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German version of the Yale Food Addiction Scale 2.0: Prevalence and correlates of 'food addiction' in students and obese individuals

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Abstract

The Yale Food Addiction Scale (YFAS) measures addiction-like eating of palatable foods based on the seven diagnostic criteria for substance dependence in the fourth revision of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV). Most recently, a new version of the YFAS has been developed based on the revised eleven diagnostic criteria for substance use disorder in DSM-5. This YFAS 2.0 was translated into German and used among other measures in a study with 455 university students (89% female) and in a study with 138 obese patients presenting for bariatric surgery (78% female). In the student sample, the one-factorial structure of the English version could be replicated and internal consistency was $\alpha = .90$. The diagnostic threshold for 'food addiction' was met by 10% of the sample. 'Food addiction' diagnoses were associated with higher body mass, binge eating frequency, trait food craving, and attentional impulsivity as well as with lower perceived self-regulatory success in dieting. In the obese sample, the diagnostic threshold for 'food addiction' was met by 47% of participants. Again, 'food addiction' symptomatology was associated with higher binge eating frequency and attentional impulsivity. However, those with a 'food addiction' diagnosis did not differ from those without a diagnosis in body mass. To conclude, psychometric properties of the English YFAS 2.0 were replicated for the German YFAS 2.0. Prevalence rates and correlates of 'food addiction' as measured with the YFAS 2.0 were similar to those found with the previous version of the YFAS. Thus, the German YFAS 2.0 appears to be a reliable measure that can be used for the investigation of addiction-like eating behavior, analogous to the original version of the YFAS and the English YFAS 2.0.

Keywords

Food addiction; Obesity; Food craving; Impulsivity; Binge eating; Body mass index

Introduction

'Food addiction' refers to the idea that certain foods (e.g., highly processed, high-calorie foods) may have an addictive potential and that some forms of overeating may represent an addicted behavior (Ifland et al., 2015). Although this concept has generated some controversy in the scientific community (Benton, 2010; Rogers & Smit, 2000; Wilson, 2010; Ziauddeen & Fletcher, 2013), it has received increasing interest in recent years (Davis & Carter, 2009, 2014; Meule, 2015). The popularity of the 'food addiction' concept can be, in part, attributed to the development of the *Yale Food Addiction Scale* (YFAS; Gearhardt, Corbin, & Brownell, 2009), which was the first standardized self-report measure for the assessment of addiction-like eating based on the diagnostic criteria for substance dependence in the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV; American Psychiatric Association, 1994).

In 2013, a new version of the DSM (DSM-5) was released, which includes revised diagnostic criteria for substance use disorder (American Psychiatric Association, 2013). Specifically, four new criteria were added and diagnostic thresholds were lowered such that the presence of two symptoms (and a clinically significant impairment or distress) suffices to receive a diagnosis of substance use disorder (for a discussion of the four new criteria in relation to food and eating, see Meule & Gearhardt, 2014b). Given these substantial changes in the diagnostic criteria for substance use disorder, the YFAS has been revised recently (Gearhardt, Corbin, & Brownell, 2016). This new version–the YFAS 2.0–measures eleven 'food addiction' symptoms: (1) Consuming large amounts of food or eating more than planned (*amounts*), (2) unsuccessful attempts to cut down (*attempts*), (3) great deal of time spent in buying or consuming food or recover from overeating (*time*), (4) important activities given up due to eating (*activities*), (5) overeating despite physical or emotional consequences (*consequences*), (6) need to eat more to achieve the same effects (*tolerance*), (7) withdrawal

symptoms when cutting down on certain foods (*withdrawal*), (8) frequent cravings for certain foods (*craving*), (9) failure in role obligations due to eating (*obligations*), (10) overeating despite interpersonal or social problems (*problems*), and (11) overeating in physically hazardous situations (*situations*). Additionally, the YFAS 2.0 differs from the original YFAS in some other aspects as well (e.g., changes in item wordings and response options; Gearhardt et al., 2016).

The aim of the current studies was to evaluate the psychometric properties and correlates of a German translation of the YFAS 2.0. In study 1, a large, predominantly student sample was investigated online. Based on the findings in the validation studies of the English YFAS 2.0 (Gearhardt et al., 2016), it was expected that the eleven YFAS 2.0 symptoms would have a one-factorial structure and high internal consistency. Those with a diagnosis were hypothesized to have higher BMI and eating pathology (i.e., more days with binge eating, more frequent food cravings, and lower self-regulatory success in dieting) and to be more likely female than those without a diagnosis (Gearhardt et al., 2016; Pursey, Stanwell, Gearhardt, Collins, & Burrows, 2014). Based on findings with the previous version of the YFAS, it was expected that those with a YFAS 2.0 diagnosis would report higher impulsivity than those without a diagnosis (Davis et al., 2011; Murphy, Stojek, & MacKillop, 2014), particularly regarding attentional impulsivity (Ceccarini, Manzoni, Castelnuovo, & Molinari, 2015; Meule, Lutz, Vögele, & Kübler, 2012; Meule, Vögele, & Kübler, 2012).

In study 2, a sample of obese individuals presenting for bariatric surgery was investigated with a paper-and-pencil version of the YFAS 2.0. Based on findings with the YFAS 2.0 and with the previous version of the YFAS, it was expected that a substantially larger proportion of participants than in study 1 would receive a diagnosis (Gearhardt et al., 2016; Meule, Heckel, Jurowich, Vögele, & Kübler, 2014; Pursey et al., 2014). Similar to study 1, those with a diagnosis were hypothesized to have higher eating pathology (i.e., more

days with binge eating, higher eating concern, weight concern, and shape concern) and higher impulsivity than those without a diagnosis, particularly regarding attentional impulsivity (e.g., Gearhardt et al., 2016; Meule, Heckel, et al., 2014). In contrast to study 1, however, gender and BMI were expected to be unrelated to YFAS 2.0 diagnoses as these variables did not differ between obese individuals with and obese individuals without 'food addiction' based on the previous version of the YFAS (Meule, 2012). Finally, age and dietary restraint were also expected to be unrelated to YFAS 2.0 diagnoses (Gearhardt et al., 2016; Meule, Heckel, et al., 2014).

STUDY 1

Methods

Participants

Participants were recruited in February and March 2015 via students' mailing lists at various universities in German-speaking countries (Germany, Austria, Switzerland, Luxembourg) by providing a link to the study's website at www.soscisurvey.de. Six-hundred and seventeen individuals started the study. Participants who were identified by the website's quality check to have answered questions too rapidly were excluded (n = 16). Moreover, data from participants who immediately terminated the study after the instructions or did not fully complete the YFAS were excluded from analyses (n = 146). The final sample comprised n = 455 participants (89.0% female, n = 405). Most participants were students (79.8%, n = 363) and had German citizenship (82.6%, n = 376). Mean age was M = 25.57 years (SD = 6.97) and mean BMI was M = 22.32 kg/m² (SD = 3.65). Most participants had normal weight (77.8%, n = 354, BMI = 18.50-24.99 kg/m²) and few were underweight (6.8%, n = 31, BMI < 18.50 kg/m²), overweight (11.6%, n = 53, BMI = 25.00-29.99 kg/m²), or obese (3.7%, n = 17, BMI ≥ 30.00 kg/m²).

Measures

YFAS 2.0. The YFAS 2.0 (Gearhardt et al., 2016) assesses addiction-like eating during the past twelve months. The scale consists of 35 items, which are scored on an eight-point scale ranging from *never* to *every day*. A symptom count can be calculated by adding up all endorsed symptoms and, thus, scores can range between zero and eleven. Moreover, based on the diagnostic thresholds for substance use disorder in DSM-5, different severity levels can be differentiated: mild 'food addiction' (indicated by meeting two or three symptoms), moderate 'food addiction' (indicated by meeting four or five symptoms), and severe 'food addiction' (indicated by meeting six or more symptoms). All 'food addiction' diagnoses also require the presence of clinically significant impairment or distress due to the eating behavior. The English version of the YFAS 2.0 was translated into German by the first author and translated back into English by a bilingual speaker, who did not have any knowledge about the original version. Discrepancies between the back-translation and the original form were discussed and adjustments were made to the German translation as necessary (Appendix A).

Food Cravings Questionnaire – Trait – reduced (FCQ-T-r). The German version of the FCQ-T-r (Hormes & Meule, 2016; Meule, Hermann, & Kübler, 2014) was used for measuring general food cravings. The scale consists of 15 items, which are scored on a six-point scale ranging from *never/not applicable* to *always*. Higher scores indicate more frequent food craving experiences. Internal consistency was $\alpha = .95$.

Binge days. Items #13-15 of the Eating Disorder Examination-Questionnaire (EDE-Q; Fairburn & Beglin, 1994; Hilbert & Tuschen-Caffier, 2006) were used for measuring binge eating severity. These items ask participants to indicate (1) how many times they consumed large amounts of food within the past 28 days, (2) how many times they felt that they lost control over eating, and (3) on how many days they consumed large amounts *and* had a loss

of control. The first two items act as primers for the third item and, thus, only the third item, which assesses the number of binge days in the past 28 days was analyzed.

Perceived Self-Regulatory Success in Dieting Scale (PSRS). The German version of the PSRS (Meule, Papies, & Kübler, 2012) was used for measuring subjectively perceived success in eating-related self-regulation. The scale consists of three items, which are scored on a seven-point scale anchored not *successful/not difficult* and *very successful/very difficult*. Higher scores indicate higher perceived self-regulatory success. Internal consistency was α = .71.

Barratt Impulsiveness Scale – short form (BIS-15). The German version of the BIS-15 (Meule, Vögele, & Kübler, 2011; Spinella, 2007) was used for measuring trait impulsivity. The scale consists of 15 items, which are scored on a four-point scale ranging from *never/rarely* to *almost always/always*. The scale contains three subscales representing *attentional impulsivity* (inability to focus attention or concentrate), *motor impulsivity* (acting without thinking), and *non-planning impulsivity* (lack of future orientation or forethought). Higher scores indicate higher impulsivity. Internal consistencies were α = .63 (attentional), α = .78 (motor), α = .79 (non-planning), and α = .81 (total scale).

Data analyses

A confirmatory factor analysis for dichotomous data was conducted using Mplus (Muthén & Muthén, 1998-2015) to examine whether the eleven YFAS 2.0 symptoms had an underlying one-factorial structure. Note that there is no sum score calculated from single items of the YFAS 2.0. Instead, there are different cut-offs for each item in order to determine if a symptom is met or not (cf. Appendix A). Therefore, factor structure and internal consistency of the YFAS 2.0 is calculated at the symptom and not at the item level. Items assessing impairment or distress were not included in this analysis as they reflect clinical significance of the full syndrome rather than indicators of individual criteria (cf. Gearhardt et

al., 2016). Internal consistency of the eleven YFAS 2.0 symptoms was evaluated with Kuder-Richardson's α. Group differences regarding age, BMI, and questionnaire measures between participants with vs. without a YFAS 2.0 diagnosis were examined with independent *t*-tests. Associations between the number of YFAS 2.0 symptoms and age, BMI, and questionnaire measures were examined with correlational analyses. Gender differences in YFAS 2.0 diagnoses were examined with a χ^2-test and gender differences in the number of YFAS 2.0 symptoms were examined with an independent *t*-test. Exact *p*-values are reported, except when $p < .001$.

Results

Endorsement rates of YFAS 2.0 symptoms are displayed in Figure 1A. The *impairment* criterion was met by 12.3% of the sample. The Comparative Fit Index (CFI: .998), Tucker-Lewis Index (TLI: .998), and Root Mean Square Error of Approximation (RMSEA: .02) suggested good fit for the one-factor model. All criteria had factor loadings for the single factor of .73 or higher. Internal consistency of the eleven symptoms was $\alpha = .90$.

Six participants (1.3%) received a mild, eight (1.8%) a moderate, and 30 (6.6%) a severe YFAS 2.0 diagnosis. Due to the small number of participants in the mild and moderate category, groups were collapsed for further analyses ($n = 44$, 9.7% of the sample). Participants with a YFAS 2.0 diagnosis had higher BMI, higher FCQ-T-r and attentional impulsivity scores, more binge days and lower PSRS scores than participants without a YFAS 2.0 diagnosis (Table 1). Similarly, the number of YFAS 2.0 symptoms was positively correlated with BMI, FCQ-T-r and attentional impulsivity scores, and the number of binge days, and negatively correlated with PSRS scores. In addition, age, motor impulsivity and total BIS-15 scores were positively correlated with the number of YFAS 2.0 symptoms (Table 1). Gender was not associated with YFAS 2.0 diagnoses ($\chi^2_{(1)} = 2.07$, $p = .15$) or symptoms ($t_{(453)} = 1.37$, $p = .17$).

STUDY 2

Methods

Participants

Data from bariatric surgery candidates were obtained between January and October 2015 at Hannover Medical School. Participants were recruited within the routine preoperative psychiatric evaluation. All participants gave written informed consent for participation according to procedures approved by the institutional ethics committee of the Hannover Medical School. One-hundred and thirty-eight individuals participated in the study (78.3% female, n = 108). The majority of participants had middle secondary education (45.7%, n = 63), lower secondary education (20.3%, n = 28), or higher secondary education (11.6%, n = 16). Most participants had German citizenship (92.0%, n = 127). Mean age was M = 39.52 years (SD = 10.71) and mean BMI was M = 48.80 kg/m² (SD = 7.08). All participants were obese (Range: 35.08-69.25 kg/m²). Five participants did not complete all items of the YFAS 2.0, leaving a final sample of n = 133 participants.

Measures

YFAS 2.0. The German version of the YFAS 2.0 was used and internal consistency of the eleven symptoms was α = .87.

EDE-Q. In addition to the items for the assessment of binge days (cf. study 1), 22 items of the EDE-Q were used for measuring *restraint*, *eating concern*, *weight concern*, and *shape concern*. Items are scored on a seven-point scale ranging from *no days/not at all* to *every day/markedly*. Higher scores indicate higher eating pathology. Internal consistencies were α = .72 (restraint), α = .74 (eating concern), α = .42 (weight concern), α = .71 (shape concern), and α = .82 (total scale).

BIS-15. The German version of the BIS-15 was used and internal consistencies were α = .72 (attentional), α = .63 (motor), α = .80 (non-planning), and α = .78 (total scale).

Data analyses

Associations between the YFAS 2.0 and age, BMI, and questionnaire measures were examined with *t*-tests (YFAS 2.0 diagnoses) and correlations (YFAS 2.0 symptoms). Associations between the YFAS 2.0 and gender were examined with a χ^2-test (YFAS 2.0 diagnoses) and *t*-test (YFAS 2.0). Exact *p*-values are reported, except when $p < .001$.

Results

Endorsement rates of YFAS 2.0 symptoms are displayed in Figure 1B. The *impairment* criterion was met by 52.6% of the sample. Fifteen participants (11.3%) received a mild, 20 (15.0%) a moderate, and 28 (21.1%) a severe YFAS 2.0 diagnosis. Due to the small number of participants in the mild and moderate category, groups were collapsed for further analyses (n = 63, 47.4% of the sample). As expected, participants with a YFAS 2.0 diagnosis reported more binge days and had higher scores on eating concern, weight concern, and shape concern than participants without a YFAS 2.0 diagnosis, but groups had similar BMI and restraint scores (Table 2). Similarly, the number of YFAS 2.0 symptoms was positively correlated with the number of binge days and scores on eating concern, weight concern, and shape concern, but not with BMI and restraint scores. In addition, attentional impulsivity scores were positively correlated with the number of YFAS 2.0 symptoms (Table 2). Gender was not associated with YFAS 2.0 diagnoses ($\chi^2_{(1)} = 0.25$, $p = .62$) or symptoms ($t_{(131)} = 0.28$, $p = .78$).

Discussion

The German YFAS 2.0 demonstrated a one-factorial structure and good internal consistency, which replicates data of the English YFAS 2.0 (Gearhardt et al., 2016) and the

prior version of the YFAS (Gearhardt et al., 2009; Meule, Heckel, & Kübler, 2012; Meule, Vögele, et al., 2012), showing that the scale measures addiction-like eating as a unidimensional construct. A substantially larger number of individuals in the obese sample received a YFAS 2.0 diagnosis as compared to the student sample, similar to previous findings (Gearhardt et al., 2016; Meule & Gearhardt, 2014a; Pursey et al., 2014).

Notably, severe YFAS 2.0 diagnoses were more common than those with mild or moderate severity and this has also been found with the English version (Gearhardt et al., 2016). The most frequently endorsed symptoms in study 1 were consuming large amounts or eating more than planned and unsuccessful attempts to reduce food intake. Criteria such as these apply to many people (particularly to overweight individuals who want to lose weight), although they may not exhibit an addiction-like eating behavior. Because of this and because of the addition of symptoms and lowering of diagnostic thresholds in DSM-5, it could have been possible that YFAS 2.0 diagnoses would have high sensitivity, but very low specificity (Meule & Gearhardt, 2014b). We would argue, however, that the current data suggest that this is not the case. Instead, it appears that, while many people may endorse two or three symptoms of addiction-like eating, they rarely meet the threshold for clinically significant impairment or distress and, thus, do not receive a YFAS 2.0 diagnosis. In contrast to the student sample, the criteria of overeating despite physical or emotional consequences and despite interpersonal or social problems were two of the three most often endorsed symptoms in bariatric surgery candidates (Figure 1). This finding corresponds to observations made with the old YFAS such that the pattern of met criteria differs between study samples (e.g., non-clinical, obese, and eating disordered samples; Meule & Gearhardt, 2014a).

Receiving a YFAS 2.0 diagnosis in the student sample was associated with a higher BMI. As predicted, however, YFAS 2.0 diagnoses were not associated with BMI within obese individuals in study 2, which is in accordance with studies, in which the old YFAS was

employed (e.g., Burmeister, Hinman, Koball, Hoffmann, & Carels, 2013; Davis et al., 2013; Eichen, Lent, Goldbacher, & Foster, 2013; Meule, Heckel, et al., 2014; Meule, Hermann, & Kübler, 2015). The absence of an association between YFAS 2.0 diagnoses and BMI in obese individuals may be due to ceiling effects, among others (Meule, 2012). As hypothesized, receiving a YFAS 2.0 diagnosis was also associated with higher eating pathology, but not with higher restraint (e.g., Gearhardt et al., 2016; Meule, Heckel, et al., 2014; Meule et al., 2015). Thus, the current studies further support discriminant validity of the YFAS 2.0, showing that the scale does not merely measure an intention (and failure) to restrict food consumption, but a distinct construct.

In line with previous findings (e.g., Ceccarini et al., 2015; Meule, Heckel, et al., 2014; Meule, Lutz, et al., 2012), attentional impulsivity scores were most consistently, but weakly, associated with YFAS 2.0 scores while there were inconsistent associations with motor impulsivity and no relationships with non-planning impulsivity. An important avenue for future research is to identify mediators that can explain how impulsivity facets translate into addiction-like eating. An intuitive assumption would be that a high attentional impulsivity may be involved in the responsiveness to food cues (e.g., that food cues more easily capture attention and elicit food craving than when attentional impulsivity is low), whereas high motor impulsivity may be involved in the behavioral consequences of these cognitive processes (e.g., that a person is more likely to give in to a craving than when motor impulsivity is low). However, existing data on such mediating mechanisms have been inconclusive. For example, an attentional bias towards high-calorie food cues was related to both attentional and motor impulsivity in one study (Hou et al., 2011), but to non-planning impulsivity in another (Meule & Platte, 2016). Furthermore, while external eating behavior was related to both attentional and motor impulsivity in the study by Hou et al. (2011), external eating mediated the association between motor impulsivity (and not attentional impulsivity) and laboratory food intake (Kakoschke, Kemps, & Tiggemann, 2015). Finally,

brain imaging studies also yielded inconsistent findings regarding differential associations between BIS subscales and brain activations during food-related tasks (Hege et al., 2015; van der Laan, Barendse, Viergever, & Smeets, 2015). To conclude, although some studies aimed to identify mediators of the relationship between impulsivity facets and eating behavior, the exact mechanisms by which trait impulsivity may lead to addiction-like eating are not clear yet.

Several issues limit interpretation of the current results. First, study 1 investigated a non-representative sample, in which there likely was a self-selection bias as recruitment was not based on probability sampling (Bethlehem, 2010; Khazaal et al., 2014). Thus, future studies need to investigate nationally representative samples to accurately estimate the prevalence of YFAS 2.0 diagnoses in the general population. Second, all data were based on self-report, which is vulnerable to bias (e.g., self-reported height and weight; Connor Gorber, Tremblay, Moher, & Gorber, 2007). Thus, future studies need to include objective measures of body composition, which have been found to be associated with addiction-like eating (Pursey, Gearhardt, & Burrows, 2016). Moreover, it may be worthwhile to develop an interview version of the YFAS 2.0 in order to avoid self-report bias. Although few interview approaches exist (Cassin & von Ranson, 2007; Curtis & Davis, 2014), no standardized and validated interview for the assessment of addiction-like eating based on DSM-5 criteria has been developed yet. Third, both studies were cross-sectional, which precludes any causal interpretations (e.g., if high attentional impulsivity is an antecedent of addiction-like eating).

To conclude, psychometric properties of the English YFAS 2.0 (one-factorial structure, high internal consistency) could be replicated for the German version. Correlates of the German YFAS 2.0 (e.g., higher eating pathology, higher attentional impulsivity) were largely similar to those found with the English version and the previous version of the YFAS. Moreover, a substantial subset of severely obese individuals received a YFAS 2.0 diagnosis,

similar to findings with the old YFAS. Thus, the German YFAS 2.0 appears to be a psychometrically sound measure for the assessment of addiction-like eating behavior, which produces consistent results that are similar to other versions of the scale.

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References

American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: American Psychiatric Association.

American Psychiatric Association. (2013). *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.). Washington, DC: American Psychiatric Association.

Benton, D. (2010). The plausibility of sugar addiction and its role in obesity and eating disorders. *Clinical Nutrition, 29*, 288-303.

Bethlehem, J. (2010). Selection Bias in Web Surveys. *International Statistical Review, 78*, 161-188.

Burmeister, J. M., Hinman, N., Koball, A., Hoffmann, D. A., & Carels, R. A. (2013). Food addiction in adults seeking weight loss treatment. Implications for psychosocial health and weight loss. *Appetite, 60*, 103-110.

Cassin, S. E., & von Ranson, K. M. (2007). Is binge eating experienced as an addiction? *Appetite, 49*, 687-690.

Ceccarini, M., Manzoni, G. M., Castelnuovo, G., & Molinari, E. (2015). An evaluation of the Italian version of the Yale Food Addiction Scale in obese adult inpatients engaged in a 1-month-weight-loss treatment. *Journal of medicinal food, 18*, 1281-1287.

Connor Gorber, S., Tremblay, M., Moher, D., & Gorber, B. (2007). A comparison of direct vs. self-report measures for assessing height, weight and body mass index: a systematic review. *Obesity Reviews, 8*, 307-326.

Curtis, C., & Davis, C. (2014). A qualitative study of binge eating and obesity from an addiction perspective. *Eat Disord, 22*, 19-32.

Davis, C., & Carter, J. C. (2009). Compulsive overeating as an addiction disorder. A review of theory and evidence. *Appetite, 53*, 1-8.

Davis, C., & Carter, J. C. (2014). If certain foods are addictive, how might this change the treatment of compulsive overeating and obesity? *Current Addiction Reports, 1*, 89-95.

Davis, C., Curtis, C., Levitan, R. D., Carter, J. C., Kaplan, A. S., & Kennedy, J. L. (2011). Evidence that 'food addiction' is a valid phenotype of obesity. *Appetite, 57*, 711-717.

Davis, C., Loxton, N. J., Levitan, R. D., Kaplan, A. S., Carter, J. C., & Kennedy, J. L. (2013). 'Food addiction' and its association with a dopaminergic multilocus genetic profile. *Physiology & Behavior, 118*, 63-69.

Eichen, D. M., Lent, M. R., Goldbacher, E., & Foster, G. D. (2013). Exploration of "food addiction" in overweight and obese treatment-seeking adults. *Appetite, 67*, 22-24.

Fairburn, C. G., & Beglin, S. J. (1994). Assessment of eating disorders: Interview or self-report questionnaire? *International Journal of Eating Disorders, 16*, 363-370.

Gearhardt, A. N., Corbin, W. R., & Brownell, K. D. (2009). Preliminary validation of the Yale Food Addiction Scale. *Appetite, 52*, 430-436.

Gearhardt, A. N., Corbin, W. R., & Brownell, K. D. (2016). Development of the Yale Food Addiction Scale Version 2.0. *Psychology of Addictive Behaviors, 30*, 113–121.

Hege, M. A., Stingl, K. T., Kullmann, S., Schag, K., Giel, K. E., Zipfel, S., & Preissl, H. (2015). Attentional impulsivity in binge eating disorder modulates response inhibition performance and frontal brain networks. *International Journal of Obesity, 39*, 353-360.

Hilbert, A., & Tuschen-Caffier, B. (2006). *Eating Disorder Examination - Questionnaire: Deutschsprachige Übersetzung*. Münster: Verlag für Psychotherapie.

Hormes, J. M., & Meule, A. (2016). Psychometric properties of the English Food Cravings Questionnaire-Trait-reduced (FCQ-T-r). *Eating Behaviors, 20*, 34-38.

Hou, R., Mogg, K., Bradley, B. P., Moss-Morris, R., Peveler, R., & Roefs, A. (2011). External eating, impulsivity and attentional bias to food cues. *Appetite, 56*, 424-427.

Ifland, J., Preuss, H. G., Marcus, M. T., Rourke, K. M., Taylor, W., & Wright, T. (2015). Clearing the confusion around processed food addiction. *Journal of the American College of Nutrition, 34*, 240-243.

Kakoschke, N., Kemps, E., & Tiggemann, M. (2015). External eating mediates the relationship between impulsivity and unhealthy food intake. *Physiology & Behavior, 147*, 117-121.

Khazaal, Y., Van Singer, M., Chatton, A., Achab, S., Zullino, D., Rothen, S., . . . Thorens, G. (2014). Does self-selection affect samples' representativeness in online surveys? An investigation in online video game research. *Journal of Medical Internet Research, 16*(7), e164.

Meule, A. (2012). Food addiction and body-mass-index: A non-linear relationship. *Medical Hypotheses, 79*, 508-511.

Meule, A. (2015). Back by popular demand: A narrative review on the history of food addiction research. *Yale Journal of Biology and Medicine, 88*, 295-302.

Meule, A., & Gearhardt, A. N. (2014a). Five years of the Yale Food Addiction Scale: Taking stock and moving forward. *Current Addiction Reports, 1*, 193-205.

Meule, A., & Gearhardt, A. N. (2014b). Food addiction in the light of DSM-5. *Nutrients, 6*, 3653-3671.

Meule, A., Heckel, D., Jurowich, C. F., Vögele, C., & Kübler, A. (2014). Correlates of food addiction in obese individuals seeking bariatric surgery. *Clinical Obesity, 4*, 228-236.

Meule, A., Heckel, D., & Kübler, A. (2012). Factor structure and item analysis of the Yale Food Addiction Scale in obese candidates for bariatric surgery. *European Eating Disorders Review, 20*, 419-422.

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), 1-10.

Meule, A., Hermann, T., & Kübler, A. (2015). Food addiction in overweight and obese adolescents seeking weight-loss treatment. *European Eating Disorders Review, 23*, 193-198.

Meule, A., Lutz, A., Vögele, C., & Kübler, A. (2012). Women with elevated food addiction symptoms show accelerated reactions, but no impaired inhibitory control, in response to pictures of high-calorie food-cues. *Eating Behaviors, 13*, 423-428.

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., & Platte, P. (2016). Attentional bias towards high-calorie food-cues and trait motor impulsivity interactively predict weight gain. *Health Psychology Open, 3*, 1-7.

Meule, A., Vögele, C., & Kübler, A. (2011). [Psychometric evaluation of the German Barratt Impulsiveness Scale - Short Version (BIS-15)]. *Diagnostica, 57*, 126-133.

Meule, A., Vögele, C., & Kübler, A. (2012). [German translation and validation of the Yale Food Addiction Scale]. *Diagnostica, 58*, 115-126.

Murphy, C. M., Stojek, M. K., & MacKillop, J. (2014). Interrelationships among impulsive personality traits, food addiction, and body mass index. *Appetite, 73*, 45-50.

Muthén, L. K., & Muthén, B. O. (1998-2015). *Mplus User's Guide* (7th ed.). Los Angeles, CA: Muthén & Muthén.

Pursey, K. M., Gearhardt, A. N., & Burrows, T. L. (2016). The relationship between "food addiction" and visceral adiposity in young females. *Physiology & Behavior, 157*, 9-12.

Pursey, K. M., Stanwell, P., Gearhardt, A. N., Collins, C. E., & Burrows, T. L. (2014). The prevalence of food addiction as assessed by the Yale Food Addiction Scale: a systematic review. *Nutrients, 6*(10), 4552-4590.

Rogers, P. J., & Smit, H. J. (2000). Food craving and food "addiction": a critical review of the evidence from a biopsychosocial perspective. *Pharmacology, Biochemistry and Behavior, 66*, 3-14.

Spinella, M. (2007). Normative data and a short form of the Barratt Impulsiveness Scale. *International Journal of Neuroscience, 117*, 359-368.

van der Laan, L. N., Barendse, M. E., Viergever, M. A., & Smeets, P. A. (2015). Subtypes of trait impulsivity differentially correlate with neural responses to food choices. *Behavioural Brain Research, 296,* 442-450.

Wilson, G. T. (2010). Eating disorders, obesity and addiction. *European Eating Disorders Review, 18,* 341-351.

Ziauddeen, H., & Fletcher, P. C. (2013). Is food addiction a valid and useful concept? *Obesity Reviews, 14,* 19-28.

Table 1

Associations of age, BMI, and questionnaire measures with YFAS 2.0 diagnoses and symptoms in study 1

	Yale Food Addiction Scale 2.0						
	Food addiction (n = 44)	No food addiction (n = 411)	t	p	d	$r_{symptoms}$	p
	M (SD)	M (SD)					
Age (years)	27.27 (8.49)	25.38 (6.77)	1.43	.16	0.27	.14	.004
Body mass index (kg/m²)	23.89 (5.29)	22.15 (3.40)	3.02	.003	0.48	.23	< .001
Food Cravings Questionnaire-Trait-reduced	61.00 (14.57)	31.52 (11.06)	16.02	< .001	2.58	.76	< .001
Binge days	9.98 (7.93)	1.19 (2.82)	15.26	< .001	2.42	.74	< .001
Perceived Self-Regulatory Success in Dieting	9.07 (3.87)	12.79 (3.62)	6.44	< .001	1.02	-.45	< .001
Barratt Impulsiveness Scale – short form							
Attentional impulsivity	10.20 (2.71)	9.38 (2.43)	2.11	.04	0.33	.22	< .001
Motor impulsivity	11.16 (3.31)	10.67 (2.61)	1.15	.35	0.18	.12	.01
Non-planning impulsivity	9.66 (3.10)	10.04 (2.77)	0.85	.40	0.14	.05	.31
Total scale	31.02 (7.24)	30.09 (5.85)	0.98	.41	0.16	.17	< .001

Table 2

Associations of age, BMI, and questionnaire measures with YFAS 2.0 diagnoses and symptoms in study 2

	Yale Food Addiction Scale 2.0						
	Food addiction (n = 63)	No food addiction (n = 70)	t	p	d	$r_{symptoms}$	p
	M (SD)	M (SD)					
Age (years)	39.83 (10.60)	39.61 (10.92)	0.11	.91	0.02	-.01	.88
Body mass index (kg/m²)	49.46 (7.51)	48.14 (6.79)	1.06	.29	0.19	.15	.09
Binge days	8.39 (8.60)	2.32 (4.46)	5.00	< .001	0.90	.58	< .001
Eating Disorder Examination – Questionnaire							
Restraint	2.74 (1.37)	2.86 (1.47)	0.48	.63	0.08	.03	.70
Eating concern	3.18 (1.26)	1.60 (1.34)	6.89	< .001	1.21	.54	< .001
Weight concern	4.53 (0.76)	3.77 (0.97)	4.89	< .001	0.87	.41	< .001
Shape concern	5.00 (0.75)	4.34 (1.09)	3.94	< .001	0.70	.32	< .001
Total scale	3.86 (0.77)	3.15 (0.92)	4.81	< .001	0.83	.43	< .001
Barratt Impulsiveness Scale – short form							
Attentional impulsivity	10.16 (3.06)	9.21 (2.87)	1.84	.07	0.32	.22	.01
Motor impulsivity	10.02 (2.31)	10.07 (2.49)	0.13	.90	0.02	-.07	.42
Non-planning impulsivity	10.86 (3.21)	10.24 (3.20)	1.10	.27	0.19	.04	.63
Total scale	31.03 (6.60)	29.53 (5.83)	1.40	.17	0.24	.10	.26

Appendix A

German items of the Yale Food Addiction Scale 2.0 with scoring instructions

Item [original English items in brackets]	Scoring		Criterion
	0	1	
1. Wenn ich anfing bestimmte Nahrungsmittel zu essen, aß ich viel mehr als geplant. [When I started to eat certain foods, I ate much more than planned.]	0-5	6-7	amount
2. Ich aß bestimmte Nahrungsmittel weiter, obwohl ich nicht mehr hungrig war. [I continued to eat certain foods even though I was no longer hungry.]	0-5	6-7	amount
3. Ich aß bis zu einem Punkt, an dem ich mich körperlich schlecht fühlte. [I ate to the point where I felt physically ill.]	0-3	4-7	amount
4. Ich machte mir viele Gedanken darüber, den Konsum bestimmter Nahrungsmittel einzuschränken, aber ich aß sie trotzdem. [I worried a lot about cutting down on certain types of food, but I ate them anyways.]	0-5	6-7	attempts
5. Ich verbrachte viel Zeit, in der ich mich träge oder müde fühlte, weil ich mich überessen hatte. [I spent a lot of time feeling sluggish or tired from overeating.]	0-4	5-7	time
6. Ich verbrachte viel Zeit, in der ich bestimmte Nahrungsmittel über den ganzen Tag hinweg aß. [I spent a lot of time eating certain foods throughout the day.]	0-5	6-7	time
7. Wenn bestimmte Nahrungsmittel nicht vorhanden waren, scheute ich keine Mühen diese zu bekommen. Zum Beispiel ging ich in den Supermarkt um bestimmte Nahrungsmittel zu kaufen, obwohl ich andere Lebensmittel zuhause hatte. [When certain foods were not available, I went out of my way to get them. For example, I went to the store to get certain foods even though I had other things to eat at home.]	0-5	6-7	time
8. Ich aß bestimmte Nahrungsmittel so häufig oder in solch großen Mengen, dass ich aufhörte andere wichtige Dinge zu tun. Diese Dinge konnten beispielsweise sein zu arbeiten oder Zeit mit Familie oder Freunden zu verbringen. [I ate certain foods so often or in such large amounts that I stopped doing other important things. These things may have been working or spending time with family or friends.]	0-2	3-7	activities
9. Ich hatte Probleme mit meiner Familie oder Freunden aufgrund der Häufigkeit meines Überessens. [I had problems with my family or friends because of how much I overate.]	0-1	2-7	problems

10. Ich mied die Arbeit, Schule oder soziale Aktivitäten, weil ich befürchtete mich dort zu überessen. [I avoided work, school or social activities because I was afraid I would overeat there.]	0-1	2-7	activities
11. Wenn ich den Konsum bestimmter Nahrungsmittel einschränkte oder ganz aufhörte sie zu essen, fühlte ich mich gereizt, nervös oder traurig. [When I cut down on or stopped eating certain foods, I felt irritable, nervous or sad.]	0-3	4-7	withdrawal
12. Wenn ich körperliche Symptome spürte, weil ich bestimmte Nahrungsmittel nicht gegessen hatte, aß ich diese Nahrungsmittel um mich besser zu fühlen. [If I had physical symptoms because I hadn't eaten certain foods, I would eat those foods to feel better.]	0-4	5-7	withdrawal
13. Wenn ich emotionale Probleme hatte, weil ich bestimmte Nahrungsmittel nicht gegessen hatte, aß ich diese Nahrungsmittel um mich besser zu fühlen. [If I had emotional problems because I hadn't eaten certain foods, I would eat those foods to feel better.]	0-3	4-7	withdrawal
14. Wenn ich den Konsum bestimmter Nahrungsmittel einschränkte oder ganz aufhörte sie zu essen, verspürte ich körperliche Symptome. Zum Beispiel hatte ich Kopfschmerzen oder fühlte mich müde oder schlapp. [When I cut down on or stopped eating certain foods, I had physical symptoms. For example, I had headaches or fatigue.]	0-3	4-7	withdrawal
15. Wenn ich den Konsum bestimmter Nahrungsmittel einschränkte oder ganz aufhörte sie zu essen, verspürte ich ein starkes Verlangen nach ihnen. [When I cut down or stopped eating certain foods, I had strong cravings for them.]	0-5	6-7	withdrawal
16. Mein Essverhalten verursachte mir sehr viel Leid. [My eating behavior caused me a lot of distress.]	0-4	5-7	impairment/ distress
17. Ich hatte erhebliche Probleme in meinem Leben aufgrund von Nahrung und Essen. Diese Probleme betrafen beispielsweise meinen Alltag, die Arbeit, die Schule, Freunde, Familie oder meine Gesundheit. [I had significant problems in my life because of food and eating. These may have been problems with my daily routine, work, school, friends, family, or health.]	0-4	5-7	impairment/ distress
18. Ich hatte ein so schlechtes Gewissen aufgrund des Überessens, dass ich andere wichtige Dinge nicht tat. Diese Dinge konnten beispielsweise sein zu arbeiten oder Zeit mit Familie oder Freunden zu verbringen. [I felt so bad about overeating that I didn't do other important things. These things may have been working or spending time with family or friends.]	0-2	3-7	activities
19. Mein Überessen stand mir dabei im Weg mich um meine Familie zu kümmern oder meine häuslichen Pflichten zu erledigen. [My overeating got in the way of me taking care of my family or doing household chores.]	0-1	2-7	obligations
20. Ich mied die Arbeit, Schule oder soziale Aktivitäten, weil ich bestimmte Nahrungsmittel dort nicht essen konnte. [I avoided work, school or social functions because I could not eat certain foods there.]	0-2	3-7	activities
21. Ich mied soziale Situationen, weil Menschen es nicht akzeptiert hätten wie viel ich gegessen hätte.	0-2	3-7	problems

[I avoided social situations because people wouldn't approve of how much I ate.]			
22. Ich aß in derselben Art und Weise weiter, obwohl mein Essverhalten emotionale Probleme verursachte. [I kept eating in the same way even though my eating caused emotional problems.]	0-3	4-7	consequences
23. Ich aß in derselben Art und Weise weiter, obwohl mein Essverhalten körperliche Probleme verursachte. [I kept eating the same way even though my eating caused physical problems.]	0-4	5-7	consequences
24. Die gleiche Nahrungsmenge zu essen brachte mir nicht den gleichen Genuss wie früher. [Eating the same amount of food did not give me as much enjoyment as it used to.]	0-4	5-7	tolerance
25. Ich wollte unbedingt den Konsum bestimmter Nahrungsmittel einschränken oder ganz auf sie verzichten, aber ich konnte es einfach nicht. [I really wanted to cut down on or stop eating certain kinds of foods, but I just couldn't.]	0-5	6-7	attempts
26. Ich musste immer mehr essen um die Gefühle zu bekommen, die ich durch essen erreichen wollte. Diese umfassten eine Verminderung negativer Emotionen wie Traurigkeit oder eine Erhöhung des Wohlbefindens. [I needed to eat more and more to get the feelings I wanted from eating. This included reducing negative emotions like sadness or increasing pleasure.]	0-4	5-7	tolerance
27. Ich erbrachte keine gute Leistung auf der Arbeit oder in der Schule, weil ich zu viel aß. [I didn't do well at work or school because I was eating too much.]	0-1	2-7	obligations
28. Ich aß bestimmte Nahrungsmittel weiterhin, obwohl ich wusste, dass es körperlich gefährlich war. Zum Beispiel aß ich weiterhin Süßigkeiten, obwohl ich Diabetes hatte oder ich aß weiterhin fettreiche Nahrungsmittel, obwohl ich eine Herzerkrankung hatte. [I kept eating certain foods even though I knew it was physically dangerous. For example, I kept eating sweets even though I had diabetes. Or I kept eating fatty foods despite having heart disease.]	0-3	4-7	situations
29. Ich hatte einen solch starken Drang bestimmte Nahrungsmittel zu essen, dass ich an nichts anderes mehr denken konnte. [I had such strong urges to eat certain foods that I couldn't think of anything else.]	0-3	4-7	craving
30. Ich hatte ein solch starkes Verlangen nach bestimmten Nahrungsmitteln, dass ich mich fühlte als müsste ich sie sofort essen. [I had such intense cravings for certain foods that I felt like I had to eat them right away.]	0-4	5-7	craving
31. Ich versuchte den Konsum bestimmter Nahrungsmittel einzuschränken oder ganz aufzuhören sie zu essen, aber ich war erfolglos. [I tried to cut down on or not eat certain kinds of food, but I wasn't successful.]	0-4	5-7	attempts
32. Ich versuchte und versagte dabei den Konsum bestimmter Nahrungsmittel einzuschränken oder ganz auf sie zu verzichten. [I tried and failed to cut down on or stop eating certain foods.]	0-4	5-7	attempts
33. Ich war durch essen so abgelenkt, dass ich mich hätte verletzen können (z.B. während des Autofahrens, beim Überqueren der Straße oder beim Bedienen	0-1	2-7	situations

von Maschinen). [I was so distracted by eating that I could have been hurt (e.g., when driving a car, crossing the street, operating machinery).]			
34. Ich war durch Gedanken an Essen so abgelenkt, dass ich mich hätte verletzen können (z.B. während des Autofahrens, beim Überqueren der Straße oder beim Bedienen von Maschinen). [I was so distracted by thinking about food that I could have been hurt (e.g., when driving a car, crossing the street, operating machinery).]	0-2	3-7	situations
35. Meine Freunde oder Familie machten sich Sorgen darüber, wie häufig ich mich überaß. [My friends or family were worried about how much I overate.]	0-1	2-7	problems

Notes. Response categories are 0 = nie [never], 1 = seltener als 1× pro Monat [less than monthly], 2 = 1× pro Monat [once a month], 3 = 2-3× pro Monat [2-3 times a month], 4 = 1× pro Woche [once a week], 5 = 2-3× pro Woche [2-3 times a week], 6 = 4-6× pro Woche [4-6 times a week], 7 = jeden Tag [every day]. Responses are recoded to a dichotomous format as displayed in the column headed *scoring*. If at least one question of each criterion is scored as one, then this criterion is met. A continuous symptom count can be calculated by adding up the criteria met (except impairment/distress). That is, the symptom count can range between zero and eleven symptoms. Food addiction can be "diagnosed" when at least two (mild), four (moderate), or six (severe) symptoms are present *and* the criterion of a clinically significant impairment or distress is met. Items are preceded by the following instructions:

"Bei dieser Befragung geht es um Ihre Essgewohnheiten innerhalb des letzten Jahres. Man hat manchmal Schwierigkeiten zu kontrollieren, wie viel man von bestimmten Nahrungsmitteln isst, beispielsweise:

- Süßwaren wie Eiscreme, Schokolade, Donuts und andere Backwaren, Kekse, Kuchen und andere Süßigkeiten
- Kohlenhydratreiche Nahrungsmittel wie Weißbrot, Brötchen, Nudeln und Reis
- Salzige Snacks wie Chips, Salzstangen und Cracker
- Fettreiche Nahrungsmittel wie Steak, Speck, Bratwurst, Hamburger, Döner, Pizza und Pommes Frites
- Zuckerhaltige Getränke wie Limonade, Cola, Fanta, Sprite und Energy Drinks

Wenn in den folgenden Fragen nach *bestimmten Nahrungsmitteln* gefragt wird, denken Sie bitte an *irgendein* Nahrungsmittel oder Getränk ähnlich wie in den oben aufgelisteten Gruppen von Nahrungsmitteln und Getränken oder denken Sie an *irgendein anderes* Nahrungsmittel, bei dem Sie im vergangenen Jahr Schwierigkeiten hatten dessen Konsum zu kontrollieren."

["This survey asks about your eating habits in the past year. People sometimes have difficulty controlling how much they eat of certain foods such as:

- Sweets like ice cream, chocolate, doughnuts, cookies, cake, candy
- Starches like white bread, rolls, pasta, and rice
- Salty snacks like chips, pretzels, and crackers
- Fatty foods like steak, bacon, hamburgers, cheeseburgers, pizza, and French fries

- Sugary drinks like soda pop, lemonade, sports drinks, and energy drinks

When the following questions ask about “CERTAIN FOODS” please think of ANY foods or beverages similar to those listed in the food or beverage groups above or ANY OTHER foods you have had difficulty with in the past year.”]

Figure caption

Figure 1. Endorsement rates of YFAS 2.0 symptoms in study 1 (A) and study 2 (B).