

**Eating in the Absence of Hunger: The Role of Punishment Sensitivity and Emotion
Regulation Skills**

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Abstract

Obesity is on the rise, resulting in various health risks such as heart disease and diabetes. Eating beyond satiety, without the presence of hunger cues (eating in the absence of hunger), may be a contributing factor to this increase. Eating in the absence of hunger (EAH) can occur due to emotional or external factors. This study aimed to investigate whether the factors of punishment sensitivity (PS); punishment responsivity (PR) and motivation to avoid punishment (PM), could predict EAH. Additionally, we looked at whether emotion regulation skills (ERS) can mediate the relationship between the factors of PS and EAH. 368 first-year psychology students at the University of Groningen (75.8% female) completed self-report online questionnaires to assess their PS, ERS and EAH. Findings indicated that both PR and PM predicted increased EAH and predicted a lower level of ERS. ERS partially mediated the relationship between PR and EAH, but not between PM and EAH. Further exploration revealed that the emotional component of EAH was strongly associated with PR and partially mediated by ERS, while the external component of EAH showed no relationship with ERS, PR or PM. These findings highlight that ERS may be a viable target for interventions, especially regarding EAH arising from an emotional source.

Keywords: eating in the absence of hunger, punishment sensitivity, punishment responsivity, motivation to avoid punishment, emotion regulation skills

Eating in the Absence of Hunger: The Role of Punishment Sensitivity and Emotion Regulation Skills

Obesity is becoming increasingly more prevalent and is associated with several health risks and detrimental psychosocial effects in both child and adult populations (World Health Organization (WHO), 2024). Eating in the absence of hunger (EAH) may be a factor contributing to this increase. EAH occurs when an individual eats beyond the point of satiety in the absence of hunger cues (Fisher & Birch, 1999). EAH has been found to increase the likelihood of overeating (Goldschmidt et al., 2017), thereby increasing the risk of obesity (Faith et al., 2006; Lansigan et al., 2015). For this reason, a more explicit understanding of EAH could prove beneficial in developing interventions. Eating behaviours in late adolescence are strongly tied to obesity and eating patterns in adulthood (Whitaker et al., 1997), making college students a viable group for interventions regarding EAH to prevent obesity. First year university students present a unique chance to study EAH, since they commonly represent a group which has been given full control over their eating behaviours for the first time. EAH has two main predicting components: negative emotions (e.g. anxiety) and external cues (e.g. smell) (Tanofsky-Kraff et al., 2008). Therefore, EAH conceptually encompasses emotional eating and external eating, and has been found to have high convergent validity with these concepts (Arnold et al., 2015). Due to the link between obesity and EAH, the current study aims to investigate possible factors associated with EAH and will therefore investigate punishment sensitivity (PS) and emotion regulation skills.

Punishment sensitivity presents itself as a variable of interest due to its association with a greater consumption of sugar (Tapper et al., 2015), and fat (Michels et al., 2020). Overconsumption of sugary and fatty foods is linked to a variety of health risks such as obesity, diabetes and heart disease (Centers for Disease Control and Prevention, 2024; WHO, 2024). Therefore, the association between PS and EAH is even more relevant in light of the

current obesity crisis. PS is a determinant of behaviour and cognition, affecting a variety of disorders and behaviours, including dysfunctional eating behaviours (Bijttebier et al., 2009). Gray's (1970) Reinforcement Sensitivity Theory (RST) proposes that individuals differ in their sensitivity to punishment, making them more or less likely to engage in behaviours which could result in punishing consequences. PS has been linked to increased emotional eating (Matton et al., 2017; Salemi et al., 2022) and external eating (Stapleton & Whitehead, 2014), which are conceptually similar to EAH, but do not exclusively occur in the absence of hunger cues. Due to the similarity of the concepts, it could be plausible that PS may also have significant effects on EAH.

Emotion regulation is another variable of interest regarding EAH. Negative emotions are integral to EAH, with Tanofsky-Kraff and colleagues (2008) defining the emotional component as consisting of primarily negative emotions such as feeling anxious, depressed or frustrated. This is akin to emotional eating, which occurs when an individual eats in response to a negative affective state (van Strien et al., 1986). The five-way model (Macht, 2008) proposes that emotional eating occurs in an attempt to alleviate or reduce negative affect. Emotional eating has also been proposed to occur as a form of emotional suppression (Herren et al., 2021). Suppression is a form of emotion regulation in which a person engages in tactics (e.g. distractions or, in this case, eating) to manage their emotional response to a situation, and is generally considered to be a less favourable strategy (Gross, 2002). Multiple empirical studies corroborate the theoretical proposal that emotional eating occurs in response to and in order to manage negative affect in clinical and non-clinical populations (Bennett et al., 2013; Macht, 2008; Stapleton & Whitehead, 2014). Emotional eating has also been shown to occur in response to routine, everyday negative emotions (Macht & Simons, 2000). It is however important to note that, especially within non-clinical samples, negative emotional states may also lead to decreased eating (Macht, 2008). Due to the conceptual overlap between emotional

eating and EAH arising from an emotional source, it may therefore be possible that EAH is also employed as a dysfunctional form of emotion regulation such as suppression.

Further support for the relationship between EAH and emotion regulation can be found when looking at the effects of stress. EAH has been shown to increase when a person is stressed (Born et al., 2010). Considering that stress is known to lead to negative affective states (Folkman, 1997), it could therefore be argued that these negative affective states result in EAH in an attempt to regulate the negative emotions. EAH could therefore be viewed as a dysfunctional form of emotion regulation which increases the likelihood of eating past satiety (Leehr et al., 2015). Generally, dysfunctional emotional regulation is related to increased food consumption (Evers et al., 2010) and a number of psychopathologies, such as eating disorders and dysfunctional eating (Bydlowski et al., 2005). Therefore, a person's use of successful emotion regulation skills (ERS) could be a valuable target for interventions to prevent dysfunctional behaviours such as EAH.

Existing evidence indicates that there could be an interaction between PS and ERS in relation to EAH. This is, for example, demonstrated by the fact that PS does not exert a straightforward influence on emotional eating. The current understanding is that negative affective states, such as shame, mediate the relationship between PS and emotional eating (Brockdorf et al., 2020; Salemi et al., 2022). Salemi and colleagues (2022) found that rumination, a maladaptive form of emotion regulation (Hilt et al., 2011), mediates the relationship between PS and emotional eating. Further evidence was provided by Stapleton and Whitehead (2014) who found that emotional eating is strongly associated with emotion regulation deficits. Additionally, this study found that dysfunctional emotion regulation and high PS are associated with external eating but did not investigate the mechanisms through which these variables could affect each other. Considering that PS is associated with greater difficulty in managing affective states (Barrios et al., 2022), and that these states can in

themselves also increase emotional eating, it would be crucial to investigate whether differences in ERS could mediate how likely a person is to engage in EAH, relative to their PS. As of yet, there is no paper which comprehensively looks at whether ERS could affect the relationship between PS and EAH. If use of more adaptive ERS could help prevent EAH, this could have significant implications for both prevention and treatment strategies regarding obesity and dysfunctional eating.

University students represent an ideal group of interest regarding EAH, since university, or the transition to university, is often a stressful period in a person's life. This could easily evoke negative emotions, making a university sample both convenient and fitting when investigating the mechanisms of EAH. This study aims to examine the relationship between PS, ERS and EAH in a first-year university sample. Additionally, the presence of a mediation of the relationship between PS and EAH through ERS will be investigated, while paying attention to the individual components of PS. Utilisation of the newly developed reward and punishment responsivity and motivation questionnaire (RPRM-Q) (Jonker et al., 2022) will allow for differentiation between the factors of PS: punishment responsivity (PR) and motivation to avoid punishment (PM). At present date, there are no studies that have investigated the relationship between EAH and the individual components of PS. We hypothesize that (H1) greater PS will be associated with increased EAH, (H2) less ERS will be associated with increased EAH, (H3) that ERS may mediate the relationship between PS and EAH, and (H4) that the emotional component of EAH may be associated with PS more significantly than the external component.

Methods

Participants

The study recruited 368 participants (75.8% female). All participants were first-year psychology students at the University of Groningen who received course credits as

compensation for their participation. Participants were on average 20 years old ($SD = 2.08$) and had a BMI of 21.2 ($SD = 5.10$).

Measures

Punishment Sensitivity

To assess the PR and PM of participants, the RPRM-Q was administered (Jonker et al., 2022). The questionnaire consists of 18 items and includes four subscales; motivation to approach reward, motivation to avoid punishment, reward responsivity and punishment responsivity. For the purpose of this study, only the subscales for motivation to avoid punishment and punishment responsivity were utilised. These 9 items consisted of statements such as “I do everything I can to avoid receiving criticism” to which the participants could indicate the extent of their agreement on a 5-point Likert scale, ranging from 1 (“this does not apply to me at all”) to 5 (“this applies to me completely”). The PR and PM variables were created by taking the means of the relevant subscale items. Both PR and PM demonstrated good internal consistency, with a Cronbach’s alpha of 0.81 and 0.79 respectively.

Emotion Regulation Skills

ERS were measured through means of the Emotion Regulation Skills Questionnaire (RES) (Grant et al., 2018) which consisted of 27 items such as “I paid attention to my feelings” to which participants could respond using a 5-point Likert scale to indicate how often they had engaged in the behaviour in the past week, ranging from 0 (“not at all”) to 4 (“almost always”). The questionnaire measures 9 different emotion regulation skills (awareness, sensations, clarity, understanding, modification, acceptance, tolerance, readiness to confront distressing situations when necessary to attain personally relevant goals, and self-support), with each of these subscales consisting of three items. ERS were measured based on a participant’s total score on the questionnaire ($\alpha = .93$).

Eating in the Absence of Hunger

To measure EAH, the Eating in the Absence of Hunger (EAH-C) questionnaire was used (Tanofsky-Kraff et al., 2008). The questionnaire consists of 14 items and has two parts: beginning EAH (7 items) and continual EAH (7 items). The EAH-C identifies two factors: emotional and external. Participants were presented with two different scenarios such as “now imagine that you finished eating a meal or snack some time ago and you are not yet hungry. In this situation, how often do you start eating because...” and were then given, for example, an emotional reason (e.g. “feeling sad”) for engaging in EAH. They could then use a 5-point Likert scale to indicate how commonly they engage in EAH due to this reason, ranging from 1 (“never”) to 5 (“always”). The EAH variable was computed using a total score of all items ($\alpha = .89$). Emotional EAH and external EAH were computed by taking the mean score of all relevant items and demonstrated good internal consistency with a Cronbach’s alpha of 0.92 and 0.80 respectively.

Validity Checks

Two items were included in the RPRM-Q which served as attention checks. Item 19 prompted participants to select “This applies to me completely” while item 20 prompted them to select “This does not apply to me at all”. The survey included two additional questions to ensure the validity of a participant’s answers. The first asked participants to confirm that they answered all questions honestly and seriously. The second question asked participants about whether they believed their level of English was sufficient to appropriately complete the survey. Data was considered valid if participants passed the validity checks. Additionally, the optional check for diagnoses or medications which could affect cognition and motivation could be used to control for potentially confounding effects.

Study Design and Procedure

The study consisted of a quantitative survey design in which the relationship between EAH, PS and ERS was investigated. Particular attention was paid to whether ERS could play

a mediating role in the relationship between EAH and PS. Figure 1a and 1b denote the model design.

Figure 1a

Graphical Representation of the Mediation Model for PR

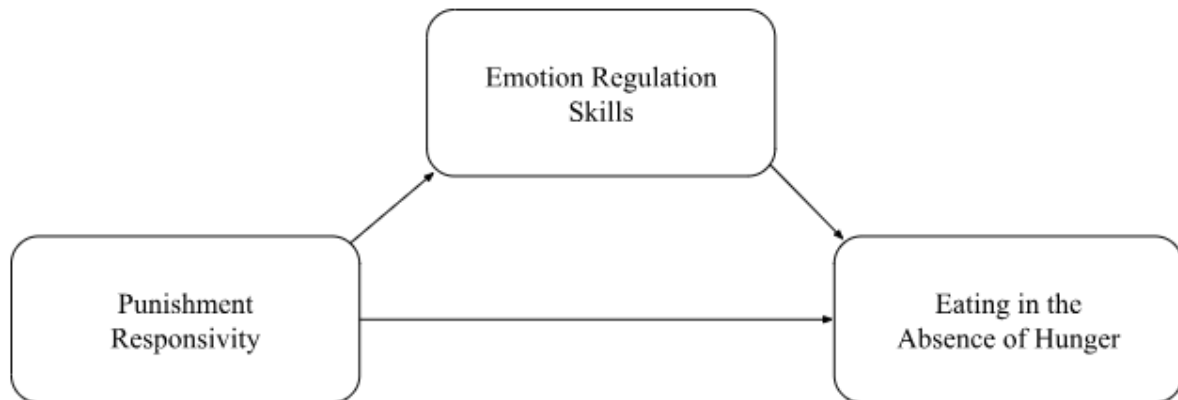
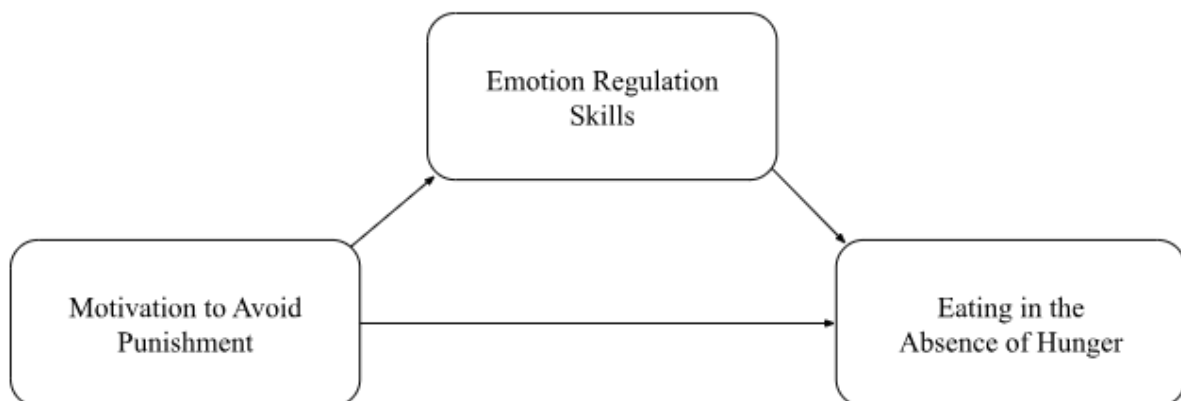


Figure 1b

Graphical Representation of the Mediation Model for PM



Ethical approval was given by the Ethics Committee of the University of Groningen before the study was opened to participants (PSY-2324-S-0163). Participants were procured through the online ‘SONA’ website, where first year psychology students could sign up in exchange for course credits. Before beginning the survey, participants were informed of the

premise of the study and were given the opportunity to consent to participate and for their data to be processed. They could thereafter begin the survey. Participants then completed a series of questionnaires in the Qualtrics online environment (Qualtrics, Provo, UT).

Questionnaires were presented in the following order: RPRM-Q, RES, EAH-C. Participants were then asked to provide descriptive information such as their age, height, and weight. They were also given the opportunity to fill in optional questions regarding whether they have any medical diagnoses or employ any medication which may have affected their cognition or motivation during the survey. With exception of the optional questions, participants had to complete all questions. Data was collected as part of a larger study, wherefore participants additionally completed questionnaires measuring their cognitive and behavioural emotion regulation strategies, internalizing and externalizing symptoms, depression and anxiety, and dietary success.

Data Analysis

Data was processed after collection, during which participants who fail the validity checks or fail to complete all questionnaires will be removed. Data was then analysed in SPSS (IBM Corp, 2022) with the addition of the PROCESS macro (Model 4; Hayes, 2013). All analyses were performed at a significance level of $\alpha = .05$. Descriptives were calculated and the data was then checked for assumptions of linearity, homoscedasticity, and normality. Checks for multicollinearity were performed by inspecting correlations between the independent variables, and with use of the variance inflation factor (VIF).

Mediation analyses were first performed with PR as the independent variable, then with PM as the independent variable. Further exploration was then conducted with the subscales of EAH (emotional, external) as dependent variables. To ensure sufficient power (.80) to identify small effects ($f^2 = .02$ or larger), a priori estimations indicated that 395 participants would be needed.

Results

Descriptives

Data collection procured 417 participants. Participants who did not finish all questionnaires ($n = 39$) or pass the validity checks ($n = 10$) were removed, resulting in a final sample of 368 participants. This resulted in the ability to detect effect sizes of $f^2 = .021$ or larger, at a significance of .05 with 80% power. The data was then visually checked for assumptions of normality, linearity and homoscedasticity with use of P-P plots and scatterplots of residuals. Multicollinearity was assessed through the inspection of VIFs. There was no indication of violation of any of the assumptions (see Appendix). The descriptive statistics of all variables were computed (see Table 1).

Table 1

Descriptive statistics of all variables

	N	Minimum	Maximum	Mean	SD
PRtotal	368	4.00	20.00	15.40	3.39
PMtotal	368	5.00	25.00	18.56	3.78
ERStotal	368	16.00	108.00	65.00	15.40
EAHtotal	368	14.00	70.00	34.89	9.99

Bivariate correlations between the variables were investigated (see Table 2). PR and PM both showed a small, positive correlation with EAH. PR and PM were negatively correlated with ERS, with PR demonstrating the strongest correlation. ERS was significantly negatively correlated with EAH.

Table 2*Bivariate correlations between all variables*

<i>Variable</i>	1	2	3
1. PR	-		
2. PM	.78**	-	
3. ERS	-.17**	-.10*	-
4. EAH	.19**	.11*	-.23**

Note. *Correlation significant at the .05 level (2-tailed). **Correlation significant at the .01 level (2-tailed).

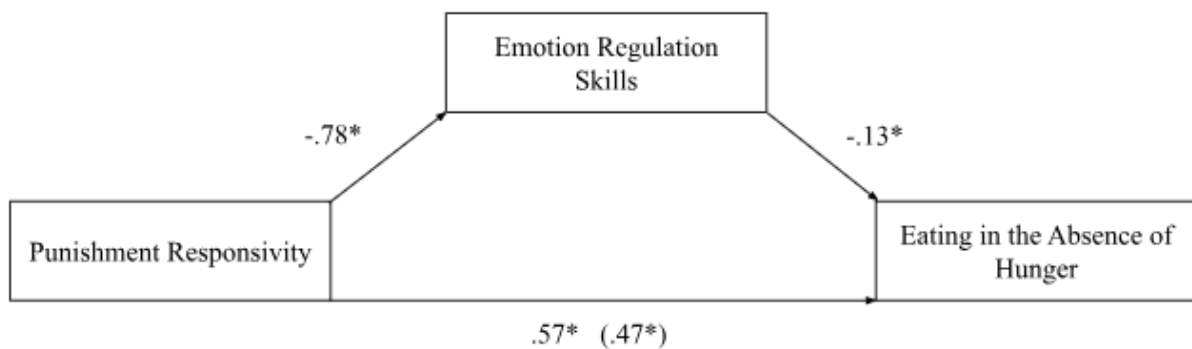
Main Analysis

Punishment Responsivity

To investigate whether ERS have a mediating effect on the relationship between PR and EAH, a mediation analysis was conducted (see Figure 2). The first stage of the analysis revealed that PR had a significant negative effect on ERS ($b = -.78$, $SE = 0.23$, $t(366) = -3.35$, $p < .001$, $95\% CI = [-1.24, -0.32]$). The second stage revealed that both PR ($b = .47$, $SE = 0.15$, $t(365) = 3.10$, $p = .002$, $95\% CI = [0.17, 0.76]$) and ERS ($b = -.13$, $SE = 0.03$, $t(365) = -4.02$, $p < .001$, $95\% CI = [-0.20, -0.07]$) individually had a significant effect on EAH. This model overall accounted for 8% of the variance in EAH ($R^2 = .08$, $F(2, 365) = 15.5$, $p < .001$).

Figure 2

Simple mediation model of the effect of PR and ERS on EAH, showing regression coefficients



Note. The regression coefficient between PR and EAH, controlling for ERS is in parentheses.

* $p < .05$.

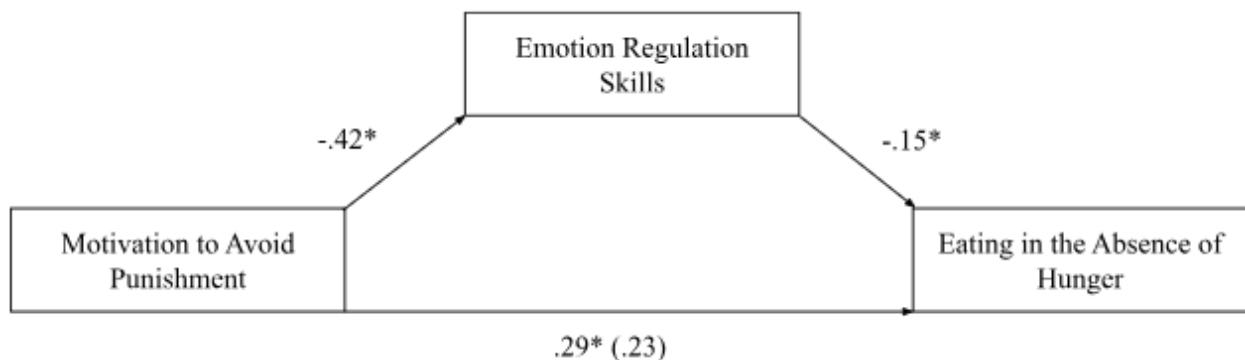
The indirect and total effects of the mediation were also analysed. The total effect model was significant ($b = .57$, $SE = 0.15$, $t(366) = 3.77$, $p < .001$, $95\% CI = [0.27, 0.87]$). There was a significant indirect effect, implying that a raw score increase in PR is associated with a 0.1 raw score increase in EAH, mediated by ERS ($b = .10$, $SE = 0.04$, $95\% CI = [0.03, 0.19]$). The significance of both the direct and indirect effects implied that ERS partially mediated the relationship between PR and EAH.

Motivation to Avoid Punishment

A mediation analysis was conducted to investigate whether ERS has a mediating effect on the relationship between PM and EAH (see Figure 3). The first stage of the analysis revealed that PM had a significant negative effect on ERS ($b = -.42$, $SE = 0.21$, $t(366) = -2.00$, $p = .046$, $95\% CI = [-0.84, -0.01]$). The second stage revealed that ERS had a significant negative effect on EAH ($b = -.15$, $SE = 0.03$, $t(365) = -4.38$, $p < .001$, $95\% CI = [-0.21, -0.08]$). PM, however, did not have a significant effect on EAH ($b = .23$, $SE = 0.13$, $t(365) = 1.67$, $p = .096$, $95\% CI = [-0.04, 0.49]$). This model overall accounted for 6% of the variance in EAH ($R^2 = .06$, $F(2, 365) = 11.89$, $p < .001$).

Figure 3

Simple mediation model of the effect of PM and ERS on EAH, showing regression coefficients



Note. The regression coefficient between PM and EAH, controlling for ERS is in parentheses.

* $p < .05$.

The indirect and total effects of the mediation were also analysed. The total effect model was significant ($b = .29$, $SE = 0.14$, $t(366) = 2.08$, $p = .038$, $95\% CI = [0.02, 0.56]$). The indirect effect, however, was not significant ($b = .06$, $SE = 0.04$, $95\% CI = [-0.00, 0.12]$), implying that no mediation of the relationship between PM and EAH was occurring through ERS.

Exploratory Analyses

Exploratory mediation analyses were performed to assess whether the mediating role of ERS differed when looking at the emotional component of EAH (EAHe), and external component (EAHex) separately, as opposed to the entire construct.

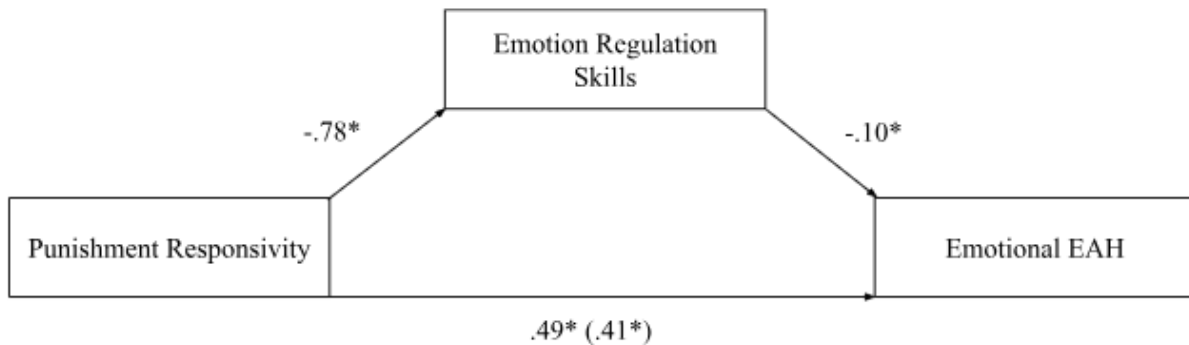
Emotional Component EAH

Exploration regarding PR found that PR has a significant effect on EAHe ($b = .41$, $SE = 0.08$, $t(365) = 5.07$, $p < .001$, $95\% CI = [0.25, 0.56]$) (see Figure 4). The model incorporating PR and ERS explained 16% of the variance in EAHe ($R^2 = .16$, $F(2, 365) = 35.11$, $p < .001$). The total effect of the model was significant ($b = .49$, $SE = 0.08$, $t(366) = 5.89$, $p < .001$,

95% $CI = [0.32, 0.65]$), as was the indirect effect ($b = .08, SE = 0.28, 95\% CI = [.008, 0.64]$), implying that ERS partially mediates the relationship between PR and EAHe.

Figure 4

Simple mediation model of the effect of PR and ERS on EAHe, showing regression coefficients



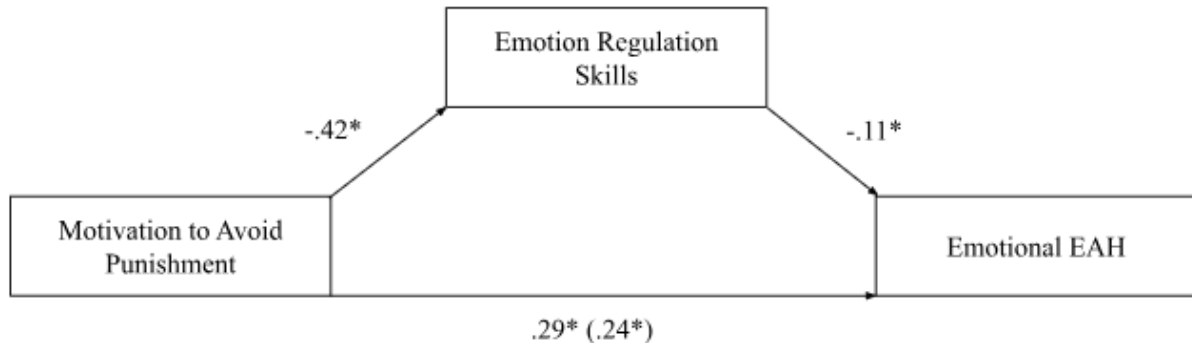
Note. The regression coefficient between PR and EAHe, controlling for ERS is in parentheses.

* $p < .05$.

Exploration regarding PM found that PM had a significant effect on EAHe ($b = .24, SE = 0.07, t(365) = 3.35, p < .001, 95\% CI = [0.00, 0.10]$) (see Figure 5). The model incorporating PM and ERS explained 13% of the variance in EAHe ($R^2 = .13, F(2, 365) = 27.10, p < .001$). The total effect of the model was significant ($b = .29, SE = 0.08, t(366) = 3.83, p < .001, 95\% CI = [0.14, 0.44]$). However, the indirect effect was not ($b = .05, SE = 0.03, 95\% CI = [-0.00, 0.10]$), implying that ERS did not mediate the relationship between PM and EAHe.

Figure 5

Simple mediation model of the effect of PM and ERS on EAHe, showing regression coefficients



Note. The regression coefficient between PM and EAHe, controlling for ERS is in parentheses.

* $p < .05$.

External Component EAH

Exploration regarding PR found that there was no significant effect of PR on EAHex ($b = -.04$, $SE = 0.05$, $t(365) = -0.81$, $p = .418$, $95\% CI = [-0.15, 0.06]$) and that ERS also had no significant effect on EAHex ($b = .00$, $SE = 0.01$, $t(365) = 0.16$, $p = .877$, $95\% CI = [-0.02, 0.02]$). The total effect ($b = -.05$, $SE = 0.05$, $t(366) = -0.85$, $p = .395$, $95\% CI = [-0.15, 0.06]$) and indirect effect ($b = -.00$, $SE = 0.01$, $95\% CI = [-0.02, 0.02]$) were not significant, indicating that there was no mediation occurring, and also that PR did not significantly influence EAHex.

Exploration regarding PM found similar results, with both PM ($b = -.05$, $SE = 0.05$, $t(365) = -0.98$, $p = .327$, $95\% CI = [-0.14, 0.05]$) and ERS ($b = .00$, $SE = 0.01$, $t(365) = 0.20$, $p = .845$, $95\% CI = [-0.02, 0.03]$) demonstrating no significant relationship with EAHex. The total effect ($b = -.05$, $SE = 0.05$, $t(366) = -1.01$, $p = .314$, $95\% CI = [-0.14, 0.05]$) and indirect

effect ($b = -.00$, $SE = 0.01$, $95\% CI = [-0.02, 0.01]$) were not significant, indicating that no mediation was occurring via ERS and that PM did not influence EAHex.

Discussion

The present study aimed to investigate whether PS and ERS are related to EAH, specifically in university students. Particular attention was paid to whether ERS mediate the relationship between PS and EAH. Results indicate that higher PR and PM, and use of less ERS is associated with increased EAH. Additionally, ERS partially mediate the relationship between PR and EAH but do not significantly affect the relationship between PM and EAH.

Our first hypothesis regarding the relationship between PS and EAH was supported by our findings. Higher levels of both PR and PM were associated with more frequent EAH. Overall, PR demonstrated a stronger relationship with EAH than PM. This generally overlaps with expectations based on previous findings that a higher PS is associated with increased emotional and external eating (Matton et al., 2017; Salemi et al., 2022; Stapleton & Whitehead., 2014). This also demonstrates that both factors of PS are linked to EAH.

Our findings also supported our hypothesis regarding the relationship between ERS and EAH, namely that lower ERS are associated with a higher occurrence of EAH. This implies that individuals who make use of less ERS display a higher frequency of EAH, which could serve as an alternate method to regulate emotions or soothe negative affect. This proposal would align with current understandings of emotional eating – namely that it occurs with the aim of reducing negative affect (Bennett et al., 2013; Macht, 2008; Stapleton & Whitehead, 2014). However, since emotional eating does not occur exclusively in the absence of hunger, further investigation would be necessary to ascertain whether this theoretical proposal can also be applied to EAH.

Our central hypothesis was that ERS would mediate the relationship between PS and EAH, which was partially supported by our research findings. ERS partially mediated the

relationship between PR and EAH. This implies that PR is associated with a decrease in a person's ERS, which in turn increases the likelihood of EAH. The partial mediation also reveals that PR, when accounting for ERS, is still significantly related to an increased occurrence of EAH. The presence of this mediation relates to Salemi and colleagues' (2022) findings that shame and rumination mediate the relationship between PS and emotional eating. Considering that shame and rumination are maladaptive forms of emotion regulation, and our findings show that less successful use of ERS in part mediates the association between PR and EAH, it is possible that dysfunctional emotion regulation may be key to understanding and intervening in EAH regarding PR. EAH could potentially be viewed as a dysfunctional form of emotion regulation, which occurs when an individual fails to use adaptive ERS. This idea is not new in literature, since it has been suggested that maladaptive eating behaviour can be used as an escape strategy from negative affect (Heatherton & Baumeister, 1991). Numerous studies have reiterated the function of maladaptive eating behaviours as a means to regulate negative emotions (Leehr et al., 2015; Macht, 2008). Therefore, ERS could possibly present themselves to be a good target for interventions regarding EAH as a result of PR. It would be worthwhile to investigate this further, since ERS are an easy target for interventions and have proven to be effective for a range of disorders and maladaptive behaviours (Grant et al., 2018).

In disagreement with our third hypothesis, there was no mediation of the relationship between PM and EAH through ERS. Our results presented themselves to be quite confusing regarding the mediation model encompassing PM, ERS and EAH. The total model explained a significant portion of the variance in EAH, although PM had no significant effect on EAH when ERS were accounted for, and there was also no evidence of mediation occurring. It is possible that the combined effects managed to reach the threshold of significance, or that a third variable was responsible for the attained results. These results indicate that PM is only

significantly related to EAH when the effects of ERS are not separated from the model.

Further research would be necessary to understand the exact relationship between PS and ERS with regard to EAH.

Exploration regarding the factors of EAH; EAHe and EAHex was conducted to gain more clarity about the mechanisms through which PR and PM are associated with EAH. As we had predicted, EAHe showed a stronger relationship with both PR and PM than EAHex. This finding is in agreement with current literature regarding the association of PS with increased emotional eating (Matton et al., 2017; Salemi et al., 2022). ERS partially mediated the relationship between PR and EAHe but did not significantly affect the relationship between PM and EAHe. This highlights that PR in particular is associated with less use of ERS in regard to EAHe, which could also explain why solely the relationship between PR and EAH was mediated by ERS. In contrast to this, EAHex did not have a significant relationship with PR, PM or ERS. Since EAHex showed no relationship with any of the variables, it would be plausible to assume that the emotional component of EAH was the main driver of the relationships between PR and EAH, and PM and EAH respectively. The lack of association between EAHex and PR, PM and ERS is in disagreement with expectations based on the current understanding of external eating. Theoretically, EAHex is conceptually similar to external eating, which has been linked to heightened PS and dysfunctional emotion regulation (Stapleton & Whitehead, 2014). However, our study failed to find similar results. This difference could potentially lie in the fact that external eating does not exclusively occur in the absence of hunger, whereas EAHex does. Further investigation could prove beneficial to determine whether EAHex is associated with PS, or whether the presence of hunger cues is necessary to establish this connection.

Research and Clinical Implications

A novelty in our research was the use of the RPRM-Q (Jonker et al., 2022) which allowed for the differentiation between the factors of PS: PR and PM. Our results show that the factors have differential relationships with both EAH and ERS, wherefore one can assume that these differential relationships may also extend to other concepts. These findings hold significant implications for future research due to the fact that it may be crucial to treat PR and PM as separate variables, rather than to unify them under the concept of PS, as the latter may result in inaccurate and misleading results. This furthermore should also be taken into account during the development of interventions and treatments, since targeting PR or PM may require different approaches to ensure efficacy and the intended outcome.

Limitations

One of the main limitations of the present study centres around the choice of questionnaire for EAH. The EAH-C (Tanofsky-Kraff et al., 2008) is a questionnaire developed specifically for use in child and adolescent populations, whereas our research focused on adult university students. Arnold and colleagues (2015) revised the EAH-C to make it suitable for college populations, and found that a third, physical factor added explanatory value. This factor encompasses physical symptoms which were found to encourage eating without the presence of physical hunger cues in university students, such as light-headedness, and headaches. Additionally, two of the items belonging to the original EAH-C's emotional subscale ("bored" and "tired") were removed. Our study utilised the old version of the EAH-C, meaning that no physical subscale was used and the emotional component of EAH still encompassed five items. Due to this, it is possible that EAH measurements were not as accurate as they could have been, especially regarding the emotional component since it included items which may not be applicable to a university sample. Additionally, we were unable to assess associations between the physical factor and PS.

A further limitation in our study is that the sample size was not sufficient to identify very small effects (smaller than $f^2 = .021$), which could possibly have contributed to the lack of significance regarding the direct effect of PM on EAH or indirect effect within this model. Additionally, all data was collected through means of self-reports, meaning it may have been susceptible to a variety of biases. Lastly, it should be acknowledged that data was collected as part of a bigger study, which encompassed a test battery of 14 questionnaires and additional questions. Therefore, participants may have been affected by fatigue effects, increasing the likelihood that their motivation and attention dropped as they progressed through the questionnaires. However, since attention checks were included in the RPRM-Q, and the RES appeared early in the order of studies, only the EAH-C results could be vulnerable to fatigue effects, since it was the last of our questionnaires to be presented.

Future Research

In future research it would be crucial to repeat this study while employing the version of the EAH-C adapted to college populations to understand the full scope of EAH. It could also be beneficial to assess the relationship between EAHex and PR with a more explicit measure of EAHex, in order to determine whether the conflicting results regarding this relationship could have arisen from methods of measurement or the difference in the conceptualisation of EAHex and external eating. Furthermore, investigation regarding specific types of ERS could prove beneficial in the development of specific strategies to reduce EAH. It could also be crucial to investigate types of ERS specifically related to PR and emotional EAH, since our model explained a significant amount of the variance in EAHe and could therefore be a promising avenue in terms of intervention.

Conclusion

Our findings lead to the conclusion that both factors of PS and ERS have a significant association with EAH. Individuals higher in PR and PM and who employ less ERS are more

likely to engage in EAH. ERS play an important mediating role in the relationship between PR and EAH, especially if it arises from an emotional source. Investigating whether helping individuals engage in more adaptive forms of emotion regulation can result in a reduced frequency of EAH could prove to be an important avenue in implementing interventions. This is especially important considering that targeting ERS could result in a more attainable intervention plan than targeting PR. Conversely, ERS would not be of interest in reducing EAH arising from an external source. Due to this, it may be advisable to treat EAH arising from emotional and external sources as separate concepts, rather than to unify them into the overarching notion of EAH, since interventions would need different approaches for effective results.

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Appendix

Figure A1

Normal P-P plot of regression standardised residuals for PR and ERS on EAH

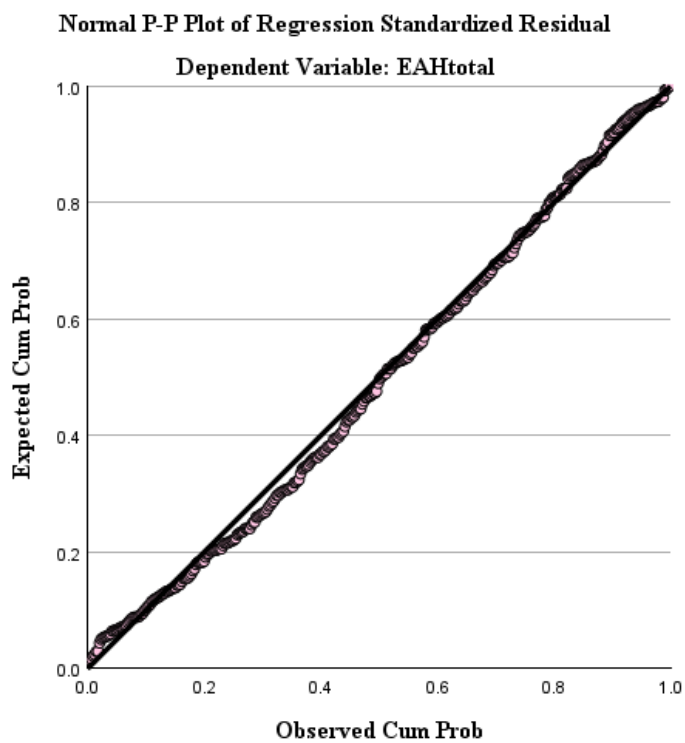


Figure A2

Scatterplot of residuals for regression of PR and ERS on EAH

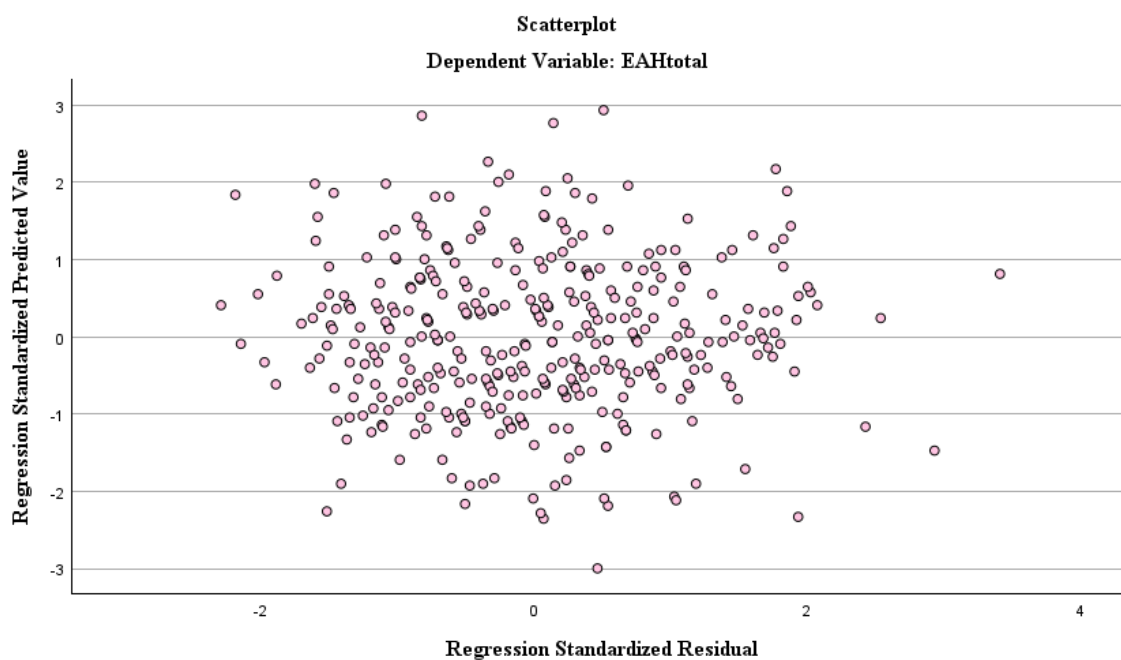
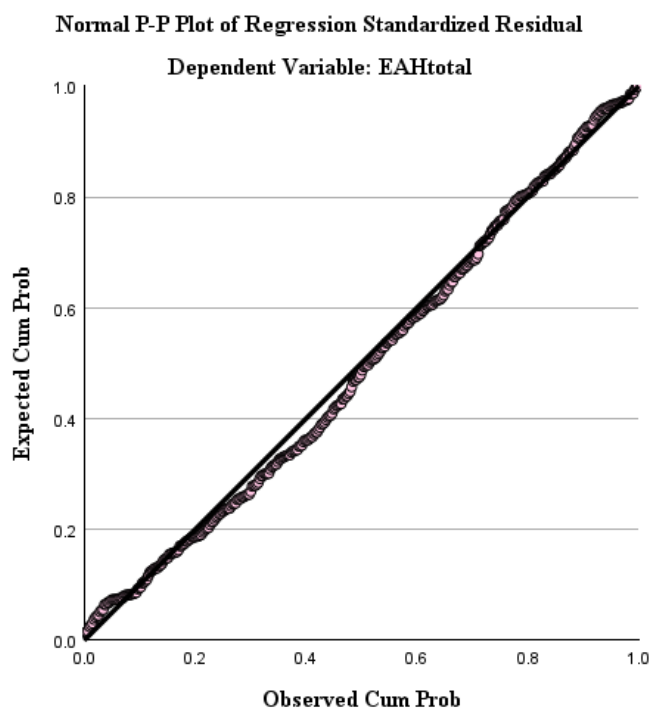


Figure A3

Normal P-P plot of regression standardised residuals for PM and ERS on EAH

**Figure A4**

Scatterplot of residuals for regression of PM and ERS on EAH

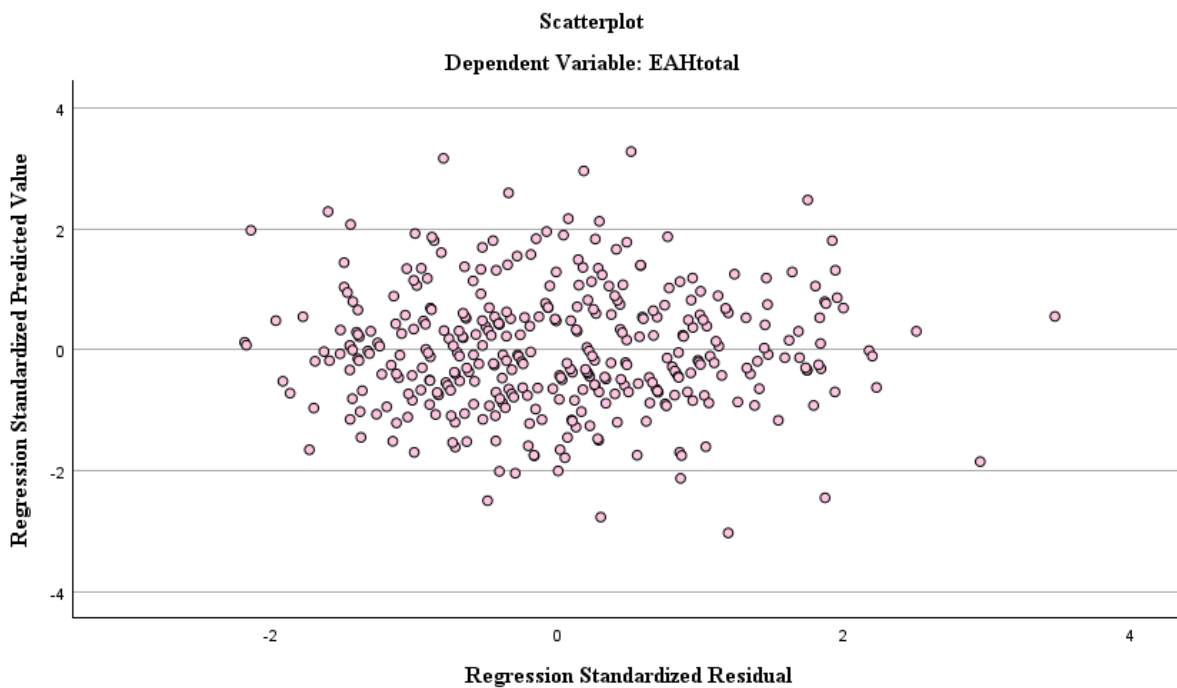


Table A1*Multicollinearity analysis of PR and ERS on EAH*

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	36.37	3.46		10.51	<.001		
	PRtotal	.47	.15	.16	3.10	.002	.97	1.03
	ERStotal	-.13	.03	-.21	-4.02	<.001	.97	1.03

a. Dependent Variable: EAHtotal

Table A2*Multicollinearity analysis of PM and ERS on EAH*

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	40.15	3.50		11.48	<.001		
	PMtotal	.22	.14	.09	1.67	.096	.99	1.01
	ERStotal	-.15	.03	-.22	-4.38	<.001	.99	1.01

a. Dependent Variable: EAHtotal