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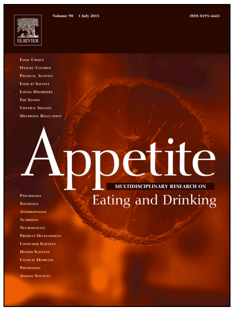

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Exposure to food cues moderates the indirect effect reward sensitivity and external eating via implicit eating expectancies

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Abstract

Previous research has suggested that the expectancy "eating is rewarding" is one pathway driving the relationship between trait reward sensitivity and externally-driven eating. The aim of the current study was to extend previous research by examining the conditions under which the indirect effect of reward sensitivity and external eating via this eating expectancy occurs. Using a conditional indirect effects approach we tested the moderating effect of exposure to food cues (e.g., images) relative to non-food cues on the association between reward sensitivity and external eating, via eating expectancies. Participants (*N* = 119, *M* = 18.67 years of age, *SD* = 2.40) were university women who completed a computerised food expectancies task (E-TASK) in which they were randomly assigned to either an appetitive food cue condition or non-food cue condition and then responded to a series of eating expectancy statements or self-description personality statements. Participants also completed self-report trait measures of reward sensitivity in addition to measures of eating expectancies (i.e., endorsement of the belief that eating is a rewarding experience). Results revealed higher reward sensitivity was associated with faster reaction times to the eating expectancies statement. This was moderated by cue-condition such that the association between reward sensitivity and faster reaction time was only found in the food cue condition. Faster endorsement of this belief (i.e., reaction time) was also associated with greater external eating. These results provide additional support for the proposal that individuals high in reward sensitivity form implicit associations with positive beliefs about eating when exposed to food cues.

Keywords: Reward sensitivity, Food cues, External eating, Expectancies

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Exposure to food cues moderates the indirect effect of reward sensitivity and external eating via implicit eating expectancies

In recent years there has been a growing interest in why individuals make poor food choices. One of the greatest challenges to addressing individuals' eating behavior and food choice is lack of understanding of processes that lead some people to over-eat more than others, despite exposure to the same environment. A growing avenue of enquiry in this area has focused on a personality trait referred to as 'Reward Sensitivity.' Reward sensitivity is a biologically-based, predisposition to seek out rewarding substances and to experience enjoyment in situations with high reward potential (Gray & McNaughton, 2000). This trait is often measured using self-report questionnaires. Such measures typically correlate with activation of the dopaminergic pathways when participants are exposed to appetitive substance (e.g., Beaver et al, 2006) and other behaviors with an appetitive approach response (e.g., Bijttebier, Beck, Claes, Vandereycken, 2009; Loxton & Tipman, in press).

The brain's dopamine "reward" pathways have been proposed as the key biological basis of this trait and have long been associated with pleasure seeking behavior and the reinforcing effects of drugs of abuse in human and animal studies of addiction (Olds & Milner, 1954; Wise, 2004; Koob, 1992). Highly palatable foods also activate this region of the brain in similar patterns to more potent drugs of abuse (Volkow, Wang, & Baler, 2011). Given the biological links between individual differences in reward sensitivity and neural response to substances of abuse and palatable foods, a core theme of recent research has been the proposal that highly reward-sensitive individuals are more attuned to the rewarding properties of drugs that are abused and to the reinforcing properties of high fat/high sugary "tasty" food (Dawe & Loxton, 2004, Hennegan, Loxton & Mattar, 2013, Loxton & Tipman, in press). Using self-report measures in community and university female samples, heightened reward sensitivity has been consistently associated with binge-eating, self-induced vomiting, being overweight, meeting diagnosis for bulimia nervosa, having a preference for foods high in fat and sugar, and a preference for colorful and varied food (Davis & Carter, 2009; Guerrieri, Nederkoorn, & Jansen, 2008; Loxton & Dawe, 2001, 2006, 2007).

Reward pathways have been implicated in forming strong memories and associations between the act of eating and the pleasure that comes with eating (Nijs, Franken, & Muris, 2009). In particular, smells and images associated with tasty foods (e.g., the smell of hot chips, pictures of chocolate cake) activate the reward pathways (Van Strien, Herman & Verheijden, 2009). Most notably, reward-related cues have been found to activate the reward pathways even more strongly than the consumption of the rewarding substance itself (Schultz, 1998). One possible reason for this activation in some individuals is the reward *hyper*sensitivity hypothesis, in which heightened reward responsiveness may motivate individuals to over-consume food (Dawe & Loxton, 2004; Stice, Spoor, Bohon, Veldhuizen & Small, 2008).

Whilst the association between reward sensitivity and problematic eating is now well-established, the aim of current research is to examine possible mechanisms by which individual differences in traits such as reward sensitivity affect eating behavior**.** Previous studies with college age students, predominately female, have found reward sensitivity to be associated with the desire to eat and greater self-reported external eating (i.e., eating when externally cued) when exposed to external food cues (Hennegan, et al., 2013; Hou et al., 2011;Van Strien et al., 2009). Individuals higher in reward sensitivity pay more attention to the processing of food related cues and allocate a greater amount of cognitive resources given to food-related cues (Hennegan et al., 2013). However, the mechanism by which this trait may result in this specific eating style has not been determined. One proposal has been that reward sensitive individuals form stronger implicit beliefs regarding the rewarding and pleasurable outcomes of eating (Hennegan, et al., 2013).

Beliefs regarding the positive outcomes from eating highly palatable, high calorie food offer additional pathways from reward sensitivity and cue-exposure to eating behavior.

Used extensively in the study of addiction, expectancy theory proposes that individuals form strong beliefs regarding the outcomes associated with specific behaviors; such beliefs guide future behavior (e.g., Bruce, Mansour & Steiger, 2009). Eating expectancies relate to the positive effects of food consumption, e.g., "eating is a good way to pass the time", "eating is a great way to celebrate" (Hohlstein, Smith & Atlas, 1998). Thus, the formation of strong expectations about the positive outcomes of eating high calorie food may be one mechanism that drives food cravings and problematic-eating in reward sensitive individuals.

Aims of the study

In a previous study, it was found that reward-sensitive university women showed stronger associations (e.g., faster reaction times to the belief that eating is a good way to celebrate) than less reward-sensitive women when presented with pictures of (appetitive and healthy) food on a computerised reaction time "Expectancies task" (E-TASK). The E-TASK was initially developed to measure implicit alcohol expectancies (Read & Curtin, 2007), but has been adapted to measure food expectancies (Hennegan et al., 2013). The E-TASK measures the speed at which participants are able to access such eating expectancies. Additionally, faster reaction times on the ETASK between the food pictures and positive beliefs about food was, in turn, associated with greater external eating (Hennegan et al., 2013). The current study aims to extend previous research through explicitly testing exposure to food cues as moderating the pathways from heightened trait reward sensitivity to external eating via implicit expectancies to the rewarding properties of palatable foods. Previous research has focused on general exposure to food cues during the E-TASK without a non-food cue condition (Hennegan et al., 2013). As such, this previous study could not address whether the activation of implicit expectancies was due to food-cue per se, or the passage of time during the experiment. Thus, the study will attempt to address this shortcoming by exposing participants to either an appetitive food cue or neutral cue (i.e., colors), in addition to replicating the effect of the E-TASK. Only women were recruited in keeping with previous research investigating reward sensitivity and eating behavior (Hennegan et al., 2013; Loxton & Dawe, 2006; Loxton & Tipman, in press). It was hypothesised that 1) women higher in reward sensitivity (and thus more likely to notice and approach appetitive stimuli) would score higher on a self-report measure of external eating, 2) that high reward sensitivity would be associated with faster responding to eating expectancies in the E-TASK, when appetitive food images are embedded with the task (but not when non-food images are embedded), 3) that faster reaction time to the eating expectancy 'eating is rewarding' would mediate the relationship between reward sensitivity and external eating for those in the food-cue E-TASK condition. This moderated mediation model is shown in Figure 1.

Method

Participants

Participants were 119 psychology undergraduate women who received course credit for participation. The sample was almost entirely Caucasian (98%) with a mean age of 18.67 (*SD* =2.40). Two participants did not endorse any of the "eating is rewarding" E-TASK items and thus were not included in the test of indirect effects, leaving a total sample of 117. The study received ethical approval from the University‘s Human Ethics board.

Experimental Design

A 2 way between subjects design was employed. Participants were randomly allocated to one of two E-TASK cue (food cue embedded, non-food cue) conditions. The dependant variable was reaction time to the E-TASK eating is rewarding expectancy statements, controlling for reaction time to self-description items. Urge to eat was measured pre- and post- E-TASK to check the food cue condition was an effective manipulation.

Procedure

Participants completed the procedure in groups of one to eight at computers separated by partitions in a university computer lab under the supervision of a research assistant. Measures were completed via an online survey system which contained instructions and safeguards to ensure participants could not skip ahead of the experimental task. Initially participants completed demographic items and baseline urge to eat scale. Participants then completed the E-TASK with approximately half of the participants (n = 59) randomly exposed to appetitive food images throughout the task (as used in Hennegan et al., 2013), whilst the other half (n = 60) in the neutral condition were exposed to screens of various colors in place of food images. After completing the E-TASK, participants completed another urge to eat visual analogue scale. Self-report personality and eating measures were then completed. At the conclusion of the study participants were debriefed and checked for their awareness of the purpose of the study.

Measures

Demographic.

Information concerning participant's age, gender, and ethnicity were collected. Participants were also asked to provide their current height (cm) and weight (kg).

Personality.

Sensitivity to Reward Scale. The dichotomously scored 24-item Sensitivity to Reward (SR) subscale of the Sensitivity to Punishment and Sensitivity to Reward Questionnaire (Torrubia et al., 2001) measures reward sensitivity. Items revolve around specific rewards, such as money, sex, and approval, for example, "Do you often do things to be praised?" Cronbach's α in the current study = .78. The SR has been frequently used by previous literature in assessing reward sensitivity to food (Davis et al., 2007; Hennegan et al., 2013; Loxton & Tipman, in press). Self-report measures of reward sensitivity have consistently shown good internal consistency with Cronbach's alpha ranging from 0.75-0.82 and test-retest reliabilities ranging from r = 0.74-0.89 (Torrubia, Ávila, Moltó & Caseras, 2001; Carver & White, 1994). The SR does not include eating-specific items. Summed scores are created for each subscale with higher scores indicating greater sensitivity to reward. Alpha is the current study = .78).

Eating Behavior.

External Eating. External eating was measured using external eating subscale from the Dutch Eating Behavior Questionnaire (DEBQ). (Van Strien, Fritjers, Bergers & Defares, 1986) The DEBQ is a 33 item measure with items scored on a 6-point Likert scale from 1 (never) to 5 (very often) in addition to a rating of 0 (not relevant). The external eating subscale consists of 10 items, which are averaged, and is a measure of disinhibited eating triggered by external cues such as taste and smell (Van Strien et al., 1986). Alpha in the current study was .79.

Urge to Eat. Urge to eat was measured using 100mm Visual Analogue Scales (VAS) in which they were asked to rate the following statement: "At the present moment, how strong is your urge to eat?" (0 = no urge to eat, 100 = high urge to eat). The VAS is commonly used in addiction literature (i.e., Traylor, Bordnick & Carter, 2008), but has also been adapted for use in the food cue literature (i.e., Staiger, Dawe & McCarthy, 2000).

Expectancy Task (E-TASK). The E-TASK was adapted from a study of alcohol cue exposure (Read & Curtin, 2007) to assess response to food cues (Hennegan et al., 2013). The E-TASK is a computerized sentence-completion task in which participants respond in agreement or disagreement, by pressing one of two keys on a computer keyboard, to a series of eating expectancy statements and self-description statements (Read & Curtin, 2007). Depending upon condition, participants were presented with an image of an appetitive food item, or a block of color for 4 seconds. Images were set to 800 x 600 pixels and food images included a range of sweet foods (e.g., candy, brownies, ice cream) and savoury foods (e.g., fries, chips, nachos). These images acted as the “food cue” or “non-food cue”. Participants in the food-cue condition saw 52 images throughout the task and those in the non-food cue condition viewed 52 blocks of colors. Following each image (food or non-food, depending on assigned condition), all participants were presented with either an eating expectancy statement or a self-description statement with each statement presented over two screens. Eating expectancy items were specific to food and eating and started with the stem “Eating is …”, while self-description items were personality specific and started with the stem “Usually I…” After a 1-second interval, each stem was followed by one of 26 eating expectancy target words such as “Eating….is a good reward," or one of 26 self-description target words, such as “Usually…. I am talkative." (52 trials in total). Within the 26 eating expectancy statements, six items were reward specific.

Expectancy items and self-description items were randomly presented to all participants. Upon presentation of the target word, participants were asked to respond as quickly and accurately as possible if they felt the item characterized themselves/beliefs about eating, or not, by pressing the appropriate key (1 = “yes” and 2 = “no”). A faster reaction time to the self-description item (i.e. Usually….) or the eating expectancy (i.e. Eating…), indicate stronger endorsement of these beliefs. Time taken to respond to expectancy words to which participants responded in the affirmative (i.e., “yes”), after controlling for response to the self-description items was the index of accessibility to eating expectancies. The E-TASK was programmed in E-Prime 2.0 software (Psychology Software Tools, Pittsburgh, PA) and all stimuli were presented on an IBM compatible personal computer with 14” CRT computer monitors to ensure timing accuracy. Participants completed eight practice trials prior to beginning the task.

Following Read and Curtin (2007), eating expectancy items were taken from the Eating Expectancies Inventory (EEI; Hohlstein, et al., 1998). The EEI was developed in order to assess expectancies that underlie problematic eating. Five key expectancies were identified and represent the subscales in the inventory. In developing the EEI, Hohlstein and colleagues (1998) found that positive reinforcement expectancies were also positively correlated with disinhibited eating. Items from the whole 26-item scale were included as per Hennegan et al. (2013); however, following from the findings of Hennegan et al. (2013) only responses to the six 'Eating is Rewarding' subscale items were of interest to the current study, with the remainder used as filler items. Self-description items were taken from the Big Five Inventory (John & Srivastava, 1999) and were used to control for individual differences in response speed to presented items. This inventory was used in accordance with previous research for use as an index of innate response time (Hennegan et al., 2013; Read & O'Connor, 2006).

Data analyses

A manipulation check was performed using a 2 (within; pre-, post-E-TASK) x 2 (between; food cue, non-food cue) mixed ANOVA on urge to eat, to test the effect of the food cue condition on eliciting the desire to eat. The hypothesized moderated mediation model (see Figure 1) was tested in a single model using a bootstrapping approach to assess the significance of the indirect effects at each level of the moderator (Hayes, 2013). Sensitivity to reward was the predictor variable, with mean reaction time to the eating is rewarding expectancy statements as the mediator. The outcome variable was external eating. To control for innate reaction time to reward, self-description reaction times were entered as a covariate. To account for potential weight differences, BMI was also entered as a covariate in the model. Moderated mediation analyses test the conditional indirect effect of a moderating variable (i.e., food cue vs non-food cue condition) on the relationship between a predictor (i.e., reward sensitivity) and an outcome variable (i.e., external eating) via potential mediators (i.e., E-TASK reaction time). The "PROCESS" macro, model 7, v2.13, (Hayes, 2013) in SPSS ver 22 with bias-corrected 95% confidence intervals (n = 10000) was used to test the significance of the indirect (i.e., mediated) effects moderated by cue condition, i.e., conditional indirect effects. This model explicitly tests the moderating effect on the predictor to mediator path (i.e., path a). An index of moderated mediation was used to test the significance of the moderated mediation, i.e., the difference of the indirect effects between the food-cue and non-food cue conditions (Hayes, 2015). Significant effects are supported by the absence of zero within the confidence intervals.

Results

Manipulation check

A 2 (time: pre-E-TASK, post-E-TASK within subjects) x 2 (cue condition: food, no food) mixed model ANOVA was employed using urge to eat as the dependent variable. The analysis revealed a significant main effect of time, F (1, 117) = 39.58, $p < .001$, $\eta_p^2 = 0.25$, but no main effect of cue condition, F (1, 117) = 2.42, $p = .12$, $\eta_p^2 = 0.02$. There was a significant interaction between time and cue condition, F (1, 117) = 9.01, $p < .01$, $\eta_p^2 = 0.07$. A follow-up ANCOVA found urge to eat following the E-TASK with participants in the food cue condition (M = 4.10, SD = 2.10) was significantly higher than participants in the non-food condition (M = 3.10, SD = 1.90), controlling for pre-E-TASK desire to eat (M_{food} = 2.84, SD_{food} = 1.93; $M_{non\text{-}food}$ = 2.68; $SD_{non\text{-}food}$ = 1.66). Thus, food images embedded within the E-TASK were effective in eliciting the desire to eat.

Descriptive statistics

Descriptive statistics and correlations are provided in Table 1. Mean scores and Cronbach's alpha reliability indicators are consistent to those reported in previous literature (Hennegan et al., 2013). Reward sensitivity was significantly negatively associated with a belief that eating is rewarding (i.e., higher scores on reward sensitivity was associated with faster reaction times to this expectancy). Reward sensitivity was also significantly positively associated with external eating. The mediator, "eating is rewarding" RT, was significantly negatively associated with external eating; i.e., faster reaction time to this expectancy statement was associated with higher external eating scores.

Table 1

Descriptive statistics and zero order correlations (N = 117).

Measure	M	SD	2.	3.	4.	5.	6.	7.	8.
1. Age	18.67	2.40	.12	.20*	-.08	-.10	-.07	.00	.00
2. Self-description RT	1306.66	304.95	-	-.07	.01	-.02	-.06	.58**	-.03
3. BMI	21.73	3.61	-	-	-.14	-.17	-.13	-.07	-.12
4. Baseline urge to eat	2.69	1.71	-	-	-	.59**	.22*	-.05	-.17
5. Post-E-TASK urge to eat	3.59	2.09	-	-	-	-	.18	-.11	.23*
6. Reward Sensitivity	11.07	4.21	-	-	-	-	-	-.20*	.39**
7. Eating is Rewarding RT	1369.72	418.81	-	-	-	-	-	-	-.21*
8. External Eating	34.39	6.16	-	-	-	-	-	-	-

*$p < .05$, **$p < .01$.

Note. RT = reaction time. BMI was calculated using kg/m².

Tests of conditional indirect effects.

The hypothesised moderated mediation model was tested using the PROCESS macro model number 7, which tests a model whereby E-TASK cue condition moderates the effect of path a (Figure 1; Hayes, 2013). BMI and Self-description RT were entered as covariates.

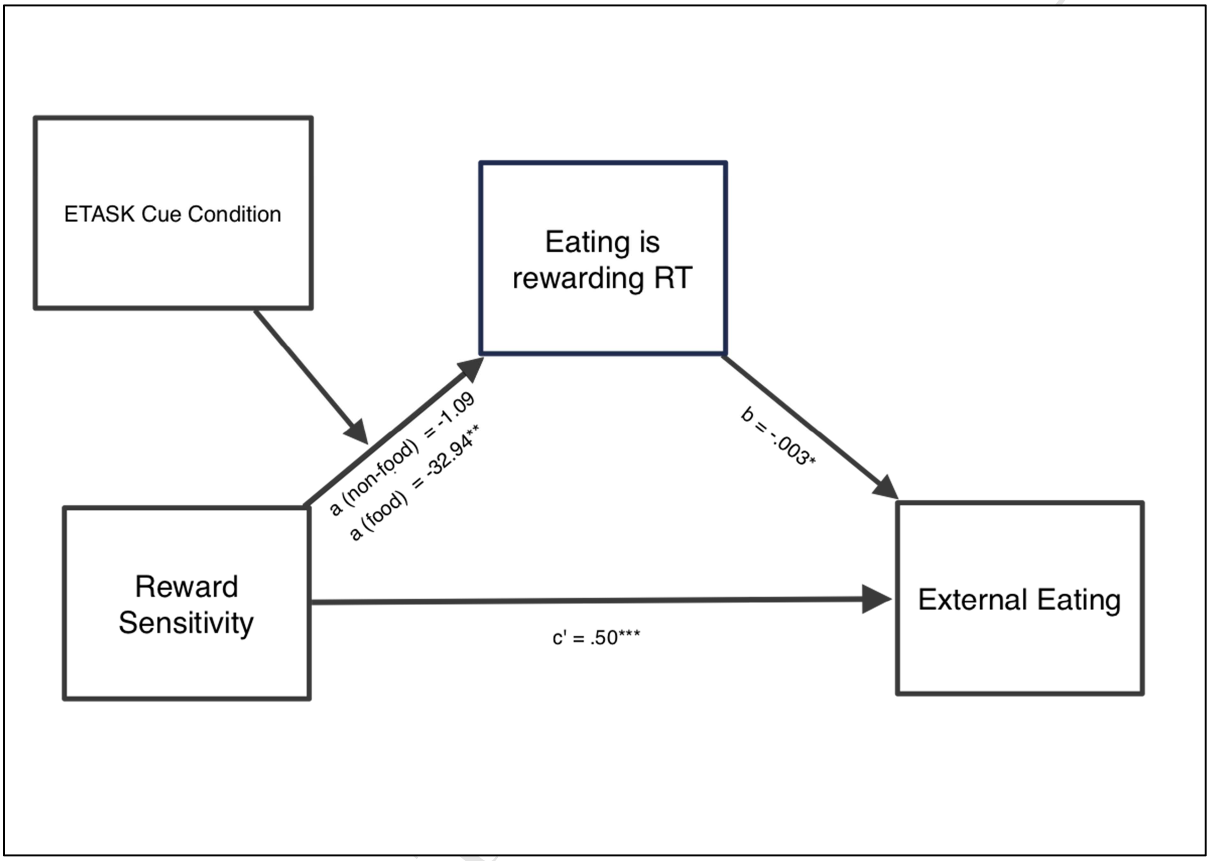

Figure 1. Conditional indirect effects reward sensitivity and external eating via E-TASK RT, at each level of cue condition. The coefficients in parentheses are unstandardised.
*p<.05, **p<.01, ***p<.001.

Cue condition was found to moderate the effect of reward sensitivity and eating expectancies (as assessed by E-TASK RT); Unstandardised interaction B = -31.85, B_{SE} = 14.94, t = -2.13, p = .04). Test of simple slopes (i.e., conditional effects on path a) found a significant association between reward sensitivity and E-TASK RT for those in the food cue condition (B = -32.94, B_{SE} = 11.30, t = -2.92, p = .004) but not in the non-food-cue condition (B = -1.09, B_{SE} = 9.80, t = -.11, p = .91). Participants with higher reward sensitivity and in the food-cue condition responded more quickly to sentences endorsing the expectancies that eating is rewarding. There was no effect of reward sensitivity and expectancy response times for those in the non-food cue condition. Faster reactions time of the eating is rewarding expectancy was associated with greater external eating (regardless of condition), $B = -.003$, $B_{SE} = .002$, $t = -2.02$, $p = .045$. The overall moderated mediation model was supported with the index of moderated mediation = .10 (95% CI = .01; .27). As zero is not within the CI this indicates a significant moderating effect of cue condition on the indirect effect via E-TASK RT (Hayes, 2015). A conditional indirect effect of reward sensitivity and external eating via E-TASK RT was found for those in the food-cue condition (unstandardized indirect effect = .105, Bootstrapped SE = .06, 95% CI = .02; .25) but not for those in the non-food cue condition (unstandardized indirect effect = .004, Bootstrapped SE = .03, 95% CI = -.05; .08). A significant direct effect was found for reward sensitivity and external eating after controlling for E-TASK RT ($B = .50$, $B_{SE} = .13$, $t = 3.98$, $p < .001$) indicating that additional pathways are implicated in the association between reward sensitivity and external eating.[1]

Discussion

The current study aimed to extend previous research to more explicitly test hypothesized pathways from a vulnerability to overeat due to sensitivity reward and stronger implicit expectancies to the rewarding properties of palatable foods. Previous research has focused on general exposure to food cues during the E-TASK (Hennegan et al., 2013). It was hypothesised that 1) women higher in reward sensitivity (and thus more likely to notice and approach appetitive stimuli) would score higher on a self-report measure of external eating, 2) that high reward sensitivity would be associated with faster responding to eating expectancies in the E-TASK, when appetitive food images are embedded with the task (but not when non-food images are embedded), 3) that faster reaction time to the eating

[1] Note. The same pattern of results is found with Urge to Eat as the covariate instead of BMI. significant indirect effect for those in the food cue condition (unstandardized coefficient = .07, SE = .04, 95CI: .0018; .1834) but not in the non-food condition (unstandardized, coefficient = .00, SE = .02, 95CI: -.0378; .0533).

expectancy 'eating is rewarding' would mediate the relationship between reward sensitivity and external eating for those in the food-cue E-TASK condition.

Previous studies found a positive association between reward sensitivity and external eating (Hennegan et al., 2013). In this study, a significant direct effect was again found between reward sensitivity and external eating. Moreover, there was a significant indirect effect between reward sensitivity and external eating, in that a belief that eating is rewarding mediated the relationship between reward sensitivity and external eating. However, this indirect effect was only evident in the food-cue condition. That is, individuals high in reward sensitivity showed a faster reaction time to endorsing statements regarding the belief that eating is rewarding but only when exposed to appetitive food images; this speed of responding was then associated with external eating scores. Additionally, women high in reward sensitivity also reported a greater desire to eat when exposed to appetitive food cues in comparison to women low in reward sensitivity. Thus, all hypotheses received support.

The consistent finding of the indirect effect of reward sensitivity and external eating via implicit expectancies when exposed to food cues in the current student and in Hennegan et al. (2013) further supports the proposal that individual differences in reward sensitivity may contribute to external eating. The additional strength of the current study was that the indirect effect of trait reward sensitivity and a measure of external eating via a reward-specific eating expectancy was only found when exposing women to food images. The effect did not occur to viewing neutral color blocks. This suggests that the findings of Hennegan et al. (2013) were not due simply to the passage of time during the experiment.

The results provide insight into how reward sensitivity (and the reward pathways) may contribute to poor food choices via the noticing of appetitive food cues and the activation of implicit positive expectancies. The results of this study support the proposal that individual personality differences in reward sensitivity have implications on the potential to notice and approach appetitive food cues within an individual's environment. This is similar to a recent study with 127 undergraduate students and using another implicit approach task – the Approach Avoidance Task (May, Juergensen, & Demaree, 2016). In this study investigating reward sensitivity and eating, more reward sensitive participants responded in an approach fashion (pull a joystick in response to a block of color on a computer screen) but only following exposure to dessert images relative to non-food images (May et al., 2016). Together, these findings supports studies investigating the mechanisms by which trait reward sensitivity translates to eating via the activation of implicit expectancies and motivated approach responding to food cues in the environment. In particular, our study found again that the specific belief that eating is rewarding mediates this relationship. We note, though, that a significant direct effect remained when controlling for eating expectancies.

This suggests additional mechanisms linking this trait vulnerability and potential eating problems. In previous work investigating a genetic profile indicative of reward responsiveness and over-consumption was mediated by food cravings (Davis & Loxton, 2013). More recently, we found reward sensitivity to be associated with external eating as well as hedonic eating (the motivation to seek out appetitive food, independently of the tendency to over-eat). Additional mechanisms may therefore include a more specific tendency to notice and seeking food (as assessed be hedonic eating) and food-specific cravings - food cue exposure likely elicits a myriad of processes including implicit and explicit eating expectancies, food cravings and heightened motivation to seek out food – of which one result may be externally-driven eating. Overall, the pathways between individual differences in reward sensitivity and eating behaviour are likely to be complex and include situational factors (such as the presence of a food cue) and internal factors (such as reward expectancies and cravings).

This study also has implications for Reinforcement Sensitivity Theory (Gray & McNaughton, 2000) with these results adding to the growing literature finding trait reward sensitivity to be consistently associated with a variety of over-eating behaviors (Bijttebier, Beck, Claes, & Vandereycken, 2009). For example, Loxton and Tipman (in press) found reward sensitivity to be associated with both food addiction symptoms and those who met criteria for food addiction diagnostic status based on the Yale Food Addiction Scale (YFAS) (Gearhardt, Corbin & Brownell, 2009) in a sample of community women. Such findings linking reward sensitivity and over-eating has now extended to potential interventions for binge-eating and obesity by targeting this and other related personality traits (Schag, et al., 2015).

Limitations

The current study had several limitations such as the use of self-report data for eating behavior and a proxy measure of urge to eat. Future research could incorporate actual food consumption as a better measure of eating behavior to combat this limitation. In order to address issues of causation and to control for variables included in food literature, future research may also need to control for baseline hunger levels, post-ratings of images, presence of binge eating established via an eating disorder interview, objectively measured BMI, assess pre and post levels of external eating, and control for time of day and dietary restraint. Controlling for these variables may provide further support for the relationship between reward sensitivity and external eating, and may help tease these effects apart. The current study was also cross-sectional in design and as such causality from personality to eating behavior cannot be determined. A test-retest longitudinal study would help determine causality. Further, given our sample these results are not generalizable beyond a young female undergraduate sample.

Conclusions

The results of this study provide support for the role of reward sensitivity in the elicitation of implicit positive associations with palatable food in young female university students. Moreover, that such associations are triggered when exposed to food cues, thereby increasing the likelihood that individuals will seek out external food cues (i.e., more likely to notice the sight or smell of appetitive food). These findings have important implications for interventions of over-eating and the effect of exposure to food images (e.g., in television advertising) for those predisposed to response these cues, i.e., those high in reward sensitivity. In particular, pro-health campaigns should also consider reward sensitivity and externally driven eating as one means that may contribute to consuming appetitive food in excess.

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