Eating on impulse: Implicit attitudes, self-regulatory resources, and trait self-control as determinants of food consumption

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1. Introduction

Overconsumption of calorie-rich foods may lead to overweight and obesity (Rosenheck, 2008). The worldwide prevalence of obesity almost doubled over the last three decades, with 35% of adults aged 20 and over overweight and 11% obese (World Health Organization, 2013). In modern societies, the high availability of calorie-rich foods causes some people to eat them impulsively, contrary to their intentions to manage weight (Novak & Brownell, 2011). However, not every person likes each high-calorie food to the same extent (Hofmann, Friese, & Wiers, 2011). Impulse can be operationalized as a specific desire to perform a particular action (such as eating candies), and it occurs automatically and without effort (Friese & Hofmann, 2009). Food consumption quantity is largely determined by which food a person is confronting and how much he or she likes it (Haynes, Kemps, Moffitt & Mohr, 2015). Positive attitudes toward specific food are likely to increase its intake, and negative attitudes toward it are likely to decrease its intake (Lebens et al., 2011).

Researchers are increasingly using implicit measures to index automatic attitudes or impulses, for implicit measures predict variation in behavior that is not accounted for by explicit measures (Nosek, Hawkins, & Frazier, 2011; Sheeran, Gollwitzer, & Bargh, 2013). However, the extent of implicit measures to predict behavior varied a lot across studies (Greenwald, Poehlman, Uhlmann, & Banaji, 2009). For example, some studies found that implicit attitudes as measured by implicit association test (IAT, Greenwald, McGhee, & Schwartz, 1998) predict choice between snacks and fruits (Richetin, Perugini, Prestwich, & O’Gorman, 2007; Perugini, 2005), whereas another study found that IAT did not predict choice between a candy bar and an apple (Karpinski & Hilton, 2001). Therefore, how well implicit measures predict eating behavior may depend critically on several moderating variables (Friese, Hofmann & Schmitt, 2008). Previous studies have identified situational moderators (such as cognitive load, self-regulatory resources, and alcohol) and dispositional moderators (such as working memory capacity and trait self-control) that increase the predictive validity of implicit measures of eating behavior (Hofmann, Friese, & Wiers, 2008). The present study focuses on situational difference in self-regulatory resources and dispositional difference in trait self-control.

Self-regulation refers to the efforts by persons to alter their thoughts, feelings, desires, and actions to achieve a desired goal or outcome (de Ridder & de Wit, 2006). Self-control can be viewed as the conscious and deliberate form of self-regulation, and it is a large subset of self-regulation (Baumeister & Alquist, 2009). These two terms are often used interchangeably in the literature (Baumeister, Vohs, & Tice, 2007). According to the limited resource model of self-regulation (Baumeister & Heatherton, 1996), self-regulation relies on common domain-general resources which restrict self-regulatory capacity. The exertion of self-control depletes these resources and leads to reduced capacity for further self-control, an effect called ego depletion (Baumeister, Bratslavsky, Muraven, & Tice, 1998). Controlling impulses, such as the impulse to eat palatable but unhealthy foods, constitutes an important domain of self-control (Baumeister et al., 2007). Studies of
ego depletion demonstrated that depleted individuals ate more unhealthy food than those who were not depleted (Volhs & Heatherton, 2000), and reduced self-regulatory resources were associated with an unfavorable dietary pattern (Sproesser, Strohbach, Schupp, & Renner, 2011).

Researchers have adopted the dual-system accounts, such as the reflective–impulsive model (RIM; Strack & Deutsch, 2004), to study the extent of an individual’s self-control and behavior. As a result, self-regulation behaviors are determined by the interaction between the impulsive system and the reflective system. Resource depletion was assumed to decrease the probability of the reflective system to override the influence of the impulsive system on behavior (Hagger, Wood, Stiff, & Chatzisarantis, 2010). To directly prove that self-regulatory resources moderate the influence of impulsive precursors on eating, measures of impulsive precursors should be included (Hofmann et al., 2008). A study measured automatic candy attitudes with a Single Category IAT (SC-IAT), and results showed that the SC-IAT predicted candy consumption in a taste-and-rate task for participants whose self-regulatory resources were depleted but not for participants whose resources were intact (Hofmann, Rauch, & Gawronski, 2007). Similarly, a SC-IAT predicted potato consumption for the depleted participants but not for the non-depleted participants (Friese, Hofmann, & Wänke, 2008).

Not only state differences in self-regulatory resources moderate the effect of implicit attitudes for food on intake, also stable individual differences did. Trait self-control was defined as the ability to override one’s inner impulses and refrain from acting on them (Tangney, Baumeister, & Boone, 2004). A meta-analysis study explored the relationship between dispositional self-control and behavior, and found a positive effect of trait self-control on behavior across a broad variety of domains including eating and weight-related behavior (de Ridder, Lensvelt-Mulders, Finkenauer, Stok, & Baumeister, 2012). It has been argued that behavior of individuals low in trait self-control is more strongly influenced by impulses, compare with individuals high in trait self-control (Friese & Hofmann, 2009).

A series of studies supported the assumption that impulses predict eating behavior for participants low in trait self-control, but not for those high in trait self-control. In one study, a variant of the IAT was used to measure automatic affective reactions to potato chips, and result showed that IAT scores predict potato chips consumption for participants low but not high in trait self-control. In another study, automatic affective reactions assessed by affect misattribution procedure (AMP, Payne, Cheng, Govorun, & Stewart, 2005) predicted alcohol consumption more strongly for participants low than high in trait self-control (Friese & Hofmann, 2009). A large-scale survey study showed that dispositional self-control helps restrained eaters become successful in controlling their weight (Keller & Siegrist, 2014). Another study revealed that, those lower in trait self-control are more likely to increase their planned food consumption in response to variety, whereas those with high trait self-control successfully manage their food consumption (Haws & Redden, 2013). An intervention study found that trait self-control moderates the effect of changed implicit food evaluations on food intake, such that only participants low in trait self-control consumed less unhealthy snack food after the food negative training (Haynes, Kemps & Moffitt, 2015).

Trait self-control may reflect the extent of an individual’s self-control reserves, and individuals high in trait self-control may have a large pool of resources available for allocation to self-control efforts (Muraven, Collins, Shiffman, & Paty, 2005). Consequently, trait self-control may moderate the effect of self-regulatory resources depletion on subsequent behavior. Evidence suggested that participants high in trait self-control are less vulnerable to the depletion of self-regulatory resources, as reflected in subsequent aggression (DeWall, Baumeister, Stillman, & Gailliot, 2007), sexual behavior (Gailliot & Baumeister, 2007), alcohol intake (Muraven et al., 2005), task persistence (Dvorak & Simons, 2009), and etc. However, to our knowledge, only two studies explored the interplay of self-regulatory resources and trait self-control in food consumption domain, and the results were inconsistent. One study found that high body mass index (BMI) participants consumed more cookies under depletion condition compared to normal BMI participants regardless of depletion condition and high BMI participants under no-depletion condition (Hagger et al., 2013). Nevertheless, this study failed to find that trait self-control moderated the effect of BMI and self-regulatory resources depletion on eating. Another study explored the interplay of trait self-control and ego depletion in candy consumption domain, and revealed that only participants high in trait self-control consumed more candy following an ego-depletion manipulation (Imhoff, Schmidt, & Gerstenberg, 2014, Study 1). This result suggested ‘an ironic effect of greater situational depletion for participants who describe themselves as high in trait self-control’ (Imhoff et al., 2014, p. 413).

In summary, it remains unclear how trait self-control and self-regulatory resources interact to influence food consumption. The existence of two studies assumed that each participant had a latent impulse to eat high-calorie food, which did not take into account individual differences in the tendency to eat specific food. In the present study, we investigated whether self-regulatory resources and trait self-control interact to moderate the impact of implicit attitudes on eating. We hypothesized that, implicit attitude measure predicted food consumption for those whose self-regulatory resources were depleted, but not for those not depleted. Furthermore, we predicted that trait self-control moderated the effects of self-regulatory resources depletion on impulsive eating, such that the effect of implicit attitudes on actual consumption under depletion condition only existed in individuals with low trait self-control.

2. Methods

2.1. Participants

Participants were one hundred twenty female undergraduate students who took part for course credit or monetary compensation (approximately US$4). The mean age was 20.9 years (SD = 2.3 years). The mean BMI was 20.6 (SD = 2.2). Participants were randomly assigned to one of two conditions in which their self-regulatory resources were manipulated: no-depletion (n = 60) and depletion (n = 60).

2.2. Procedures

All participants took part in the study individually between 10:30 and 11:30 am, or between 3:30 and 5:30 pm. Each participant was greeted by a female experimenter and was seated at a separate room equipped with a computer. They were told that the study included a perception task, a product taste test, and some questionnaires. First, they completed the perception task, which measured their implicit attitudes for chocolate. Next, they performed a task that required them to cross out letters on two pages of text, which manipulated their self-regulatory resources. Then in the product taste test phase, they tasted several plates of Kisses chocolates. Finally, participants completed the trait self-control scale, indicated the time since they last consumed food, and answered personal information questions. Participants were debriefed via email after data collection had been completed. This study was approved by the university’s ethics committee.

2.3. Manipulation of self-regulatory resources

To deplete self-regulatory resources, we used an established “e-crossing” task (Baumeister et al., 1998). On the first page of a text, all participants were instructed to cross out all the letters “e”. For the second page of the text, participants were given different instructions depending on the condition to which they had been assigned.
Participants in the no-depletion condition were instructed to follow the same rule as before by crossing out all the letters “e”. However, participants in the depletion condition were instructed to change their behavior by following new rules. Specifically, participants in the depletion condition had to cross out all the letters “e” except for “e”s that were followed by a vowel or “e”s that appeared in a word with a vowel appearing two letters before the “e”. Therefore, the depletion task required participants to override their established response tendency in the first page (which is crossing out all “e”s), and so it consumed self-regulatory resources.

Immediately after this task, participants completed a 20-item Positive and Negative Affect Schedule (Watson, Clark, & Tellegen, 1988), which measured their current mood on a 5-point rating scale (Cronbach’s α = 0.770 for positive affect and 0.871 for negative affect). As a manipulation check, participants were asked to rate how effortful it was to follow the instructions for crossing out letters on a 6-point scale.

2.4. Measures

2.4.1. Implicit measure

Implicit attitudes toward chocolate were measured with a personalized Single Category Implicit Association Test (SC-IAT, Karpinski & Steinman, 2006). The target category was “Kisses chocolate” and the attribute categories were “I like” and “I don’t like”. The target stimuli were six chocolate pictures of the same brand (“Kisses”) as used in the product taste test. The attribute stimuli were six positive pictures and six negative pictures from the International Affective Picture System (IAPS, Lang, Bradley, & Cuthbert, 2008; IAPS#1275, IAPS#1301, IAPS#1610, IAPS#1750, IAPS#1920, IAPS#1999, IAPS#2057, IAPS#2209, IAPS#2900, IAPS#3300, IAPS#9470, IAPS#9561). The chocolate SC-IAT consisted of two stages, and all participants completed the same hypothesis (Karpinski & Steinman, 2006). Each stage consisted of 24 practice trials followed by 72 test trials. In the first stage (chocolate + I like), chocolate pictures and positive pictures were categorized on the E key, and negative pictures were categorized on the I key. In the second stage (chocolate + I don’t like), positive pictures were categorized on the E key, and chocolate pictures and negative pictures were categorized on the I key. During each trial, the target or attribute stimulus appeared centered on the screen, and category reminder labels remained on the bottom of the screen. A SC-IAT score for each participant was computed using the D-algorithm (Greenwald, Nosek, & Banaji, 2003), with more positive values indicating more positive implicit attitudes for chocolate.

2.4.2. Trait self-control

The 13-item Brief Self-Control Scale (Tangney et al., 2004) was used to measure trait self-control. Participants indicated themselves on a scale from 1 (Not at all) to 4 (very much) on how well each statement describes them (e.g., “I am good at resisting temptation”, “I refuse things that are bad for me”). A scale score was calculated as the mean of all 13 items, in which higher scores indicated better self-control (Cronbach’s α = 0.763). The mean level of self-control was 2.61 (SD = 0.46), varying from 2.30 to 3.41 (de Ridder et al., 2012).

2.4.3. Chocolate consumption

During the product taste test phase, each participant was provided with 120 separately wrapped (5 g) chocolates of a well-known brand with different flavors. Participants were given 8 min to taste and rate them on a questionnaire containing 28 questions. After time had expired, the chocolates were removed from the participant’s desk and sent to another room. The amount eaten by each participant served as the dependent variable.

3. Results

3.1. Manipulation check and mood

Participants in the depletion condition found it more effortful to follow the instructions for crossing out letters than did participants in the no-depletion condition (M = 4.23, SD = 1.16 vs. M = 2.93, SD = 1.53, t(118) = 5.26, p < .001). Depleted and non-depleted participants did not differ in positive or negative affect (both ps > 0.1).

3.2. Main variables as a function of self-regulatory resources

Table 1 reported the descriptive statistics of the main variables measured in this study (implicit chocolate attitudes, trait self-control, and chocolate consumption). The implicit chocolate attitudes, trait self-control, and chocolate consumption did not differ between depletion condition and no-depletion condition (all ps > 0.17).

3.3. Predicting chocolate consumption

Zero-order correlations between chocolate consumption, implicit chocolate attitudes, and trait self-control as a function of experimental condition were shown in Table 2. Consistent with our hypotheses, implicit chocolate attitudes showed a positive correlation to chocolate consumption in the depletion condition, but not in the no-depletion condition.

We performed a multiple regression analysis on z-standardized grams of chocolate consumption as a dependent variable. As predictors we firstly entered the dummy-coded experimental condition (0 = depletion, 1 = no-depletion), implicit chocolate attitudes, and trait self-control. Second, we entered all possible two-way interaction terms among experimental condition, implicit chocolate attitudes, and trait self-control. In the third step, the three-way interaction terms were entered. All continuous predictor variables were z-standardized.
and interaction terms were computed from these standardized scores (Aiken & West, 1991).

Results from the regression analysis ($R^2 = 0.19$) revealed that the three-way interaction of experimental condition, implicit chocolate attitudes, and trait self-control was significant, $\beta = 0.307$, $p = 0.013$, explaining an additional 5% of the variance. We conducted simple slope analyses, and the pattern is presented in Fig. 1 (Dawson & Richter, 2006). For participants in the no-depletion condition, implicit attitudes were not related to chocolate consumption, both for low trait self-control participants ($\beta = -0.004$, $p = 0.982$) and for high trait self-control participants ($\beta = 0.129$, $p = 0.360$). For participants in the depletion condition, implicit attitudes were related to chocolate consumption for low trait self-control participants ($\beta = 0.850$, $p < 0.001$), but not for high trait self-control participants ($\beta = 0.134$, $p = 0.484$).

4. Discussion

The present study found that trait self-control and self-regulatory resources depletion interact to moderate the effect of implicit attitudes on actual food consumption. In line with previous research on ego depletion and eating behavior, participants whose self-regulatory resources were depleted by an initial task ate chocolate in accordance with their implicit attitudes when given an opportunity to do so in the allegedly taste and rate task. However, only people low in trait self-control showed this tendency. Therefore, high trait self-control seems to buffer the effect of ego depletion on individual’s impulsive eating.

In this study, we adopted the classic dual-task paradigm in ego depletion studies. The first task required all participants to cross out designated letters, while half of them had to break out the established habits and the other half just followed the habitual response (Baumeister et al., 1998). The second task was faked as a taste and rate test, whereas the amount of chocolate consumption was the variable of interest. According to the strength model of self control, people whose self-regulatory resources have been depleted were more likely to act on their impulses. However, previous studies testing this prediction often relied on group differences between depleted and non-depleted conditions, rather than directly measure impulses (Hofmann et al., 2009). In the present study, we used an adapted implicit association test to index each participant’s impulse toward chocolate, and used this continuous variable to predict actual eating behavior. Our results are consistent with recent studies showing that automatic affective reactions predicted food consumption only under depleted condition (Hofmann et al., 2007; Friese, Hofmann & Wänke, 2008). We extended the previous work by investigating the moderating role of trait self-control in the eating on impulse after depletion phenomenon. The current data showed that individuals high in trait self-control did not consume chocolate according to their impulses. Specifically, these individuals eat relatively stable amount of chocolate, regardless of their implicit attitudes and whether or not they were in the depleted condition.

Understanding and prediction of health-related behavior can improve greatly if both impulsive and reflective influences on behavior are considered (Hofmann et al., 2008). Although some health researchers are aware of the influence of impulse on behavior, they tend to neglect this component in their theoretical models and empirical works (Hofmann et al., 2011). Our results confirmed that impulses, as indexed by implicit measures, predicted food consumption under the condition of insufficient self-regulatory resources, especially for individuals with low trait self-control. In other words, individual differences in impulses were important determinants such that people with strong impulses toward tempting food would exhibit high degrees of unhealthy behaviors, especially under the circumstances of ego depletion and low trait self-control (Hofmann et al., 2008). Consequently, health interventions targeting the impulsive processes may be particularly effective for those high-risk persons under high-risk situations. Researchers have begun using attentional retraining to reduce automatic attentional bias for food cues (Kemps, Tiggemann, Orr, & Gue, 2014; Kakoschke, Kemps, & Tiggemann, 2014), using evaluative conditioning procedures to change automatic affective reactions toward tempting food (Dwyer, Jarratt, & Dick, 2007; Hollands, Prestwich, & Marteau, 2011; Lebens et al., 2011), linking unhealthy palatable foods to stop signal (Verling, Aarts, & Stroebe, 2013), and retraining automatic approach bias for alcohol (Wiers, Eberl, Rinck, Becker, & Lindenmeyer, 2011).
These impulse-oriented interventions provide promising avenues for improving people’s health behavior in tempting situations (Sheeran et al., 2013). Furthermore, experimentally manipulating or changing impulse and demonstrating the corresponding behavioral change can provide support for the causal influence of impulsive determinants on health behavior (Veling & Aarts, 2011).

Having high trait self-control has been proved to have beneficial effects across a variety of behaviors and outcomes, including eating and weight-related behaviors (de Ridder et al., 2012). People with high trait self-control are better at controlling their thoughts, emotions, and impulses than people with low trait self-control (Tangney et al., 2004). Trait self-control also enables people to resist the temptations of food and to keep their weights normal (Keller & Siegrist, 2014). The present study found that participants high in trait self-control were more resistant to the effects of self-regulatory resource depletion on subsequent eating behavior. In fact, their chocolate consumption under the depleted state remained unrelated to their impulses, which was opposite to those low in trait self-control. Two studies failed to find the expected buffering effect of trait self-control on ego depletion; one possible reason is that they did not take into account individual differences in impulses toward food (Hagger et al., 2013; Imhoff et al., 2014).

Regardless, future research should clarify when and why trait self-control has positive versus negative effects on health outcomes. Furthermore, some researchers suggested that trait self-control might reflect the extent of an individual’s self-control reserves (Muraven et al., 2005). Others proposed that people with good self-control operates more by avoiding tempting situations in the first place than by resisting strong desires that conflict with their goals and values (Hofmann, Baumeister, Förster, & Vohs, 2012; Imhoff et al., 2014). These issues need to be further explored, and may provide valuable insight for health promotion. Moreover, low-income populations are at high risk for obesity, partly because of their repeated exposure to less healthy foods and the resulting preference for those foods (Dressler & Smith, 2013). Our results suggested that trait self-control buffered against the influence of implicit preferences on food consumption under depleted status. Consequently, this trait may prevent some low-income people from overeating unhealthy foods. Future research testing this possibility would be valuable.

Strengths of the present study include the use of objective measure of food consumption under the taste test cover study, the use of established implicit measure to index impulse toward specific food, and the exploration of the interactive effect of trait self-control and situational self-regulatory resources on impulsive eating. One limitation of the current study is that the sample consisted of female undergraduate students of mostly normal weight. It remains to be tested whether these findings apply to other populations, such as overweight and obese people or restrained eaters. For example, most restrained eaters fail to control their weight but some succeed (Stroebe, van Koningsbruggen, Papiès, & Aarts, 2013), and one study found that the interaction between trait impulsiveness and dietary restraint predicted dieting success (van Koningsbruggen, Stroebe, & Aarts, 2013). Future research needs to test whether trait self-control moderates restrained eaters’ impulsive eating under stressed or depleted conditions. Another limitation is that we involved only a single snack food (chocolate). Future research needs to test whether trait self-control and self-regulatory resources interact to moderate the prediction of implicit attitude on healthy food consumption.

In conclusion, the present study proved that implicit attitudes predicted chocolate consumption among participants whose self-regulatory resources had been depleted. However, individual differences in trait self-control were associated with individual’s susceptibility to self-regulatory depletion. In fact, individuals high in trait self-control did not show this impulse-behavior consistency under depletion condition. These findings contribute to theories and models of eating and self-control, and have implications for health interventions aiming at increasing healthy behaviors.