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# Unravelling the association between inhibitory control and loss of control over eating among adolescents

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ABSTRACT

*Objective:* Loss of control over eating is common among adolescents and is associated with negative developmental outcomes. Recent evidence points to impaired self-regulation, and more specifically poor inhibitory control, as a contributing factor to loss of control over eating among adults; however evidence in adolescent samples is limited. Moreover, in line with dual-process models, researchers have recently started to investigate the moderating role of automatic processes in this relationship, but again studies in adolescents are lacking. Therefore, the aim of the current study was to: (1) investigate whether there is an association between poor inhibitory control and loss of control over eating also among adolescents, and (2) explore whether this relationship is moderated by automatic processing.
*Method:* A community sample of 124 adolescents (10–17 years; 65.3% girls; $M_{age} = 14$ years; $SD = 1.90$) was divided into a 'Loss of Control Group' (n = 30) and a 'No Loss of Control Group' (n = 94) based on a clinical interview. Inhibitory control and automatic processing (general and food specific) were measured by self-report questionnaires.
*Results:* Adolescents in the Loss of Control Group reported significantly more problems with overall self-regulation compared to the No Loss of Control Group; however, there was no group difference for inhibition specifically. Contrary to dual-process predictions, there was a trend significant interaction between poor inhibitory control and weaker food specific automatic processing in explaining loss of control over eating.
*Conclusions:* Evidence was found for problems with overall self-regulation in adolescents with loss of control over eating. Concerning the specific role of inhibitory control, future studies should replicate whether automatic processing is indeed a crucial moderator.


## 1. Introduction

### 1.1. Loss of control over eating

Loss of control over eating, conceptualized as a subjective experience while eating, is characterized by a lack of control over eating once eating has started (Fairburn, Wilson, & Schleimer, 1993, pp. 317–360; Marcus & Kalarchian, 2003). Loss of control over eating is a common experience among youth in the general community, with prevalence rates of up to 28% (Kelly et al., 2016), and even higher estimates reported in female and overweight samples (Tanofsky-Kraff et al., 2011). In addition, a recent meta-analysis across 36 studies found an overall loss of control prevalence rate of 31% among overweight or obese children and adolescents (aged 5–21 years) (He, Cai, & Fan, 2017). Importantly, this prevalence rate can be considered reliable, as it was obtained using the 'golden standard' for assessing loss of control over eating among adolescents, namely the Children's Eating Disorder Examination (Ch-EDE; Bryant-Waugh, Cooper, Taylor, & Lask, 1996). Youth who report loss of control over eating have higher levels of psychopathology and maladjustment, such as exacerbated eating pathology (e.g., restraint eating, body, shape and weight concerns), excessive weight/fat gain, depressive symptomatology and poorer self-esteem (Rosenbaum & White, 2015; Tanofsky-Kraff et al., 2009, 2011). Loss of control over eating can also be a precursor to clinical eating disorders, such as Bulimia Nervosa or Binge Eating Disorder (Tanofsky-Kraff et al., 2011), and other psychiatric disorders such as depression or addiction (Herpertz-Dahlmann et al., 2015). Over the

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last decade, research on loss of control over eating in youth has expanded (Attia et al., 2013; Tanofsky-Kraff et al., 2013), but the mechanisms underlying this pathological eating behavior remain unclear (Tanofsky-Kraff et al., 2013). From a preventative perspective, and taking into account the negative physical and psychosocial outcomes associated with loss of control over eating, further research is important to gain insight into the mechanisms that underlie this pathological eating behavior in adolescents.

### 1.2. Loss of control over eating and inhibitory control

Given the compulsive nature of loss of control over eating (Gearhardt, White, & Potenza, 2011), studies in this research domain emphasize the role of self-regulation, and more specifically inhibitory control. Inhibitory control can be defined as "the ability to inhibit a behavioral impulse in order to attain higher-order goals" (Barkley, 1997; Nigg, 2000). Previous research in adults has found an association between poor inhibitory control and increased food intake in the laboratory (e.g., Kakoschke, Kemps, & Tiggemann, 2015), as well as increased body mass index (e.g., Stice, Lawrence, Kemps, & Veling, 2016). However, the specific role of inhibitory control in loss of control over eating has been studied less. In adults, results demonstrate that impaired inhibitory control may contribute to the development and maintenance of loss of control over eating over and above its role in general obesity (e.g., Balodis et al., 2013; Manasse et al., 2016; Svaldi, Naumann, Trentowska, & Schmitz, 2014).

In line with adult samples, some studies have found a relationship between impaired inhibitory control and body mass index in obese children (e.g., Smith, Hay, Campbell, & Trollor, 2011; Verbeken, Braet, Bosmans, & Goossens, 2014). Specifically, Goldschmidt et al. (2017) compared obese children (9–12 years old) with loss of control over eating with obese children without loss of control over eating and healthy controls on a broad range of self-regulation skills. Parents reported on their child's self-regulation using questionnaires, whereas the children completed several behavioral measures of self-regulation. The researchers concluded that each group had a unique pattern of self-regulatory dysfunctions: obese children with and without loss of control over eating had more difficulties with planning compared to normal weight controls (as assessed by the Tower of London task); obese children with loss of control over eating also performed more poorly than both obese children without loss of control over eating and normal weight controls on a working memory task (the List Sorting Task). However, there were no significant group differences for inhibitory control specifically (neither on the self-report questionnaires, nor on the behavioral measures of self-regulation). A possible explanation may be that Goldschmidt et al. (2017) only asked the parents to report on their child's self-regulation, and did not measure the children's own self-reported inhibitory control. Thus it remains unclear whether this aspect of self-regulation is an underlying mechanism of loss of control over eating in youth. Moreover, most of the research to date has assessed self-regulatory processing with the use of behavioral tasks. However, concerns regarding the limited ecological validity of such tasks (e.g., Chaytor & Schmitter-Edgecombe, 2003) emphasize the importance and advantages (e.g., measuring general executive functioning in daily life) of self-report questionnaires such as the Behavior Rating Inventory of Executive Function (i.e., BRIEF Gioia, Isquith, Guy, & Kenworthy, 2000).

Despite the fact that loss of control over eating typically emerges during adolescence (Kessler et al., 2013), and that inhibitory control develops during that period with increasing maturation of the prefrontal cortex (Crone, 2009), there is a paucity of research that focuses on inhibitory control as a potential contributing factor to loss of control over eating among adolescents. In addition, as adolescence is a time when individuals gain more autonomy, and thus assume greater responsibility for their own food choices, this is an important segment of the population in which to investigate the underlying self-regulatory mechanisms of loss of control over eating (Van Leijenhorst et al., 2010). To our knowledge, thus far only one study has investigated the specific role of inhibitory control in an adolescent sample with loss of control over eating. In particular, Kittel, Schmidt, and Hilbert (2017) compared inhibitory control capacities (using the Color-Word Interference Test) of obese adolescents with binge eating disorder (which encompasses loss of control over eating) with obese adolescents without binge eating disorder and normal-weight controls (all aged 12–20 years). The authors reported more inhibitory control problems among obese adolescents with binge eating disorder compared to normal-weight adolescents. However, no differences were found between obese adolescents with binge eating disorder compared to obese adolescents without binge eating disorder, making it difficult to ascertain whether inhibitory control makes a unique contribution to loss of control over eating in adolescents beyond its role in obesity. Moreover, this study specifically focused on a clinical (currently in treatment) sample of adolescents with binge eating disorder. Therefore, the results cannot be generalized to adolescents with loss of control over eating in the general community. In addition, and as acknowledged by the authors, again only behavioral measures were used to assess inhibitory control. As mentioned previously, it is important that future studies replicate and extend the findings with self-report questionnaires such as the Behavior Rating Inventory of Executive Function (i.e., BRIEF; Gioia et al., 2000). In addition, the limited number of studies that have been conducted in this area have focused on the association between loss of control over eating and inhibitory control without taking the role of automatic processing as a possible moderator into account.

### 1.3. Joint influences of inhibitory control and automatic processes

Dual-process models (e.g., Strack & Deutsch, 2004) propose that eating behavior is governed not only by self-regulatory processes such as inhibitory control, but also by automatic processes (e.g., automatically driven attention towards salient stimuli in the environment). In contrast with self-regulatory processes, automatic processes are fast, implicit and effortless (Cauffman et al., 2010). Studies in adult samples conducted within the dual-process framework have recently begun to take the joint influences of self-regulatory and automatic processes into account, based on the premise that automatic processes play a moderating role in the relationship between inhibitory control and eating behavior. For example, Kakoschke et al. (2015) found a significant interaction between behavioral measures of automatic processing (i.e., attentional and approach avoidance bias) and inhibitory control on unhealthy snack food intake in adult women, such that participants with a strong automatic system combined with poor inhibitory control consumed the most snack foods. In contrast, and counter to dual-process predictions, Manasse et al. (2015) found that poorer behavioral inhibitory control distinguished obese adults with binge eating from those without binge eating, but only when automatic appetitive drives (as measured with the Power of Food Scale; Lowe et al., 2009) were low. Within the context of specifically loss of control among adults, this latter finding seems to be the first indication of the dynamic interplay between self-regulatory and automatic processes beyond their role in obesity more generally.

During adolescence, development of automatic processes reaches its peak, whereas inhibitory control continues to evolve, at a moderate pace (e.g., Cauffman et al., 2010). Hence, the difference in