AKADÉMIAI KIADÓ

Journal of Behavioral Addictions

10 (2021) 3, 534–539

Special Section on Overweight, obesity and eating disorders in relation to addiction

DOI:
10.1556/2006.2021.00027

BRIEF REPORT

Distress-driven impulsivity interacts with cognitive inflexibility to determine addiction-like eating

CHANG LIU[1]*, KRISTIAN ROTARU[1,2], RICO S. C. LEE[1], JEGGAN TIEGO[3], CHAO SUO[1], MURAT YÜCEL[1] and LUCY ALBERTELLA[1]

[1] BrainPark, Turner Institute for Brain and Mental Health and School of Psychological Sciences, Monash University, Australia

[2] Monash Business School, Monash University, Australia

[3] Neural Systems & Behaviour Lab, Turner Institute for Brain and Mental Health and School of Psychological Sciences, Monash University, Australia

Received: November 13, 2020 • Revised manuscript received: February 17, 2021 • Accepted: April 5, 2021
Published online: April 27, 2021

ABSTRACT

Background: Researchers are only just beginning to understand the neurocognitive drivers of addiction-like eating behaviours, a highly distressing and relatively common condition. Two constructs have been consistently linked to addiction-like eating: distress-driven impulsivity and cognitive inflexibility. Despite a large body of addiction research showing that impulsivity-related traits can interact with other risk markers to result in an especially heightened risk for addictive behaviours, no study to date has examined how distress-driven impulsivity interacts with cognitive inflexibility in relation to addiction-like eating behaviours. The current study examines the interactive contribution of distress-driven impulsivity and cognitive inflexibility to addiction-like eating behaviours. *Method:* One hundred and thirty-one participants [mean age 21 years (SD = 2.3), 61.8% female] completed the modified Yale Food Addiction Scale, the S-UPPS-P impulsivity scale, and a cognitive flexibility task. A bootstrap method was used to examine the associations between distress-driven impulsivity, cognitive inflexibility, and their interaction with addiction-like eating behaviours. *Results:* There was a significant interaction effect between distress-driven impulsivity and cognitive flexibility ($P = 0.03$). The follow-up test revealed that higher distress-driven impulsivity was associated with more addiction-like eating behaviours among participants classified as cognitively inflexible only. *Conclusion:* The current findings shed light on the mechanisms underlying addiction-like eating behaviours, including how traits and cognition might interact to drive them. The findings also suggest that interventions that directly address distress-driven impulsivity and cognitive inflexibility might be effective in reducing risk for addiction-like eating and related disorders.

KEYWORDS

cognitive inflexibility, distress-driven impulsivity, addiction-like eating

Addiction-like eating (AE) refers to a pattern of problematic eating behaviours characterised by intense cravings, loss of control over eating, and repetitively engaging in the consumption of excessive amounts of food despite aversive consequences (Meule & Gearhardt, 2014). Research suggests a prevalence between 5 and 15%, depending on the population being studied (Meule, 2011; Meule & Gearhardt, 2014; Tang et al., 2021). Importantly, people with AE report elevated psychological distress and reduced quality of life (Burmeister, Hinman, Koball, Hoffmann, & Carels, 2013; Burrows, Kay-Lambkin, Pursey, Skinner, & Dayas, 2018; Tang et al., 2021). However, likely due to a lack of knowledge about what drives these behaviours, there is a lack of targeted interventions for AE. Given the high prevalence and significant negative consequences associated with AE, it is critical to understand the

*Corresponding author.
E-mail: chang.liu5@monash.edu

AKJournals

underlying mechanism that drives risk for these behaviours in order to inform the development of effective interventions.

Past studies suggest that certain aspects of trait impulsivity are related to AE (Murphy, Stojek, & MacKillop, 2014; VanderBroek-Stice, Stojek, Beach, vanDellen, & MacKillop, 2017). Impulsivity is a multifaceted trait, including traits such as a tendency toward impulsive action (acting without forethought), making risky decisions, and most pertinent to the present study, a tendency to act rashly under negative emotions, i.e. distress-driven impulsivity [also known as negative urgency (Cyders & Smith, 2008)]. Among these domains, distress-driven impulsivity is most consistently reported as a key driver for problematic eating behaviours (Fischer, Smith, & Cyders, 2008; Murphy et al., 2014; Pivarunas & Conner, 2015). Non-impulsivity related traits have also been shown to play a key role in AE. For instance, compulsivity-related constructs, such as cognitive inflexibility [i.e. the inability to adjust one's behaviours according to changes in the environment (Morris & Mansell, 2018)], have been shown to be related to addiction-like eating patterns, including compulsive eating, binge eating disorder, and bulimia nervosa (Kakoschke, Aarts, & Verdejo-Garcia, 2018; Wu et al., 2014).

The notion that eating behaviours can have addiction-like features is in line with current views of transdiagnostic drivers of psychopathology (e.g. RDoC; Cuthbert & Insel, 2013), and suggests that AE may be driven by similar neurocognitive mechanisms as other, more well-established addictions. Indeed, emerging evidence suggests both compulsivity- (Albertella, Watson, Yucel, & Le Pelley, 2019; Leppink, Redden, Chamberlain, & Grant, 2016) and impulsivity-related constructs (Torres et al., 2013; Verdejo-Garcia, Lawrence, & Clark, 2008) are key drivers of addiction. Further, research in the field of addiction and compulsivity suggests that impulsivity-related constructs interact with compulsivity-related constructs to influence risk across impulsive-compulsive behaviours (Albertella et al., 2020; Chamberlain & Grant, 2018; Prochazkova et al., 2018). That is, the interaction itself appears to be a critical factor for problematic behaviours across diagnostic and behavioural boundaries. However, no research to date has examined whether impulsivity-related constructs and compulsivity-related constructs may interact to influence AE. To give an example of how such an interaction may drive AEs, people high in distress-driven impulsivity may be more likely to engage in impulsive eating under distress. As a result of this propensity to engage in impulsive eating while feeling distressed, these individuals would have more opportunities to learn that binge eating can reduce stress (Pivarunas & Conner, 2015), reinforcing its use [through negative reinforcement (Baker, Piper, McCarthy, Majeskie, & Fiore, 2004; Pearson, Wonderlich, & Smith, 2015; Reaves et al., 2019)] as a coping strategy. Over time, such a coping strategy may become maladaptive, at which point, individuals who are flexible may be able to adjust their behaviours and find an alternative coping strategy. However, individuals with low cognitive flexibility may struggle to adapt and thus continue to use the maladaptive strategy.

In summary, distress-driven impulsivity and cognitive flexibility are ideally positioned to interact in association with AEs and such knowledge could help in understanding how personality and cognition may interact to influence risk across addictive behaviours. Thus, the current study aims to 1) explore how distress-driven impulsivity, cognitive inflexibility, and their interaction are associated with severity of AE; 2) examine cognitive flexibility's role as a moderator between distress-driven impulsivity and AE.

METHODS

Participants

Participants were recruited through a student research participation pool at Monash Business School. As an incentive, students received bonus credit in their course for participating in the online study. Only adult participants who provided informed consent were included in the study. Seventy-three participants had missing data for the cognitive tasks. Twenty-eight participants who scored lower than 50% (i.e. performing below chance level) for the training phase (before the reversal phase) of the cognitive flexibility task (i.e. see: as has been done in previous studies using this task (Albertella et al., 2020; Albertella, Watson, et al., 2019); were excluded for data analysis. The final sample included 131 participants.

Procedure

Participants completed the 2-h online study in two parts. Part 1 included a survey via Qualtrics (Qualtrics, Provo, UT). Part 2 included cognitive tests via Inquisit 6 [Computer software] (2020). Demographic information was collected at the start of the survey (Part 1).

Measures

Modified Yale Food Addiction Questionnaire 2.0 (mYFAS 2.0). The mYFAS 2.0 (Schulte & Gearhardt, 2017) is a 13-item questionnaire assessing addiction-like eating behaviours. The measure of interest was the total score. The scale has shown good reliability in past studies [e.g. (Imperatori et al., 2019); Cronbach's $\alpha = 0.88$]. In the current study, the scale demonstrated excellent reliability (Cronbach's $\alpha = 0.91$).

Short version of the Urgency, Premeditation (lack of), Perseverance (lack of), Sensation Seeking and Positive Urgency (S-UPPS-P) Impulsivity Behaviour Scale. The S-UPPS-P Impulsivity Behaviour Scale (Cyders, Littlefield, Coffey, & Karyadi, 2014) is a 20-item scale assessing impulsivity. It includes five subscales: Negative Urgency, Positive Urgency, Lack of Perseverance, Lack of Premeditation and Sensation Seeking. Negative urgency subscale score was our measure of distress-driven impulsivity and was set as the independent variable for data analysis. The scale has shown acceptable reliability in past studies [e.g. (Dalley et al., 2020); Cronbach's

α = 0.77]. In the current study, the scale demonstrated acceptable reliability (Cronbach's α = 0.75).

The Depression Anxiety, Stress Scale (DASS-21). Participants completed DASS-21, which contains 21 items assessing depression, anxiety, and stress/tension symptoms (Lovibond & Lovibond, 1995). The measure of interest was the total score, reflecting general psychological distress. The scale has shown good reliability in past studies [e.g. (Henry & Crawford, 2005); Cronbach's α = 0.88)]. In the current study, the scale demonstrated excellent reliability (Cronbach's α = 0.93).

Modified Value-Modulated Attentional Capture Task and Reversal (mVAMC-R). The Modified Value-Modulated Attentional Capture Task and Reversal (mVMAC-R; Albertella et al., 2020); is a reward-only variant of the original VMAC visual search task (Le Pelley, Pearson, Griffiths, & Beesley, 2015), with an additional reversal phase to assess flexibility of attentional capture. This task has been described in detail in Albertella et al., 2020. Briefly, in this task, on every trial, participants have to respond to a line inside a diamond target according to whether it is horizontal or vertical, and they have to do this as quickly as possible. On most trials, one of the circles is coloured either orange or blue (counter-balanced) and is referred to as the distractor. The colour of the distractor signals the magnitude of reward that is available on that trial. During the reversal phase, participants completed the reversal phase with reversed colour-reward contingencies.

The training phase of the task included five blocks and the reversal phase included three blocks. All blocks contained 24 trials in each (10 high-reward; 10 low-reward; and 4 distractor absent). A VMAC reversal score was calculated by subtracting RT on trials with a previously low-reward distractor from RT on trials with a previously high-reward distractor. Higher VMAC reversal score indicates greater persistence of previously learnt colour-reward relationship, reflecting difficulties in adjusting attentional responses to changes in task contingencies (i.e. cognitive inflexibility). Previous research using the same paradigm (Albertella et al., 2020; Albertella, Watson, et al., 2019) has shown this measure of inflexibility to be sensitive to addiction-related cognitive risk.

Statistical analysis

To examine the interaction effect of distress-driven impulsivity and cognitive inflexibility on AE and the moderating role of cognitive flexibility in the relationship between distress-driven impulsivity and AE, we conducted a bootstrapped moderation analysis with 5,000 bootstrap sampling iterations of the data using PROCESS (Hayes, 2017) for SPSS v.26. All continuous variables were mean-centred. Negative urgency subscale score was set as the independent variable, mVMAC reversal score was set as the moderator and mYFAS score was set as the dependent variable. Age, gender, mVMAC training score, Positive Urgency, Lack of Perseverance, Lack of Premeditation, Sensation Seeking and DASS-21 were set as covariates due to past research showing they are related to distress-driven impulsivity or inflexibility as well as addiction-like eating or compulsive behaviours (Albertella, Le Pelley et al., 2019) and thereby have confounding potential.

Table 1. Moderation analysis

Variables	*b*	*s.e.*	*t*	*P*
NU	1.04	0.59	1.80	0.08
mVMAC-R	0.02	0.02	1.09	0.28
NU*mVMAC-R	0.02	0.01	2.14	0.03
VMAC	0.01	0.01	−0.56	0.57
DASS-21	0.20	0.11	1.78	0.08
LoPRE	0.40	0.60	0.66	0.51
LoP	1.21	0.64	1.89	0.06
PU	−0.20	0.58	−0.34	0.73
SS	0.10	0.42	0.23	0.82
Age	−0.72	0.42	−1.74	0.08
Gender	−0.42	2.14	−0.20	0.84

N = 131; bootstrap sample size = 5,000.
Note: NU = S-UPPS-P Negative Urgency; LoPRE = S-UPPS-P lack of Premeditation; LoP = S-UPPS-P lack of Perseverance; PU = S-UPPS-P Positive Urgency; SS = UPPS-P Sensation Seeking; mVMAC-R = value modulated attentional capture-reversal score; DASS-21 = The Depression Anxiety, Stress Scale score.

Ethics

All participants consented to the study and all study procedures were approved by the Human Research Ethics Committee at Monash University, Australia.

RESULTS

Participants were 131 students (81 females; age M = 21.15, SD = 2.34, range 18–36). The results of the moderation analysis are presented in Table 1. There was a significant interaction effect between distress-driven impulsivity and cognitive inflexibility on mYFAS scores (β = 0.018, SE = 0.01, 95% CI = [0.001, 0.034], P = 0.034), indicating that the relationship between distress-driven impulsivity and AE was moderated by cognitive flexibility.

According to the conditional effect analysis, the effect of distress-driven impulsivity on mYFAS score was significant in the inflexible group only (β = 2.19, SE = 0.78, 95% CI = [0.644, 3.741], P = 0.006). Figure 1 presents the relationship between AE behaviours and distress-driven impulsivity at two levels of cognitive flexibility (i.e. flexible: 1 SD below the mean and inflexible: 1 SD above the mean). In summary, greater distress-driven impulsivity was associated with greater mYFAS scores among participants classified as cognitively inflexible only.

DISCUSSION

The current study examined the interactive contribution of distress-driven impulsivity and cognitive flexibility on AE.

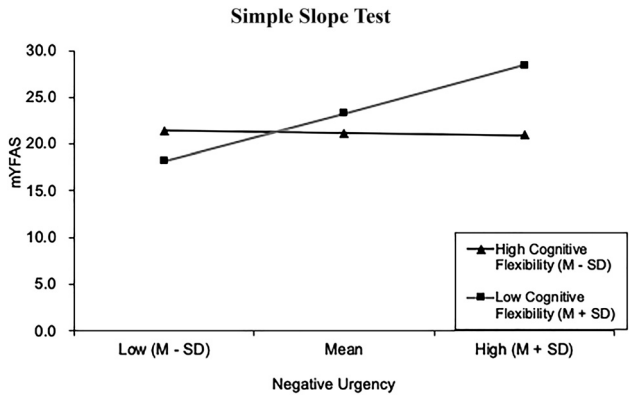

Fig. 1. The moderating role of cognitive flexibility in the association between negative urgency subscale score and mYFAS score. The moderating effect is graphed for two levels of cognitive flexibility: (1) low cognitive flexibility/inflexible group (1 SD above the mean) and (2) high cognitive flexibility/flexible group (1 SD below the mean)

We found that distress-driven impulsivity interacted significantly with cognitive inflexibility in association with AE. Follow-up analyses showed that this interaction was driven by distress-driven impulsivity being positively related to AE among participants classified as cognitively inflexible only, i.e. no such association was found among participants classified as cognitively flexible.

Distress-driven impulsivity serves as a risk factor for a wide range of addiction-related behaviours, including AE, disordered gambling, alcohol misuse and internet addiction (Billieux, Gay, Rochat, & Van der Linden, 2010; Dir, Karyadi, & Cyders, 2013; Pivarunas & Conner, 2015). This relationship may be explained by distress-driven impulsivity reflecting impaired response inhibition (Cyders & Coskunpinar, 2011), which may increase vulnerability to the disrupting effects of strong emotions on top-down control (Kalanthroff, Henik, Derakshan, & Usher, 2016). Consequently, impaired cognitive control in the context of negative emotions could decrease one's ability to resist urges towards immediately gratifying behaviours (Zorrilla & Koob, 2019), such as overeating. Importantly, overconsumption of highly palatable food may be instantly gratifying and provide temporary relief for negative mood (Macht & Mueller, 2007). Because individuals with high distress-driven impulsivity are more likely to engage in these behaviours when distressed, such (initially) impulsive tendencies may be more likely to become learnt coping strategies through negative reinforcement (Baker et al., 2004; Pearson et al., 2015; Reaves et al., 2019).

Further, we found that the association between distress-driven impulsivity and AE was moderated by cognitive flexibility. Specifically, we found that inflexible participants with elevated distress-driven impulsivity traits exhibited more AE behaviours. Past research suggests that cognitive inflexibility is related to maladaptive emotion regulation strategies (Gabrys, Tabri, Anisman, & Matheson, 2018; Morris & Mansell, 2018), which in turn have been linked to addiction and compulsion related behaviours (Morris & Mansell, 2018). In view of the current findings, people with high distress-driven impulsivity levels may use AE in response to negative emotions and the persistence of using this maladaptive coping strategy is exacerbated by cognitive inflexibility. Specifically, the lack of flexibility may restrict people's ability to adopt alternative coping strategies, leading to the persistence of engaging in AE when distressed, despite adverse consequences.

The interaction effect of distress-driven impulsivity and cognitive inflexibility may contribute to the low efficacy and high relapse rates associated with ED treatments. Specifically, the gold standard psychological treatment for EDs – Enhanced Cognitive Behaviour Therapy – merely addresses the deficit in neurocognitive functioning (Juarascio, Manasse, Espel, Kerrigan & Forman, 2015). Without adequately addressing the underlying factors, it may be hard for inflexible individuals with high distress-driven impulsivity to acquire the adaptive emotional skills/thinking styles offered by treatment due to impaired cognitive functions. Recent research suggests that cognitive control training may be effective in reducing emotion-driven impulsivity (Peckham & Johnson, 2018). In terms of cognitive flexibility, despite it being consistently highlighted as a potential target for treatments of problematic eating (Wu et al., 2014), there is a lack of research examining its potential. The current study highlights the need for future research to examine the potential of cognitive flexibility and cognitive control training in reducing AE behaviours, or even addictive behaviours in general.

The current study used a student sample, and thus the results may not be generalisable to non-student populations. However, it is important to note that students have higher rates of AE and EDs than the general population, and were targeted for this reason.

Our current findings are important to researchers as well as mental health services providers by revealing the interplay of distress-driven impulsivity and cognitive inflexibility in relation to AE behaviours. Based on our findings, cognitive training that directly addresses distress-driven impulsivity and cognitive inflexibility seems to be a promising intervention for the subclinical population with AE behaviours.

Funding sources: Murat Yücel has received funding from Monash University, the National Health and Medical Research Council (NHMRC; including Fellowship #APP1117188), the Australian Research Council (ARC), Australian Defence Science and Technology (DST), and the Department of Industry, Innovation and Science (DIIS). He has also received philanthropic donations from the David Winston Turner Endowment Fund, Wilson Foundation, as well as payment from law firms in relation to court and/or expert witness reports. He has also received funding from the law firms in relation to expert witness report/statement.

Authors' contribution: C.L., L.A., and K.R. developed study idea and design. C.L wrote the original draft of this

manuscript. All authors contributed to revising subsequent versions of the paper.

Conflict of interests: The authors have no conflicts of interest to declare.

REFERENCES

Albertella, L., Le Pelley, M. E., Chamberlain, S. R., Westbrook, F., Fontenelle, L. F., Segrave, R., et al. (2019). Reward-related attentional capture is associated with severity of addictive and obsessive-compulsive behaviors. *Psychology of Addictive Behaviors*, *33*(5), 495–502. https://doi.org/10.1037/adb0000484.

Albertella, L., Le Pelley, M. E., Chamberlain, S. R., Westbrook, F., Lee, R. S. C., Fontenelle, L. F., et al. (2020). Reward-related attentional capture and cognitive inflexibility interact to determine greater severity of compulsivity-related problems. *Journal of Behavior Therapy and Experimental Psychiatry*, *69*, 101580. https://doi.org/10.1016/j.jbtep.2020.101580.

Albertella, L., Watson, P., Yucel, M., & Le Pelley, M. E. (2019). Persistence of value-modulated attentional capture is associated with risky alcohol use. *Addictive Behaviors Reports*, *10*, 100195. https://doi.org/10.1016/j.abrep.2019.100195.

Baker, T. B., Piper, M. E., McCarthy, D. E., Majeskie, M. R., & Fiore, M. C. (2004). Addiction motivation reformulated: An affective processing model of negative reinforcement. *Psychological Review*, *111*(1), 33–51. https://doi.org/10.1037/0033-295X.111.1.33.

Billieux, J., Gay, P., Rochat, L., & Van der Linden, M. (2010). The role of urgency and its underlying psychological mechanisms in problematic behaviours. *Behaviour Research and Therapy*, *48*(11), 1085–1096. https://doi.org/10.1016/j.brat.2010.07.008.

Burmeister, J. M., Hinman, N., Koball, A., Hoffmann, D. A., & Carels, R. A. (2013). Food addiction in adults seeking weight loss treatment. Implications for psychosocial health and weight loss. *Appetite*, *60*, 103–110. https://doi.org/10.1016/j.appet.2012.09.013.

Burrows, T., Kay-Lambkin, F., Pursey, K., Skinner, J., & Dayas, C. (2018). Food addiction and associations with mental health symptoms: A systematic review with meta-analysis. *Journal of Human Nutrition and Dietetics*, *31*(4), 544–572. https://doi.org/10.1111/jhn.12532.

Chamberlain, S. R., & Grant, J. E. (2018). Initial validation of a transdiagnostic compulsivity questionnaire: The Cambridge–Chicago compulsivity trait scale. *CNS Spectrums*, *23*(5), 340–346. https://doi.org/10.1017/S1092852918000810.

Cuthbert, B. N., & Insel, T. R. (2013). Toward the future of psychiatric diagnosis: The seven pillars of RDoC. *BMC Medicine*, *11*(1), 1–8. doi:https://doi.org/10.1186/1741-7015-11-126.

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*(6), 965–982. https://doi.org/10.1016/j.cpr.2011.06.001.

Cyders, M. A., Littlefield, A. K., Coffey, S., & Karyadi, K. A. (2014). Examination of a short English version of the UPPS-P impulsive behavior scale. *Addictive Behaviors*, *39*(9), 1372–1376. https://doi.org/10.1016/j.addbeh.2014.02.013.

Cyders, M. A., & Smith, G. T. (2008). Emotion-based dispositions to rash action: Positive and negative urgency. *Psychological Bulletin*, *134*(6), 807–828. https://doi.org/10.1037/a0013341.

Dalley, S. E., Bron, G. G., Hagl, I. F. A., Heseding, F., Hoppe, S., & Wit, L. (2020). Bulimic symptoms in a sample of college women: Disentangling the roles of body size, body shame and negative urgency. *Eating and Weight Disorders: EWD*, *25*(5), 1357–1364. https://doi.org/10.1007/s40519-019-00771-z.

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*(5), 2158–2162. https://doi.org/10.1016/j.addbeh.2013.01.025.

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*(8), 1413–1425. https://doi.org/10.1016/j.cpr.2008.09.001.

Gabrys, R. L., Tabri, N., Anisman, H., & Matheson, K. (2018). Cognitive control and flexibility in the context of stress and depressive symptoms: The cognitive control and flexibility questionnaire. *Frontiers in Psychology*, *9*(2219), 2219. https://doi.org/10.3389/fpsyg.2018.02219.

Hayes, A. F. (2017). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. Guilford Publications.

Henry, J. D., & Crawford, J. R. (2005). The short-form version of the depression anxiety stress scales (DASS-21): Construct validity and normative data in a large non-clinical sample. *British Journal of Clinical Psychology*, *44*(Pt 2), 227–239. https://doi.org/10.1348/014466505X29657.

Imperatori, C., Fabbricatore, M., Lester, D., Manzoni, G. M., Castelnuovo, G., Raimondi, G., et al. (2019). Psychometric properties of the modified Yale food addiction scale version 2.0 in an Italian non-clinical sample. *Eating and Weight Disorders: EWD*, *24*(1), 37–45. https://doi.org/10.1007/s40519-018-0607-x.

Juarascio, A., Manasse, S., Espel, H., Kerrigan, S., & Forman, E. (2015). Could training executive function improve treatment outcomes for eating disorders? *Appetite*, *90*, 187–193. https://doi.org/10.1016/j.appet.2015.03.013.

Kakoschke, N., Aarts, E., & Verdejo-Garcia, A. (2018). The cognitive drivers of compulsive eating behavior. *Frontiers in Behavioral Neuroscience*, *12*, 338. https://doi.org/10.3389/fnbeh.2018.00338.

Kalanthroff, E., Henik, A., Derakshan, N., & Usher, M. (2016). Anxiety, emotional distraction, and attentional control in the Stroop task. *Emotion*, *16*(3), 293–300. https://doi.org/10.1037/emo0000129.

Le Pelley, M. E., Pearson, D., Griffiths, O., & Beesley, T. (2015). When goals conflict with values: Counterproductive attentional and oculomotor capture by reward-related stimuli. *Journal of Experimental Psychology: General*, *144*(1), 158–171. https://doi.org/10.1037/xge0000037.

Leppink, E. W., Redden, S. A., Chamberlain, S. R., & Grant, J. E. (2016). Cognitive flexibility correlates with gambling severity in young adults. *Journal of Psychiatric Research*, *81*, 9–15. https://doi.org/10.1016/j.jpsychires.2016.06.010.

Lovibond, P. F., & Lovibond, S. H. (1995). The structure of negative emotional states: Comparison of the depression anxiety stress scales (DASS) with the Beck depression and anxiety inventories. *Behaviour Research and Therapy*, *33*(3), 335–343. https://doi.org/10.1016/0005-7967(94)00075-u.

Macht, M., & Mueller, J. (2007). Immediate effects of chocolate on experimentally induced mood states. *Appetite*, *49*(3), 667–674. https://doi.org/10.1016/j.appet.2007.05.004.

Meule, A. (2011). How prevalent is "food addiction"? *Frontiers in Psychiatry*, *2*(61), 61. https://doi.org/10.3389/fpsyt.2011.00061.

Meule, A., & Gearhardt, A. N. (2014). Five years of the Yale food addiction scale: Taking stock and moving forward. *Current Addiction Reports*, *1*(3), 193–205. https://doi.org/10.1007/s40429-014-0021-z.

Morris, L., & Mansell, W. (2018). A systematic review of the relationship between rigidity/flexibility and transdiagnostic cognitive and behavioral processes that maintain psychopathology. *Journal of Experimental Psychopathology*, *9*(3), 2043808718779431. https://doi.org/10.1177/2043808718779431.

Murphy, C. M., Stojek, M. K., & MacKillop, J. (2014). Interrelationships among impulsive personality traits, food addiction, and Body Mass Index. *Appetite*, *73*, 45–50. https://doi.org/10.1016/j.appet.2013.10.008.

Pearson, C. M., Wonderlich, S. A., & Smith, G. T. (2015). A risk and maintenance model for bulimia nervosa: From impulsive action to compulsive behavior. *Psychological Review*, *122*(3), 516–535. https://doi.org/10.1037/a0039268.

Peckham, A. D., & Johnson, S. L. (2018). Cognitive control training for emotion-related impulsivity. *Behaviour Research and Therapy*, *105*, 17–26. https://doi.org/10.1016/j.brat.2018.03.009.

Pivarunas, B., & Conner, B. T. (2015). Impulsivity and emotion dysregulation as predictors of food addiction. *Eating Behaviors*, *19*, 9–14. https://doi.org/10.1016/j.eatbeh.2015.06.007.

Prochazkova, L., Parkes, L., Dawson, A., Youssef, G., Ferreira, G. M., Lorenzetti, V., et al. (2018). Unpacking the role of self-reported compulsivity and impulsivity in obsessive-compulsive disorder. *CNS Spectrums*, *23*(1), 51–58. https://doi.org/10.1017/S1092852917000244.

Reaves, D. L., Christiansen, P., Boyland, E. J., Halford, J. C. G., Llewellyn, C. H., & Hardman, C. A. (2019). Modeling the distinct negative-reinforcement mechanisms associated with alcohol misuse and unhealthy snacking. *Substance Use & Misuse*, *54*(6), 921–933. https://doi.org/10.1080/10826084.2018.1552299.

Schulte, E. M., & Gearhardt, A. N. (2017). Development of the modified Yale food addiction scale version 2.0. *European Eating Disorders Review*, *25*(4), 302–308. https://doi.org/10.1002/erv.2515.

Tang, C. S., Gan, Y., Ko, J., Kwon, J. H., Wu, A., Yan, E., et al. (2021). The associations among emotional factors, personality traits, and addiction-like eating: A study on university students in six Asian countries/regions. *International Journal of Eating Disorders*, *54*(2), 125–131. https://doi.org/10.1002/eat.23298.

Torres, A., Catena, A., Megias, A., Maldonado, A., Candido, A., Verdejo-Garcia, A., et al. (2013). Emotional and non-emotional pathways to impulsive behavior and addiction. *Frontiers in Human Neuroscience*, *7*(43), 43. https://doi.org/10.3389/fnhum.2013.00043.

VanderBroek-Stice, L., Stojek, M. K., Beach, S. R. H., vanDellen, M. R., & MacKillop, J. (2017). Multidimensional assessment of impulsivity in relation to obesity and food addiction. *Appetite*, *112*, 59–68. https://doi.org/10.1016/j.appet.2017.01.009.

Verdejo-Garcia, A., Lawrence, A. J., & Clark, L. (2008). Impulsivity as a vulnerability marker for substance-use disorders: Review of findings from high-risk research, problem gamblers and genetic association studies. *Neuroscience and Biobehavioral Reviews*, *32*(4), 777–810. https://doi.org/10.1016/j.neubiorev.2007.11.003.

Wu, M., Brockmeyer, T., Hartmann, M., Skunde, M., Herzog, W., & Friederich, H. C. (2014). Set-shifting ability across the spectrum of eating disorders and in overweight and obesity: A systematic review and meta-analysis. *Psychological Medicine*, *44*(16), 3365–3385. https://doi.org/10.1017/S0033291714000294.

Zorrilla, E. P., & Koob, G. F. (2019). Impulsivity derived from the dark side: Neurocircuits that contribute to negative urgency. *Frontiers in Behavioral Neuroscience*, *13*, 136. https://doi.org/10.3389/fnbeh.2019.00136.