Title: Confirmatory Factor Analysis and Psychometric Properties of the Norwegian Version of the Repetitive Eating-Questionnaire [Rep(eat)-Q]: Further Evidence of Two Distinct Subtypes of Grazing Behaviour

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Running Head: REPETITIVE EATING-QUESTIONNAIRE

Abstract

Objective: The Repetitive Eating–Questionnaire [Rep(eat)-Q] is a 12-item self-report measure of compulsive and non-compulsive forms of grazing behaviour (i.e., eating modest amounts of food in a repetitive and unplanned manner). The aim was to validate the proposed two-factor model of the Rep(eat)-Q in a community sample. **Method:** A total of 190 university students (78% female) were administered the Rep(eat)-Q along with other measures of eating behaviour. Mean age was 22.6 (*SD*=4.2, 19-43) and mean body mass index (BMI; kg/m^2) was 22.4 (*SD* = 2.9, 17-37). **Results:** Findings revealed good fit indexes for the 2-factor model by CFA, supporting the original solution. Internal consistency was excellent for the total score and two subscales (range 0.86 to 0.91). Age and BMI did not correlate significantly with the Rep(eat)-Q, but moderate to strong correlations ($r_{sp} \geq 0.48$ to 0.61) were found between the Compulsive Grazing (GC) subscale and eating-related measures, whereas weaker correlations ($r_{sp} \geq 0.37$ to 0.45) were found for Repetitive Eating (RE). **Conclusions:** This study confirmed the proposed factor structure of the Rep(eat)-Q in a community sample, offering support to the conceptual distinction between compulsive (marked by loss of control) and repetitive (non-compulsive) subtypes of grazing behaviour.

Keywords: Grazing, loss of control, compulsive, repetitive eating, psychometric properties, self-report questionnaire

Highlights

- The Rep(eat)-Q demonstrated reliability and validity as a measure of grazing behaviour in a community sample of young Norwegian adults.
- Confirmatory factor analysis confirmed the originally proposed two-factor model of compulsive and non-compulsive/repetitive eating subtypes of grazing behavior.
- This study provides evidence of distinct subtypes of grazing behavior distinguished by loss of control (LOC): compulsive grazing (marked by LOC) and repetitive eating (eating in a distracted or mindless way).

Confirmatory Factor Analysis and Psychometric Properties of the Norwegian Version of the Repetitive Eating-Questionnaire [Rep(eat)-Q]: Further Evidence of Two Distinct Subtypes of Grazing Behaviour

The repetitive eating of small/modest amounts of food in an unplanned manner, often referred to as "grazing", has been characterized as a pattern of unstructured and unanticipated eating outside of planned meals and snacks , and/or not in response to sensations of hunger or satiety (Conceicao, Mitchell, Engel, et al., 2014; Conceição et al., 2017). Grazing behaviour has been investigated most extensively within treatment-seeking populations of eating disorders (EDs) and obesity (see meta-analysis by Heriseanu, Hay, Corbit, & Touyz, 2017), especially obese bariatric samples at pre- and post-operative assessment, yet knowledge regarding the nature and frequency of grazing behaviour in the community remains sparse. Additional data would further inform the construct of grazing behavior, and clarify its associations with features of disordered eating and body mass index (BMI) in different populations across the BMI spectrum.

At present, it remains unclear whether grazing represents a high-risk or maladaptive eating behaviour warranting specific clinical attention, or whether grazing lies outside the spectrum of disordered eating. Grazing which persists or emerges post-operatively has been, albeit inconsistently, associated with poorer weight loss outcomes in bariatric surgery (Colles, Dixon, & O'Brien, 2008; Conceicao, Mitchell, Vaz, et al., 2014; Kofman, Lent, & Swencionis, 2010; Robinson et al., 2014). A few studies have also demonstrated links between grazing and various aspects of quality of life and mental health (Micanti et al., 2017; Nicolau et al., 2015). Associations with eating disorder (ED) pathology, such as binge eating, have been found, albeit inconsistently, within treatment-seeking individuals with eating disorders or obesity (Conceicao, Bastos, et al., 2014; Conceicao, Mitchell, Vaz, et al., 2014;

Goodpaster et al., 2016), with relatively few corresponding studies in non-clinical populations (Heriseanu et al., 2017). Collectively, findings tend to diverge according to whether the construct of loss of control (LOC) is reflected in the definition and assessment of grazing. In particular, little to no evidence exists for an association between ED pathology and conceptualizations of grazing which do not capture LOC (i.e., picking or nibbling) (Conceicao et al., 2013; Masheb, Roberto, & White, 2013; Reas, Wisting, Kapstad, & Lask, 2012), in line with prior conceptualizations delineating pathological versus non-pathological forms of grazing based upon accompanying LOC (Lane & Szabo, 2013). Recent findings in a bariatric sample suggest that grazing lies on a continuum of LOC eating within the spectrum of ED psychopathology, with non-compulsive grazing associated with the lowest degree of LOC/psychopathology, whereas compulsive grazing lies more similarly to subjective and objective binge eating (Conceicao et al., 2018), highlighting the importance of compulsive grazing behaviour as a clinically relevant eating behaviour.

Varying definitions and inconsistent measurement of grazing and related eating behaviour has posed major challenges to this literature (for a comprehensive review, see Conceicao, Mitchell, Engel, et al., 2014). One attempt to operationalize grazing based upon expert consensus recently led to the development of a structured clinical interview and companion self-report questionnaire, the Repetitive Eating Questionnaire [Rep(eat)-Q] (Conceição et al., 2017). Items provide a dimensional assessment of two theoretically distinct subtypes of grazing, namely compulsive grazing (i.e., marked by a loss of control or feeling unable to resist eating despite attempts) and repetitive eating, or non-compulsive grazing (i.e., eating in a distracted, mindless fashion). The initial development study supported the utility and validity of the Rep(eat)-Q as a brief, 12-item measure of grazing behaviour (Conceicão et al., 2017). An exploratory factor analysis revealed a two-factor model, providing evidence for theoretical subtypes of compulsive versus non-compulsive grazing, showing a good fit by a

confirmatory factor analysis in an obese bariatric sample. Tests of convergent validity showed that compulsive grazing had stronger associations with core ED features than repetitive or non-compulsive grazing, in line with a priori assumptions. Additional validation studies are warranted to replicate the utility of the Rep(eat)-Q as a brief, self-report measure of grazing behaviour. This is also in line with efforts to standardize the assessment of grazing to allow meaningful comparisons and interpretation of findings across studies (Conceicao, Mitchell, Engel, et al., 2014; Heriseanu et al., 2017).

To date, there are no studies which have replicated and validated the two-factor structure of the Rep(eat)-Q aside from the initial development study. This is despite clear relevance for improving the evidence base for this newly-developed measure, and the value of such data to ascertain the frequency and clarify associations of grazing behaviour with ED pathology in the community. Thus, the aim of the present study was to examine the psychometric properties and test the proposed two-factor model of the Rep(eat)-Q using confirmatory factor analysis in a community sample.

Method

Participants

A total of 190 university students (78% female) were administered the Rep(eat)-Q along with other measures of eating behaviour. Mean age was 22.6 (*SD*= 4.2, 19-43) and self-reported mean BMI was 22.4 (*SD* = 2.9, 17-37). The majority of participants (n =147, 80.3%) were classified in the healthy weight range (BMI = 18.5–24.9), while 6 (3.2%) participants were classified as underweight, 26 (14.2%) as overweight and 4 (2.2%) as obese.

Measures

The Repetitive Eating Questionnaire [Rep(eat)-Q] (Conceição et al., 2017) is a 12-item self-report questionnaire designed to assess the frequency of attitudinal and behavioural features of grazing over the past month (e.g., "*Ate "on and off" all day without planning it*" or

"*Could not resist going back to snacking on food even if you were trying to resist doing so*"). Responses are rated on a 7-point Likert-scale ranging from 0 (never) to 6 (every day), with higher scores indicating greater frequency. The total score and two subscales, Compulsive Grazing (CG) and Repetitive Eating (RE), are calculated by averaging the scale items. The lead author on the development study was contacted who provided supplemental materials and the items (Conceicao, Simões, Machado, & Mitchell, 2015; Conceicao, Mitchell, Engel, et al., 2014). The Rep(eat)-Q was forward and backward-translated in an iterative process by a bilingual research team of native English and Norwegian speakers (as has been described previously, see Reas, Bang, Øverås, Lask, & Rø, 2011).

The Eating Disorder Diagnosis Scale (EDDS)- DSM-5 Version (Stice, Telch, & Rizvi, 2000) is a brief self-report measure to assess diagnostic features of EDs. The EDDS (Stice et al., 2000) has shown good reliability and convergent validity, predictive validity, and criterion validity against diagnoses derived from clinical interviews (Stice, Fisher, & Martinez, 2004; Sysko et al., 2015). For the present study, the symptom composite score was calculated by standardizing all items (to control for the effects of the different response formats) and then summing across all items (except the height and birth control pill items) to provide an overall indicator of ED pathology. In addition, we used the binge eating frequency item (item 6) (i.e., "*how many times per month on average over the past 3 months have you eaten an unusually large amount of food and experienced a loss of control*"). Internal consistency of the EDDS symptom composite in the present study was .89.

The Yale Food Addiction Scale (YFAS) version 2.0 (Gearhardt, Corbin, & Brownell, 2016) is a self-report measure operationalizing addictive-like eating behaviour according to the DSM-5 diagnostic criteria for substance- use disorders. The YFAS 2.0 demonstrated good internal consistency, as well as convergent, discriminant, and incremental validity (Gearhardt

et al., 2016). We used the continuous symptom count that reflects the number of diagnostic criteria met (0-11). Internal consistency of the YFAS in the present study was .86.

Students volunteered for participation via a university platform for online recruitment and data collection. All data collected were anonymised and students received course credit for participation. This study was approved by the Department of Psychology's Institutional Review Board and Ethics Committee at University of Oslo.

Statistical Analyses

The two factor model described by Conceição et al. (2017) was tested using confirmatory factor analysis (CFA) with the maximum likelihood discrepancy method. Confirmatory factor analysis (CFA) is the method of choice to test a priori hypotheses about latent variables and to evaluate factor invariance across time and groups. Fit indexes indicate a good fit when: $\chi 2$ (CMIN) is non-significant ($p > 0.05$); HOELTER.05 > 200; Standardized Root Mean Square Residual (SRMR) < 0.08; Root Mean Square Error of Approximation (RMSEA) < 0.05; PCLOSE > 0.05; Comparative Fit Index (CFI) > 0.95; Normed Fit Index (NFI) > 0.95; NNFI (TLI) > 0.991; Akaike Information Criterion (AIC) (smaller values indicate a better model fit) (Hooper, Coughlan, & Mullen, 2008). CFA was conducted using IBM® SPSS® Amos™ 20.0. Five variables had missing values, all less than 5% missing, which were replaced with the median values given the variables assess on an ordinal scale. Modification indexes were examined to determine the co-variance between errors that improved the model fit. Internal consistency of the Rep(eat)-Q was assessed by Cronbach's α coefficients. Due to non-normality in the data, Spearman's rank order coefficients were used to test correlations between the Rep(eat)-Q and self-reported BMI (kg/m^2), age, binge eating frequency, YFAS 2.0 symptom count, and EDDS composite. Effect sizes were interpreted according to Cohen's criteria of .1 = small effect, .3 = medium effect, and .5 = large effect

(Cohen, 1988; Miles & Shevlin, 2011). These data analyses were performed using IBM® SPSS® Statistics 23.0.

Results

The Kaiser-Meyer-Olkin measure of sampling adequacy was .905 and the Bartlett's test of sphericity was significant ($p < .001$), supporting the appropriateness of factor analysis. Confirmatory factor analysis revealed good fit indexes for the 2-factor model to support the two subscales: RMSEA = 0.073, CFI = 0.970 and TLI = 0.947; CMIN= 85.982; DF = 43; p = 0.000; CMIN/df = 2.00; HOELTER.05 = 132; SRMR = 0.048; PCLOSE = 0.050; NFI = 0.942; AIC = 155.982. Figure 1 depicts the standardized coefficients as well as the covariances between errors that improved model fit. Internal consistency was adequate at .923, 906, and .864 for the total, CG and RE subscales, respectively. Table 1 summarizes the correlations among the Rep(eat)-Q scores, BMI, age, and measures of ED pathology. The average total Rep(eat)-Q score for the entire sample was 0.98 (SD: 0.89), and females scored significantly higher than males on the total and CG and RE subscales, respectively [Ms = 1.06 (.95) vs 0.65 (.57), t (189) 3.42, p <.001; Ms = 1.16 (.98) vs 0.77 (0.70), t (189) 2.88, p = .005, and Ms = 0.95 (1.05) versus 0.53 (.66), t (189) 3.09, p = .003).

The bivariate correlation between CG and RE for the total sample was $r_{sp=}$ 0.69, p < .001. As illustrated in Table 1, age and BMI did not correlate significantly with the Rep(eat)-Q, but moderate to strong correlations ($r_{sp} \geq$ 0.48 to 0.61) were found between the CG subscale and eating-related measures, whereas weaker, yet significant correlations ($r_{sp} \geq$ 0.37 - 0.45) were found for the RE subscale. The differential pattern of correlations for CG versus RE mirrored the total sample when split by gender, except for weaker, yet significant, correlations among males for CG ($r_{sp} \geq$ 0.28 to 0.49), while all correlations between RE and eating measures became non-significant ($r_{sp} \geq$ 0.11 to 0.22). For females, the corresponding results indicated moderate to strong correlations ($r_{sp} \geq$ 0.51 to 0.63) between the CG subscale

and eating-related measures, and moderate correlations for RE ($r_{sp} \geq 0.42$ - 0.51; data not shown).

Discussion

This study supported the utility and validity of the Repetitive Eating Questionnaire [Rep(eat)-Q] as a brief and easily administered 12-item measure of two subtypes of grazing behaviour, namely, compulsive grazing (marked by loss of control) and repetitive eating (eating in a distracted or mindless way). This study represents the first to provide a validation and replication of the proposed factor structure of the Rep(eat)-Q aside from the initial development study.

Our overall total Rep(eat)-Q score of 0.98 (*SD* 0.89) was lower than previously reported (i.e., M = 1.59, *SD* 1.22) (Conceição et al., 2017), yet this appears to attribute to disproportionately lower scores in our male participants. Consistent with the subsample of community participants in the original study (Conceição et al., 2017), women reported a higher frequency of total and compulsive grazing than men, and we also found higher levels of repetitive eating in women than men. The observed pattern of associations, in which stronger associations were found between compulsive grazing and measure of ED pathology than non-compulsive grazing, was similar for both genders. This invariance indicates that the proposed differentiating scheme, in which compulsive grazing (marked by a loss of control) is linked to higher levels of overall eating disorder pathology than non-compulsive grazing, applies to both genders. This is also in line with recent evidence for the conceptualization of grazing (in its two subtypes) on a continuum of LOC eating and in the spectrum of ED psychopathology, in which non-compulsive grazing is associated with the lowest degree of LOC/psychopathology and compulsive with the highest (Conceicao et al., 2018). In contrast to the initial development study, however, we found no significant associations between the frequency of grazing and higher BMI or younger age. It is possible our lack of findings for

age or BMI may attribute to our relatively homogenous and smaller sample, whereas the original study sampled over 1000 participants from different recruitment channels. We note, however, the correlations originally reported by Conceicão et al. (2017) for age and BMI were quite weak, despite reaching statistical significance, (i.e., r_{sp} = -0.23 for age and 0.087 for BMI).

Several limitations of the present investigation are noteworthy. This study utilized a convenience sample of normal weight, educated young adults recruited from a university setting. Thus, the homogenous sample characteristics place limits on the generalizability of these findings. Temporal stability was not established in this study, although the original development study reported good test-retest reliability of the Rep(eat)-Q (0.82). A more comprehensive assessment battery would have enabled a broader investigation of the relationship between grazing and other important aspects of mental health (e.g., quality of life, depression, anxiety) or aspects of eating-related pathology. Longitudinal studies are required to investigate the prospective validity of grazing as a potential risk behaviour or precursor for the emergence of other clinically significant disordered eating problems or weight fluctuations over time.

In conclusion, these data provide further confidence in the originally proposed two-factor model of the Re(peat)-Q and provide support for the utility of this brief assessment to measure grazing behaviour in non-treatment seeking, community samples of young adults. This study offers further evidence of two distinct subtypes of grazing behaviour as delineated by the presence or absence of loss of control, namely, compulsive (marked by loss of control) and repetitive eating (eating in a distracted or mindless way).

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Table 1. Correlations among Rep(eat)-Q scales, age, BMI, overall ED pathology, binge eating frequency, and YFAS scores (N=191)

	Rep(eat)-Total[1]	Rep(eat)-CG	Rep(eat)- RE
Age	-0.034	0.020	-0.085
BMI	0.057	0.085	0.019
Overall ED pathology[2]	**0.575****	**0.612****	**0.454****
Binge eating frequency[3]	**0.462****	**0.476****	0.366**
YFAS symptom count[4]	**0.489****	**0.534****	0.385**

Note. Rep(eat)-CG = Compulsive grazing subscale; Rep(eat)-RE = Repetitive eating subscale; BMI = Body Mass Index; ED = Eating Disorder; YFAS = Yale Food Addiction Scale; [1] = The total mean score from the 12-item Rep(eat)-Q; [2] = The Eating Disorder Diagnostic Scale (EDDS) symptom composite score; [3] = EDDS item 6 ("*how many times per month on average over the past 3 months have you eaten an unusually large amount of food and experienced a loss of control")* [4] = The continuous symptom count from the YFAS. Spearman's rho correlations *$p < .05$, **$p < .01$; Correlations in **bold** indicate coefficients $\geq$0.40.

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