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## Research report

# Eating traits questionnaires as a continuum of a single concept. Uncontrolled eating <sup>☆</sup>

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## ABSTRACT

Research on eating behaviour has identified several potentially relevant eating-related traits captured by different questionnaires. Often, these questionnaires predict Body Mass Index (BMI), but the relationship between them has not been explicitly studied. We studied the unity and diversity of questionnaires capturing five common eating-related traits: Power of Food, Eating Impulsivity, emotional eating, Disinhibition, and binge eating in women from Estonia ( $n = 740$ ) and Canada ( $n = 456$ ). Using bifactor analysis, we showed that a) these questionnaires are largely explained by a single factor, and b) relative to this shared factor, only some questionnaires offered additional variance in predicting BMI. Hence, these questionnaires seemed to characterise a common factor, which we label Uncontrolled Eating. Item Response Theory techniques were then applied to demonstrate that c) within this common factor, the questionnaires could be placed on a continuum of Uncontrolled Eating. That is, Eating Impulsivity focused on the milder degree, Power of Food Scale, emotional eating scales, and Disinhibition on intermediate degrees, and the Binge Eating Scale on the most severe degrees of Uncontrolled Eating. In sum, evidence from two samples showed that questionnaires capturing five common BMI-related traits largely reflected the same underlying latent trait – Uncontrolled Eating. In Estonia, some questionnaires focused on different severities of this common construct, supporting a continuum model of Uncontrolled Eating. These findings provide a starting point for developing better questionnaires of the neurobehavioural correlates of obesity, and provide a unifying perspective from which to view the existing literature. R scripts and data used for the analysis are provided.

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## Introduction

Many important psychological constructs are captured with different questionnaires that nevertheless reflect the same underlying mechanism. Kelley (1927) was first to coin this phenomenon as the jangle fallacy, commenting on studies of intelligence. He pointed out that this fallacy can lead to confusion and segregation of research. Work addressing this issue has led to consensus that intelligence mainly relies on a common  $g$  factor (Jensen, 1998; Johnson, Bouchard, Krueger, McGue, & Gottesman, 2004; Johnson, te Nijenhuis, & Bouchard, 2008; Spearman, 1904). Similarly, negative affect has been shown to act as the common construct amongst several related traits (Judge, Erez, Bono, & Thoresen, 2002; Watson

& Clark, 1984) and 35 different impulsivity subscales have been reduced to just 4 subdimensions (Whiteside & Lynam, 2001).

A similar multitude of constructs can be seen in eating psychology. The continued increase of obesity throughout the last century (Komlos & Brabec, 2010; Ng et al., 2014) has motivated the development of numerous questionnaires assessing how people respond to the food environment (reviewed in Vainik, Dagher, Dubé, & Fellows, 2013). These questionnaires aim to describe various traits (i.e. constructs), including attention paid to food (e.g., Power of Food Scale; Lowe et al., 2009), eating in response to emotions (i.e. emotional eating, Macht, 2008), and generally having little control over eating behaviours (including Disinhibition: Bryant, King, & Blundell, 2008; impulsivity: Guerrieri, Nederkoorn, & Jansen, 2008; and trait binge eating: Dalton, Finlayson, Esdaile, & King, 2013; Schag, Schönleber, Teufel, Zipfel, & Giel, 2013). However, there is both theoretical and empirical evidence suggesting that these questionnaires may be markers of a single common factor.

The theoretical similarity of these questionnaires is evident when the traits are considered within a larger, neurobiologically-grounded theoretical framework of how eating behaviour is regulated. A common conceptualisation has been a dualistic interplay between

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a bottom-up, hedonic appetitive system and top-down, goal-driven control (e.g., Alonso-Alonso & Pascual-Leone, 2007; Appelhans, 2009; Carnell, Gibson, Benson, Ochner, & Geliebter, 2011; Dagher, 2012; Hofmann, Friese, & Strack, 2009; Pursey, Stanwell et al., 2014; Vainik et al., 2013; Van den Bos & de Ridder, 2006). When assigned to this framework, the above-mentioned questionnaires capture the combination of two mechanisms, increased appetite (a desire for food) and decreased self-control. This combination suggests overall difficulties in eating regulation – in short, Uncontrolled Eating (c.f., Karlsson, Persson, Sjöström, & Sullivan, 2000).

A closer look at the definitions of these eating-related traits reveals their similarity with Uncontrolled Eating. Decreased self-control over eating is the key characteristic of impulsivity – inability to control cravings and urges (Costa & McCrae, 1992; Vainik, Möttöus, Allik, Esko, & Realo, 2014), binge eating – recurrent episodes of eating too much food and perceiving lack of control (American Psychiatric Association, 2013; Colles, Dixon, & O'Brien, 2008), and Disinhibition – a disposition to opportunistic eating (Bryant et al., 2008). Further, there are questionnaires capturing the reasons leading to Uncontrolled Eating. These include traits such as emotional eating – overeating in response to negative emotions (Van Strien, Frijters, Bergers, & Defares, 1986), and hedonic hunger/external eating – eating in response to the appetitive environment in general (Herman & Polivy, 2008; Lowe et al., 2009). Although the common hedonic hunger questionnaire Power of Food Scale aims to focus on eating-related thoughts, rather than actions, the questionnaire has some items that directly imply loss of control, such as item #5 “It’s scary to think of the power that food has over me” (Cappelleri et al., 2009, p. 916). In sum, all these questionnaires seem to capture traits that relate to a single construct, which we term Uncontrolled Eating.

Given the theoretical similarity of the underlying traits, the questionnaires should correlate strongly with each other. Indeed, a short summary of correlations between questionnaires from the existing literature (Table 1) reveals that many correlations are large (above 0.5, Cohen, 1992), suggesting that these questionnaires are more similar than distinct. For comparison, when measuring personality traits, facets of a single personality domain typically report a correlation of just 0.40, on average. These facets are nevertheless summed up when a trait indicator is needed in NEO-PI (Costa & McCrae, 1992). Evidence so far seems to favour a jangle fallacy,

suggesting that all these questionnaires are capturing a common underlying construct, Uncontrolled Eating.

However, these questionnaires are not empirically interchangeable. Fundamentally similar measures should manifest similar correlation profiles with external criteria (Lubinski, 2004). In Table 1, some questionnaires, such as Disinhibition and Impulsiveness, relate to BMI more strongly than others, such as Power of Food Scale and emotional eating. Lack of empirical interchangeability means that each questionnaire could involve unique traits, separate from the hypothesised common construct of Uncontrolled Eating, and these unique traits could offer useful additional insights. Explicitly modelling the relationship of these questionnaires addresses this question directly, establishing whether the different questionnaires also contribute something unique, or reflect the same latent construct. This can be achieved with bifactor analysis, a form of Structural Equation Modelling that is able to model the shared and unique variance of latent traits the questionnaires capture, and assess their independent contribution in predicting an outcome (e.g., Chen, Hayes, Carver, Laurenceau, & Zhang, 2012; Reise, 2012, see Methods section for details).

#### *A continuum model of Uncontrolled Eating*

Even if the questionnaires largely capture the same construct, they could differ in the level of severity of Uncontrolled Eating that they capture. A recent review has proposed a continuum of uncontrolled eating (Davis, 2013; Fig. 1A). The continuum starts with homeostatic eating, where no excessive food is consumed. The next stage is passive overeating, with slightly positive energy balance that leads to slow weight gain. This stage is probably triggered responsiveness to the appetitive food cues from the environment. However, people might not notice that they are overeating, and therefore exert little control over their eating behaviours. More severe stages are characterised by intermittent and eventually regular bingeing and food addiction episodes. In the latter stages, appetitive drives dominate and people notice their inability to control themselves (Fig. 1A). Item Response Theory (e.g., Baker, 2001, see Methods for details) provides an analytic framework for testing such a model: the eating-related questionnaires mentioned above may measure different stages of the same dimension – Uncontrolled Eating (Fig. 1). We

**Table 1**  
Representative correlations between eating questionnaires and BMI from the literature.

Questionnaires	BMI	N5: Impulsiveness	Power of Food Scale	Emotional Eating	Disinhibition
N5: Impulsiveness (Costa & McCrae, 1992)	0.27 (Sutin, Ferrucci, Zonderman, & Terracciano, 2011)				
*UPPS-Negative Urgency (Whiteside & Lynam, 2001)					
Power of Food (Lowe et al., 2009)	0.03 (Lowe et al., 2009)	0.51* (Elfhag & Morey, 2008)			
*External eating (Van Strien et al., 1986)					
Emotional Eating (Karlsson et al., 2000; Van Strien et al., 1986)	0.11 (Elfhag & Morey, 2008)	0.49 (Elfhag & Morey, 2008)	0.54 (Lowe et al., 2009)		
Disinhibition (Stunkard & Messick, 1985)	0.34 (Bellisle et al., 2004)	0.35* (Wenzel, Weinstock, Vander Wal, & Weaver, 2014)	0.61 (Lowe et al., 2009)	0.77* (Cappelleri et al., 2009)	
*Uncontrolled Eating (Karlsson et al., 2000)					
Binge Eating Scale (Gormally et al., 1982)	0.21 (Finlayson, Cecil, Higgs, Hill, & Hetherington, 2012)	0.35* (Conley & Garza, 2011)	0.61 (Finlayson et al., 2012)	0.49 (Póinhos, Oliveira, & Correia, 2013)	0.75 (Finlayson et al., 2012)

Note: Asterisk (\*) denotes proxy questionnaire or correlation based on proxy questionnaires. Proxy questionnaires were either new iterations of Three-Factor Eating Questionnaire (Karlsson et al., 2000) or theoretically linked traits. For instance, UPPS-Negative Urgency has been mapped to N5: Impulsiveness (Whiteside & Lynam, 2001), and there is a conceptual similarity between Power of Food Scale and external eating (Herman & Polivy, 2008). When several studies were available, we prioritised larger and non-clinical samples. When women and men were analysed separately, we show the correlations found in women.

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