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Food cravings discriminate differentially between successful and unsuccessful dieters. Validation of the Food Cravings Questionnaires in German

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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 α > .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 subscales 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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I n t r o d u c t i o n

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 Schaef er (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...
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 could 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, Rodriguez, 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-subscales have been found to discriminate between anorexia and bulimia nervosa subtypes (Moreno, Rodriguez, Fernández, & Cepeda-Benito, 2003). 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 (Ablé and colleagues, 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, Papes, & 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.

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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

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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.

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Participants

The study’s 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 kg/m² (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 α > .90 (Cepeda-Benito, Geaves, Fernández et al., 2000; Cepeda-Benito, Geaves, 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 divergent 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 α = .81–.86 (Gearhardt et al., 2009; Meule et al., in press), which could be confirmed in the present study (α = .83).

Restrain 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 (Stroebel, 2008). Furthermore, RS-CD has been found to have higher internal consistency than RS-WF (α = .82 vs. .69, Dinkel et al., 2005). In the present study, we thus used the RS-CD only and internal consistency was α = .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 and 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 Papiers 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 α = .74, which is higher than previously reported (α = .66; Van Koningsbruggen, Stroebel, & Aarts, 2011).

Flexible and rigid control of eating behavior

These scales were originally developed by Westenhoefer (1991) and 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 α = .83), whereas the rigid control scale consists of 16 items (RC16; Cronbach’s α = .81). Internal consistencies were also good in the present sample (α = .82 for FC12, α = .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 (α = .87–.93; Nakovics, Diehl, Geiselhart, & Mann, 2009) and in the present study (α = .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 (α = .78) compared to the validation studies (α > .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-subscases (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 momentarily 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 validity 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 \( \alpha \) 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 \( \rho \)). Biserial correlation coefficient was used for gender.

Specific relationships of FCQs-subscases with dietary restraint status were explored in greater detail. Participants were divided into dieters and non-dieters based on a median split of RS-CDQ-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, \( \text{MS} < .001 \)), 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-subscases. 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 \( r_{tt} = .37-.76 \) (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 \( \rho \)) 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 \( r_{tt} = .47 \) 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 \( \rho \)) 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 (\( r = .27, p < .001 \)), 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.

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Thoughts/guilt: 2.23 .54
Thoughts: 2.27 .79
Emotions: 2.97 .64
Reinforcement: 2.75 .83
Control/intentions: 2.77 .47
Lack of control/intentions: 2.43 .68
Cues: 3.54 .49
Lack of control/intentions: 2.93 .71
Lack of control/intentions: 3.19 .64
When I crave certain foods, I usually try to eat them as soon as I can (Wenn ich ein starkes Verlangen nach bestimmten Nahrungsmitteln verspüre, versuche ich gewöhnlich, diese so bald wie möglich auch zu essen).

I have no will power to resist my food crave (Ich habe nicht die Willensstärke, um meinen Essensgelüsten widerstehen zu können).

Once I start eating, I have trouble stopping (Wenn ich einmal anfange, zu essen, fällt es mir schwer, wieder aufzuhören).

If I give in to a food craving, all control is lost (Wenn ich dem starken Verlangen nach bestimmten Nahrungsmitteln nachgebe, ist alles verloren).

Thinking about my favorite foods makes my mouth water (Wenn ich an meine Lieblingsessen denke, läuft mir das Wasser im Mund zusammen).

I crave foods when my stomach is empty (Ich verspüre ein starkes Verlangen nach bestimmten Nahrungsmitteln, wenn mein Magen leer ist).

It feels as if my body asks me for certain foods (Es fühlt sich an, als würde mein Körper nach bestimmten Nahrungsmitteln geradezu verlangen).

I get so hungry that my stomach seems like a bottomless pit (Ich werde so hungrig, dass mir mein Magen wie ein Fass ohne Boden vorkommt).

FCQs-subscale in relation to dietary restraint status

FCQ-T

The first and second discriminant function discriminated significantly between non-dieters, successful and unsuccessful dieters (Wilks $\lambda = .57$, $\chi^2_{(12)} = 278.6, p < .001$). After removing function one, the second function was still significant (Wilks $\lambda = .94$, $\chi^2_{(8)} = 30.8, p < .001$). Function 1 had an eigenvalue of .65 and explained 91.0% of the variance while function 2 contributed further 9.0% (eigenvalue .06). Function 1 discriminated between dieters and non-dieters whereas function 2 discriminated between successful and unsuccessful dieters (Fig. 1a). Table 4 presents the structure matrix and standardized coefficients for both discriminant functions. Within the first discriminant function, factor LACK OF CONTROL/INTENTIONS discriminated best between groups as did factor LACK OF CONTROL discriminated best (Table 4). Press’s $Q$ indicated that correct classification of participants was better than what would be expected by chance alone, according to Press’s $Q (\chi^2_{11} = 281.5, p < .001)$. Classification results showed that 68.7% of originally grouped cases and 68.1% of cross-validated grouped cases (jackknife procedure) were correctly classified. Classifying participants by chance would have resulted in 37.9% of correct classifications.

FCQ-S

Total FCQ-S scores were unrelated to BMI ($r = .003$, ns) or gender ($r_{(b)} = .02$, ns). State cravings were positively associated with hours elapsed since the last meal ($r = .25, p < .001$). FCQ-S scores were moderately correlated with negative affect ($r = .32, p < .001$) and weakly and negatively with positive affect ($r = -.08, p < .05$).

Psychometric properties of the German FCQs

The factor structure of the original FCQs could only be replicated partially. While the trait version has previously been reported to consist of nine and the state version of five subscales

Note: Retrival 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-subscales 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, the 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 (Shearin et al., 1994; Stewart et al., 2002; Timko & Perone, 2005; Westenhofer, 1991; Westenhofer et al., 1999). One possible mediator could be the experience of food cravings that are fostered by rigid eating behavior (Meule, Westenhofer, & Kühler, 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 when indicating their craving. Here, we speculate that participants included food as an addictive substance.
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 explicit differentiation between successful and unsuccessful dieters (see Papes et al., 2008; Van Koningsbruggen, Stroebe, & Aarts, 2011; Van Koningsbruggen, Stroebe, & Papes, 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 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 experiences of craving.
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. New research needs 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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References


