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Research report

Facets of impulsivity interactively predict body fat and binge eating in young women [☆]Adrian Meule ^{a,b,*}, Petra Platte ^a^a Institute of Psychology, Department of Psychology I, University of Würzburg, Würzburg, Germany^b Hospital for Child and Adolescent Psychiatry, LWL University Hospital, Ruhr University Bochum, Hamm, Germany

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ABSTRACT

Impulsivity has been positively linked to overeating and obesity, but findings are inconsistent. Studies using the *Barratt Impulsiveness Scale* (BIS) show that measures of overeating appear to be most consistently associated with scores on the subscale *attentional impulsivity* in both non-clinical and clinical samples. Additionally, individuals with binge-eating behaviors may have elevated scores on the subscale *motor impulsivity*. In the current study, young women ($N = 133$) completed the short form of the BIS (BIS-15), the *Eating Disorder Examination – Questionnaire*, and height, weight and body composition were measured. Regression analyses showed that attentional and motor impulsivity positively predicted binge eating and general eating pathology, while non-planning impulsivity negatively predicted these variables. Moreover, attentional and motor impulsivity interactively predicted percent body fat, and the number of subjective and objective binge episodes. Results show that only specific aspects of trait impulsivity (attentional and motor impulsivity) are positively associated with body mass and binge eating. Non-planning impulsivity appears to be unrelated or even inversely related to those variables, at least in female students. Elevated levels of attentional impulsivity in conjunction with high motor impulsivity may be a risk factor for overweight and clinically relevant binge eating.

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Introduction

Impulsivity can be defined as “a predisposition toward rapid, unplanned reactions to internal or external stimuli without regard to the negative consequences of these reactions to the impulsive individual or to others” (Moeller, Barratt, Dougherty, Schmitz, & Swann, 2001, p. 1784). Accordingly, it appears to be a common risk factor for several mental disorders such as certain personality disorders, substance use disorders, bipolar disorder, and attention deficit hyperactivity disorder (Moeller et al., 2001). Impulsivity is a multifaceted construct and there are a range of methods available for its measurement. Specifically, it can be assessed through self-report questionnaires or behavioral tasks such as motor response inhibition tasks or delay discounting. Motor response inhibition is usually measured using go/no-go or stop-signal tasks, in which failures to inhibit responses (e.g., button presses) are interpreted as impulsive behavior. In delay discounting paradigms, the preference for choosing small, immediate rewards over large, delayed rewards is interpreted as impulsive behavior. Self-reported impulsivity

is positively correlated with impulsive reactions in behavioral measures, yet correlations are often weak and inconsistent (Cyders & Coskunpinar, 2011, 2012). Nonetheless, both self-report and behavioral measures suggest that impulsivity is positively associated with overeating and body mass.

Obesity is a condition of excessive fat accumulation in adipose tissue and is defined as a body mass index (BMI) ≥ 30.0 kg/m² (World Health Organization, 2000). Binge-eating disorder (BED) and bulimia nervosa (BN) are eating disorders that are marked by recurrent binge-eating episodes, which include eating large amounts of food in a discrete period of time and a sense of lack of control over eating (American Psychiatric Association, 2013). Unlike individuals with BED, those with BN additionally engage in compensatory behaviors (e.g., vomiting) in order to prevent weight gain. Some studies found greater delay discounting or poorer response inhibition in obese adults compared to normal-weight individuals (Mobbs, Iglesias, Golay, & Van der Linden, 2011; Nederkoorn, Smulders, Havermans, Roefs, & Jansen, 2006; Weller, Cook, Avsar, & Cox, 2008) or in adults with BED or BN compared to controls (Manwaring, Green, Myerson, Strube, & Wilfley, 2011; Rosval et al., 2006; Wu et al., 2013). These findings, however, are contrasted by a number of studies that did not find differences in delay discounting or response inhibition between those groups (Claes, Mitchell, & Vandereycken, 2012; Claes, Nederkoorn, Vandereycken, Guerrieri, & Vertommen, 2006; Galimberti, Martoni, Cavallini, Erzegovesi, & Bellodi, 2012; Hendrick,

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Luo, Zhang, & Li, 2012; Loeber et al., 2012; Nederkoorn et al., 2006; Van den Eynde et al., 2012; Wu et al., 2013).

Similarly, higher self-reported impulsivity was found in obese adults compared to normal-weight individuals (Mobbs, Crépin, Thiéry, Golay, & Van der Linden, 2010; Rydén et al., 2003) or in adults with BED or BN compared to controls (Claes et al., 2006; Claes, Vandereycken, & Vertommen, 2002; Rosval et al., 2006; Wu et al., 2013). However, there are again numerous studies that did not find group differences or only found differences in subgroups, for example, women (Fields, Sabet, & Reynolds, 2013; Koritzky, Yechiam, Bukay, & Milman, 2012; Loeber et al., 2012; Nasser, Gluck, & Geliebter, 2004; Nederkoorn et al., 2006; Weller et al., 2008; Wu et al., 2013). Thus, although several studies suggest an association between higher impulsivity in behavioral and self-report measures and overeating (e.g., higher scores in individuals with obesity, BED, or BN), findings are inconsistent.

One explanation for the lack of associations between self-reported impulsivity and measures of overeating in many studies may be that only specific facets of impulsivity are relevant in this context. For instance, studies using the *UPPS Impulsive Behavior Scale* consistently show that its subscales *urgency* (i.e., tendency to experience strong impulses, frequently under conditions of negative effect) and *lack of perseverance* (i.e., problems to remain focused on a task that may be boring or difficult), but not its other subscales – *lack of premeditation* (i.e., not thinking and reflecting on the consequences of an act before engaging in that act) and *sensation seeking* (i.e., enjoying and pursuing exciting activities and openness for new experiences) – are associated with obesity, BED, BN, and other measures of overeating (Dir, Karyadi, & Cyders, 2013; Fischer, Smith, & Anderson, 2003; Fischer, Smith, & Cyders, 2008; Manwaring et al., 2011; Mobbs et al., 2010; Mobbs, Ghisletta, & Van der Linden, 2008; Murphy, Stojek, & MacKillop, 2014). Likewise, the *Barratt Impulsiveness Scale* (BIS) consists of several subscales, which assess an inability to focus attention or concentrate (*attentional impulsivity*), acting without thinking (*motor impulsivity*), and a lack of future orientation or forethought (*non-planning impulsivity*). A recent examination of studies that used the BIS revealed that particularly its *attentional impulsivity* subscale is related to various measures of overeating, but that *non-planning impulsivity* appears to be unrelated to these measures (Meule, 2013). Additionally, it appears that *motor impulsivity* is elevated in individuals with clinically relevant binge-eating behaviors (i.e., BED, BN, and anorexia nervosa – binge/purge type; Claes et al., 2006; Nasser et al., 2004; Rosval et al., 2006). Accordingly, it has been proposed that there may also be interactive effects between BIS-subscales that have not been considered in previous research. Specifically, high attentional impulsivity may be related to moderate overeating, but may be particularly crucial in combination with high motor impulsivity, increasing the risk to become overweight and engaging in clinically relevant binge eating (Meule, 2013).

In the present study, we investigated this issue in a sample of young women. Specifically, relationships between subscales of a short form of the BIS with self-reported eating disorder symptoms such as binge eating and objectively measured body mass were examined. As BMI only represents an indirect estimate of body fat, body composition was also measured. We hypothesized that attentional impulsivity would be most strongly, positively associated with eating disorder pathology, for example binge eating, as well as with BMI and percent body fat. Motor impulsivity was also expected to be positively associated with those measures, but to a lesser extent. Importantly, interactive effects between attentional and motor impulsivity were expected such that individuals with both high attentional and high motor impulsivity would show the highest levels of binge eating and BMI/percent body fat. Non-planning impulsivity was expected to be unrelated to those eating- and weight-related variables.

Material and methods

Participants

Female university freshmen were recruited at the University of Würzburg (Würzburg, Germany) via notices posted on campus and student councils' Facebook groups. Advertisements did not reveal the purpose or procedure of the study, except stating that the study would involve presentation of food pictures. There was no pre-screening; that is, no participants were excluded due to any disorders. One hundred and thirty-three students took part in the study. Mean age was $M = 20.08$ years ($SD = 2.68$, Range: 18–45). Mean BMI and percent body fat are reported in Table 1. According to the guidelines of the *World Health Organization* (2000), $n = 10$ women (7.52%) were underweight (BMI < 18.50 kg/m²), $n = 107$ (80.45%) had normal-weight (BMI = 18.50–24.99 kg/m²), and $n = 16$ (12.03%) were overweight (BMI = 25.00–29.99 kg/m²). Participants received either course credits or 7€ for compensation.

Measures

BMI

Height (in cm) was measured with a body height meter. Weight (in kg) was measured with a personal scale (SECA, Hamburg, Germany). BMI was calculated as weight in kilogram divided by squared height in meters.

Body composition

Bioelectrical impedance analysis (BIA) was carried out with the BIA 101 (RJL Systems, Detroit, MI) in supine position with limbs away from the trunk with two electrodes placed on the dorsal surfaces of the hands and feet on the non-dominant side of the body. Hand electrodes were placed at the distal metacarpals, and also between

Table 1
Descriptive statistics of and correlations between study variables.

N = 133	M	SD	Range	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. BIS-15 – Attentional impulsivity	9.61	2.23	6–18	–								
2. BIS-15 – Motor impulsivity	11.29	2.39	6–18	.08	–							
3. BIS-15 – Non-planning impulsivity	10.84	2.95	5–17	.09	.47***	–						
4. Body mass index (kg/m ²)	22.01	2.66	15.11–29.67	–.08	.08	–.05	–					
5. Body fat (%)	25.97	3.19	17.70–33.90	–.04	.10	–.05	.92***	–				
6. EDE-Q – Overeating	3.14	4.67	0–28	–.02	.05	–.01	.01	–.00	–			
7. EDE-Q – Loss of control	1.60	3.39	0–20	–.01	.11	–.10	.06	.04	.70***	–		
8. EDE-Q – Binge days	1.55	3.27	0–20	.06	.09	–.10	.01	.00	.69***	.93***	–	
9. EDE-Q – Total score	1.32	1.11	0.00–5.21	.17	.12	–.20*	.30***	.31***	.24**	.47***	.50***	–

Note: BIS-15 = short form of the Barratt Impulsiveness Scale; EDE-Q = Eating Disorder Examination – Questionnaire.

* $p \leq .05$, ** $p < .01$, *** $p < .001$.

Table 2
Regression analyses of scores on subscales of the *Barratt Impulsiveness Scale – short form* predicting body composition and scores on the *Eating Disorder Examination – Questionnaire*.

	Eating Disorder Examination – Questionnaire														
	Body fat (%)			Overeating			Loss of control			Binge days			Total score		
	B	SE	p	B	SE	p	B	SE	p	B	SE	p	B	SE	p
Attentional impulsivity	0.04	0.31	ns	0.07	0.13	ns	0.15	0.17	ns	0.29	0.14	.04	0.24	0.10	.03
Motor impulsivity	0.51	0.31	ns	0.10	0.12	ns	0.58	0.15	<.001	0.39	0.14	.005	0.28	0.10	.008
Non-planning impulsivity	–0.37	0.31	ns	–0.02	0.12	ns	–0.43	0.16	.007	–0.43	0.14	.002	–0.36	0.10	.001
Attentional impulsivity × motor impulsivity	0.85	0.35	.02	0.20	0.15	ns	0.69	0.20	.001	0.36	0.17	.03	0.16	0.12	ns
Attentional impulsivity × non-planning impulsivity	0.01	0.30	ns	0.05	0.13	ns	–0.16	0.16	ns	–0.08	0.15	ns	–0.08	0.10	ns
Motor impulsivity × non-planning impulsivity	0.02	0.28	ns	0.12	0.11	ns	0.05	0.15	ns	–0.07	0.13	ns	–0.06	0.10	ns
Attentional impulsivity × motor impulsivity × non-planning impulsivity	0.00	0.29	ns	–0.07	0.13	ns	–0.15	0.17	ns	–0.10	0.15	ns	–0.04	0.10	ns

Note: Significant predictors are printed in boldface.

the distal prominences of the radius and the ulna. Foot electrodes were placed at the distal metatarsals, and between the medial and lateral malleoli of the ankle. Percent body fat was calculated using an online tool (www.rjlsystems.com/interactive-online-bia).

Eating Disorder Examination – Questionnaire (EDE-Q)

The German version of the EDE-Q (Fairburn & Beglin, 1994; Hilbert & Tuschen-Caffier, 2006) was used for the assessment of eating disorder symptomatology within the past 28 days. It consists of 22 items measuring *eating restraint* (e.g., “Have you been deliberately trying to limit the amount of food you eat to influence your shape or weight [whether or not you have succeeded]?”), “Have you gone for long periods of time [8 waking hours or more] without eating anything at all in order to influence your shape or weight?”), *eating concern* (e.g., “Has thinking about food, eating or calories made it very difficult to concentrate on things you are interested in [for example, working, following a conversation, or reading]?”), “Have you had a definite fear of losing control over eating?”), *weight concern* (e.g., “Have you had a strong desire to lose weight?”), “Has your weight influenced how you think about [judge] yourself as a person?”), and *shape concern* (e.g., “Have you had a definite desire to have a totally flat stomach?”, “Has your shape influenced how you think about [judge] yourself as a person?”). As factor structure varied between studies (Berg, Peterson, Frazier, & Crow, 2012; Hilbert, de Zwaan, & Braehler, 2012) and internal consistency usually is very high, only the total score was used in the current study and internal consistency was $\alpha = .95$. Six additional items assess other relevant behaviors, three questions of which assess instances of overeating or binge eating. Specifically, participants are asked to indicate how many times they consumed large amounts of food within the past 28 days (*overeating*), how many times they felt that they lost control over eating (*loss of control*), and on how many days they consumed large amounts and had a loss of control (*binge days*).

Barratt Impulsiveness Scale – short form (BIS-15)

The BIS-15 (Spinella, 2007) is a short form of the 11th version of the *Barratt Impulsiveness Scale* (BIS-11; Patton, Stanford, & Barratt, 1995) and its German version (Meule, Vögele, & Kübler, 2011) was used in the current study. It contains 15 items assessing trait impulsivity on the subscales *attentional* (e.g., “I am restless at lectures or talks.”, “I get easily bored when solving thought problems.”), *motor* (e.g., “I buy things on impulse.”, “I say things without thinking.”), and *non-planning* (e.g., “I plan for the future [inverted].”, “I plan tasks carefully [inverted].”) impulsivity. Internal consistency of the total scale was $\alpha = .74$ and ranged between $\alpha = .60$ and $.78$ for the subscales in the current study.

Procedure

The study was conducted in October and November 2013. Participants were tested between 8:30 a.m. and 6:30 p.m. (*Mdn* = 2:00 p.m.). They were not instructed regarding their food intake prior to the study, but were asked to report the time since their last meal, which was $M = 2.40$ h ($SD = 2.28$, Range: 0–15). After arrival at the laboratory, participants read and signed informed consent. Approximately half of participants then performed a computer task, which is not relevant for the present data analyses and will be reported elsewhere.¹ All participants completed the EDE-Q, the BIS-15, and other questionnaires. Finally, body composition, height, and weight were measured.

Data analyses

Descriptive statistics of and correlations between study variables are presented in Table 1. Because of the very high correlation between BMI and percent body fat, only the latter was used in the subsequent regression analyses (results for BMI were similar). Regression analyses were calculated to examine interactive effects of BIS-15 subscales when predicting percent body fat, EDE-Q total scores, overeating, loss of control eating and binge days. Specifically, *z*-standardized BIS-15 subscale scores as well as all two-way interactions and the three-way interaction were used as predictor variables. Linear regression analyses were calculated for the prediction of percent body fat, and EDE-Q total scores. Negative binomial regression analyses were calculated for the prediction of overeating, loss of control, and binge days as those variables were positively skewed frequency distributions. Significant interactions were followed up with the procedure described by Aiken and West (1991). Exact *p*-values (two-tailed) are reported, except for *p*-values smaller than .001 and larger than .05 (*ns*).

Results

Body composition

An interaction between attentional and motor impulsivity significantly predicted percent body fat (Table 2). Attentional impulsivity was positively associated with percent body fat in participants with high motor impulsivity (+1 *SD*; $B = 0.89$, $SE = 0.43$, $p = .04$), but was unrelated to percent body fat in participants with low motor

¹ We also conducted all analyses controlling for group (i.e. those who did and did not perform the computer task before questionnaire completion). This did not influence results.

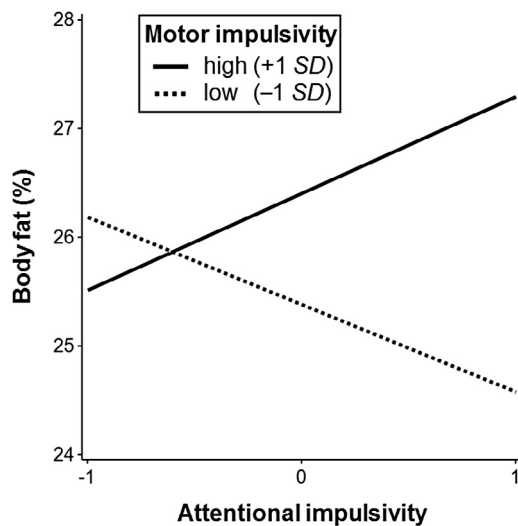


Fig. 1. Interactive effects between attentional and motor impulsivity as measured with the short form of the *Barratt Impulsiveness Scale* when predicting percent body fat.

impulsivity (-1 SD; $B = -0.80$, $SE = 0.45$, ns ; Fig. 1). All other predictors of percent body fat were non-significant (Table 2).

EDE-Q

Attentional impulsivity positively predicted binge days and EDE-Q total scores and motor impulsivity positively predicted loss of control eating, binge days, and EDE-Q total scores (Table 2). Non-planning impulsivity negatively predicted loss of control eating, binge days and EDE-Q total scores (Table 2).

Loss of control eating and binge days were further predicted by an interaction of attentional impulsivity and motor impulsivity (Table 2). Attentional impulsivity was positively associated with loss of control eating in participants with high motor impulsivity ($+1$ SD; $B = 1.07$, $SE = 0.45$, $p = .02$), but was unrelated to loss of control eating in participants with low motor impulsivity (-1 SD; $B = -0.40$, $SE = 0.47$, ns ; Fig. 2A). Similarly, attentional impulsivity was positively associated with binge days in participants with high motor impulsivity ($+1$ SD; $B = 0.87$, $SE = 0.45$, $p = .05$), but was unrelated to

binge days in participants with low motor impulsivity (-1 SD; $B = -0.07$, $SE = 0.46$, ns ; Fig. 2B). Neither predictor was significantly associated with overeating (Table 2).

Discussion

The current study investigated associations between trait impulsivity and measures of overeating in young women. Our hypotheses could only partially be confirmed. Unexpectedly, subscales of the BIS-15 neither correlated with scores on the EDE-Q nor with percent body fat, except that scores on non-planning impulsivity were inversely correlated with EDE-Q total scores. However, distinct relationships between BIS-15 subscales and those eating- and weight-related measures could be observed in the regression analyses.

Relationships between trait impulsivity and body composition

BMI was almost perfectly correlated with percent body fat and, thus, associations with impulsivity were similar for both variables. In previous studies, scores on the BIS-11 or BIS-15 were rarely associated with higher BMI and if so, effect sizes were small (Fields et al., 2013; Loeber et al., 2012; Meule, 2013; van Koningsbruggen, Stroebe, & Aarts, 2013). Similarly, BIS-15 subscales neither correlated with BMI nor percent body fat in the current study. However, scores on attentional and motor impulsivity interactively predicted those variables: higher attentional impulsivity was only related to higher percent body fat when motor impulsivity was also high, but not when motor impulsivity levels were low. To our knowledge, such interactions have not been reported before in the literature. Yet, it is in line with findings in children and adolescents, which suggest that deficits on several dimensions of impulsivity may have additive effects on body weight. For example, children who performed poorly in two self-control tasks at the ages of three and five had higher weight gain at age twelve as compared to those who showed high self-regulation in one of the tasks or in both tasks (Francis & Susman, 2009). Those findings are complemented by a recent study showing that obese adolescents were more impulsive in two laboratory tasks as compared to normal-weight adolescents, while overweight adolescents were only more impulsive in one of those tasks (Fields et al., 2013). Thus, it appears that high levels on at least two dimensions of impulsivity increase the risk for weight gain.

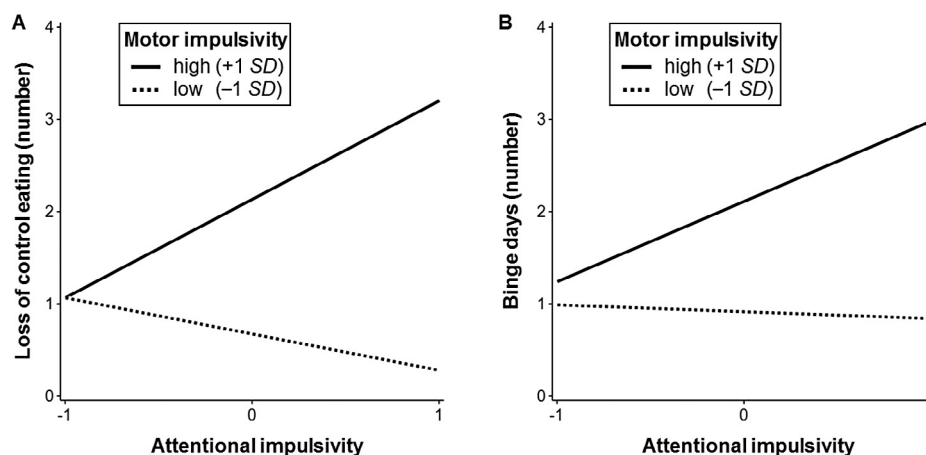


Fig. 2. Interactive effects between attentional and motor impulsivity as measured with the short form of the *Barratt Impulsiveness Scale* when predicting (A) loss of control eating and (B) binge days as measured with the *Eating Disorder Examination – Questionnaire*.

Relationships between trait impulsivity and eating pathology

Attentional and motor impulsivity positively predicted binge days and general eating disorder pathology while non-planning impulsivity negatively predicted those variables. Thus, these findings are in line with studies showing that higher scores on attentional and motor impulsivity are associated (although inconsistently) with higher binge-eating severity and other eating disorder pathology (Claes et al., 2006; Meule, 2013; Meule, Heckel, Jurowich, Vögele, & Kübler, 2014; Meule, Hermann, & Kübler, 2013; Nasser et al., 2004; Rosval et al., 2006). Attentional impulsivity may increase the likelihood to allocate attention to high-calorie food stimuli (Hou et al., 2011), which is in turn related to higher behavioral (i.e., motor) impulsivity (Coskunpinar & Cyders, 2013).

The fact that non-planning impulsivity was negatively related to eating and weight outcomes stands in contrast to previous studies that did not find a relation (cf. Meule, 2013) or found that higher levels of non-planning impulsivity were associated with other measures of low eating-related self-regulation such as unsuccessful dieting (Timko & Perone, 2005; van Koningsbruggen et al., 2013). In another study, however, higher levels of non-planning impulsivity correlated with *reduced* test meal intake, an unexpected finding that the authors attributed to the controlled eating situation in the laboratory (Nasser et al., 2004). The finding that higher non-planning impulsivity may even be related to lower food intake, less frequent binge eating and lower general eating pathology is counterintuitive and future studies that replicate this finding and address possible mediating variables are needed. It can be speculated that this inverse relationship may be specific for the current sample (i.e., young female university students). Prevalence rates of eating disorder symptoms are higher in such samples as compared to the general population, while at the same time most of these women may be future-oriented high achievers (i.e., they may score low on non-planning impulsivity) (Eisenberg, Nicklett, Roeder, & Kirz, 2011; Jacobi, Hayward, de Zwaan, Kraemer, & Agras, 2004). Nonetheless, the present findings support previous results showing that non-planning impulsivity appears to be unrelated, or may even be inversely related to eating pathology such as binge eating and that more clear-cut, positive associations can be found for attentional and motor impulsivity.

Moreover, interactive effects between BIS-15 subscales were found, confirming our hypothesis. Similar to results for body mass and body composition, high attentional impulsivity in combination with high motor impulsivity was predictive of more instances of loss of control eating and more binge days. Notably, those interactive effects were absent when predicting instances of consuming large amounts of food (overeating) and general eating pathology (EDE-Q total scores). Thus, it appears that high attentional and motor impulsivity are specifically related to higher body mass and to overeating that involves a subjective feeling of loss of control over consumption. However, attentional and motor impulsivity seem to be unrelated to overeating that may not be clinically relevant (as it is not marked by a loss of control) and to cognitive aspects such as eating-, weight-, and shape-concern. It needs to be noted, however, that the sample of the current study primarily consisted of normal-weight, healthy women. Thus, inferences about the clinical relevance of the current findings should be drawn with caution and results need to be replicated in clinical populations, for example in individuals with obesity or BED.

Limitations and future directions

Firstly, interpretation of results is limited to women and, thus, future studies need to investigate if similar associations between trait impulsivity, binge eating, and body mass can be found in men. Secondly, this was a cross-sectional study and, thus, no definite

conclusions about causal relationships or predictions about future weight gain can be made. However, some prospective studies exist which show that specific dimensions of impulsivity, for example inhibitory control, predicted future weight gain or attenuated weight loss in children (Nederkoorn, Jansen, Mulkens, & Jansen, 2007; Reinert, Po'e, & Barkin, 2013) or in university students (Nederkoorn, Houben, Hofmann, Roefs, & Jansen, 2010). Hence, we would argue that higher trait impulsivity, particularly attentional and motor aspects, is a likely risk factor for having higher weight and engaging in binge eating rather than the other way around. Finally, impulsivity and eating pathology were assessed through self-report, which is subject to potential bias. However, validity of the questionnaires has been supported in previous studies. For example, scores on the BIS-15 correlated with the number of commission errors (indicating lower motor response inhibition) in a go/no-go task, supporting its convergent validity (Meule & Kübler, 2014; Meule et al., 2014). Moreover, scores on the EDE-Q, particularly on its items assessing overeating, loss of control eating, and binge days, are highly correlated with those obtained with the *Eating Disorder Examination – Interview* (Hilbert, Tuschen-Caffier, Karwautz, Niederhofer, & Munsch, 2007). Thus, we would argue that the current results based on self-reports are valid, although future studies may additionally include interviews for the assessment of eating disorder symptoms or behavioral tasks such as go/no-go tasks for the assessment of impulsivity.

Conclusions

Although it is widely accepted that impulsivity is a multifaceted construct, this is often not considered when it comes to its measurement (King, Patock-Peckham, Dager, Thimm, & Gates, 2014). For example, researchers often prefer reporting total instead of subscale scores of self-report impulsivity measures. With regard to relationships between trait impulsivity and eating and weight, the present results clearly show that differentiating between specific facets of impulsivity, for example as measured with the subscales of the BIS-15, is relevant and, thus, studies investigating associations between trait impulsivity and obesity, binge eating, or other measures related to overeating need to consider these aspects in their analyses. That is, findings that failed to find a relationship between obesity or binge eating and trait impulsivity may simply be due to the fact that only total scores of impulsivity questionnaires were used (e.g., Fields et al., 2013; Loeber et al., 2012). The present study showed that non-planning impulsivity is unrelated or may even be inversely related to anthropometric and psychometric measures associated with overeating in young, female university students. In contrast, attentional and motor impulsivity are positively and interactively related to these measures. Future studies may investigate if these (and potentially other) impulsivity facets prospectively and interactively predict weight gain and the development of binge eating-related eating disorders.

References

- Aiken, L. S., & West, S. G. (1991). *Multiple regression. Testing and interpreting interactions*. Thousand Oaks, CA: Sage.
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC: American Psychiatric Association.
- Berg, K. C., Peterson, C. B., Frazier, P., & Crow, S. J. (2012). Psychometric evaluation of the eating disorder examination and eating disorder examination-questionnaire. A systematic review of the literature. *The International Journal of Eating Disorders*, 45, 428–438.
- Claes, L., Mitchell, J. E., & Vandereycken, W. (2012). Out of control? Inhibition processes in eating disorders from a personality and cognitive perspective. *The International Journal of Eating Disorders*, 45, 407–414.
- Claes, L., Nederkoorn, C., Vandereycken, W., Guerrieri, R., & Vertommen, H. (2006). Impulsiveness and lack of inhibitory control in eating disorders. *Eating Behaviors*, 7, 196–203.

- Claes, L., Vandereycken, W., & Vertommen, H. (2002). Impulsive and compulsive traits in eating disordered patients compared with controls. *Personality and Individual Differences*, 32, 707–714.
- Coskunpinar, A., & Cyders, M. A. (2013). Impulsivity and substance-related attentional bias. A meta-analytic review. *Drug and Alcohol Dependence*, 133, 1–14.
- Cyders, M. A., & Coskunpinar, A. (2011). Measurement of constructs using self-report and behavioral lab tasks. Is there overlap in nomothetic span and construct representation for impulsivity? *Clinical Psychology Review*, 31, 965–982.
- Cyders, M. A., & Coskunpinar, A. (2012). The relationship between self-report and lab task conceptualizations of impulsivity. *Journal of Research in Personality*, 46, 121–124.
- Dir, A. L., Karyadi, K., & Cyders, M. A. (2013). The uniqueness of negative urgency as a common risk factor for self-harm behaviors, alcohol consumption, and eating problems. *Addictive Behaviors*, 38, 2158–2162.
- Eisenberg, D., Nicklett, E. J., Roeder, K., & Kirz, N. E. (2011). Eating disorder symptoms among college students. Prevalence, persistence, correlates, and treatment-seeking. *Journal of American College Health: J of ACH*, 59, 700–707.
- Fairburn, C. G., & Beglin, S. J. (1994). Assessment of eating disorders. Interview or self-report questionnaire? *The International Journal of Eating Disorders*, 16, 363–370.
- Fields, S. A., Sabet, M., & Reynolds, B. (2013). Dimensions of impulsive behavior in obese, overweight, and healthy-weight adolescents. *Appetite*, 70, 60–66.
- Fischer, S., Smith, G. T., & Anderson, K. G. (2003). Clarifying the role of impulsivity in bulimia nervosa. *The International Journal of Eating Disorders*, 33, 406–411.
- Fischer, S., Smith, G. T., & Cyders, M. A. (2008). Another look at impulsivity. A meta-analytic review comparing specific dispositions to rash action in their relationship to bulimic symptoms. *Clinical Psychology Review*, 28, 1413–1425.
- Francis, L. A., & Susman, E. J. (2009). Self-regulation and rapid weight gain in children from age 3 to 12 years. *Archives of Pediatrics & Adolescent Medicine*, 163, 297–302.
- Galimberti, E., Martoni, R. M., Cavallini, M. C., Erzegovesi, S., & Bellodi, L. (2012). Motor inhibition and cognitive flexibility in eating disorder subtypes. *Progress in Neuro-Psychopharmacology & Biological Psychiatry*, 36, 307–312.
- Hendrick, O. M., Luo, X., Zhang, S., & Li, C. S. R. (2012). Saliency processing and obesity. A preliminary imaging study of the Stop Signal Task. *Obesity*, 20, 1796–1802.
- Hilbert, A., de Zwaan, M., & Braehler, E. (2012). How frequent are eating disturbances in the population? Norms of the eating disorder examination-questionnaire. *PLoS ONE*, 7(e29125), 1–7.
- Hilbert, A., & Tuschen-Caffier, B. (2006). *Eating disorder examination – questionnaire. Deutschsprachige Übersetzung*. Münster: Verlag für Psychotherapie.
- Hilbert, A., Tuschen-Caffier, B., Karwautz, A., Niederhofer, H., & Munsch, S. (2007). Eating disorder examination-questionnaire. Evaluation der deutschsprachigen Übersetzung. *Diagnostica*, 53, 144–154.
- Hou, R., Mogg, K., Bradley, B. P., Moss-Morris, R., Peveler, R., & Roefs, A. (2011). External eating, impulsivity and attentional bias to food cues. *Appetite*, 56, 424–427.
- Jacobi, C., Hayward, C., de Zwaan, M., Kraemer, H. C., & Agras, W. S. (2004). Coming to terms with risk factors for eating disorders. Application of risk terminology and suggestions for a general taxonomy. *Psychological Bulletin*, 130, 19–65.
- King, K. M., Patock-Peckham, J. A., Dager, A. D., Thimm, K., & Gates, J. R. (2014). On the mismeasurement of impulsivity. Trait, behavioral, and neural models in alcohol research among adolescents and young adults. *Current Addiction Reports*, 1, 19–32.
- Koritzky, G., Yechiam, E., Bukay, I., & Milman, U. (2012). Obesity and risk taking. A male phenomenon. *Appetite*, 59, 289–297.
- Loeber, S., Grosshans, M., Korucuoglu, O., Vollmert, C., Vollstädt-Klein, S., Schneider, S., et al. (2012). Impairment of inhibitory control in response to food-associated cues and attentional bias of obese participants and normal-weight controls. *International Journal of Obesity*, 36, 1334–1339.
- Manwaring, J. L., Green, L., Myerson, J., Strube, M. J., & Wilfley, D. E. (2011). Discounting of various types of rewards by women with and without binge eating disorder. Evidence for general rather than specific differences. *The Psychological Record*, 61, 561–582.
- Meule, A. (2013). Impulsivity and overeating. A closer look at the subscales of the Barratt Impulsiveness Scale. *Frontiers in Psychology*, 4, 177, doi:10.3389/fpsyg.2013.00177.
- Meule, A., Heckel, D., Jurowich, C. F., Vögele, C., & Kübler, A. (2014). Correlates of food addiction in obese individuals seeking bariatric surgery. *Clinical Obesity*, 4, 228–236.
- Meule, A., Hermann, T., & Kübler, A. (2013). Food addiction in overweight and obese adolescents seeking weight-loss treatment. *Adipositas*, 7, A48.
- Meule, A., & Kübler, A. (2014). Double trouble. Trait food craving and impulsivity interactively predict food-cue affected behavioral inhibition. *Appetite*, 79, 174–182.
- Meule, A., Lutz, A. P. C., Krawietz, V., Stützer, J., Vögele, C., & Kübler, A. (2014). Food-cue affected motor response inhibition and self-reported dieting success. A pictorial affective shifting task. *Frontiers in Psychology*, 5, 216, doi:10.3389/fpsyg.2014.00216.
- Meule, A., Vögele, C., & Kübler, A. (2011). [Psychometric evaluation of the German Barratt Impulsiveness Scale – Short Version (BIS-15)]. *Diagnostica*, 57, 126–133.
- Mobbs, O., Crépin, C., Thiéry, C., Golay, A., & Van der Linden, M. (2010). Obesity and the four facets of impulsivity. *Patient Education and Counseling*, 79, 372–377.
- Mobbs, O., Ghisletta, P., & Van der Linden, M. (2008). Clarifying the role of impulsivity in dietary restraint. A structural equation modeling approach. *Personality and Individual Differences*, 45, 602–606.
- Mobbs, O., Iglesias, K., Golay, A., & Van der Linden, M. (2011). Cognitive deficits in obese persons with and without binge eating disorder. Investigation using a mental flexibility task. *Appetite*, 57, 263–271.
- Moeller, F. G., Barratt, E. S., Dougherty, D. M., Schmitz, J. M., & Swann, A. C. (2001). Psychiatric aspects of impulsivity. *The American Journal of Psychiatry*, 158, 1783–1793.
- Murphy, C. M., Stojek, M. K., & MacKillop, J. (2014). Interrelationships among impulsive personality traits, food addiction, and body mass index. *Appetite*, 73, 45–50.
- Nasser, J. A., Gluck, M. E., & Geliebter, A. (2004). Impulsivity and test meal intake in obese binge eating women. *Appetite*, 43, 303–307.
- Nederkoorn, C., Houben, K., Hofmann, W., Roefs, A., & Jansen, A. (2010). Control yourself or just eat what you like? Weight gain over a year is predicted by an interactive effect of response inhibition and implicit preference for snack foods. *Health Psychology*, 29, 389–393.
- Nederkoorn, C., Jansen, E., Mulken, S., & Jansen, A. (2007). Impulsivity predicts treatment outcome in obese children. *Behaviour Research and Therapy*, 45, 1071–1075.
- Nederkoorn, C., Smulders, F. T. Y., Havermans, R., Roefs, A., & Jansen, A. (2006). Impulsivity in obese women. *Appetite*, 47, 253–256.
- Patton, J. H., Stanford, M. S., & Barratt, E. S. (1995). Factor structure of the Barratt Impulsiveness Scale. *Journal of Clinical Psychology*, 51, 768–774.
- Reinert, K. R. S., Po'e, E. K., & Barkin, S. L. (2013). The relationship between executive function and obesity in children and adolescents. A systematic literature review. *Journal of Obesity*, 2013(820956), 1–10.
- Rosval, L., Steiger, H., Bruce, K., Israël, M., Richardson, J., & Aubut, M. (2006). Impulsivity in women with eating disorders. Problem of response inhibition, planning, or attention? *The International Journal of Eating Disorders*, 39, 590–593.
- Rydén, A., Sullivan, M., Torgerson, J. S., Karlsson, J., Lindroos, A.-K., & Taft, C. (2003). Severe obesity and personality. A comparative controlled study of personality traits. *International Journal of Obesity*, 27, 1534–1540.
- Spinella, M. (2007). Normative data and a short form of the Barratt Impulsiveness Scale. *The International Journal of Neuroscience*, 117, 359–368.
- Timko, C. A., & Perone, J. (2005). Rigid and flexible control of eating behavior in a college population. *Eating Behaviors*, 6, 119–125.
- van Koningsbruggen, G. M., Stroebe, W., & Aarts, H. (2013). Successful restrained eating and trait impulsiveness. *Appetite*, 60, 81–84.
- Van den Eynde, F., Samarawickrema, N., Kenyon, M., DeJong, H., Lavender, A., Startup, H., et al. (2012). A study of neurocognition in bulimia nervosa and eating disorder not otherwise specified-bulimia type. *Journal of Clinical and Experimental Neuropsychology*, 34, 67–77.
- Weller, R. E., Cook, E. W., Avsar, K. B., & Cox, J. E. (2008). Obese women show greater delay discounting than healthy-weight women. *Appetite*, 51, 563–569.
- World Health Organization. (2000). *Obesity. Preventing and managing the global epidemic*. Geneva: World Health Organization.
- Wu, M., Giel, K. E., Skunde, M., Schag, K., Rudofsky, G., de Zwaan, M., et al. (2013). Inhibitory control and decision making under risk in bulimia nervosa and binge-eating disorder. *The International Journal of Eating Disorders*, 46, 721–728.