFEQ (Stunkard & Messick, 1985) can be further divided into flexible and rigid control strategies of dietary restraint. Later, additional items were added to increase internal consistencies (Westenhoefer et al., 1999). Flexible control is now assessed with 12 items (FC12; Cronbach's $\alpha = .83$), whereas the rigid control scale consists of 16 items (RC16; Cronbach's $\alpha = .81$). Internal consistencies were also good in the present sample ($\alpha = .82$ for FC12, $\alpha = .80$ for RC16).

Eating Disorder Examination-Questionnaire (EDE-Q)

The EDE-Q (Fairburn & Beglin, 1994; Hilbert & Tuschen-Caffier, 2006) measures specific eating pathologies with 22 items. In addition, six items assess essential behavioral patterns like binge eating and compensatory behaviors. Three of these six items, which assess binge eating frequencies within the past 28 days, were chosen for this study (the first two acted as primers for the third item).

Measures to establish divergent validity

Mannheimer Craving Scale (MaCS)

The MaCS is a questionnaire for the assessment of cravings for different addictive substances (e.g. alcohol, nicotine, drugs) and consists of 12 items. It includes obsessive thoughts and compulsive behavior related to substance use. The intensity and frequency of substance-related cravings, assessed with visual analog scales, and duration of abstinence are measured with four additional items. Internal consistencies were high in a sample of patients with different substance dependencies ($\alpha = .87-.93$; Nakovics, Diehl, Geiselhart, & Mann, 2009) and in the present study ($\alpha = .89$).

Barratt Impulsiveness Scale (BIS-15)

The BIS-15 was proposed by Spinella (2007) as short version of the BIS-11 (Patton, Stanford, & Barratt, 1995) for the measurement of impulsivity. It consists of 15 items and subjects have to rate each item on a 4-point Likert scale. The three-factor solution with *motor*, *attentional*, and *non-planning impulsivity* could be confirmed for the German version (Meule, Vögele, 2011). Internal consistency was slightly lower in the present study ($\alpha = .78$) compared to the validation studies ($\alpha > .80$; Meule, Vögele, 2011; Spinella, 2007).

Behavioral Inhibition System/Behavioral Activation System (BIS/BAS)

The BIS/BAS scales (Carver & White, 1994; Strobel, Beauducel, Debener, & Brocke, 2001) were created to measure the behavioral

inhibition and behavioral activation systems proposed by Gray (1982). The 24-item scale includes one BIS- and several BAS-subcales (*Reward Responsiveness, Drive, Fun Seeking*). Internal consistencies of the BIS- and BAS-scales are higher (BIS: $\alpha = .78$, BAS: $\alpha = .81$) than that of the subscales ($\alpha = .67$ – $.69$; Strobel et al., 2001). In the current study, internal consistencies of the BIS- and BAS-scales were $\alpha = .80$ and $\alpha = .79$.

Positive and Negative Affect Schedule (PANAS)

The PANAS consists of two ten-item dimensions measuring momentary positive affect (PA) and negative affect (NA; Watson, Clark, & Tellegen, 1988). Here, participants have to indicate how single adjectives apply to their current mood. For this state measure, internal consistencies were $\alpha = .88$ (PA) and $\alpha = .84$ (NA) which is comparable to validation studies ($\alpha = .85$ for PA and $\alpha = .86$ for NA; Krohne, Egloff, Kohlmann, & Tausch, 1996).

Data analysis

Exploratory factor analysis with principal component analysis (PCA) was chosen to investigate the factor structure of the German FCQs because of possible cultural differences in craving (Hill, 2007; Rodríguez et al., 2007). Criterion for the number of extracted factors was an eigenvalue >1 (Kaiser, 1960). An oblique rotation (Promax; $\kappa = 4$) was chosen because factors were expected to be correlated (Cepeda-Benito, Gleaves, Williams et al., 2000). Item means and item-total-correlations were calculated for item analysis. Cronbach's α and retest-coefficients were calculated for evaluating reliability. Construct validity was determined by correlations with the respective questionnaires. Convergent validity of the FCQ-T was evaluated by correlations with other measures of eating behavior (restrained eating, binge eating, food addiction, dietary control strategies, dieting success) while divergent validity was determined by correlations with relevant, but not eating-related constructs (substance craving, impulsivity, BIS/BAS). The FCQ-S was correlated with current affective states and hours elapsed since the last meal. Non-parametric correlation was conducted in case data were not normally distributed (Spearman's ρ). Biserial correlation coefficient was used for gender.

Specific relationships of FCQs-subcales with dietary restraint status were explored in greater detail. Participants were divided into dieters and non-dieters based on a median split of RS-CD-scores ($Mdn = 5$). Dieters were further classified as being successful or unsuccessful in their attempt to lose weight or prevent weight gain by median split of PSRS-scores. Participants whose scores matched the median were excluded from analyses. Obviously, it is inappropriate to differentiate non-dieters as being successful or unsuccessful because they are not watching their weight. Therefore, this procedure resulted in three groups: non-dieters ($n = 241$), successful dieters ($n = 90$), and unsuccessful dieters ($n = 168$). Groups did not differ in age ($F_{(2,495)} = .04$, *ns*), but differed in BMI ($F_{(2,495)} = 38.7$, $p < .001$). Post-hoc Scheffé-tests revealed that unsuccessful dieters ($M = 24.14 \text{ kg/m}^2$, $SD = 4.03$) had higher BMI than successful dieters ($M = 21.4 \text{ kg/m}^2$, $SD = 2.68$, $p < .001$) and non-dieters ($M = 21.51 \text{ kg/m}^2$, $SD = 2.64$, $p < .001$); BMI of successful dieters and non-dieters were equal. To further elucidate if and how different dimensions of food cravings are able to discriminate between these groups, discriminant analyses were performed separately for FCQ-T- and FCQ-S-subcales. Structure coefficients were considered as meaningful when they were higher than .33 (Tabachnick & Fidell, 2007, p. 400). In a second step, we interpreted the actual contribution of each variable to the calculation of the discriminant score (standardized coefficients) only for those variables with high structure coefficients.

Results

Psychometric properties of the German FCQs

FCQ-T

PCA extracted six factors. Eigenvalues before rotation were 16.3, 3.2, 1.7, 1.6, 1.2, and 1.2. After oblique rotation, eigenvalues were 13.0, 7.9, 11.3, 8.3, 10.8, and 3.2. These six factors explained 64.6% of variance compared to 41.7% of the one-factorial solution. Although we extracted fewer factors than Cepeda-Benito and colleagues (2000), inspection of factor loadings showed that our six-factorial solution was a combination of the nine original subscales (Table 1). While the factors CUES, EMOTIONS, and HUNGER could be replicated, the subscales POS REINFORCEMENT and NEG REINFORCEMENT were combined, reforming a factor REINFORCEMENT (Table 1). Furthermore, the subscales THOUGHTS and GUILT could also be merged into one factor. Finally, the subscales INTENTIONS and LACK OF CONTROL were also combined to one factor. It has to be noted that some items had high loadings on more than one factor (Table 1), but were kept in the original factor to adhere to the theoretical foundation by Cepeda-Benito and colleagues (2000) and to maintain comparability to the original FCQs. Factors were highly correlated (Range: $r = .44$ – $.75$, all p 's $< .001$).

Item difficulties ranged between $M = 1.7$ – 3.9 (Table 1). Range of item-total-correlations was $r_{itc} = .37$ – $.76$ (Table 1). Internal consistency was $\alpha = .96$ for the FCQ-T total score and ranged between $\alpha = .72$ (HUNGER) and $\alpha = .93$ (THOUGHTS/GUILT) for the subscales. Retest-reliability (Spearman's ρ) was $r_{tt} = .84$ for the FCQ-T total score and ranged between $r_{tt} = .69$ (HUNGER) and $r_{tt} = .84$ (EMOTIONS) for the subscales (all p 's $< .001$).

FCQ-S

PCA yielded a three-factorial solution. Eigenvalues were 7.4, 1.9, 1.1 before, and 6.1, 4.9, 5.2 after oblique rotation. These three factors explained 70.0% of variance compared to 49.5% of the one-factorial solution. Again, factors found by Cepeda-Benito and colleagues (2000) were combined which resulted in fewer subscales. Like for the trait version, the factor HUNGER was replicated while the factors POS REINFORCEMENT and NEG REINFORCEMENT were merged (Table 2). Factors DESIRE and LACK OF CONTROL were also merged (Table 2). Again, factors were highly correlated (range: $r = .55$ – $.75$, all p 's $< .001$).

Item difficulties ranged between $M = 1.4$ – 2.2 , and item-total-correlations between $r_{itc} = .47$ and $.79$ (Table 2). Internal consistency was $\alpha = .92$ for the FCQ-S total score and ranged between $\alpha = .87$ (REINFORCEMENT) and $\alpha = .89$ (HUNGER, DESIRE/LACK OF CONTROL) for the subscales. Retest-reliability (Spearman's ρ) was $r_{tt} = .40$ ($p < .001$) for the FCQ-S total score and $r_{tt} = .12$ (HUNGER, *ns*), $r_{tt} = .46$ (DESIRE/LACK OF CONTROL, $p < .001$) and $r_{tt} = .52$ (REINFORCEMENT, $p < .001$) for the subscales.

Construct validity

FCQ-T

Total FCQ-T scores were positively and weakly correlated with BMI ($r = .14$, $p < .001$) and gender ($r_b = .27$, $p < .001$), indicating increased FCQ-T scores in women compared to men. Medium-to-high correlations with measures of dysfunctional eating behavior supported convergent validity (Table 3). Restrained eating behavior, binge eating frequencies, food addiction symptoms, and rigid control of eating behavior were positively related to FCQ-T scores while perceived self-regulatory success in dieting was negatively correlated. No relationship was found with flexible control of eating behavior (Table 3). Confirming divergent validity, FCQ-T scores were positively, but weakly correlated with substance craving, impulsivity, and the BIS/BAS scales (Table 3).

Table 1
Factor loadings and item statistics of the Food Cravings Questionnaire-Trait.

Factor						Item	Factor	Item mean	Item-total-correlation
1	2	3	4	5	6				
.44	-.22	.53	.04	-.14	-.05	4. I hate it when I give in to cravings (Ich hasse es, wenn ich dem starken Verlangen nach bestimmten Nahrungsmitteln nachgebe)	Thoughts/guilt	2.83	.54
.87	-.03	-.04	.09	-.04	.05	6. I feel like I have food on my mind all the time (Ich habe das Gefühl, dass ich die ganze Zeit nur Essen im Kopf habe)	Thoughts/guilt	2.15	.71
.61	-.14	.44	-.02	-.16	-.07	7. I often feel guilty for craving certain foods (Ich fühle mich oft schuldig, weil ich ein starkes Verlangen nach bestimmten Nahrungsmitteln verspüre)	Thoughts/guilt	2.10	.61
.88	-.07	.03	.07	-.10	.12	8. I find myself preoccupied with food (Ich ertappe mich dabei, wie ich mich gedanklich ständig mit Essen beschäftige)	Thoughts/guilt	2.14	.72
.55	-.20	.50	-.05	-.08	-.09	17. When I eat what I am craving I feel guilty about myself (Wenn ich das esse, wonach ich ein starkes Verlangen verspüre, fühle ich mich schuldig)	Thoughts/guilt	2.10	.60
.85	-.03	.09	.00	-.03	-.02	27. I can't stop thinking about eating no matter how hard I try (Ich kann nicht aufhören, übers Essen nachzudenken, wie sehr ich mich auch bemühe)	Thoughts/guilt	1.81	.73
.86	.11	-.18	.05	-.04	.05	28. I spend a lot of time thinking about whatever it is I will eat next (Ich verbringe viel Zeit damit über das, was ich als nächstes essen werde, nachzudenken)	Thoughts/guilt	2.27	.66
.76	.25	-.22	-.04	-.05	.20	31. I daydream about food (Manchmal stelle ich fest, dass ich mit offenen Augen vor mich hin träume und an Essen denke)	Thoughts/guilt	1.76	.60
.56	.04	-.03	-.16	.45	.07	32. Whenever I have a food craving, I keep on thinking about eating until I actually eat the food (Immer wenn ich ein starkes Verlangen nach bestimmten Nahrungsmitteln verspüre, denke ich so lange weiter ans Essen, bis ich diese tatsächlich esse)	Thoughts/guilt	2.04	.72
.68	.06	-.04	-.16	.33	.06	33. If I am craving something, thoughts of eating it consume me (Wenn ich ein starkes Verlangen nach bestimmten Nahrungsmitteln verspüre, verzehren mich die Gedanken daran, diese zu essen, geradezu)	Thoughts/guilt	1.78	.73
.10	.53	.39	-.05	-.05	-.05	9. I eat to feel better (Ich esse, um mich besser zu fühlen)	Reinforcement	2.75	.63
.19	.66	.00	-.06	-.03	.05	10. Sometimes, eating makes things seem just perfect (Etwas zu essen, lässt manchmal einfach alles perfekt erscheinen)	Reinforcement	2.31	.51
-.27	.59	-.07	-.03	.42	.07	15. Eating what I crave makes me feel better (Das zu essen, wonach ich ein starkes Verlangen verspüre, führt dazu, dass ich mich besser fühle)	Reinforcement	3.40	.41
-.10	.52	.48	-.15	.07	.01	16. When I satisfy a craving I feel less depressed (Wenn ich ein starkes Verlangen nach bestimmten Nahrungsmitteln stille, in dem ich diese esse, fühle ich mich weniger deprimiert)	Reinforcement	2.33	.57
.09	.62	.30	.15	-.18	.03	19. Eating calms me down (Essen beruhigt mich)	Reinforcement	3.00	.65
.07	.62	.41	-.17	-.09	-.10	21. I feel less anxious after I eat (Ich fühle mich weniger ängstlich besorgt, nachdem ich gegessen habe)	Reinforcement	1.98	.54
-.08	.81	-.28	.06	.20	-.10	24. When I eat what I crave I feel great (Wenn ich das esse, wonach ich ein starkes Verlangen verspüre, fühle ich mich großartig)	Reinforcement	2.68	.37
-.06	.85	.05	.12	-.11	-.10	38. When I eat food, I feel comforted (Wenn ich etwas esse, fühle ich mich behaglich oder erleichtert)	Reinforcement	2.79	.47
-.07	.09	.71	.12	.06	.15	20. I crave foods when I feel bored, angry, or sad (Ich verspüre ein starkes Verlangen nach bestimmten Nahrungsmitteln, wenn ich mich gelangweilt, wütend oder traurig fühle)	Emotions	3.02	.72
-.17	.00	.79	.04	.08	.26	30. When I'm stressed out, I crave food (Wenn ich total gestresst bin, verspüre ich ein starkes Verlangen nach bestimmten Nahrungsmitteln)	Emotions	2.97	.64
.08	.11	.71	.01	.05	.08	34. My emotions often make me want to eat (Meine Emotionen bringen mich oft dazu, etwas essen zu wollen)	Emotions	2.38	.76
.01	.15	.78	-.10	-.03	.13	39. I crave foods when I'm upset (Ich verspüre ein starkes Verlangen nach bestimmten Nahrungsmitteln, wenn ich aufgebracht bin)	Emotions	2.07	.65
.05	.07	.00	.66	-.13	.25	1. Being with someone who is eating often makes me hungry (Mit jemandem zusammen zu sein, der gerade isst, macht mich oft hungrig)	Cues	3.34	.49
-.07	-.06	-.10	.83	.08	.13	35. Whenever I go to a buffet I end up eating more than what I needed (Immer wenn es ein Buffet gibt, esse ich am Ende mehr, als ich gebraucht hätte)	Cues	3.92	.47
-.02	-.02	.04	.64	.28	.11	36. It is hard for me to resist the temptation to eat appetizing foods that are in my reach (Wenn sich appetitliche Nahrungsmittel in meiner Reichweite befinden, fällt es mir schwer, der Versuchung zu widerstehen, sie zu essen)	Cues	3.58	.68
.07	.03	.05	.67	.04	-.05	37. When I am with someone who is overeating, I usually overeat too (Wenn ich mit jemandem zusammen bin, der sich gerade überisst, überesse ich mich gewöhnlich auch)	Cues	2.46	.56
.27	.11	.06	.32	.22	-.14	2. When I crave something, I know I won't be able to stop eating once I start (Wenn ich ein starkes Verlangen nach etwas verspüre, weiß ich, dass ich nicht mehr aufhören kann zu essen, wenn ich erst mal angefangen habe)	Lack of control/intentions	2.61	.67
.17	.02	.16	.34	.34	-.20	3. If I eat what I am craving, I often lose control and eat too much (Wenn ich das esse, wonach ich ein starkes Verlangen verspüre, verliere ich oft die Kontrolle und esse zu viel)	Lack of control/intentions	2.94	.71
.52	.00	-.05	-.14	.45	.10	5. Food cravings invariably make me think of ways to get what I want to eat (Wenn ich ein starkes Verlangen nach bestimmten Nahrungsmitteln verspüre, denke ich ausnahmslos darüber nach, wie ich das bekomme, was ich essen will)	Lack of control/intentions	2.43	.68
.26	.09	-.06	.10	.50	.11	18. Whenever I have cravings, I find myself making plans to eat (Immer wenn ich ein starkes Verlangen nach bestimmten Nahrungsmitteln verspüre, merke ich, dass ich gleich plane, etwas zu essen)	Lack of control/intentions	2.93	.71
-.08	-.04	.05	.23	.73	-.03	22. If I get what I am craving I cannot stop myself from eating it (Wenn ich das bekomme, wonach ich ein starkes Verlangen verspüre,	Lack of	3.19	.64

Table 2
Factor loadings and item statistics of the Food Cravings Questionnaire-State.

Factor			Item	Factor	Item mean	Item-total-correlation
1	2	3				
.69	.45	-.15	1. I have an intense desire to eat [one or more specific foods] (Ich verspüre den intensiven Wunsch [eines oder mehrere bestimmte Nahrungsmittel] zu essen)	Desire/lack of control	2.15	.77
.74	.38	-.11	2. I'm craving [one or more specific foods] (Ich verspüre ein starkes Verlangen nach [einem oder mehreren bestimmten Nahrungsmitteln])	Desire/lack of control	2.04	.79
.69	.40	-.09	3. I have an urge for [one or more specific foods] (Ich verspüre den Drang, [eines oder mehrere bestimmte Nahrungsmittel] zu essen)	Desire/lack of control	2.05	.78
.85	-.26	.00	10. If I had [one or more specific foods], I could not stop eating it (Wenn ich [eines oder mehrere bestimmte Nahrungsmittel] hätte, könnte ich nicht aufhören, davon zu essen)	Desire/lack of control	1.89	.47
.82	-.22	.14	11. My desire to eat [one or more specific foods] seems overpowering (Mein Verlangen, [eines oder mehrere bestimmte Nahrungsmittel] zu essen, scheint überwältigend zu sein)	Desire/lack of control	1.44	.60
.77	-.22	.20	12. I know I'm going to keep on thinking about [one or more specific foods] until I actually have it (Ich weiß, dass ich solange an [eines oder mehrere bestimmte Nahrungsmittel] denken werde, bis ich es tatsächlich habe)	Desire/lack of control	1.56	.59
-.09	.96	-.02	13. I am hungry (Ich habe Hunger)	Hunger	2.24	.59
-.13	.91	.09	14. If I ate right now, my stomach wouldn't feel as empty.(Wenn ich jetzt etwas essen würde, würde sich mein Magen nicht so leer anfühlen)	Hunger	2.24	.61
-.22	.76	.30	15. I feel weak because of not eating (Ich fühle mich schwach, weil ich nichts gegessen habe)	Hunger	1.65	.58
.47	-.08	.39	6. Eating [one or more specific foods] would make things seem just perfect ([Eines oder mehrere bestimmte Nahrungsmittel] zu essen, würde mir alles einfach perfekt erscheinen lassen)	Reinforcement	1.51	.59
.21	.06	.64	5. If I were to eat what I am craving, I am sure my mood would improve (Wenn ich das essen würde, wonach ich mich gerade sehne, würde sich sicher meine Stimmung verbessern)	Reinforcement	1.94	.68
.45	.08	.36	8. Satisfying my craving would make me feel less grouchy and irritable ([Eines oder mehrere bestimmte Nahrungsmittel] zu essen, würde sich großartig anfühlen)	Reinforcement	2.09	.68
-.04	.21	.69	7. If I ate something, I wouldn't feel so sluggish and lethargic (Wenn ich etwas essen würde, würde ich mich nicht so träge und antriebslos fühlen)	Reinforcement	1.79	.61
.17	-.09	.81	8. Satisfying my craving would make me feel less grouchy and irritable (Wenn ich mein Verlangen stillen könnte, würde ich mich weniger schlecht gelaunt und gereizt fühlen)	Reinforcement	1.75	.67
-.05	.22	.77	9. I would feel more alert if I could satisfy my craving (Wenn ich mein Verlangen stillen könnte, würde ich michmunterer fühlen)	Reinforcement	1.86	.68

Note. Item-total-correlation was part-whole corrected.

(Cepeda-Benito, Gleaves, Williams et al., 2000), the German FCQs were composed of six (FCQ-T) and three (FCQ-S) subscales. This was achieved by merging three FCQ-T- and two FCQ-S-subscals into other factors. Similar results were presented by Vander Wal and colleagues (2007) where – both in the state and the trait version – subscales for positive and negative reinforcement through eating, could be combined into one factor. Furthermore, PCA of an adaptation of the FCQ-T to chocolate cravings also resulted in a six-factorial solution (Rodríguez et al., 2007). Contrarily, Nijs and colleagues (2007) found a four-factorial solution for their Dutch version of the FCQ-T. However, these differences could be due to methodological reasons because they modified wording of the items. Cultural differences or translational issues might also account for diverging results in factor structure as no equivalent of the term craving exists in Dutch (Nijs et al., 2007) as in other languages (Hormes & Rozin, 2010).

Although some items had also high factor loadings on other subscales, the combination of subscales in our study was supported by good internal consistencies. For instance, even the subscale with the most items with multiple high factor loadings (LACK OF CONTROL/INTENTIONS, Table 1) had a Cronbach's α of .92. Moreover, overall internal consistency was also very good for both the state and trait version (>.90). As expected, retest-reliabilities were higher for the trait- than for the state version and comparable to the original version (Cepeda-Benito, Gleaves, Williams et al., 2000).

FCQ-T was positively associated with eating behaviors that are related to a loss of control over eating (restrained eating, binge eating, food addiction, low success in dieting, BMI) confirming convergent validity. Rigid control strategies of eating behavior were associated with increased food cravings whereas there was no such relationship between food cravings and flexible control of eating behavior. Rigid dietary control strategies have previously been associated with disinhibited eating behavior or higher BMI

Table 3
Construct validity of the Food Cravings Questionnaire-Trait (FCQ-T).

	FCQ-T	p-Value
<i>Convergent validity</i>		
Restraint Scale-Concern for Dieting	.56	< .001
Binge Eating ^a	.54	< .001
Yale Food Addiction Scale ^b	.50	< .001
Perceived Self-Regulatory Success in Dieting	-.42	< .001
Rigid Control of Eating Behavior	.41	< .001
Flexible Control of Eating Behavior	.07	ns
<i>Divergent validity</i>		
Mannheimer Craving Scale	.16	< .001
Barratt Impulsiveness Scale	.17	< .001
Behavioral Inhibition System	.31	< .001
Behavioral Activation System	.09	< .05

^a Binge eating refers to the number of days within the last 28 days when binge eating occurred as measured with the Eating Disorder Examination-Questionnaire.
^b Questionnaire scores represent the amount of food addiction symptoms.

(Shearin et al., 1994; Stewart et al., 2002; Timko & Perone, 2005; Westenhoefer, 1991; Westenhoefer et al., 1999). One possible mediator could be the experience of food cravings that are fostered by rigid eating behavior (Meule, Westenhöfer, & Kübler, 2011). For instance, sticking to a monotone diet has been found to lead to food cravings in the absence of hunger feelings (Pelchat & Schaefer, 2000).

Small correlations were found between the FCQ-T and substance craving. The MaCS instructs participants to think of any addictive substance when indicating their craving. Here, we speculate that participants included food as an addictive substance. Accordingly, it has been found that the terms *craving* and *addiction* are used for food and drugs alike in the general population (Hormes & Rozin, 2010). In accordance with the crucial role of cravings in impulsive behaviors like food and drug addiction, impulsivity

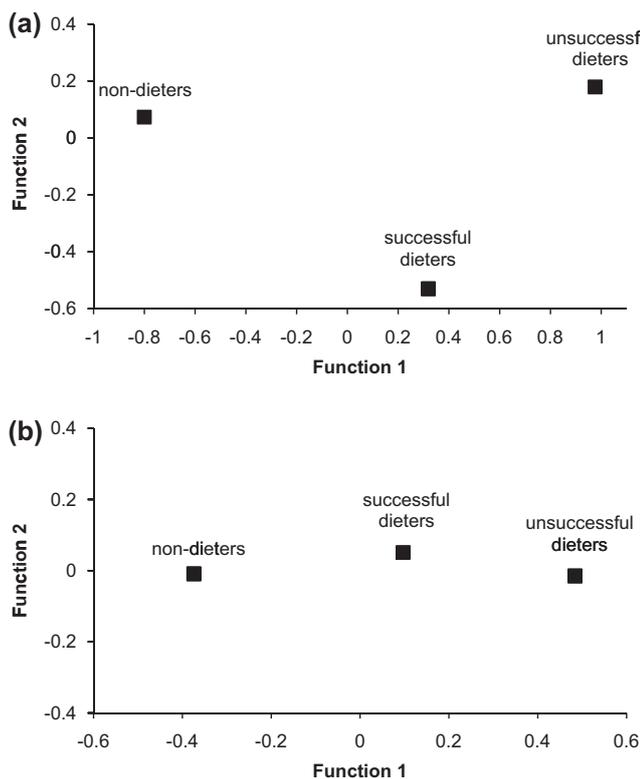


Fig. 1. Location of groups along the first and second discriminant functions according to their respective centroids for the (a) trait and (b) state version of the Food Cravings Questionnaire.

was also associated with food cravings. Additionally, BIS/BAS-reactivity was also positively correlated with food cravings which corresponds to increased BIS reactivity in food addiction (Gearhardt et al., 2009; Meule et al., in press), but also to a positive relationship between reward sensitivity and food cravings (Franken & Muris, 2005). In a similar vein, Bijttebier and colleagues (2009) have suggested BIS sensitivity to be related to withdrawal relief craving in substance abuse, while BAS sensitivity can induce reward craving. Taken together, substance craving, BIS/BAS reactivity and impulsivity were significantly, but weakly related to the FCQ-T, thereby confirming divergent validity.

Hours elapsed since the last meal were positively associated with state cravings, replicating previous findings (Cepeda-Benito, Gleaves, Williams et al., 2000; Cepeda-Benito et al., 2003). However, correlations between state cravings and affective state indicated that also factors other than hunger modulated current cravings. Negative affect was positively and positive affect negatively correlated with state cravings. While this is the first study showing that the FCQ-S is also sensitive to current mood states the causal direction between food cravings and mood states cannot be inferred from these results.

Food craving dimensions in dietary restraint

In the current study, we found a positive correlation between restrained eating and FCQ-T-scores. Nevertheless, there is an ongoing debate on the confounding of success and failure in the measurement of dietary restraint. For instance, Van Strien (1999) concluded that the total population of dieters consists of two sub-populations of successful and unsuccessful dieters who cannot be discriminated by considering the restraint score alone. Therefore, we used a measure solely of cognitive restraint combined with

Table 4
Structure matrix and standardized discriminant function coefficients.

	Structure matrix		Standardized coefficients	
	Function 1	Function 2	Function 1	Function 2
<i>Food Cravings Questionnaire-Trait</i>				
Thoughts/guilt	.95	-.21	.92	-1.1
Lack of control/intentions	.75	.41	.10	1.2
Emotions	.63	.26	.06	.40
Cues	.53	.29	.12	.09
Reinforcement	.41	.15	.11	-.05
Hunger	.29	-.23	-.36	-.58
<i>Food Cravings Questionnaire-State</i>				
Desire/lack of control	.85	-	1.09	-
Reinforcement	.50	-	.07	-
Hunger	-.07	-	-.62	-

Note. The second discriminant function was not significant for the Food Cravings Questionnaire-State.

explicit differentiation between successful and unsuccessful dieters (see Papies et al., 2008; Van Koningsbruggen, Stroebe, & Aarts, 2011; Van Koningsbruggen, Stroebe, Papies, 2011). We found that dieters – regardless of being successful or unsuccessful in their pursuit – experienced more cravings that are related to a preoccupation with food and guilt from cravings or for giving into them. Moreover, unsuccessful dieters reported more food cravings that were related to a lack of control over eating and plans to consume food than successful dieters. Therefore, this is the first study showing that (1) differences in food cravings between non-dieters and dieters depend on success or failure of these dieters and (2) that specific types of food cravings discriminate differentially between these three groups.

While the FCQ-S also discriminated between dieters and non-dieters, successful and unsuccessful dieters could not be discriminated. Specifically, the FCQ-S was not able to identify one single successful dieter. This finding corresponds to results showing that the FCQ-S is also related to dysfunctional eating behavior but the relationship is attenuated (Cepeda-Benito, Gleaves, Williams et al., 2000; Moreno et al., 2008). Furthermore, it shows that successful and unsuccessful dieters do not differ in their current experiences of craving. Successful dieters may be as susceptible as unsuccessful dieters to allurements of food, but possess mechanisms that enable them to resist those temptations.

Limitations

First, it has to be noted that the current methodology was different from other FCQs-validation studies. We conducted an online study whereas usually paper-and-pencil versions of the FCQs were used. However, there is evidence that questionnaires assessed online do not differ from traditional assessment methods (e.g. Miller et al., 2002). Furthermore, psychometric properties of the German FCQs largely corresponded to the Spanish and English version which supports comparability of studies. Second, the majority of our sample consisted of young women attending University. Therefore, results must be interpreted with caution as they may not be transferrable to the general population. Future studies using the FCQs should investigate a broader range of participants, including more men and people of higher age and with lower social status. Third, our investigation was a cross-sectional study based on self-report measures. Field or experimental designs are needed to reveal the exact role of food cravings for success or failure in dieting. For instance, factors could be examined that determine why some dieters can stick to their diet although experiencing certain food cravings.

To summarize, the German version of the FCQs is a reliable and valid measure of state and trait food cravings. Although overall food cravings are positively associated with restrained eating behavior and less dieting success, the subpopulations of successful and unsuccessful dieters show distinct experiences of specific types of cravings. These differences need to be considered when the relationship between dieting and food cravings, and particularly mechanisms leading to success or failure in dieting, are investigated.

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