

Obesity and the four facets of impulsivity

Olivia Mobbs^a, Christelle Crepin^b, Christelle Thiery^a, Alain Golay^b, Martial Van der Linden^{a,c}

^a*Cognitive Psychopathology and Neuropsychology Unit, Psychology Department, University of Geneva, Switzerland*

^b*Division of Therapeutic Patient Education for Chronic Diseases, University Hospital Geneva, Geneva, Switzerland*

^c*Cognitive Psychopathology Unit, University of Liège, Belgium*

KEYWORDS: Impulsivity; Obesity; Eating disorders; UPPS model of impulsivity; UPPS Impulsive Behavior Scale; Sensitivity to Punishment and Sensitivity to; Reward Questionnaire

ABSTRACT

Objective: Obesity is a complex condition involving biological, psychological, sociocultural and environmental components. Impulsivity seems to be a particularly important factor. Whiteside and Lynam recently proposed dividing impulsivity into four separate dimensions: Urgency, lack of Premeditation, lack of Perseverance and Sensation Seeking (associated with a tendency to exaggerate the impact of rewards). The objective of this article is to examine how obesity and eating disorder symptoms may be related to the four facets of impulsivity.

Methods: Whiteside and Lynam's Impulsive Behavior Scale, the Sensitivity to Punishment and Sensitivity to Reward Questionnaire, the Eating Disorder Examination Questionnaire and the Mizes Anorectic Cognitions Questionnaire were used to explore the association between the cognitive and motivational facets of impulsivity and obesity in 47 overweight or obese persons with eating disorders and 47 normal-weight controls.

Results: Results suggest that overweight and obese persons have higher levels of Urgency, lack of Perseverance and Sensitivity to Reward.

Conclusion: These results suggest that obese and overweight persons have difficulty inhibiting automatic or dominant behavior and intrusive thoughts and a higher sensitivity to reward.

Practice implications: Overweight and obese persons may benefit from psychological interventions targeting self-control problems associated with impulsive eating behaviors.

1. Introduction

In western society, food temptations are everywhere; however, not everyone has difficulty regulating their food intake or resisting food temptations. What, then, makes overweight and obese persons different from the rest of the population? It is recognized that various biological (e.g.,

reduced thermogenesis), psychological (e.g., eating disorders, depression) and socio-cultural (e.g., low socio-economic status) factors contribute to the development and maintenance of excess weight [1]. Among these factors, impulsivity plays a particularly important role in obesity and eating behaviors. Recent studies using self-report questionnaires and psychological tasks have shown that impulsivity contributes to the development and maintenance of obesity [2-4].

1.1. The four facets of impulsivity

Impulsivity is an important construct that covers a wide range of behavioral, motivational and emotional phenomena. In this context, according to Whiteside and Lynam's work [5], impulsivity must be considered as a multifaceted construct, made up of four separate components, which are the basis for the creation of a scale called the UPPS Impulsive Behavior Scale:

- (1) Urgency, defined as “the tendency to experience strong impulses, frequently under conditions of negative affect”;
- (2) lack of Perseverance, defined as “the difficulty to remain focused on a task that may be boring or difficult”;
- (3) lack of Premeditation, defined as “the difficulty to think and reflect on the consequences of an act before engaging in the act”;
- (4) Sensation Seeking, defined as “a tendency to enjoy and pursue activities that are exciting, and openness for new experiences.”

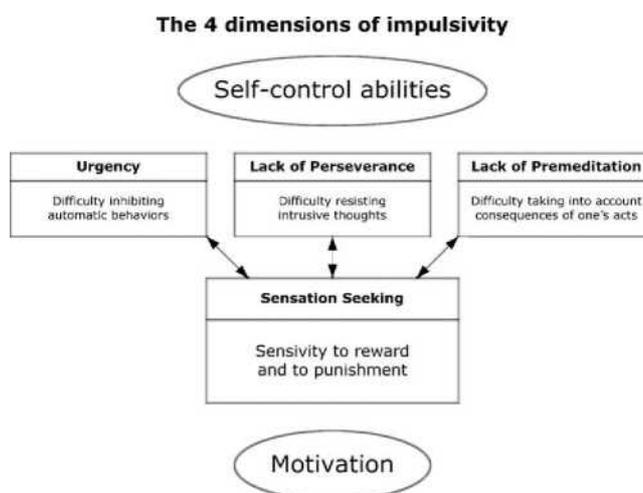


Fig. 1. The 4 dimensions of impulsivity

Bechara and Van der Linden [6, see also 7] recently proposed to relate the various facets of impulsivity to specific cognitive and motivational processes (Fig. 1). They suggested that the facets “Urgency,” “lack of Perseverance” and “lack of Premeditation” may be related to cognitive/self-

control mechanisms, while “Sensation Seeking” may be related to motivational factors [7]. More specifically, “Urgency” may be related to the inability to deliberately suppress dominant, automatic or prepotent responses, especially in conditions of intense emotions. “Lack of Perseverance” could be related to difficulty resisting intrusive thoughts or intrusive images, while “lack of Premeditation” could be related to the inability to take into account the positive or negative consequences of a decision on the basis of the emotional responses associated with it. Finally, “Sensation Seeking” may be related to a tendency to exaggerate the impact of rewards and may operate automatically [8, 9]. Each facet is supported by a specific cerebral network [7].

1.2. Obesity and the four facets of impulsivity

Several studies have assessed obese persons by means of self-report questionnaires and/or cognitive tasks that examine one or more of the four components of impulsivity.

The Urgency component has been measured by self-report questionnaires [10] and psychological tasks [11]. Urgency may contribute to an obese person’s problem controlling eating in situations of strong emotion. Guerrieri et al. [12] found that difficulty suppressing an automatic response (as measured by stop signal reaction time) predicted heightened food intake.

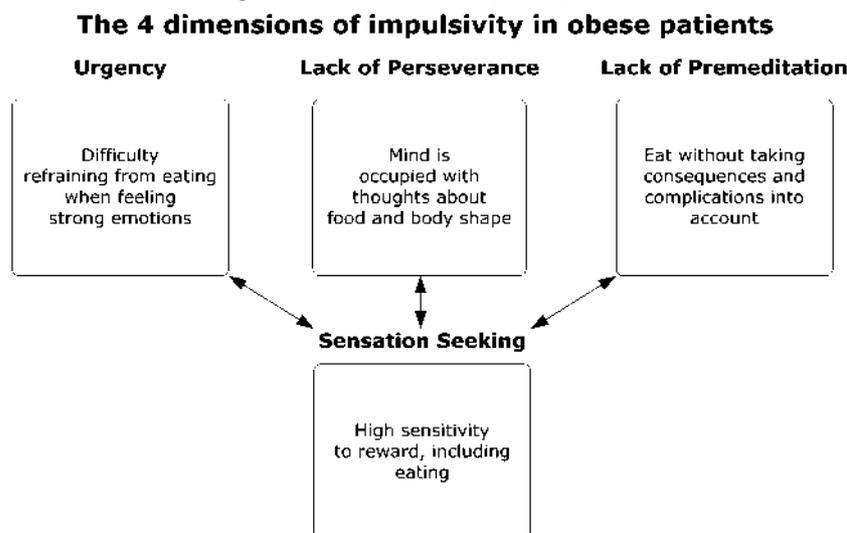
To the best of our knowledge, lack of Perseverance has only been measured in obese persons by means of self-report questionnaires [1]. There is a link between obesity and the self-discipline facet of the well-known NEO Personality Inventory (NEO-PI-R), which is related to lack of Perseverance [10]. Obese persons who overeat have a strong tendency to suppress thoughts [13], which may make the suppressed thoughts (e.g., thoughts of food) become hyperaccessible, which in turn causes distress and increased food consumption [14]. This may explain why obese people overeat, despite their intentions to control their food intake. In the same vein, it has been shown that avoidance of body/shape concerns actually increases such preoccupations [15]. Thought control difficulties may discourage patients and interfere with their treatment.

The lack of Premeditation aspect of impulsivity has been measured by self-report questionnaires [10] and psychological tasks [16]. Previous studies have shown that obese persons choose immediate rewards even when future long-term negative consequences are associated with them. This reflects an inability to assess future impact, which may potentially contribute to disadvantageous decision-making (e.g., not considering the possible long-term negative consequences of overeating).

The Sensation Seeking dimension has been measured by self-report questionnaires [17-19] and a psychological task [20]. Overweight persons with binge eating disorders have enhanced sensitivity to rewards [19]. The tendency to seek rewards (e.g., food) is associated with food intake, overeating and subsequent weight gain, as well as difficulty maintaining or losing weight [21]. This tendency affects food intake, especially when varied food (food that varies in color, form, taste and texture) is offered [20]. It may be related to a heightened selective attention to food stimuli and may make it difficult to regulate eating, particularly in obese individuals who have impaired sensitivity to the hunger and satiety signals that normally regulate eating [22].

2. Objective

The objective of this study is to examine for the first time how eating disorder symptoms, eating-disorder-related dysfunctional cognitions and obesity may be related to the four facets of



Hypersensitivity to food stimuli and poor self-control contribute, along with other factors, to the development and maintenance of obesity

impulsivity. If we return to the general framework of this article (Fig. 2), we may hypothesize that hypersensitivity to food stimuli associated with good self-regulatory capacities should not lead to difficulties regulating eating behavior and related thoughts. However, hypersensitivity to food stimuli associated with poor self-control would lead to such difficulties, suggesting that controlled processes and automatic processes interact in this context [23].

Fig. 2. The 4 dimensions of impulsivity in obese patients. Hypersensitivity to food stimuli and poor self-control contribute, along with other factors, to the development and maintenance of obesity

3. Methods

3.1. Participants

The study sample consisted of 47 overweight (defined as a body mass index (BMI) ≥ 25 kg/m²) and obese patients (defined as a BMI ≥ 30 kg/m²) who were recruited through local advertisements and in the Therapeutic Patient Education for Chronic Diseases Division of the University Hospital of Geneva. Women were included if they met the following criteria: age 18-60 years and body mass index in the overweight (BMI ≥ 25 kg/m²) or obese range (BMI ≥ 30 kg/m²). The 47 normal-weight controls were recruited through local advertisements in the community and represented a range of

professions. Women were included in this group if they conformed to the following inclusion criteria: age 18-60 years and body mass index in the normal range ($BMI = 18.5-24.9 \text{ kg/m}^2$). All participants were female, native or fluent French speakers (criterion for inclusion), had normal or corrected vision (criterion for inclusion), and 90% were Caucasian. They gave written informed consent prior to taking part in the study.

The study was approved by the Medical Ethics Committee of the University Hospital of Geneva.

3.2. Measures

Demographic information (age, ethnicity, years of education) and information about the duration of weight problems was collected during a face-to-face interview before the study.

The French versions of the UPPS Impulsive Behavior Scale [5, 24] and the Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ) [25, 26] were used to explore the cognitive and motivational facets of impulsivity. The Eating Disorder Examination Questionnaire (EDE-Q) [27] and the Mizes Anorectic Cognitions Questionnaire (MAC-24) [28, 29] were used to explore eating disorder symptoms and eating-disorder-related dysfunctional cognitions.

The UPPS Impulsive Behavior Scale consists of 45 items that evaluate four different facets of impulsivity, labeled Urgency (12 items, e.g., “I have trouble controlling my impulses”), lack of Premeditation (11 items, e.g., “Before I get into a new situation I like to find out what to expect from it”), lack of Perseverance (10 items, e.g., “I finish what I start”), and Sensation Seeking (12 items, e.g., “I generally seek new and exciting experiences and sensations”). Items on the scale are scored from 1 to 4, with 1 = “I agree strongly,” 2 = “I agree somewhat,” 3 = “I disagree somewhat,” and 4 = “I disagree strongly.” Some items are reversed so that, across all items, a high score reveals impulsivity. This instrument has been validated in French [24]. The alpha reliabilities in the present sample were .88, .87, .86, and .80 for Urgency, (lack of) Premeditation, (lack of) Perseverance, and Sensation Seeking, respectively.

The French version of the SPSRQ consists of 35 items with a yes/ no response format divided into two subscales: Sensitivity to Punishment (18 items, e.g., “Comparing yourself to people you know, are you afraid of many things?”) and Sensitivity to Reward (17 items, e.g., “Do you often do things to be praised?”). This instrument has been validated in French with 360 volunteer women and men from the community aged from 17 to 30 years old [26]. The alpha reliabilities in the present sample were .87, and .84 for Sensitivity to Punishment and Sensitivity to Reward, respectively.

The Eating Disorder Examination Questionnaire (EDE-Q) consists of 28 items that evaluate four aspects of eating disorders: restraint (5 items, 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?)”), eating concerns (5 items, 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?)”), shape concerns (8 items, e.g., “How dissatisfied have you been with your shape”) and weight concerns (5 items, e.g., “How dissatisfied have you been with your weight?”). Items refer to the past 4 weeks (28 days) and are scored in terms of severity or frequency from 0 to 6, with higher

scores reflecting greater severity or frequency. In addition, the EDE-Q provides frequency data on key behavioral features of eating disorders (loss of control over eating) in terms of number of episodes or number of days on which the behavior has occurred. This instrument is a translation of the original validated English version [30]. The alpha reliabilities in the present sample were .75, .90, .94, and .78 for restraint, eating concerns, shape concerns, and weight concerns, respectively.

The Mizes Anorectic Cognitions Questionnaire (MAC-24) consists of 24 items that assess three types of cognitions relevant to eating disorders. It has three subscales measuring rigid weight regulation and fear of weight gain (8 items, e.g., “If I don’t have a specific routine for my daily eating, I’ll lose all control and I’ll gain weight”), excessive self-control of eating and weight as a basis of self-esteem (7 items, e.g., “I am proud of myself when I control my urge to eat”), and beliefs that body weight is an important factor in approval from others (9 items, e.g., “How much I weigh has little to do with how popular I am”). Some items are reversed so that, across all items, a high score reveals more dysfunctional cognitions. This instrument is a translation of the original validated English version and has been used with obese individuals in previous studies [28, 29]. The alpha reliabilities in the present sample were .79, .86, and .76 for rigid weight regulation and fear of weight gain, excessive self-control of eating and weight as a basis of self-esteem, and beliefs that body weight is an important factor in approval from others, respectively.

3.3. Data analysis

Statistical analyses were performed with the Statistica 7.0 program.

Descriptive statistics for BMI and age revealed that the normality assumption was not violated. The skewness (degree of symmetry) of the distributions ranged from 0.23 to 1.13 and the kurtosis (degree of peakedness/flatness) ranged from -1.59 to 1.31. Small skewness and kurtosis deviations from zero indicate little or no departure from normality.

Differences between obese, overweight and normal-weight participants on questionnaires, BMI and demographic data (age and years of education) were tested using *t*-tests. Spearman correlations were performed among obese and overweight participants to explore the association between BMI, duration of weight problems, eating disorder symptoms, eating-disorder-related dysfunctional cognitions and each of the four facets of impulsivity, with *p* set at .05. We pooled the data from overweight and obese participants for all statistical analyses, as there were only 6 persons in the overweight group.

4. Results

The mean age of the overweight/obese sample was 35.49 ± 9.75 years; they had a mean of 14.40 ± 2.57 years of education and a mean BMI of 35.07 ± 4.78 kg/m². The controls’ mean age was 34.83 ± 11.34 years, with a mean of 14.96 ± 2.06 years of education and a mean BMI of 20.91 ± 1.48 kg/m². *t*-Tests revealed no significant differences between patients and controls in terms of age (*p* > .05) or years of education (*p* > .05), but significant differences in BMI (*p* < .001).

The results suggest that overweight and obese persons have higher levels of Urgency, lack of

Perseverance, Sensitivity to Reward and Sensitivity to Punishment. Obese and overweight persons are also characterized by problematic eating behavior (loss of control over eating) and eating-disorder-related dysfunctional cognitions (all results with p set at .01).

In addition, the analyses suggest that, for overweight and obese persons, the levels of Urgency ($r_s = .32, p < .05$), Sensitivity to Reward ($r_s = .35, p < .05$) and Sensitivity to Punishment ($r_s = .37, p < .05$) correlated significantly with dysfunctional cognitions. Sensitivity to Punishment correlated significantly with problematic eating ($r_s = .33, p < .05$). There was also a significant correlation between lack of Premeditation and problematic eating ($r_s = -.32, p < .05$). However, when we excluded overweight persons from the analysis, this negative association was no longer significant, suggesting that it may be limited to overweight (as opposed to obese) persons. However, as the overweight group is small (6 persons), we could not investigate this association further in this study. Neither BMI nor duration of weight problems correlated significantly with the four facets of impulsivity.

5. Discussion and conclusion

5.1. Discussion

The aim of this study was to examine for the first time how obesity and eating disorder symptoms are related to the four facets of impulsivity in a clinical sample of overweight and obese women. The French versions of Whiteside and Lynam's Impulsive Behavior Scale, the Sensitivity to Punishment and Sensitivity to Reward Questionnaire, the Eating Disorder Examination Questionnaire and the Mizes Anorectic Cognitions Questionnaire were administered to 47 overweight or obese women with eating disorders and 47 normal-weight controls. The results suggest that overweight and obese persons have higher levels of Urgency, lack of Perseverance, Sensitivity to Reward, and Sensitivity to Punishment.

One finding of this study, as mentioned above, was that obese and overweight persons have high levels of Urgency, which has been found to be related to difficulties suppressing dominant or automatic responses, especially in conditions of intense emotions [6]. In other words, our results suggest that obese and overweight persons may have difficulties controlling their eating behavior, and especially when they are experiencing intense emotions. This inability to prevent oneself from overeating may have detrimental immediate (e.g., self-depreciation, depressed mood, abdominal pain) and long-term consequences (e.g., weight gain). This tendency to overeat can, in turn, lead to the development of maladaptive strategies to control weight (e.g., dieting, skipping meals). As such, it may help explain why certain overweight and obese individuals develop an eating disorder.

Our results also showed that obese and overweight persons have high levels of lack of Perseverance, which has been associated with difficulties inhibiting irrelevant thoughts or memories. It follows that obese and overweight individuals may have difficulties controlling their thoughts of food or thoughts concerning their shape and weight. This phenomenon may lead to overeating because thoughts of food increase the desire to eat [13]. Moreover, Engel et al. [15] showed that attentional avoidance of body and shape concerns - a dysfunctional cognitive strategy - increases such

concerns. Alternatively, eating may be used to escape from negative thoughts (e.g., general negative thoughts or self-depreciating thoughts following out-of-control eating). This phenomenon is probably reinforced by the temporary alleviation of the negative thoughts and emotions and it may well increase the likelihood of excessive food intake (see the Escape Theory of Binge Eating [31]). We also found that obese and overweight persons have high levels of Sensitivity to Reward. This tendency to exaggerate the impact of rewards (food, in this case) may lead to weight gain or impede weight loss.

Finally, the correlation analyses suggest that cognitive and motivational aspects of impulsivity, specifically Urgency and Sensitivity to Reward, are associated with eating-disorder psychopathology in overweight and obese persons. These results are in line with the results of other studies [12, 21] and indicate that Urgency may be reflected in difficulty controlling binge eating. The associations between Sensitivity to Reward and eating-disorder psychopathology suggest that it is difficult to control binge eating, particularly in overweight and obese persons who have enhanced sensitivity to food.

5.2. Conclusion

These results suggest that obese and overweight persons find it difficult to inhibit automatic or dominant behaviors and intrusive thoughts. They also have a tendency to exaggerate the impact of rewards and punishments. The study confirmed and extended previous results regarding the relationship between impulsivity and dysfunctional eating. To the best of our knowledge, this is the first study to investigate the four facets of impulsivity in obesity. Although the findings of this study provide important information concerning the relationship between impulsivity and dysfunctional eating, several limitations should be noted. First, the design of this study is cross-sectional, which means that causal links cannot be established between impulsivity, obesity and eating disorders. Second, the results are only preliminary and the sample size will be doubled to increase the statistical power of the study. Finally, the results rely on self-reported data, which are potentially subject to social desirability bias.

Future longitudinal studies should examine the relationship between impulsivity, obesity and dysfunctional eating. This kind of extension would allow stronger inferences to be made about causality. Studies are also required to explore the cognitive processes underlying the four facets of impulsivity by using cognitive tasks specifically designed for this purpose (see [6] for suggestions) and thereby circumvent self-report biases. Finally, these results have several important clinical implications.

5.3. Practice implications

To maximize treatment efficacy, the psychological assessment of obese persons should explore the different facets of impulsivity, for example by using the UPPS Impulsive Behavior Scale [5, 24]. Based on this evaluation, psychological interventions should target the self-control problems that characterize impulsive behaviors. Two types of interventions should be offered: first, obese and overweight patients may benefit from treatment that focuses directly on remediation of inhibition, attention and mental flexibility and improves processing resources. They may also benefit from interventions that circumvent limited cognitive resources and work on automatic processes.

To the extent that obese persons have deficits affecting inhibition and mental flexibility, they may benefit from mindfulness techniques that target inhibition (of dominant or automatic behaviors and of intrusive thoughts) and mental flexibility processes. The primary goal of mindfulness-based therapy is to develop attentional control by the daily practice of mindful meditation [32]. The practice teaches individuals to observe their thoughts, emotions, and bodily sensations without judgment. Individuals are also guided in voluntarily shifting attention sequentially to the movements of breathing, sensations in the body, sounds in the environment, and thoughts and emotions that may arise. As such, mindfulness encourages a more adaptive relationship with the thoughts and negative emotions that previously triggered problematic eating; it also encourages patients to observe their feelings of hunger and satiety. Early results on the efficacy of mindfulness for problematic eating are promising and suggest that this kind of training improves self-control of eating, with binges decreasing in frequency and severity. They also suggest that participants became more aware of their physiological signals of hunger and satiety [33].

Since intrusive thoughts and visual images of food (visualizing a specific food item) and olfactory images of food (smelling a specific food item) play a key role in triggering overeating, obese persons may benefit from imagery techniques that aim to strengthen their thought-control abilities, as proposed by Kemps and Tiggemann [34]. The imagery technique uses visual and olfactory imagery tasks in which persons are trained to form images that interfere with images of food. To this end, they are asked to read visual and olfactory cues silently. These cues are unrelated to food and are printed on a sheet of paper, for example “Imagine the appearance of a rainbow” or “Imagine the smell of freshly mown grass.” Then, the patients are instructed to maintain the imagined scene or smell by focusing exclusively on the picture or on the smell that each one brought to mind. Kemps and Tiggemann found that this procedure reduced food desire. They suggest that this is because the visual and olfactory images interfere with food-related images.

Given that binge eating often occurs when cognitive resources are depleted (e.g., when the person is tired or under stress), obese persons may benefit from implementation intention techniques that rely on automatic components of self-regulation [35-37]. Implementation intentions are if-then plans that link situational cues with responses that are effective in attaining goals or desired outcomes. They are formed to enhance the translation of goal intentions into action. The idea is that planning in advance when, where and how a person will complete a self-assigned goal (“If situation x is encountered, I will perform behavior y!”) leads to effective and automatic goal initiation and pursuit. Indeed, implementation intentions create a mental link between a specified critical situation and an intended goal-directed behavior. Consequently, the mental representation of the anticipated critical situation is activated and therefore becomes highly accessible. Implementation intentions save people’s self-regulatory resources and allow them to simultaneously perform other activities [35-37]. This technique has been found to facilitate the attainment of goals to eat healthier foods (less fat and more fruits) and to engage in physical exercise [38, 39]. Sufficient cognitive control may help obese individuals to control their impulsive eating habits, and their high sensitivity to reward as well. Finally, inasmuch as food deprivation increases the reinforcing value of food, interventions should also warn people against restrictive diets [40].

In light of our results, we believe that targeted and individualized psychological interventions in accordance with the cognitive and motivational facets of impulsivity could provide considerable support in improving eating behaviors and long-term weight loss.

References

- [1] Gelay A, Volery M, Rieker A, Fossati M, Nguyen Howles M. *Approche cognitivo-comportementale [Cognitive-behavioral approach]*. In: Basdevant A, GuyGrand B, editors. *Médecine de l'obésité [Obesity medicine]*. Paris: Medecine- Sciences Flammarion; 2004. p. 246-52.
- [2] Bonato DP, Boland FJ. *Delay of gratification in obese children*. *Addict Behav* 1983;8:71-4.
- [3] Nederkoorn C, Braet C, Van Eijs Y, Tanghe A, Jansen A. *Why obese children cannot resist food: the role of impulsivity*. *Eat Behav* 2006;7:315-22.
- [4] Stice E. *Risk and maintenance factors for eating pathology: a meta-analytic review*. *Psychol Bull* 2002;128:825-48.
- [5] Whiteside SP, Lynam DR. *The five factor model and impulsivity: using a structural model of personality to understand impulsivity*. *Pers Individ Differ* 2001;30:669-89.
- [6] Bechara A, Van der Linden M. *Decision-making and impulse control after frontal lobe injuries*. *Curr Opin Neurol* 2005;18:734-9.
- [7] Van der Linden M, Rochat L, Billieux J. *Troubles du comportement socio-émotionnel et impulsivité: une approche cognitive et neuropsychologique [Socio-emotional behavior problems and impulsivity: a cognitive and neuropsychological approach]*. In: Azouvy P, Mazaux JM, Pradat-Diehl P, editors. *Comportement et lésions cérébrales [Behavior and brain lesions]*. Paris: Frison-Roche; 2006. p. 53-8.
- [8] Bechara A, Dolan S, Hindes A. *Decision-making and addiction (part II): myopia for the future or hypersensitivity to reward?* *Neuropsychologia* 2002;40: 1690-705.
- [9] Avila C. *Distinguishing BIS-mediated and BAS-mediated disinhibition mechanisms: a comparison of disinhibition models of Gray (1981, 1987) and of Patterson and Newman (1993)*. *J Pers Soc Psychol* 2001;80:311-24.
- [10] Elfhag K, Morey LC. *Personality traits and eating behavior in the obese: poor self-control in emotional and external eating but personality assets in restrained eating*. *Eat Behav* 2008;9:285-93.
- [11] Nederkoorn C, Smulders FTY, Havermans RC, Roefs A, Jansen A. *Impulsivity in obese women*. *Appetite* 2006;47:253-6.
- [12] Guerrieri R, Nederkoorn C, Stankiewicz K, Alberts H, Geschwind N, Martijn C, et al. *The influence of trait and induced state impulsivity on food intake in normal-weight healthy women*. *Appetite* 2007;49:66-73.
- [13] Soetens B, Braet C, Moens E. *Thought suppression in obese and non-obese restrained eaters: piece of cake or forbidden fruit?* *Eur Eat Disord Rev* 2008;16:67-76.
- [14] Johnston L, Bulik CM, Anstiss V. *Suppressing thoughts about chocolate*. *Int J Eat Disord* 1999;26:21-7.
- [15] Engel SG, Robinson MD, Wonderlich SJ, Meier BP, Wonderlich SA, Crosby RD, et al. *Does the avoidance of body and shape concerns reinforce eating disordered attitudes? Evidence from a manipulation study*. *Eat*

Behav 2006;7:368-74.

[16] Davis C, Levitan RD, Muglia P, Bewell C, Kennedy JL. Decision-making deficits and overeating: a risk model for obesity. *Obes Res* 2004;12:929-35.

[17] Davis C, Strachan S, Berkson M. Sensitivity to reward: implications for overeating and overweight. *Appetite* 2004;42:131-8.

[18] Rissanen A, Hakala P, Lissner L, Mattlar CE, Koskenvuo M, Ronnema T. Acquired preference especially for dietary fat and obesity: study of weightdiscordant monozygotic twin pairs. *Int J Obes Relat Metab Disord* 2002;26:973-7.

[19] Davis C, Patte K, Levitan R, Reid C, Tweed S, Curtis C. From motivation to behaviour: a model of reward sensitivity, overeating, and food preferences in the risk profile for obesity. *Appetite* 2007;48:12-9.

[20] Guerrieri R, Nederkoorn C, Jansen A. The interaction between impulsivity and a varied food environment: its influence on food intake and overweight. *Int J Obes* 2008;32:708-14.

[21] Schienle A, Schafer A, Hermann A, Vaitl D. Binge-eating disorder: reward sensitivity and brain activation to images of food. *Biol Psychiatry* 2009;65:654-61.

[22] Craighead LW, Allen HN. Appetite awareness training: a cognitive behavioral intervention for binge eating. *Cogn Behav Pract* 1995;2:249-70.

[23] Robinson MD, Pearce EA, Engel SG, Wonderlich SA. Cognitive control moderates relations between impulsivity and bulimic symptoms. *Cogn Ther Res* 2009;33:356-67.

[24] Van der Linden M, d'Acremont M, Zermatten A, Jermann F, Laroï F, Willems S, et al. A French adaptation of the UPPS impulsive behavior scale: confirmatory factor analysis in a sample of undergraduate students. *Eur J Psychol Assess* 2006;22:38-42.

[25] Torrubia R, Avila C, Molto J, Caseras X. The sensitivity to punishment and sensitivity to reward questionnaire (SPSRQ) as a measure of Gray's anxiety and impulsivity dimensions. *Pers Individ Differ* 2001;31:837-62.

[26] Lardi C, Billieux J, d'Acremont M, Van der Linden M. A French adaptation of a short version of the sensitivity to punishment and sensitivity to reward questionnaire (SPSRQ). *Pers Individ Differ* 2008;45:722-5.

[27] Fairburn CG, Beglin SJ. Assessment of eating disorders: interview or self-report questionnaire? *Int J Eat Disord* 1994;16:363-70.

[28] Mizes JS, Christiano B, Madison J, Post G, Seime R, Varnado P. Development of the Mizes anorectic cognitions questionnaire - revised: psychometric properties and factor structure in a large sample of eating disorder patients. *Int J Eat Disord* 2000;28:415-21.

[29] Volery M, Carrard I, Rouget P, Archinard M, Golay M. Cognitive distortions in obese patients with or without eating disorders. *Eat Weight Disord* 2006;11:123-6.

[30] Mond JM, Hay PJ, Rodgers B, Owen C, Beumont PJV. Validity of the eating disorder examination questionnaire (EDE-Q) in screening for eating disorders in community samples. *Behav Res Ther* 2004;42:551-67.

[31] Heatherton TF, Baumeister RF. Binge eating as escape from self-awareness. *Psychol Bull* 1991;110:86-108.

- [32] Kristeller JL, Baer RA, Quillian-Wolever R. Mindfulness-based approaches to eating disorders. In: Baer RA, editor. *Mindfulness-based treatment approaches: clinician's guide to evidence base and application*. San Diego, CA: Elsevier; 2006. p. 75-91.
- [33] Kristeller JL, Hallett B. Effects of a meditation-based intervention in the treatment of binge eating. *J Health Psychol* 1999;4:357-63.
- [34] Kemps E, Tiggemann M. Modality-specific imagery reduces cravings for food: an application of the elaborated intrusion theory of desire to food craving. *J Exp Psychol Appl* 2007;13:95-104.
- [35] Achtziger A, Gollwitzer PM, Sheeran P. Implementation intentions and shielding goal striving from unwanted thoughts and feelings. *Pers Soc Psychol Bull* 2008;34:381-93.
- [36] Gollwitzer PM, Sheeran P. Implementation intentions and goal achievement: a meta-analysis of effects and processes. *Adv Exp Soc Psychol* 2006;38:69-119.
- [37] Schweiger Gallo I, Gollwitzer PM. Implementation intentions: control of fear despite cognitive load. *Psicotherma* 2007;19:280-5.
- [38] Armitage CJ. Evidence that implementation intentions reduce dietary fat intake: a randomized trial. *Health Psychol* 2004;23:319-23.
- [39] Verplanken B, Faes S. Good intentions, bad habits, and effects of forming implementation intentions on healthy eating. *Eur J Soc Psychol* 1999;29: 591-604.
- [40] Raynor HA, Epstein LH. The relative-reinforcing value of food under differing levels of food deprivation and restriction. *Appetite* 2003;40:15-24

--

This research was supported by the Swiss National Science Foundation (SNSF) (grant number 100014-122398/1) and INTACT (Individually Tailored Stepped Care for Women with Eating Disorders) Research Training Network funded by the European Commission (2007-2011) in the Marie Curie Program (MRTN-CT-2006-035988). Both provided financial support for the conduct of the research and preparation of the article.

Acknowledgement to

Zofia Laubitz who provided language help for the preparation of the article Serge Broennimann who provided technical help for the preparation of the figures