Validation of the Adult Eating Behaviour Questionnaire adapted for the French-speaking Canadian population

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Compliance with ethical standards:

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The French version of the questionnaire is available upon request to the corresponding author.

Ethical approval: The study was approved by the Research Ethics Board of Université Laval (ethics number: 2017-330).

Informed consent: Written informed consent was obtained from all participants prior to the start of the study.

Abstract

Purpose: The Adult Eating Behaviour Questionnaire (AEBQ) is a newly developed questionnaire adapted from the widely used Child Eating Behaviour Questionnaire. This questionnaire assesses four food approach scales, namely hunger, food responsiveness, emotional overeating (EOE) and enjoyment of food, and four food avoidance scales, namely satiety responsiveness (SR), emotional undereating (EUE), food fussiness and slowness in eating (SE). This study aimed to validate a French version of the AEBQ in controlled conditions among French-speaking adults from Quebec, Canada. **Methods:** The AEBQ was pre-tested through structured interviews with 30 individuals. Participants of the validation study (n=197, aged 19-65 years) had their height and weight measured and completed the AEBQ, Three-Factor Eating Questionnaire (TFEQ) and Intuitive Eating Scale-2 to assess factorial structure, internal consistency and construct validity. Test-retest reliability over two weeks was assessed among 144 participants. **Results:** Confirmatory factor analysis indicated an excellent model fit (NNFI=0.98, CFI=0.98, RMSEA=0.03, χ^2/df=1.17) and provided support for the use of the original 8-factor questionnaire. Internal consistency was adequate for most scales (Chronbach's alpha=0.66-0.94) and moderate to excellent test-retest reliability was observed for all scales (ICC=0.70-90). Women showed higher levels of EOE and SR, and individuals with overweight and obesity showed higher levels of EOE and lower levels of EUE and SE. Construct validity was also supported by expected correlations with disinhibition and susceptibility to hunger from the TFEQ and intuitive eating. **Conclusion:** This study indicates that the French AEBQ is a valid and reliable tool to measure eating behaviours in the adult population of Quebec.

Level of evidence: Level III: Evidence obtained from well-designed cohort or case-control analytic studies. The data are cross-sectional, but all measurement were undertaken in controlled laboratory conditions and the study provided new informations.

Keywords: Eating behaviors, Appetite, Obesity, Adult, Validation, Questionnaire.

Introduction

Eating behaviour traits are important determinants of weight gain and obesity [1-5]. They are also increasingly recognized as important components of healthy eating that not only encompasses diet quality, but also provides the context and motivation around food intake. For instance, the 2019 version of Canada's Food Guide recommends being mindful of our own eating habits by taking the time to eat and focusing on hunger and satiety cues, cooking more often, enjoying food and eating meals with others [6].

Eating behaviour traits have also been found to mediate part of the genetic susceptibility to obesity [7-10]. This suggests that eating behaviours could be a prime target for the development of interventions aimed at preventing and treating obesity. However, this requires a better understanding of their aetiology and evolution across the life cycle, which would need consistent measurements of eating behaviours from childhood into adulthood. Recently, the short version of the widely used Three-Factor Eating Questionnaire (TFEQ) [11, 12], which assesses cognitive restraint, emotional overeating and uncontrolled eating, was adapted and validated for use with children and adolescents [13, 14]. In addition, the most extensively used questionnaire in children, the Child Eating Behaviour Questionnaire (CEBQ) [15, 16], which had previously been adapted for use in infancy [17], was also recently adapted and validated for use with adults [18]. This questionnaire, named the Adult Eating Behaviour Questionnaire (AEBQ), assesses a wide range of eating behaviour traits aggregated into four food approach traits, namely hunger, food responsiveness, emotional overeating and enjoyment of food, and four food avoidance traits, namely satiety responsiveness, emotional undereating, food fussiness and slowness in eating [18]. This questionnaire measures eating behaviour traits that complement the TFEQ by assessing

behaviours related to appetite sensations, appreciation and enjoyment of food, eating rate and emotional undereating as a separate construct to emotional overeating.

To date, the AEBQ has been validated in adults and adolescents from the UK [18, 19], in adults from Australia [20], China [21] and Mexico [22], in adult bariatric surgery candidates and adolescents with obesity from the United States [23, 24] and in adolescents from Poland [25], but not in a French-speaking population as there is currently no French version of this questionnaire. In studies performed in non-clinical samples, the AEBQ has been validated using self-reported measures of weight and height [18, 20, 21], except in the recent study among the mexican population [22]. It has also been validated against the short version of the TFEQ in undergraduate students from China [21] and the Dutch Eating Behaviour Questionnaire among adolescents from the UK [19]. Among the clinical population, the AEBQ has been validated against the eating habit section of the Weight and Lifestyle Inventory, assessing eating in response to emotions, social situations and external cues, in bariatric surgery candidates [23] and risk of binge eating in adolescents receiving obesity treatment [24]. However, there is a need to further validate the AEBQ using standardized measurements of weight and height and a broader range of eating behaviour traits in the general adult population. In this regard, the full version of the TFEQ is a suitable validation tool as its subscales capture different aspects of eating behaviour traits, which share some similarities with the AEBQ. Moreover, comparing the AEBQ with intuitive eating is also relevant since the latter is an adaptive eating style characterized by a strong connection with hunger and satiety cues [26].

The objective of the present study was to translate and validate the AEBQ in the French-speaking Canadian adult population. More specifically, this study aimed to assess psychometric properties and construct validity, using body mass index (BMI) calculated from objectively measured

weight and height data, age, sex, intuitive eating and eating behaviour traits from the TFEQ. We hypothesized that most food approach scales would be positively associated with disinhibition and susceptibility to hunger and negatively associated with intuitive eating. We also hypothesized that most food avoidance scales would be negatively associated with disinhibition and susceptibility to hunger and that satiety responsiveness and slowness in eating would be positively associated with intuitive eating.

Methods

French adaptation protocol

Two members of the research team who were both native French-speaking registered dietitians, as well as proficient in English, independently completed forward translation and cultural adaptation of the English version of the AEBQ [18]. The two independent French versions were compared, and a consensus was reached between the two translators to produce one common version. A researcher with expertise in eating behaviour traits and appetite oversaw the translation process and approved the French version. Following this initial stage, two other members of the research team who were both blinded to the original English version of the questionnaire proceeded to the backward translation; one was a native English speaker with proficiency in French, and the other was a native French speaker and English professional translator. These two versions were then compared to the original English version and adaptations were made in the case of discrepancies between the two backward translations and the original English version. Researchers involved in the development and validation of the original English version of the AEBQ [18] reviewed the forward and backward translations and provided feedback on the adapted French version. Informal assessment of the clarity of the

questionnaire was performed by asking an opportunity sample of ten individuals (5 women, 5 men) to complete the questionnaire and provide verbal or written comments.

Pretest

Prior to the validation study, the questionnaire was pretested among 30 participants consisting of an opportunity sample and individuals recruited via an existing list of individuals interested in participating in nutrition studies. Participants met the same inclusion criteria as the validation study, which were confirmed in person or during a screening telephone interview prior to the pretest. Participants visited the laboratory and completed the AEBQ, followed by a 15-minute structured interview aimed to assess the comprehension of items, response scale and instructions for the questionnaire. Participants also completed a sociodemographic questionnaire and had their weight and height measured to calculate their BMI (kg/m^2). Compensation was provided through a random draw of two 20$ CA gift certificates from the shopping center. The pretest was approved by the Research Ethics Board of Université Laval (ethics number: 2017-330) and written informed consent was obtained from all participants prior to the start of the study. The results of the pretest and relevant modifications of the questionnaire (see results) were discussed with the research team to produce a final version of the questionnaire.

Validation study

Participants

Participants of the validation study were recruited through e-mail lists of Université Laval students and employees and of individuals interested in participating in nutrition studies at the Institute of Nutrition and Functional Foods (INAF) and via advertisements on social media (i.e., Facebook) and on campus. Some participants were also recruited at the screening or the baseline visits of two weight-loss studies (currently unpublished) that were under the supervision of two

researchers of the present study. Inclusion criteria were: 18 to 65 years of age, non-smoking, BMI between 18.5 and 40 kg/m^2, relatively stable body weight (±4.0 kg) during the last two months, not currently dieting, free of any metabolic conditions (e.g., type 1 or type 2 diabetes, hypo- or hyperthyroidism) and not be taking medication that could interfere with study outcomes, not be allergic or dislike the food served during the standardized breakfast (i.e., white bread, butter, peanut butter, cheese and orange juice), not be pregnant or lactating, have a perfect understanding of the French language, and currently residing and having lived in the Province of Quebec for at least 8 months to ensure a minimal adaptation or knowledge of the French-Canadian culture. Students in dietetics or registered dietitians were excluded. These inclusion criteria were assessed by telephone interview and confirmed at the beginning of the first visit to the laboratory or during the baseline visit of the weight loss studies. Compensation for the validation study was provided through a random draw of twelve 20$ CA gift certificates from the shopping center. The study was approved by the Research Ethics Board of Université Laval (ethics number: 2017-330) and written informed consent was obtained from all participants prior to the start of the study.

Measurements

Questionnaires

Participants reported their age, sex, ethnicity, highest completed level of education and primary occupation (e.g., student, employed, unemployed) on a sociodemographic questionnaire.

In addition to the AEBQ, the validated French versions of the TFEQ [11, 27] and the Intuitive Eating Scale-2 (IES-2) [28] were completed. The AEBQ is a 35-item questionnaire comprised of four food approach scales, namely hunger (5 items), food responsiveness (4 items), emotional overeating (5 items), enjoyment of food (3 items), and four food avoidance scales, namely satiety responsiveness (4 items), emotional undereating (5 items), food fussiness (5 items) and slowness

in eating (4 items) [18]. Item responses were rated on a 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5) and a mean score was calculated for each scale.

The TFEQ assesses three main eating behaviour traits, namely cognitive restraint, disinhibition and susceptibility to hunger [11]. Cognitive restraint refers to the intention to restrain food intake to control or lose body weight [11]. This eating behaviour is assessed with 21 items and includes the subscales rigid control (7 items) and flexible control (7 items) over food intake [29]. Disinhibition (16 items) is defined as an overconsumption of food triggered by different cues representing its three subscales, namely habitual (5 items) emotional (3 items) or situational (5 items) susceptibility to disinhibition [11, 30]. Susceptibility to hunger (14 items) represents the susceptibility to experience feelings of hunger triggered by internal (i.e., internal locus of hunger, 6 items) or external cues (i.e., external locus of hunger, 6 items) [11, 30]. Thirty-six out of the 51 items of the TFEQ have a true or false format coded as 0 or 1, whereas the remaining items are assessed on 4 or 6-point scale (e.g., rarely (1) to always (4), not at all (1) to very much (4)), which were recoded as 0 or 1. The total score of each scale and subscale represents the sum of related items.

The Intuitive Eating Scale-2 (IES-2), validated in a French-speaking Canadian sample [28], was completed to assess the intuitive eating concept which represents a positive approach toward eating based on the reliance on physiological cues to determine when, what, and how much to eat [26]. Intuitive eating also implies setting aside dieting rules and maintaining a healthy relationship with body, mind and food [26]. The IES-2 measures four factors, namely unconditional permission to eat (6 items), eating for physical rather than emotional reasons (8 items), reliance on hunger and satiety cues (6 items) and body-food choice congruence (3 items) which implies that food choices are made while considering health, taste and well-being [28]. All

items were assessed on a 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5). A mean score for each subscale was calculated and a total intuitive eating score was calculated as a mean of the 23 items.

Anthropometric measurements

Body weight was measured by trained research assistants using a bioimpedance scale (Tanita TBF-310) to the nearest 0.1 kg and height was measured with a standard stadiometer to the nearest 0.1 cm. Body mass index was calculated as body weight divided by height squared (kg/m^2). These measurements were performed according to standardized procedures recommended at the Airlie Conference [31].

Procedures

Participants came to the laboratory after a 12h overnight fast. Their weight and height were first measured to validate the BMI inclusion criterion. Participants were not aware of the values of their weight until the end of the first visit to limit the bias that making weight salient can potentially have on the different measures. A standardized breakfast consisting of white bread toast(s) with butter and peanut butter, cheese and orange juice was then served and consumed within a maximum of 20 minutes. The quantity of the breakfast was adapted to each sex and body weight status [i.e., normal weight (women: 497 kcal, men: 642 kcal) or overweight/obesity (women: 594 kcal, men: 738 kcal)] and represented approximately 25% of daily energy intake estimated from a three-day food record from a cohort study [32]. Questionnaires were completed between 40 minutes and 1 hour after breakfast. Participants recruited from the two weight loss studies completed three additional questionnaires (i.e., sociodemographic, IES-2 and AEBQ) during the baseline visit of their weight loss study which included the same measurements as the validation study. To assess test-retest reliability, participants who were not recruited from the

weight loss studies came to the laboratory after a two-week period to complete the AEBQ a second time. Only two participants from the weight loss studies completed the AEBQ at the screening and baseline visits of the weight loss studies which were held approximately two weeks apart.

Statistical analyses

A sample size calculation indicated that 177 participants would be required for factorial analysis, considering a power of 80%, a significance level of 5% and factor loadings of 0.30 for the 8-factor, 35-item model [33]. The test-retest analysis was intended to be conducted among a subsample of approximately 100 participants who were not currently involved in the weight loss phase of their studies, as previously done [18]. Descriptive statistics were computed as means ± standard deviations (SD) and frequencies. The frequency of missing data was 0.03% (n=2) and 0.06% (n=3) for the first and second completion of the AEBQ respectively, corresponding to ≤0.7% of missing data per item. One participant had all data missing on the TFEQ and the remaining sample had 0.1% of missing data on the TFEQ (n=10; ≤ 1% missing data per item). Similarly, 0.02% (n=1; ≤0.5% per item) of data on the IES-2 were missing. All missing data were imputed using the participant's individual mean of other items from the related scale for the AEBQ or the related subscale for the TFEQ and IES-2, except for one participant with missing data on the all of the TFEQ who was excluded from the analyses related to the TFEQ.

The factorial structure of the AEBQ was assessed through a confirmatory factory analysis (CFA) with a maximum likelihood estimation method with robust option treating data as ordinal. In line with previous AEBQ validation studies [18-21, 23], a 7-factor model combining the hunger and food responsiveness scales (35 items) and a 7-factor model excluding the hunger scale (30 items) were tested in addition to the 8-factor model to determine the best model among the Quebec

population. Model fit was assessed using the Non-Normed Fit Index (NNFI, also known as the Tucker-Lewis Index [TLI]), the Comparative Fit Index (CFI), the Standardized Root Mean Square Error of Approximation (RMSEA) and the Normed Chi-Square (NC, i.e., Satorra-Bentler χ^2/df). A NNFI and CFI values close to or higher than 0.95, a RMSEA close to or lower than 0.06 [34] and a χ^2/df lower than 2 and 5 are generally considered as good and acceptable fits, respectively [35-37]. The three models were compared using the model Akaike Information Criterion (AIC) to select the most parsimonious model as indicated by a lower AIC value [38].

Internal consistency for each factor was assessed with Cronbach's alpha and McDonald's omega coefficients based on polychoric correlations. Values above 0.70 were considered internally consistent [38, 39]. Test-retest reliability was assessed by conducting intraclass correlations (ICC) between the two AEBQ completions using the ICC9 Macro which is based on a two-way mixed effect model [40]. Intraclass correlation coefficients lower than 0.50, between 0.50 and 0.75, between 0.75 and 0.90 and higher than 0.90 were interpreted as poor, moderate, good and excellent reliability, respectively [41].

The construct validity was assessed by investigating sex, age (i.e., 18-34 y vs. 35-49 y vs. 50-65 y) and BMI (i.e., normal weight vs. overweight/obesity) group differences using the general lineal model (GLM), which is appropriate for unbalanced design (i.e., sex and age groups). Construct validity was also assessed by conducting Pearson’s correlations among AEBQ scales and between the AEBQ, the TFEQ and IES-2 scales and subscales. The strength of associations was interpreted according to Cohen (1992), with coefficients of 0.10, 0.30 and 0.50 representing small, medium and large effect sizes, respectively. Analyses related to the construct validity were performed with and without considering age and sex as covariates, except for sex and age group differences that only considered age or sex as a covariate, respectively. These latter analyses also

considered BMI as a covariate. CFA, Cronbach's alpha and McDonald's omega were conducted in EQS v. 6.2. (Multivariate Software, Inc. Encino, CA, USA) and the remaining statistical analyses were conducted in SAS v. 9.4 (SAS Institute Inc., Cary, NC, USA). Statistical significance was considered at $p<0.05$.

Results

Prestest

The pretest was conducted among 14 women and 16 men. These participants had a mean age of 34.9±14.3 years and a mean BMI of 24.2±3.4 kg/m^2 (66.7% normal weight; 26.7% overweight; 6.7% obesity). Ninety-seven percent (n=29) of the sample were Caucasian, 73.3% (n=22) had a university degree and 56.7% (n=17), 36.7% (n=11) and 6.7% (n=2) were employed individuals, students and retired inviduals, respectively.

The analysis of participant comments revealed that two items were ambiguous. Item 17, i.e., "*Si j'avais le choix, je mangerais la plupart du temps*" (Given the choice, I would eat most of the time) was modified for "*Si c'était possible, je mangerais la plupart du temps*". Item 26, i.e., "*Je mange de plus en plus lentement au cours d'un repas*" (I eat more and more slowly during the course of a meal), was modified for "*Je mange de plus en plus lentement au cours d'un même repas*". Although well understood, item 33 (When I see or smell food that I like, it makes me want to eat) was also modified to improve its translation. "*Lorsque je vois ou je sens l'odeur d'aliments que j'aime, cela me donne envie de manger*" was thus modified for "*Lorsque je vois un aliment que j'aime ou que je sens son odeur, cela me donne envie de manger"*. Finally, to improve the clarity of the whole questionnaire, the instruction was slightly modified as follows: "*Pour chacune des affirmations suivantes, veuiller cocher la case qui correspond le mieux à votre comportement* (Please read each statement and tick the box most appropriate for you) was

changed for "*Pour chacune des affirmations suivantes, cochez la case qui correspond le mieux à votre comportement de manière générale.*".

Validation study

Participants

The validation study included 197 participants (147 women, 50 men), with 55 recruited from the weight loss studies. One hundred forty-four participants participated in the test-retest analyses. Participants had a mean age of 36.1±14.5 years (range 19 to 65 years) and a mean BMI of 26.2±4.7 kg/m^2 (range 18.5 to 38.8 kg/m^2) (**Table 1**). Slightly more than half of the sample had overweight or obesity. The sample was mainly Caucasian (88.8%) and was highly educated, with 55.3% reporting having completed a university degree or certificate and 46.2% indicating student as their main professional occupation.

Confirmatory factor analysis

The confirmatory factor analysis indicated that the three models yielded an excellent fit to the data (**Table 2**). The NNFI and CFI were slightly higher for the 7-factor model that excluded the hunger scale, while the RMSEA and χ^2/df ratio were slightly lower in the 8-factor model. All factor loadings of the 8-factor model were higher than 0.40 (**Table 3**). Factor loadings were also adequate for the 7-factor model excluding hunger but one factor loading (i.e., item 34) was lower than 0.30 in the 7-factor model combining hunger and food responsiveness scales (**Supplemental Table 1**). The AIC indicated that the original 8-factor model was the most parsimonious model and was thus considered superior to the other two models (Table 2).

Internal consistency and test-retest reliability

The Cronbach's alpha and McDonald's omega coefficients were above 0.70 for most scales but were slightly lower than 0.70 for hunger and satiety responsiveness (Table 3). The 95% CI for

ICC coefficients ranged between 0.61 to 0.93, indicating moderate to excellent reliability. The mean number of days between the two completions was 14.3±1.1 and the range was 12 to 21 days. Adjusting ICC for the time between completions yielded the same results (data not shown).

Sex, age and BMI group differences in AEBQ scales

Gender differences were observed for emotional overeating and satiety responsiveness, with women scoring higher than men (2.70±0.97 vs. 2.21±1.03, p=0.003 and 2.70±0.67 vs. 2.28±0.72, p=0.0002, respectively) (**Table 4**). These results remained significant after adjusting for age and BMI. In addition, emotional undereating was higher in women in the adjusted model (2.87±0.85 vs. 2.62±0.91, p=0.04). Food responsiveness was higher among younger individuals (18-34 y) compared to the older group (50-65 y), in the unadjusted model (3.30±0.72 vs. 2.71±0.70, p<0.0001), and was higher in the younger group than the two other groups after adjustment for sex and BMI (p=0.04 and p<0.0001). BMI group differences were observed for emotional over- and undereating and for slowness in eating; individuals with overweight or obesity had higher scores for emotional overeating (2.82±1.01 vs. 2.30±0.94, p=0.0002) and lower scores for emotional undereating (2.67±0.84 vs. 2.96±0.89, p=0.02) and slowness in eating (2.57±1.11 vs. 2.99±0.96, p=0.005). Adjusting for age and sex did not change these results. However, food responsiveness was higher among individuals with overweight or obesity compared to those with normal weight in the adjusted model (3.18±0.76 vs. 2.99±0.72, p=0.03).

Associations among AEBQ scales

All four food approach scales were positively associated with each other (r=0.18 to 0.48, p=0.01 to <0.0001), but the only significant, and positive associations among the food avoidance scales were satiety responsiveness with emotional undereating and slowness in eating (r=0.16, p=0.03 and r=0.33, p<0.0001) (**Table 5**). Scales from different categories were either negatively or not

associated with each other. Adjusting for age and sex did not change the pattern of associations, except for the association between satiety responsiveness and emotional undereating which was no longer significant (r=0.13, *p*=0.08) (**Supplemental Table 2**).

Associations among AEBQ scales and eating behaviour traits (TFEQ and IES-2)

All four AEBQ food approach scales were positively associated with TFEQ-susceptibility to hunger, disinhibition and their subscales (r=0.15 to r=0.79, *p*=0.04 to <0.0001), except for hunger and enjoyment of food which were not associated with all or one of the three disinhibition subscales, respectively (r=0.09 to 0.14, *p*=0.051 to 0.21) (**Table 6**). Hunger, food responsiveness and emotional overeating were negatively associated with intuitive eating (r=-0.16 to -0.65, *p*=0.02 to <0.0001) and all four food approach scales were negatively associated with the IES-2 eating for physical rather than emotional reasons subscale (r=-0.21 to -0.84, *p*=0.004 to <0.0001). Food responsiveness and emotional overeating showed a negative association with the IES-2 reliance on hunger and satiety cues subscale (r=-0.30 and r=-0.28, respectively, all *p*<0.0001). Enjoyment of food was also negatively associated with cognitive restraint and flexible restraint (r=-0.20, *p*=0.006 and r=-0.19, *p*=0.007, respectively).

As for the food avoidance scales, satiety responsiveness showed negative associations with disinhibition and its subscale situational susceptibility and with TFEQ-susceptibility to hunger and its two subscales (r=-0.18 to -0.37, *p*=0.01 to <0.0001). Satiety responsiveness was positively associated with cognitive restraint, flexible restraint and the IES-2 reliance on hunger and satiety cues subscale (r=0.20 to 0.27, *p*=0.003 to 0.0001). Emotional undereating was negatively associated with disinhibition and TFEQ-susceptibility to hunger and most of their subscales (r=-0.14 to -0.29, *p*=0.04 to <0.0001). Emotional undereating also showed a negative and a positive associations with the IES-2 unconditional permission to eat (r=-0.14, *p*=0.047) and eating for

physical rather than emotional reasons (r=0.23, p=0.001), respectively. Food fussiness was only negatively correlated with the IES-2 body-food choice congruence subscale (r=-0.24, p=0.0008). Slowness in eating was negatively associated with disinhibition and its subscales habitual and situational susceptibility and with TFEQ-external locus of hunger (r=-0.14 to -0.25, p=0.048 to 0.0005). Slowness in eating also showed positive associations with intuitive eating and its subscales eating for physical rather than emotional reasons and reliance on hunger and satiety cues (r=0.19 to 0.33, p=0.007 to <0.0001).

The pattern of associations remained similar when adjusting for age and sex for most scales (**Supplemental Table 3**). However, the associations between AEBQ-hunger and disinhibition and between emotional undereating and TFEQ-susceptibility to hunger, internal locus of hunger, or IES-2-unconditional permission to eat were no longer significant. Emotional undereating was significantly associated with intuitive eating (r=0.16, p=0.02) and slowness in eating was significantly and negatively associated with TFEQ-emotional susceptibility to disinhibition (r=-0.16, p=0.03).

Discussion

Summary of findings

This study aimed to translate and validate the French version of the Adult Eating Behaviour Questionnaire among the French-speaking adult population of Quebec, Canada. The results provide support for the use of the original 8-factor model over the two alternate models (i.e., a 7-factor model combining hunger and food responsiveness, or a 7-factor model excluding the hunger scale). The questionnaire showed adequate internal consistency for most scales, except for hunger and satiety responsiveness, and showed moderate to excellent reliability over two weeks. Higher levels of food responsiveness and emotional overeating and lower levels of emotional

364 undereating and slowness in eating were observed in individuals with overweight and obesity.
365 Most associations among AEBQ scales and with eating behaviour traits from the TFEQ and IES-
366 2 were in the expected directions, supporting the construct validity of the questionnaire.

367 *Factorial structure*

368 Several reasons motivated the choice of the 8-factor model. In addition to showing a lower AIC,
369 this model provided consistency with most previous studies among adults [18, 20, 21, 23].
370 Keeping the original 8-factor model allows the flexibility to use the whole questionnaire or to
371 remove the hunger scale and use a 7-factor 30-item questionnaire, similar to the validation studies
372 conducted among adolescents [19, 24, 25] and Mexican adults [22]. This latter model also
373 demonstrated a very good fit to the data and adequate factor loadings. Moreover, hunger is an
374 important aspect of appetite control that is specifically implicated in the drive for food as opposed
375 to satiety responsiveness which is more closely related to satiation (i.e., meal termination) and
376 satiety (i.e., inhibition of food intake following a meal) [43, 44].

377 *Hunger*

378 The hunger scale assesses hunger sensations that are interpreted internally or physically. The
379 scale demonstrated good test-retest reliability and its construct validity was mainly provided by
380 strong correlations with TFEQ-susceptibility to hunger and its subscale internal locus of hunger.
381 Consistent with previous studies, hunger was positively associated with the three other AEBQ
382 food approach scales [18-24]. In those studies, the construct validity of hunger had been
383 questioned because of its positive association with emotional undereating [18, 20, 22, 23], the
384 negative [20] or null association with BMI [18, 21-23] and the low internal consistency in one
385 study [20]. Several hypotheses have been proposed to explain these results, including individual
386 differences in the perception of hunger sensations, or that the hunger scale may reflect dieting or

cognitive restraint [18, 20], awareness of and responsiveness to physical hunger sensations [21, 23] or internal hunger state rather than a trait [22].

The slightly low internal consistency of the hunger scale observed in the present study as well as in Mallan et al. (2017) may be explained by the great variability in individual perception of hunger sensations and appetite sensations in general [45]. Nonetheless, the scale demonstrated a good reliability over two weeks, which is consistent with previous studies [18, 19, 21, 22]. The present study showed no associations between hunger and emotional undereating, body weight status, or cognitive restraint or its two subscales. Furthermore, adjusting for cognitive restraint or its subscales did not change the association between hunger and BMI (data not shown). The lack of association with cognitive restraint is consistent with previous studies among young Chinese adults and adolescents from the UK [19, 21] and with the literature that generally shows no association or a slight (positive or negative) association between TFEQ-susceptibility to hunger and cognitive restraint [30, 46-48]. Moreover, the negative associations between hunger and intuitive eating, particularly with the IES-2 eating for physical rather than emotional reason subscale [26, 49], and the lack of association with the IES-2 reliance on hunger and satiety cues subscale, do not seem to support the hypothesis that the hunger scale reflects awareness and responsiveness to physical hunger sensations. Based on these results, the hunger scale may rather represent experiencing very strong hunger sensations which could reflect a lack of awareness or responsiveness to more subtle or adequate hunger sensations. Symptoms of ‘lightheadedness’ and ‘irritability’ referred to in AEBQ-hunger items have been described as extreme hunger sensations [43, 50]. The hunger scale may thus characterize a maladaptive form of eating regulation, but not necessarily a risk factor for obesity. In order to further demonstrate a susceptibility to overconsumption and address the limitations indicated above, the hunger scale might be

improved by replacing the specific hunger sensation items (i.e., items 6, 9 and 34) with items reflecting more general hunger sensations which trigger food intake, similar to AEBQ items 28 and 32 (e.g., I often feel so hungry that I have to eat something right away) and to TFEQ-susceptibility to hunger. However, before such modifications are made to the questionnaire, future studies should assess the association of this scale with energy intake and symptoms of eating disorders among adults. Accordingly, among a clinical sample of American adolescents with obesity, those at higher risk for binge eating presented higher levels of AEBQ-hunger [24].

Food responsiveness

Food responsiveness showed adequate reliability and strong construct validity mainly provided by the strong correlation with TFEQ-external locus of hunger. These two eating behaviours assess a similar construct, namely, the susceptibility to eat in response to food cues, but food responsiveness also represents a strong desire to eat. Food responsiveness correlated strongly with TFEQ-disinhibition and susceptibility to hunger, which again support construct validity, as these two latter eating behaviours have been consistently associated with each other [30, 46-48]. The construct validity was also demonstrated by the negative association with intuitive eating. The pattern of intercorrelations among AEBQ scales was consistent with previous studies [18-24], although there was no negative association between food responsiveness and emotional undereating, food fussiness or slowness in eating in the present study. No associations with any of these three variables have been previously reported [18, 19, 21-25]. Interestingly, higher scores of food responsiveness have been observed in younger participants, whereas the opposite was observed in a study among adolescents [19]. This suggests that the association between food responsiveness and age may not be linear and could peak in later adolescence or young adulthood, but longitudinal studies are needed to verify this hypothesis. Food responsiveness was

also slightly higher among participants with overweight and obesity, which is consistent with the small association with BMI observed in Hunot et al. (2016).

Emotional overeating and emotional undereating

Emotional over- and undereating demonstrated good construct validity and reliability. Notably, emotional overeating was strongly positively and negatively associated with TFEQ-emotional susceptibility to disinhibition and IES-2-eating for physical rather than emotional reasons, respectively, while emotional undereating was moderately negatively and positively associated with these two variables, respectively. The general pattern of correlations of emotional overeating with other eating behaviours from the AEBQ and TFEQ is similar to previous studies [18-21, 23], and to associations of TFEQ-emotional eating with intuitive eating and other eating behaviours [4, 51]. In addition to being moderately negatively associated with each other, emotional over- and undereating were associated with BMI in the opposite and expected directions [4, 7, 18, 20, 22, 23] and were higher in women as previously observed [7, 9, 23, 52, 53].

Enjoyment of food

Enjoyment of food showed good reliability and a similar pattern of intercorrelations with AEBQ scales as other studies [18-24]. The only exception is for slowness in eating which was negatively associated with enjoyment of food in most studies [18-20, 23, 24] but showed no association in the present study. No difference was observed between BMI groups, which corroborates previous results [20, 21, 23, 24]. The lack of association with BMI and the very high mean score of this behaviour may suggest that the scale may not discriminate between visceral eating pleasure (i.e., the short-term pleasure that derives from the relief of eating impulses) which is associated with overeating and obesity, and epicurean eating pleasure (i.e., the enduring eating pleasure that

derives from aesthetic, sensory and symbolic value of eating experiences) which is associated with moderation [54]. This might particularly be the case in the province of Quebec because of the influence of both American and French cultures [55, 56] in its food culture. Accordingly, visceral and epicurean types of eating pleasure were recently identified in the perceptions of eating pleasure among adults from Quebec [57]. Validation against energy intake is needed to verify if the enjoyment of food scale reflects a risk for overconsumption. Nonetheless, this scale probably still reflects a certain amount of visceral pleasure, being positively associated with TFEQ-disinhibition and susceptibility to hunger.

Satiety responsiveness

Satiety responsiveness showed good test-retest reliability and adequate construct validity. The latter was mainly supported by the positive association with IES-2-reliance on hunger and satiety cues, which captures the awareness, confidence and reliance on hunger and satiety cues to determine when and how much to eat [28, 49]. These two scales share some similarities but also seem to capture different aspects as shown by a rather small association and the fact that AEBQ-satiety responsiveness does not explicitly feature confidence on hunger and satiety cues to guide food intake. This justifies the need to further validate this scale with a more similar construct, such as the satiety quotient, which is a marker of satiety responsiveness that represents changes in appetite sensations in response to a standardized meal [44]. Consistent with results of the present study, a low satiety responsiveness measured by the satiety quotient has also been associated with higher levels of TFEQ-disinhibition and external locus of hunger [58, 59], supporting the construct validity of AEBQ-satiety responsiveness. However, an exploratory analysis showed a lack of association between AEBQ-satiety responsiveness and the satiety quotient [60]. This may be explained by the fact that the satiety quotient was not assessed using most robust standardized

conditions in that study and suggests that AEBQ-satiety responsiveness needs to be further validated against the satiety quotient.

Moreover, AEBQ-satiety responsiveness was negatively associated with food responsiveness and positively associated with slowness in eating, which were also observed in previous studies [18-20, 23] except in the study among Chinese [21]. Women showed higher levels of satiety responsiveness, a result consistent with previous AEBQ studies [19, 21, 23] and studies based on the satiety quotient [58, 61]. However, the positive association with cognitive restraint, also observed in the adolescent sample [19], is generally not observed in studies using the satiety quotient [58, 59, 62] or the IES-2 reliance on hunger and satiety cues subscale [51]. This result suggests that individuals prone to dietary restraint may interpret some of the satiety responsiveness items as restraint behaviours and this could explain the rather low internal consistency observed in the present study. Specific references to satiety in items 11 and 30, by adding, for instance, "because I am full" or "because I am not hungry" at the end of these items, may help to prevent this ambiguity. Despite the absence of association with BMI, low satiety responsiveness may nonetheless represent a risk factor for overconsumption because of its association with eating behaviour traits favouring overeating. Accordingly, future studies should assess whether satiety responsiveness, measured with the AEBQ is inversely associated with energy intake.

Slowness in eating

Slowness in eating showed good reliability and construct validity. Lower slowness in eating scores were observed among individuals with overweight and obesity in the present study, as well as in four previous studies [18, 20-22], which is consistent with results from two systematic reviews and meta-analyses indicating that a faster eating rate is positively associated with energy

intake, obesity and weight gain [63, 64]. The positive association between slowness in eating and satiety responsiveness is suggestive of a lower drive towards eating or a smaller appetite. Additionally, the positive association with intuitive eating, which has been previously reported [65], and with IES-2 eating for physical rather than emotional reasons and reliance on hunger and satiety cues subscales, suggest that eating slowly may facilitate reliance on homeostatic appetite signals. However, direction of associations cannot be established in the present study. Similarly, the negative association with disinhibition is consistent with the notion that slowness in eating may be a protective factor towards overeating.

Food fussiness

Consistent with previous studies, food fussiness demonstrated good reliability, but did not correlate with many traits, which supports the assumption that this scale captures a distinct behaviour that is more closely related to food choices [18, 20, 23]. The negative associations with enjoyment of food and IES-2-body-food choice congruence support the construct validity of this scale. Accordingly, food fussiness theoretically symbolizes the opposite of enjoyment of food. The negative association with IES-2-body-food choice congruence was also expected since this subscale aimed to assess the extent to which individuals match their food choices with their body needs. This reflects the "honour your health with gentle nutrition" principle which is intended to be associated with diet quality [26, 49]. However, very few studies have evaluated associations between body-food choice congruence and diet quality. These studies showed either no association or a very small positive association with diet quality or food groups with higher nutrient density, namely fruits, vegetables, whole grains and dairy products [66, 67]. Whether AEBQ-food fussiness reflects low diet quality and diversity among adults remains to be assessed.

Strengths and limitations

One of the main strengths of this study was the use of structured interviews during the translation process which allowed refinement to be made to the questionnaire [68, 69]. Other important strengths were the use of laboratory measures of weight and height [70] and undertaking all measurements under controlled conditions, which limit external influences on responses to the questionnaires. This study is also the first to assess construct validity of the questionnaire against the diverse range of eating behaviour traits as measured by the full version of the TFEQ [11, 29, 30] and by the IES-2 [28]. This study also had limitations. While a cross-sectional design is expected for questionnaire translation and validation, it is not possible to establish any causal associations among eating behaviours and BMI. The sample was highly educated compared to the Quebec population [71], which limit the generalizability of findings. Women and young adults were overly represented but accounting for age and sex had no impact on construct validity of the questionnaire.

Conclusions

The present study suggests the French version of the AEBQ is a valid and reliable tool to measure eating behaviour traits among the French-speaking Canadian population. The questionnaire should be further validated against measurements of appetite sensations, energy intake, diet quality and symptoms of eating disorders as well as in diverse clinical populations. Suggestions to modify hunger and satiety responsiveness scales should also be validated. This questionnaire is a convenient and useful tool to assess a broad range of eating behaviours primarily related to appetite, which is complementary to existing measures of eating behaviours. Combined with the Baby and the Child Eating Behaviour Questionnaires [15, 17], the AEBQ will allow exploration of the evolution of eating behaviours over the life course and will also be useful as an evaluation tool in clinical interventions for obesity treatment and prevention.

What is already known on this subject?

The AEBQ is a new questionnaire adapted from the CEBQ that assesses a wide range of eating behaviour traits aggregated into four food approach traits and four food avoidance traits. It has been validated in English, Chinese and Spanish but there is currently no French version of this questionnaire.

What your study adds?

This study shows that the French version of the AEBQ is a valid and reliable tool to measure eating behaviours in the adult population of Quebec, Canada. This study is the first to have validated the AEBQ in controlled conditions among the general adult population and against a broad range of eating behaviour traits using the full version of the Three-Factor Eating Questionnaire and the Intuitive Eating Scale-2.

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Table 1. Participant characteristics

	Total sample (n=197)	Test-retest sample (n=144)
Women, n (%)	147 (74.6)	98 (68.1)
Age, y	36.1 ± 14.5	38.2 ± 15.6
Age group, n (%)		
18-34 y	110 (55.8)	72 (50.0)
35-49 y	39 (19.8)	25 (17.4)
50-65 y	48 (24.4)	47 (32.6)
BMI, kg/m^2	26.2 ± 4.7	24.7 ± 4.3
BMI classification, n (%)		
Normal weight (BMI<25.0 kg/m^2)	92 (46.7)	92 (63.9)
Overweight (BMI 25.0 to 29.9 kg/m^2)	59 (30.0)	34 (23.6)
Obese (BMI>30.0 kg/m^2)	46 (23.4)	18 (12.5)
Ethnicity, n (%)		
Caucasian	175 (88.8)	129 (89.6)
Other[1]	22 (11.2)	15 (10.4)
Education, n (%)		
High school	7 (3.6)	5 (3.5)
College	81 (41.1)	62 (43.1)
University	109 (55.3)	77 (53.5)
Occupation, n (%)		
Employed	82 (41.6)	56 (38.9)
Student	91 (46.2)	65 (45.1)
Unemployed/at home	5 (2.5)	4 (2.8)
Retired	19 (9.6)	19 (13.2)

Values are presented as means ± standard deviations or as n (%).
[1] Asian, African, First Nation, Latino, multiracial individuals

Table 2. Fit indices of the three AEBQ models tested through confirmatory factor analysis

Model	Items	NNFI	CFI	RMSEA (90% CI)	χ^2	df	χ^2/df	AIC
8 Factors	35	0.978	0.980	0.030 (0.018, 0.039)	623.662 (p=0.004)	532	1.172	-440.338
7 Factors (H and FR combined)	35	0.973	0.976	0.033 (0.022, 0.041)	650.869 (p=0.0007)	539	1.208	-427.131
7 Factors (without H)	30	0.981	0.983	0.031 (0.017, 0.041)	456.472 (p=0.006)	384	1.189	-311.528

NNFI, Non-Normed Fit Index; CFI, Comparative Fit Index; RMSEA, Standardized Root Mean Square Error of Approximation; CI, Confidence Interval, χ^2, Satorra-Bentler Chi-Squared; df, Degree of freedom; χ^2/df, Normed Chi-Squared; AIC, Model Akaike Information Criterion.

Table 3. Standardized factor loadings, mean and reliability estimates for the 8-factor model

Factors	Item number	Questions	Factor loadings	Mean ± SD	Chronbach's α	McDonald' ω	ICC (95%CI)
Hunger				2.92 ± 0.72	0.67	0.68	0.83 (0.78-0.88)
	6	I often notice my stomach rumbling	0.45 + 0.89				
	9	If I miss a meal, I get irritable	0.51 + 0.86				
	28	I often feel so hungry that I have to eat something right away	0.69 + 0.73				
	32	I often feel hungry	0.60 + 0.80				
	34	If my meals are delayed, I get light-headed	0.43 + 0.91				
Food responsiveness				3.09 ± 0.74	0.74	0.74	0.74 (0.66-0.81)
	13	I often feel hungry when I am with someone who is eating	0.51 + 0.86				
	17	Given the choice, I would eat most of the time	0.78 + 0.63				
	22	I am always thinking about food	0.73 + 0.69				
	33	When I see or smell food that I like, it makes me want to eat	0.57 + 0.83				
Emotional overeating				2.57 ± 1.01	0.94	0.94	0.84 (0.78-0.88)
	5	I eat more when I'm annoyed	0.89 + 0.45				
	8	I eat more when I'm worried	0.90 + 0.44				
	10	I eat more when I'm upset	0.90 + 0.44				
	16	I eat more when I´m anxious	0.88 + 0.48				
	21	I eat more when I'm angry	0.79 + 0.62				
Enjoyment of food				4.30 ± 0.61	0.86	0.86	0.83 (0.78-0.88)
	1	I love food	0.89 + 0.45				
	3	I enjoy eating	0.88 + 0.47				
	4	I look forward to mealtimes	0.68 + 0.73				
Satiety responsiveness				2.59 ± 0.71	0.66	0.67	0.77 (0.70-0.83)
	11	I often leave food on my plate at the end of a meal	0.56 + 0.83				
	23	I often get full before my meal is finished	0.45 + 0.90				
	30	I cannot eat a meal if I have had a snack just before	0.62 + 0.78				
	31	I get full up easily	0.67 + 0.75				
Emotional undereating				2.80 ± 0.87	0.89	0.89	0.70 (0.61-0.77)
	15	I eat less when I'm worried	0.84 + 0.54				
	18	I eat less when I'm angry	0.62 + 0.79				
	20	I eat less when I'm upset	0.79 + 0.61				
	27	I eat less when I'm annoyed	0.84 + 0.55				
	35	I eat less when I'm anxious	0.84 + 0.55				
Food fussiness				1.76 ± 0.73	0.91	0.91	0.80 (0.73-0.85)
	2	I often decide that I don't like a food, before tasting it	0.74 + 0.67				
	7	I refuse new foods at first	0.85 + 0.53				
	12*	I enjoy tasting new foods	0.90 + 0.43				
	19*	I am interested in tasting new food I haven't tasted before	0.88 + 0.47				
	24*	I enjoy a wide variety of foods	0.74 + 0.67				
Slowness in eating				2.77 ± 1.06	0.88	0.89	0.90 (0.86-0.93)
	14*	I often finish my meals quickly	0.84 + 0.55				
	25	I am often last at finishing a meal	0.84 + 0.54				
	26	I eat more and more slowly during the course of a meal	0.59 + 0.81				
	29	I eat slowly	0.98 + 0.18				

SD, Standard deviations; ICC, Intraclass Correlations; CI, Confidence Interval.
* Reverse coded items. Factor loadings are standardized factor loading + error term, Chronbach's α calculated based on polychoric correlations, n=144 for ICC.

Table 4. Mean of AEBQ scales according to sex, age and BMI groups

	Gender				Age Group					BMI Group			
	Men (n=50)	Women (n=147)	*P* crude	*P* adjusted for age and BMI	18-34 y (n=110)	35-49 y (n=39)	50-65 y (n=48)	*P* crude	*P* adjusted for sex and BMI	Normal weight (n=92)	Overweight / obese (n=105)	*P* crude	*P* adjusted for sex and age
Food approach traits													
Hunger	2.89 ± 0.78	2.93 ± 0.70	0.78	0.73	2.98 ± 0.68	2.98 ± 0.76	2.73 ± 0.77	0.12	0.10	3.02 ± 0.69	2.83 ± 0.74	0.07	0.08
Food responsiveness	3.10 ± 0.73	3.09 ± 0.75	0.99	0.66	3.30 ± 0.72	2.99 ± 0.68[†]	2.71 ± 0.70[*]	**<0.0001**	**<0.0001**	2.99 ± 0.72	3.18 ± 0.76	0.07	**0.03**
Emotional overeating	2.21 ± 1.03	2.70 ± 0.97	**0.003**	**0.01**	2.62 ± 0.97	2.65 ± 1.06	2.40 ± 1.06	0.38	0.46	2.30 ± 0.94	2.82 ± 1.01	**0.0002**	**0.0003**
Enjoyment of food	4.31 ± 0.54	4.30 ± 0.64	0.92	0.92	4.37 ± 0.54	4.15 ± 0.73	4.26 ± 0.65	0.12	0.16	4.34 ± 0.63	4.26 ± 0.60	0.38	0.43
Food avoidance traits													
Satiety responsiveness	2.28 ± 0.72	2.70 ± 0.67	**0.0002**	**0.0002**	2.54 ± 0.71	2.63 ± 0.79	2.70 ± 0.64	0.40	0.29	2.57 ± 0.69	2.61 ± 0.73	0.70	0.93
Emotional undereating	2.62 ± 0.91	2.87 ± 0.85	0.08	**0.04**	2.79 ± 0.88	2.69 ± 0.79	2.93 ± 0.92	0.42	0.50	2.96 ± 0.89	2.67 ± 0.84	**0.02**	**0.01**
Food fussiness	1.72 ± 0.73	1.77 ± 0.73	0.64	0.64	1.78 ± 0.80	1.66 ± 0.59	1.79 ± 0.66	0.63	0.63	1.72 ± 0.66	1.79 ± 0.78	0.50	0.51
Slowness in eating	2.72 ± 1.04	2.79 ± 1.07	0.68	0.56	2.84 ± 1.13	2.57 ± 0.81	2.76 ± 1.05	0.39	0.60	2.99 ± 0.96	2.57 ± 1.11	**0.005**	**0.005**

Values are presented as means ± standard deviations.
[†] vs. 18-34 y, unadjusted model, p=0.06, adjusted model, p=0.04, [*] vs. 18-34 y, p<0.0001 for both models, n=197.
BMI, body mass index. Age and BMI were added as continuous covariates in relevant adjusted models.

Table 5. Associations among AEBQ scales

	Food approach scales								Food avoidance scales							
	Hunger		Food responsiveness		Emotional overeating		Enjoyment of food		Satiety responsiveness		Emotional undereating		Food fussiness		Slowness in eating	
	r	*p*	r	*p*	r	*p*	r	*p*	r	*p*	r	*p*	r	*p*	r	*p*
Food approach traits																
Hunger	-	-	**0.41**	**<0.0001**	**0.22**	**0.002**	**0.28**	**<0.0001**	-0.09	0.22	0.07	0.31	-0.03	0.69	0.02	0.76
Food responsiveness			-	-	**0.42**	**<0.0001**	**0.48**	**<0.0001**	**-0.21**	**0.003**	-0.06	0.42	-0.13	0.08	-0.09	0.23
Emotional overeating					-	-	**0.18**	**0.01**	-0.07	0.30	**-0.28**	**<0.0001**	-0.02	0.78	**-0.19**	**0.007**
Enjoyment of food							-	-	**-0.19**	**0.007**	-0.10	0.17	**-0.28**	**<0.0001**	0.03	0.68
Food avoidance traits																
Satiety responsiveness									-	-	**0.16**	**0.03**	0.09	0.20	**0.33**	**<0.0001**
Emotional undereating											-	-	0.13	0.06	0.07	0.30
Food fussiness													-	-	0.04	0.57
Slowness in eating															-	-

Values are Pearson correlation coefficients, n=197.

Table 6. Associations among AEBQ scales and eating behaviour traits (TFEQ and IES-2)

	Food approach scales								Food avoidance scales							
	Hunger		Food responsiveness		Emotional overeating		Enjoyment of food		Satiety responsiveness		Emotional undereating		Food fussiness		Slowness in eating	
	r	*p*	r	*p*	r	*p*	r	*p*	r	*p*	r	*p*	r	*p*	r	*p*
Cognitive restraint	-0.08	0.27	-0.03	0.68	0.10	0.18	**-0.20**	**0.006**	**0.20**	**0.004**	0.02	0.76	0.01	0.89	-0.04	0.54
Rigid restraint	0.02	0.83	0.05	0.51	0.13	0.06	-0.07	0.30	0.13	0.08	-0.03	0.63	-0.03	0.65	-0.07	0.33
Flexible restraint	-0.06	0.41	0.02	0.73	0.08	0.24	**-0.19**	**0.007**	**0.27**	**0.0001**	0.01	0.90	-0.05	0.52	-0.04	0.57
Disinhibition	**0.15**	**0.04**	**0.58**	**<0.0001**	**0.65**	**<0.0001**	**0.19**	**0.006**	**-0.18**	**0.01**	**-0.29**	**<0.0001**	-0.09	0.19	**-0.25**	**0.0005**
Habitual susceptibility	0.12	0.09	**0.40**	**<0.0001**	**0.37**	**<0.0001**	0.09	0.21	-0.02	0.75	-0.11	0.13	-0.06	0.44	**-0.18**	**0.01**
Emotional susceptibility	0.14	0.06	**0.46**	**<0.0001**	**0.79**	**<0.0001**	**0.16**	**0.02**	-0.01	0.91	**-0.29**	**<0.0001**	-0.06	0.44	-0.14	0.051
Situational susceptibility	0.14	0.051	**0.53**	**<0.0001**	**0.39**	**<0.0001**	**0.28**	**<0.0001**	**-0.36**	**<0.0001**	**-0.28**	**<0.0001**	-0.09	0.20	**-0.23**	**0.0009**
Susceptibility to hunger	**0.52**	**<0.0001**	**0.60**	**<0.0001**	**0.39**	**<0.0001**	**0.38**	**<0.0001**	**-0.35**	**<0.0001**	**-0.15**	**0.04**	0.004	0.96	-0.10	0.14
Internal locus of hunger	**0.52**	**<0.0001**	**0.46**	**<0.0001**	**0.30**	**<0.0001**	**0.35**	**<0.0001**	**-0.33**	**<0.0001**	**-0.14**	**0.04**	-0.02	0.76	-0.09	0.20
External locus of hunger	**0.37**	**<0.0001**	**0.62**	**<0.0001**	**0.42**	**<0.0001**	**0.37**	**<0.0001**	**-0.37**	**<0.0001**	**-0.16**	**0.02**	-0.01	0.92	**-0.14**	**0.048**
Intuitive eating	**-0.16**	**0.02**	**-0.48**	**<0.0001**	**-0.65**	**<0.0001**	-0.09	0.23	0.07	0.35	0.14	0.06	-0.08	0.29	**0.28**	**<0.0001**
Unconditional permission to eat	-0.02	0.74	-0.04	0.61	-0.01	0.84	0.11	0.11	-0.12	0.09	**-0.14**	**0.047**	-0.05	0.49	0.13	0.06
Eating for physical rather than emotional reasons	**-0.23**	**0.001**	**-0.55**	**<0.0001**	**-0.84**	**<0.0001**	**-0.21**	**0.004**	0.05	0.53	**0.23**	**0.001**	0.02	0.79	**0.19**	**0.007**
Reliance on hunger and satiety cues	-0.03	0.64	**-0.30**	**<0.0001**	**-0.28**	**<0.0001**	-0.02	0.81	**0.21**	**0.003**	0.11	0.11	-0.08	0.27	**0.33**	**<0.0001**
Body-food choice congruence	0.01	0.84	-0.07	0.33	-0.11	0.12	0.06	0.41	0.00	0.95	-0.01	0.88	**-0.24**	**0.0008**	-0.03	0.65

Values are Pearson correlation coefficients.
Associations among AEBQ scales and cognitive restraint, disinhibition and susceptibility to hunger, n=196.
Associations among AEBQ and intuitive eating, n=197.
Cognitive restraint, disinhibition and susceptibility to hunger assessed by the Three-Factor Eating Questionnaire (TFEQ), Intuitive eating assessed by the Intuitive Eating Scale 2 (IES-2).

Supplemental Table 1. Standardized factor loadings for the 7-factor models excluding Hunger or combining hunger and food responsiveness

Factors	Item number	Questions	7-factor model excluding Hunger (30 items)	7-factor model combining Hunger and Food responsiveness (35 items)
Hunger				
	6	I often notice my stomach rumbling		0.37 + 0.93
	9	If I miss a meal, I get irritable		0.36 + 0.93
	28	I often feel so hungry that I have to eat something right away		0.52 + 0.85
	32	I often feel hungry		0.56 + 0.83
	34	If my meals are delayed, I get light-headed		0.25 + 0.97
Food responsiveness				
	13	I often feel hungry when I am with someone who is eating	0.52 + 0.85	0.48 + 0.88
	17	Given the choice, I would eat most of the time	0.79 + 0.62	0.73 + 0.68
	22	I am always thinking about food	0.71 + 0.71	0.72 + 0.69
	33	When I see or smell food that I like, it makes me want to eat	0.57 + 0.83	0.55 + 0.83
Emotional overeating				
	5	I eat more when I'm annoyed	0.89 + 0.45	0.89 + 0.45
	8	I eat more when I'm worried	0.90 + 0.44	0.90 + 0.44
	10	I eat more when I'm upset	0.90 + 0.44	0.90 + 0.44
	16	I eat more when I´m anxious	0.88 + 0.48	0.88 + 0.48
	21	I eat more when I'm angry	0.79 + 0.62	0.79 + 0.62
Enjoyment of food				
	1	I love food	0.89 + 0.45	0.89 + 0.46
	3	I enjoy eating	0.88 + 0.47	0.88 + 0.47
	4	I look forward to mealtimes	0.68 + 0.73	0.69 + 0.73
Satiety responsiveness				
	11	I often leave food on my plate at the end of a meal	0.57 + 0.82	0.56 + 0.83
	23	I often get full before my meal is finished	0.44 + 0.90	0.45 + 0.90
	30	I cannot eat a meal if I have had a snack just before	0.62 + 0.78	0.62 + 0.78
	31	I get full up easily	0.66 + 0.75	0.67 + 0.75
Emotional undereating				
	15	I eat less when I'm worried	0.84 + 0.54	0.84 + 0.54
	18	I eat less when I'm angry	0.62 + 0.79	0.62 + 0.79
	20	I eat less when I'm upset	0.79 + 0.61	0.79 + 0.61
	27	I eat less when I'm annoyed	0.84 + 0.55	0.84 + 0.55
	35	I eat less when I'm anxious	0.84 + 0.54	0.84 + 0.55
Food fussiness				
	2	I often decide that I don't like a food, before tasting it	0.74 + 0.67	0.74 + 0.67
	7	I refuse new foods at first	0.85 + 0.53	0.85 + 0.53
	12*	I enjoy tasting new foods	0.90 + 0.43	0.90 + 0.43
	19*	I am interested in tasting new food I haven't tasted before	0.89 + 0.47	0.88 + 0.47
	24*	I enjoy a wide variety of foods	0.74 + 0.67	0.74 + 0.67
Slowness in eating				
	14*	I often finish my meals quickly	0.84 + 0.55	0.84 + 0.55
	25	I am often last at finishing a meal	0.84 + 0.54	0.84 + 0.54
	26	I eat more and more slowly during the course of a meal	0.59 + 0.81	0.59 + 0.81
	29	I eat slowly	0.98 + 0.18	0.98 + 0.18

* Reverse coded items. Factor loadings are standardized factor loading + error term

Supplemental Table 2. Associations among AEBQ scales adjusted for age and sex

	Food approach scales								Food avoidance scales							
	Hunger		Food responsiveness		Emotional overeating		Enjoyment of food		Satiety responsiveness		Emotional undereating		Food fussiness		Slowness in eating	
	r	*p*	r	*p*	r	*p*	r	*p*	r	*p*	r	*p*	r	*p*	r	*p*
Food approach traits																
Hunger	-	-	**0.39**	**<0.0001**	**0.22**	**0.002**	**0.27**	**0.0001**	-0.08	0.24	0.08	0.27	-0.03	0.68	0.02	0.83
Food responsiveness			-	-	**0.43**	**<0.0001**	**0.47**	**<0.0001**	**-0.20**	**0.006**	-0.04	0.58	-0.13	0.06	-0.11	0.13
Emotional overeating					-	-	**0.17**	**0.02**	-0.13	0.07	**-0.31**	**<0.0001**	-0.03	0.70	**-0.21**	**0.003**
Enjoyment of food							-	-	**-0.19**	**0.009**	-0.09	0.20	**-0.28**	**<0.0001**	0.02	0.74
Food avoidance traits																
Satiety responsiveness									-	-	0.13	0.08	0.09	0.23	**0.35**	**<0.0001**
Emotional undereating											-	-	0.13	0.07	0.07	0.30
Food fussiness													-	-	0.04	0.58
Slowness in eating															-	-

Values are Partial Pearson correlation coefficients, adjusted for age and sex (men, 0; women, 1), n=197.

Supplemental Table 3. Associations among AEBQ scales and eating behaviour traits (TFEQ and IES-2) adjusted for age and sex

	Food approach scales								Food avoidance scales							
	Hunger		Food responsiveness		Emotional overeating		Enjoyment of food		Satiety responsiveness		Emotional undereating		Food fussiness		Slowness in eating	
	r	*p*	r	*p*	r	*p*	r	*p*	r	*p*	r	*p*	r	*p*	r	*p*
Cognitive restraint	-0.06	0.39	0.03	0.67	0.09	0.21	**-0.18**	**0.01**	**0.16**	**0.03**	-0.01	0.93	0.01	0.93	-0.04	0.57
Rigid restraint	0.03	0.68	0.11	0.14	0.11	0.12	-0.06	0.43	0.06	0.43	-0.07	0.31	-0.04	0.58	-0.07	0.32
Flexible restraint	-0.05	0.52	0.08	0.29	0.08	0.29	**-0.18**	**0.01**	**0.24**	**0.0008**	-0.02	0.83	-0.05	0.48	-0.04	0.60
Disinhibition	0.12	0.09	**0.54**	**<0.0001**	**0.65**	**<0.0001**	**0.17**	**0.02**	**-0.18**	**0.01**	**-0.30**	**<0.0001**	-0.10	0.16	**-0.27**	**0.0001**
Habitual susceptibility	0.10	0.17	**0.37**	**<0.0001**	**0.35**	**<0.0001**	0.07	0.34	-0.04	0.55	-0.12	0.10	-0.06	0.39	**-0.20**	**0.006**
Emotional susceptibility	0.12	0.10	**0.44**	**<0.0001**	**0.78**	**<0.0001**	**0.15**	**0.04**	-0.03	0.66	**-0.31**	**<0.0001**	-0.06	0.39	**-0.16**	**0.03**
Situational susceptibility	0.11	0.11	**0.49**	**<0.0001**	**0.41**	**<0.0001**	**0.26**	**0.0003**	**-0.35**	**<0.0001**	**-0.27**	**0.0001**	-0.10	0.19	**-0.26**	**0.0003**
Susceptibility to hunger	**0.52**	**<0.0001**	**0.56**	**<0.0001**	**0.42**	**<0.0001**	**0.37**	**<0.0001**	**-0.32**	**<0.0001**	-0.12	0.09	0.01	0.93	-0.12	0.09
Internal locus of hunger	**0.52**	**<0.0001**	**0.43**	**<0.0001**	**0.32**	**<0.0001**	**0.33**	**<0.0001**	**-0.30**	**<0.0001**	-0.12	0.08	-0.02	0.78	-0.10	0.16
External locus of hunger	**0.35**	**<0.0001**	**0.58**	**<0.0001**	**0.44**	**<0.0001**	**0.35**	**<0.0001**	**-0.34**	**<0.0001**	**-0.14**	**0.0496**	-0.01	0.94	**-0.16**	**0.02**
Intuitive eating	**-0.15**	**0.04**	**-0.49**	**<0.0001**	**-0.63**	**<0.0001**	-0.08	0.29	0.12	0.08	**0.16**	**0.02**	-0.07	0.33	**0.31**	**<0.0001**
Unconditional permission to eat	-0.05	0.47	-0.13	0.08	-0.02	0.80	0.09	0.23	-0.08	0.27	-0.12	0.09	-0.05	0.50	0.13	0.07
Eating for physical rather than emotional reasons	**-0.21**	**0.003**	**-0.54**	**<0.0001**	**-0.83**	**<0.0001**	**-0.19**	**0.007**	0.10	0.17	**0.27**	**0.0002**	0.03	0.69	**0.22**	**0.002**
Reliance on hunger and satiety cues	-0.02	0.79	**-0.28**	**<0.0001**	**-0.26**	**0.0002**	0.00	0.96	**0.24**	**0.0007**	0.12	0.09	-0.08	0.28	**0.34**	**<0.0001**
Body-food choice congruence	0.02	0.74	-0.05	0.52	-0.11	0.13	0.07	0.33	-0.01	0.85	-0.02	0.83	**-0.24**	**0.0008**	-0.03	0.69

Values are Partial Pearson correlation coefficients, adjusted for age and sex (men, 0; women, 1).
Associations among AEBQ scales and cognitive restraint, disinhibition and susceptibility to hunger, n=196.
Associations among AEBQ and intuitive eating, n=197.
Cognitive restraint, disinhibition and susceptibility to hunger assessed by the Three-Factor Eating Questionnaire (TFEQ), Intuitive eating assessed by the Intuitive Eating Scale 2 (IES-2).