

Relations between Food and Drink Consumption and Eating Behavior Assessment DEBQ – a Study on Chinese College Students

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Abstract

Eating disorders and eating behavior patterns have been studied for decades. Study around the late 20th century focused majorly on generalizing clinical patterns of eating disorders for diagnostic purposes. However, it was in recent years that researchers have found prevalence of abnormal eating behaviors, emotional eating for instance, from people who don't necessarily meet clinical disorder criteria well. Furthermore, study shown that no exclusive measurement of general eating behaviors is available so far. However, few self-administered questionnaires on reporting eating disorders and corresponding patterns, for example, EAT-40, EDI and DEBQ, have shown considerable effectiveness on differentiating general abnormal eating patterns on non-clinical samples. In order to replicate robustness of DEBQ, one of the most widely-used eating questionnaires, on Chinese college student samples as well as predicting their food/drink choices and intake, measured by SDSCA-style scales, we collected 52 pieces of DEBQ from SYSU students. Some relations between three DEBQ subscales and food/drink consumption have been established. Also, implementation of machine learning algorithms provides promising potential for relation discovery and symptom prediction for future study.

Keywords

DEBQ, food/drink consumption, college students, machine learning

Objective

Background

Prior study on abnormal eating behavior patterns and eating disorders began with characterizing distinct kinds of eating disorders, inventing accurate diagnostic criteria as well as effective measurement of the extent of abnormal symptoms. The Eating Attitude Test(EAT), consisting of 40 items(EAT-40), was the first self-reported questionnaire for evaluation of eating disorder patterns(Garner and Garfinkel 1979). Later, a more efficient version EAT-26 was introduced still with great performance in validation(Garner et al. 1982).

However, as research went further, the reliability of EAT was challenged. First, clinical criteria of anorexia nervosa have since changed greatly along with the development of

pathology, meaning the original clinical standard(Feighner et al. 1972) used for EAT validation could be obsolete. Also, more types of eating disorders have been separated into different categories. For instance, (Russell 1979) first separated bulimia nervosa(overeating) from anorexia nervosa, leading to the distinction between the two most common eating disorders that are indistinguishable for the original EAT-40.

Consequently, the original EAT test was then validated and used as a general but still effective assessment for abnormal eating patterns instead of specific clinical disorders(Carter and Moss 1984; Gross et al. 1986). This was when abnormal eating patterns were discovered from non-clinical samples(at least under "modern" criteria). More questionnaires with the same aim were invented, including the Eating Disorder Inventory(EDI)(Garner, Olmstead, and Polivy 1983), the Dutch Eating Behavior Questionnaire(DEBQ)(Van Strien et al. 1986a), the Emotional Eating Questionnaire(EMAQ)(Geliebter and Aversa 2003) and so forth. Usually higher scores in the tests indicate worse eating patterns

Questionnaires on detection of bad eating patterns, such as DEBQ and EMAQ, usually derived from few but major theories on the formative mechanism inside eating disorders. For instance, the psychosomatic theory(Bruch 1964) corresponds to EMAQ and the emotional part of DEBQ. Amid several validated and reliable questionnaires, DEBQ presents high theoretical flexibility while maintaining extraordinary reliability(Hyland et al. 1989; Braet and Van Strien 1997; Nolan, Halperin, and Geliebter 2010), which made it an effective tool for detection of abnormal eating patterns.

For DEBQ, few questions are still under-researched. Firstly, until recent years, it wasn't systematically validated on Chinese samples even translated into Chinese by researchers(Wu, Cai, and Luo 2017; Wang et al. 2018). Although researchers supported its effectiveness on some Chinese samples, there are reasons to worry about. For example, questions in the **External Eating** section like **"If you walk pass the baker do you have the desire to buy something delicious?"** may not work well for Chinese samples considering an eating environment with much fewer **bakeries** and **cafes** and totally different eating habits. Plus, the self-report biases can significantly reduce the effectiveness of the questionnaire. Consequently, the reliability and effectiveness of

DEBQ were tested in this research. Secondly, positive relation has been found in prior study between restrained eating and emotional eating patterns (Van Strien et al. 1986b; Wardle 1987; Macht, Roth, and Ellgring 2002), meaning that restrained eating can bring adverse consequences to one's eating health, which is especially consistent with common sense today. Given the prevalence of unhealthy eating patterns among young adults (Neumark-Sztainer et al. 2011), we also studied this relation in the research.

Objectives

In this research, we were to achieve the following objectives.

1. to replicate reliability of DEBQ on a sample set of Chinese college students.
2. to discover relations between three DEBQ subscales, gender, and food/drink consumption, assessed by SDSCA-type scales.
3. as a minor objective, positive relation between restrained eating and unhealthy eating patterns is expected. Gender differences will also be tested.

Method

Participants

Participants of this study were 52 college students from Sun Yat-sen University, a public research university in China. Demographic information is presented in Table 1. All 31 males and 21 females were young Asian adults, with average BMI 20.8 (± 2.67) for male samples and 19.0 (± 1.82) for females. Demographic analysis shows typicality of samples used for the research. Few samples were discarded in demographic analysis as participants responded with abnormal values due to privacy concerns.

Table 1: Sample demographics ($N=52$)

Characteristics	average (N)	percentage(range)
Female ($N=21$)		0.404
Age ($N=20$)	19.25 (± 0.44)	(19-20)
BMI ($N=20$)	19.1 (± 1.82)	(16.7-23.7)
Underweight	(9)	0.45
Normal Weight	(11)	0.55
Overweight	(0)	0
Obese	(0)	0
Male ($N=31$)		0.596
Age ($N=28$)	19.35 (± 0.56)	(19-20)
BMI ($N=30$)	20.8 (± 2.67)	(14.9-24.1)
Underweight	(3)	0.1
Normal Weight	(24)	0.8
Overweight	(3)	0.1
Obese	(0)	0

Measures

Demographic information Participants were asked to answer several questions about their age, gender, stature and weight information for demographic analysis. BMI was not directly asked but computed using stature and weight data. Validity of self-reported collection has been supported by prior research (Kuczmarski, Kuczmarski, and Najjar 2001). We introduced Chinese instead of the WHO BMI categorization standard for grouping BMI information from a sample set of predominantly Chinese students. The result was introduced as control variables to ensure a typical sample set. Furthermore, we included gender as a variable in statistical analysis for discovering sexual differences in food/drink intake.

Food and Drink Consumption Participants answered four SDSCA-style questions about their consumption frequency on food and unhealthy drink. The Summary of Diabetes Self-Care Activities (SDSCA), was introduced aiming at measuring diabetes self-management (Toobert, Hampson, and Glasgow 2000). Part **Diet** of the self-administered questionnaire includes questions that well measure fatty food and vegetable consumption frequency. We adapted the question form and reduced day range from 7 days to 4 for simplification and higher reliability, considering self-report biases. Each question asked "How many of the last four days did you eat(drink) ...", in order to measure participants' tendency of healthy/unhealthy intake. Concretely, four questions have been asked as follows:

Table 2: Questions on Food/Drink Consumption

Questions (range:0-4)

- How many of the last four days did you:
1. have snacks or late supper besides the normal meals?
 2. eat four or more servings of vegetables and fruits?
 3. eat any high-fat food or full-fat dairy product?
 4. drink high-sugar soft drink?

Eating Behavior Patterns Participants were then asked to answer 25 Likert-style DEBQ questions evaluating their eating behavior patterns. DEBQ is a widely-used, self-reported questionnaire with three subscales (Van Strien et al. 1986a), each derived from one of the three main formative theories of eating disorders, and has since been validated as with high reliability and validity (Van Strien et al. 1986b; Hyland et al. 1989; Wardle 1987; Braet and Van Strien 1997). Effectiveness of DEBQ as well as its Chinese version C-DEBQ has also been verified recently (Wu, Cai, and Luo 2017; Wang et al. 2018). In the study, 7 questions on **External Eating**, 9 questions on **Emotional Eating** and 9 questions on **Restrained Eating** were translated into Chinese and randomly placed in the electronic question sheet in order to reduce self-report biases. Three External Eating questions were removed due to their low critical ratios ($CR < 3.00$) (Wu, Cai, and Luo 2017). We also removed four questions on diffused emotional eating that were not relevant in order to simplify the questionnaire.

Procedure

The Web-based questionnaire was distributed through on-line communication platforms. Participants who volunteered to take part in used their cellphones to answer the questionnaires. They sequentially answered demographic questions, food/drink consumption questions and finally DEBQ eating behavior questions. Results were then submitted and immediately collected by the Web-based questionnaire platform. All 52 participants returned fully answered, valid questionnaires for further analysis. No specific personal data was asked or collected throughout the research procedure.

Statistical Analysis

After all questionnaires and corresponding data have been collected by the online questionnaire platform, We first tested the reliability of the questionnaire through SPSS statistical analysis for Cronbach's α indexes on each part of the questionnaire separately then as a whole.

Then, MATLAB program script was launched to rearrange all data, filter extreme, abnormal values in demographic information, then produce final demographic statistics and three subscales in DEBQ parts.

Finally, we took advantage of the third-party Python package **sklearn**(Pedregosa et al. 2011) to implement concise and efficient machine learning algorithms to reveal relations between variables. **Sklearn** is an integrated machine learning package that implements several well-designed software tools that support data processing and accessible machine learning algorithms(Buitinck et al. 2013). In this research, gender and three subscales of DEBQ were treated as input, while food/drink consumption indexes were tested as output.

Results

Reliability

We first tested the reliability of DEBQ. Cronbach's α indexes have been computed for each part of the questionnaire and as a whole. **Table 3** shows the results. The overall re-

Table 3: Reliability measured by α

part	reliability
DEBQ	0.921
Emotional Eating	0.964
Restrained Eating	0.910
External Eating	0.587

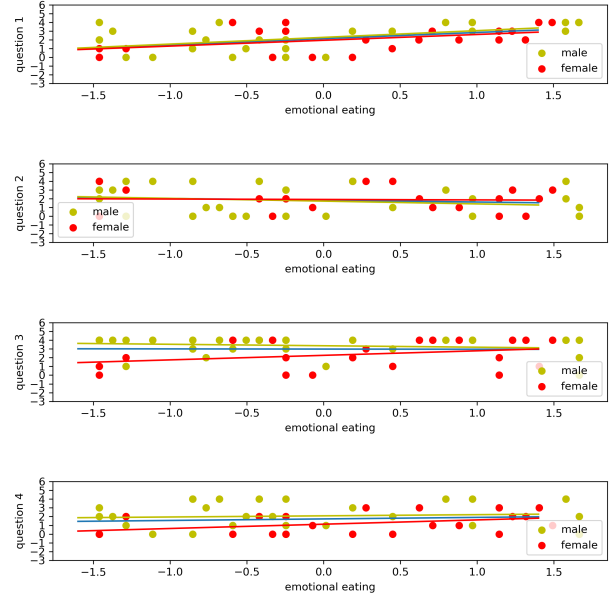
liability of DEBQ is solid(≥ 0.9). Also, **Emotional Eating** and **Restrained Eating** parts present perfect reliability. However, the **External Eating** part present relatively poor reliability, which is consistent with our hypothesis and prior study.

Relation Discovery

Figure 1, 2 and 3 present the diagrams indicating relations between four SDSCA-type results and three DEBQ eating subscales. Due to the limited size of the data set, the overall relations between variables are not prominently clear. Male

samples are labeled yellow in the diagrams, while females are labeled red. As for the curves, yellow and red lines corresponds to male and female samples, respectively. Those blue lines are for the whole data set.

Figure 1: Emotional Eating



Discussion

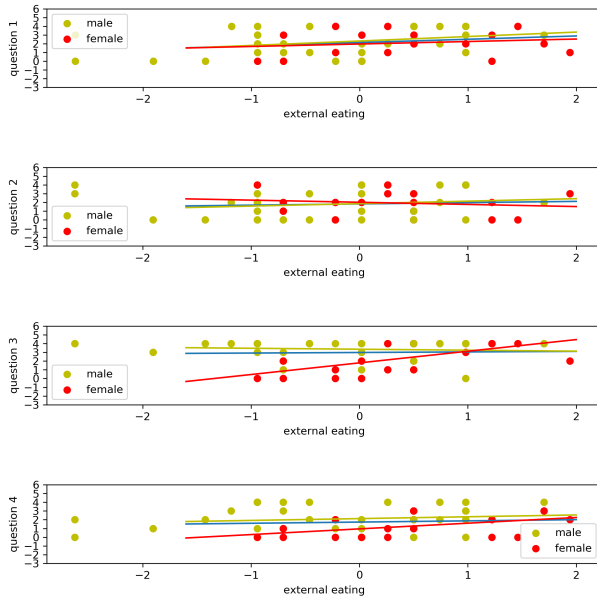
Reliability

The reliability of DEBQ as a whole questionnaire has been confirmed. Although part **External Eating** always present lowest reliability among the three subscales(Nolan, Halperin, and Geliebter 2010; Wu, Cai, and Luo 2017), the result is still surprising. One possible reason for the extreme outcome is the removal of three less-critical questions. Despite poor importance in the section, these three questions may still make non-negligible contributions to the internal consistency. Further research should look into the problem, as a good balance between effectiveness and reliability should be achieved for design improvement.

Relation Discovery

DEBQ scores To our surprise, gender differences are significant for DEBQ subscales. In all three sections, females score higher than males on average. The difference is particularly prominent on **Emotional Eating** and **Restrained Eating**, while slight difference on **External Eating** is observed. Higher scores for the female is consistent with that from research on Taiwanese parents(Wang et al. 2018), although two samples didn't share similar age patterns. Prior study on samples of the French elderly didn't find gender difference on the scores(Bailly et al. 2012). This result challenged the reliability of DEBQ, as no gender difference should be observed to ensure consistent criteria. We hypothesize that age probably could affect DEBQ scales systematically, as different interpretations or other differences could

Figure 2: External Eating

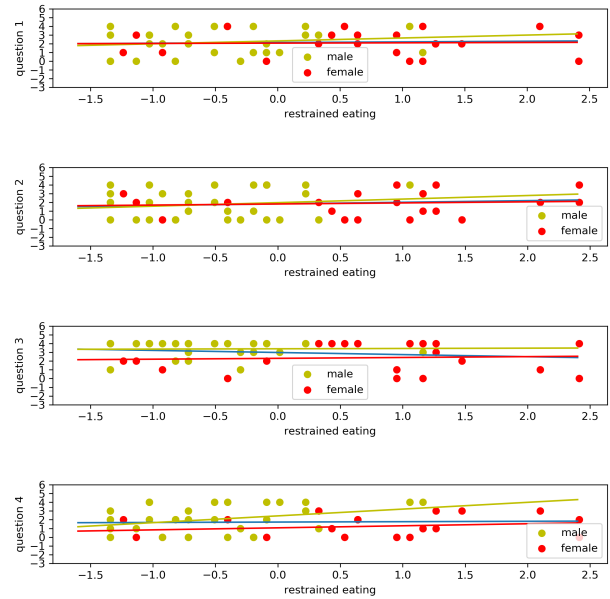


be influential. This also means that in practice criteria applied to samples should be adjusted according to both age and gender.

DEBQ to Consumption As for consumption, there are several significant relations with DEBQ subscales. First, for snacks and late supper frequency, **Emotional Eating** is a significant predictor, both for males and females. This is consistent with prior study that high impulsivity contributes to high fatty food intake (Limbers and Young 2015). Second, contrary to our hypothesis, none of the three subscales present correlation with healthy food intake, measured by vegetable/fruit frequency in the past 4 days. The result implied statistically consistent vegetable and fruit intake among Chinese student samples. We then propose that this outcome is affected by food structure differences. Then, strong positive relation between **External Eating** for females and high-fat food consumption is observed. However, given the context of this research, the possible explanation is not obvious. Finally, we found positive relation between high-sugar drink intake and **Emotional Eating**, **External Eating** scores for females. Given soft drink as a kind of common unhealthy intake, this finding can also be interpreted as affected by low impulsivity control in females.

The overall results show mediocre effectiveness. Given DEBQ as a long-tested but solid eating questionnaire, this may come from the ineffectiveness of SDSCA-type questions we designed. The four-day range could inhibit effectiveness and bring up randomness of the answers, while a larger range could bring up biases. For self-reported questionnaires, randomness and self-report biases can both be influential, thus requiring balance between effectiveness and reliability for future test design. Besides differences in eat-

Figure 3: Restrained Eating



ing structure and habits, the effectiveness of DEBQ itself is still questionable, as little structure has been found in male samples. Also, unexpected high scores on **Restrained Eating** and **External Eating** for females are noticeable. These results challenged the reliability of DEBQ as a general detection tool for unhealthy eating behaviors, since different understandings on the questions by college students, particularly female students, may have greatly affected the results. The vague differences between 'bad' and 'good' eating patterns, implied by the questionnaire, probably magnified the biases of the examinees. Additionally, the self-report questionnaires present unavoidable drawbacks, as actual physical conditions of the tested samples are not clear. Detailed and behavior-based research should be adapted for more in-depth study.

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