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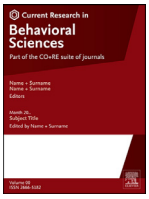

Loneliness and preferences for palatable foods: The role of coping

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ABSTRACT

Loneliness is an important public health issue with consequences for health-related outcomes. Health-related behaviors is a proposed explanatory pathway. There is some evidence that loneliness influences eating behaviors, although the reasons for this have not been fully examined. In addition, how eating behaviors are conceptualised and the subsequent findings are often inconsistent. Across two studies, we aimed to address these issues by investigating whether loneliness is associated with preferences for palatable over healthy foods, and two possible explanatory pathways: negative affect and using palatable foods as a coping strategy. Study 1 (N = 361) used a within-subjects design to test whether chronic loneliness influenced palatable food preferences in a healthy versus palatable food choice task, and if negative affect and using palatable food to cope explained this preference. Study 2 (N = 163) aimed to replicate the dispositional-correlational associations from Study 1 and experimentally test whether situational loneliness influenced food preferences. In Study 1, the indirect effects of chronic loneliness on preferences for palatable foods was significant for coping motives, ab = 0.0923, SE = 0.0324, 95% CI = [0.0417, 0.1732], but not for negative affect, ab = 0.0035, SE = 0.0486, 95% CI = [-0.0928, 0.0986]. Findings from Study 2 mirrored those from Study 1 with significant indirect effects of loneliness on preferences for palatable foods through coping motives, ab = 0.1831, SE = 0.1027, 95% CI = [0.0338, 0.4680], but not depressive symptoms, ab = -0.1046, SE = 0.2438, 95% CI = [-0.5576, 0.4092]. The loneliness manipulation did not increase state loneliness. Together these findings make important and novel contributions to our understanding of the strategies that lonely people use to cope with the distress they experience, and further highlights susceptibility to eating palatable foods as a potential behavioral pathway linking loneliness to poor health outcomes.

Introduction

Loneliness is an important and urgent public health issue that is linked to a range of negative health-related outcomes (Park et al., 2020). Defined as the subjective feeling of social isolation from a perceived gap between the actual and desired number of meaningful relationships (de Jong-Gierveld, 1987; Hawkley and Cacioppo, 2010), loneliness can be experienced as a passing state or as a more chronic feeling of social isolation. The growing rates of loneliness in recent years have led public health officials in the UK and USA to refer to loneliness as the "greatest public health challenge of our time" (May 2018), and as "a growing health epidemic" (Murthy, 2017). Indeed, research suggests that the detrimental effects of loneliness on physical health outcomes including mortality are comparable to those reported for other risk factors such as obesity and smoking (Holt-Lunstad et al., 2015, 2010). The well-documented associations of loneliness with poor cardiovascular health (Hawkley et al., 2006, 2010), poor physical health status (Park et al., 2020; Richard et al., 2017), increased risk for metabolic syndrome (Henriksen et al., 2019), poor physical health status (Richard et al., 2017), poor sleep quality (Griffin et al., 2020), and poor health behaviors (Hawkley et al., 2009), attest to the significant and concerning impact that loneliness has on health.

Understanding the pathways and processes that link loneliness to poor health outcomes is crucial for reducing its harmful effects. Researchers have proposed a number of possible mechanisms linking loneliness to health (e.g., Cacioppo et al., 2002), including biological and stress-related factors (Jaremka et al., 2013), and health-related behavioural factors (Shankar et al., 2011). However, investigations examining the role of health behaviors for explaining the effects of loneliness on poor physical health have mainly focused on physical inactivity (Broen et al., 2023; Cacioppo et al., 2002; Christiansen et al., 2016; Hawkley et al., 2009), and health-risk behaviors such as smoking (Christiansen et al., 2016). The links between loneliness and eating behaviors, or the possible processes involved, are less well understood, owing in part to inconsistencies in the way that eating behaviors are defined and studied. These are important gaps to address given that maintaining a healthy diet is key for reducing the risk of obesity, diabetes, cardiovascular disease, and even some cancers (World Health Organization, 2015), and therefore making poor dietary choices can increase risk for a range of physical health conditions. Of particular con-

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cern is a preference for eating energy dense palatable foods as this is linked to overeating, a key contributor to obesity (Morris et al., 2015). In the current research we therefore examined the effects of loneliness on preferences for palatable versus healthy foods, and the psychological processes that may explain this proposed association.

Loneliness and eating-related behaviors

Research into how loneliness may impact eating behaviors has often focused on eating behavior in the context of health behaviors more generally, or with respect to disordered eating patterns and eating disorders. The quality of dietary choices is not often considered. For example, in a 7-day experience sample study conducted with undergraduate students, loneliness was not associated with health behaviors, including eating behaviors (Hawkley et al., 2003). However, only the frequency of eating and time spent eating were assessed; the type of food eaten was not considered. Similarly, a longitudinal study conducted with a large representative sample during the COVID-19 pandemic found that loneliness was linked to persistently eating more over the 2 months of the study (Herle et al., 2021). Other investigations that have only considered eating behavior with respect to disordered eating patterns and have found that loneliness is linked to unrestrained eating. For example, in one study dieters exposed to a loneliness mood induction ate more cookies than those in the neutral condition (Rotenberg and Flood, 1999), suggesting that loneliness may interfere with attempts to control eating and sticking to a healthy diet.

There is also some evidence suggesting that loneliness is linked to preferences for eating palatable foods. Highly palatable foods are energy dense, tasty, and typically high in sugar, salt or fat, making them a primary choice for hedonic eating (Burgess et al., 2014), and also difficult to regulate due to this palatability (Thomas et al., 2011). For example, in one population-based study higher levels of chronic loneliness were associated with higher consumption of sugary beverages (Henriksen et al., 2014). In another study investigating the health behaviors of undergraduate students, loneliness was associated with having a higher fat diet (Jiang et al., 2022). Taken together, these findings provide preliminary support for the proposition that loneliness may confer vulnerability for eating highly palatable rather than healthy foods.

Loneliness and motives for eating palatable food

Understanding the reasons why loneliness may influence eating behaviors, and in particular a possible preference for highly palatable foods, is an important goal for addressing the health consequences of loneliness. A self-regulation perspective may hold some promise for providing insights into the processes involved. Health behaviors are often viewed as the prototypical self-regulation task (Baumeister et al., 1994), as they involve setting goals (e.g., eating a healthier diet), monitoring progress towards reaching goals (e.g., tracking the reductions in sugar intake), as well as shielding these goals from potentially derailing temptations (e.g., turning down an offer of chocolate cake). There are a number of reasons why people may struggle with regulating their health behaviors, including being in an obesogenic environment that is filled with tempting stimuli (Watson et al., 2016). However, one factor that is well-known to disrupt self-regulation in general, and with respect to health behaviors specifically, is negative affect (Wagner and Heatherton, 2015). Negative affect is particularly relevant for understanding why loneliness may compromise health behaviors as a robust evidence base links loneliness to negative affective states, including depression and anxiety (Cacioppo et al., 2010, 2006a; Lim et al., 2016).

One way that the experience of negative emotional states can disrupt self-regulation is by shifting the focus away from future goals and towards more immediate concerns (Wagner and Heatherton, 2015). Because thinking about the future is a key factor that contributes to all components of self-regulation (Baird et al., 2021), this shift in attention towards the present can weaken self-regulation. In effect, negative affect facilitates a temporal trade-off whereby resources are redirected from thinking about and working to reach future goals, towards focusing on securing immediate rewards. Negative affect is also linked to increased preferences for immediate rewards over later rewards, as well as heightened sensitivity to rewards, including food (Wagner and Heatherton, 2015). In short, when presented with palatable and tempting food options, the negative affect that characterises loneliness depletes self-regulatory capacity to monitoring current behaviors and resist tempting food options, resulting in self-regulation failure. Taken together, both theory and evidence suggest that high levels of negative affect may explain why loneliness is linked to a preference for eating palatable foods.

Alternatively, loneliness may heighten preferences for palatable foods because of their coping value. The immediate pleasure experienced from eating palatable foods may be a way to cope with the negative emotions associated with feeling lonely. This proposition is consistent with a systematic review which found that loneliness was consistently associated with greater use of emotion-focused coping styles (Deckx et al., 2018), and with evidence indicating that loneliness is linked to emotional eating in adolescents (Mason, 2020). In essence, palatable foods serve an emotion regulation function, with the goal being to down-regulate negative emotions (Gross & Thompson, 2007). Although this explanation also involves prioritizing short-term mood regulation over long-term health goals, it focuses specifically on using palatable foods for coping with negative states as opposed to the disruption of self-regulatory processes by negative states.

The current research

A growing evidence base has highlighted the relevance of loneliness for key health outcomes, including health behaviors. Yet despite this evidence, research investigating how loneliness may impact eating behaviors, or the possible processes involved, is scant and inconsistent in terms of how it conceptualises eating behaviors. The current research aimed to address this important gap and extend current knowledge on the health consequences of loneliness by examining how loneliness was associated with preferences for palatable versus healthy foods. We chose to examine palatable food preferences rather than more general eating behaviors as a preference for palatable foods is a key component of hedonic eating (Burgess et al., 2014), which in turn plays a significant role in the development of overweight and obesity (Ribeiro et al., 2018).

Across two studies, we tested whether loneliness is associated with favouring palatable over healthy foods, and two possible explanatory pathways. Consistent with theoretical views of the disruptive role of negative affect on self-regulatory processes and abilities, including temporal thinking and susceptibility to temptations (Baird et al., 2021; Wagner and Heatherton, 2015), we hypothesised that loneliness would be associated with preferences for palatable over healthy foods in a food choice task, and that higher levels of negative affect would account for this preference (*self-regulation failure hypothesis*). Alternatively, given the known links between loneliness and emotion-focused coping (Deckx et al., 2018), and the mitigating effects of hedonic eating on negative mood (Burgess et al., 2014), we hypothesised that using palatable foods as a strategy for coping with negative affect would explain the proposed link between loneliness and preferences for palatable foods in a food choice task (*coping hypothesis*). In Study 1, we examined the dispositional-correlational link between loneliness and palatable food preferences using a forced-choice food image task. Study 2 replicated and extended the methods from Study 1 using snack images instead of meals, and additionally testing the situational-experimental associations between loneliness and preferences for palatable foods.

Table 1
Correlations among Measured Variables in Study 1.

					Correlation with			
	Scale	α	*M*	*SD*	2	3	4	5
1	Chronic loneliness	.92	1.99	0.54	.40***	.22***	.08	.02
2	Negative affect	.85	1.81	0.83	–	.21***	.06	−0.11**
3	Coping via eating palatable foods	.88	2.09	0.89		–	.21***	−0.19***
4	Palatable foods preference	–	1.86	1.10			–	−0.22***
5	Age		23.07	9.10				–

Note. ***$p < .001$.

Study 1

Method

Participants and procedures

After receiving ethical clearance, 365 participants were recruited using social media and the university's SONA student participation system to take part in a study about how social status can affect one's nutritional choices (this being the cover study to not reveal the true aims of the research). Those interested in taking part were directed to an online consent form, and after giving consent, were asked to complete an online questionnaire hosted on Qualtrics. Participants who completed the questionnaire were given an opportunity to enter a draw to win a £25 voucher. Participants had to be 18 years of age and without a history of eating disorders.

Participants who provided the same responses when completing the majority of the scales ($N = 4$), were excluded. This left a final sample of 361 participants (284 women, 75 men, 2 other) aged between 18 and 71 years ($M = 23.07$, $SD = 9.10$), whose ethnicity was predominantly white (66.1%), with the majority (89%) identifying as meat/fish eaters.

Materials

In addition to basic demographic questions about age, sex, ethnicity, and dietary preference (meat/fish-eater vs. vegan/vegetarian), participants completed the following measures. Descriptives and reliability values for each scale appear in Table 1.

Chronic loneliness. The 20-item UCLA revised loneliness questionnaire (Russell et al., 1980) assesses persistent feelings of loneliness. Items such as "I feel left out," and "I feel isolated by others" are rated on a 4-point scale (1 = *never*, 4 = *often*). After reverse scoring relevant items, a mean score is calculated for the 20 items with higher scores reflecting a greater degree of chronic loneliness. The UCLA revised loneliness scale has demonstrated good psychometric properties in previous research with Coefficient alpha ranging from 0.89 to 0.94, and good test-retest reliability over a 1-year period ($r = 0.73$) (Russell, 1996).

Negative affect. General negative affect was assessed with the 5-item negative affect subscale from the 10-item International Positive and Negative Affect Schedule Short-Form (I-PANAS-SF) (Thompson, 2007). The I-PANAS-SF is a short-form version of the original 20-item PANAS (Watson et al., 1988), with all items chosen from the original scale. The five adjectives (e.g., "nervous," "upset,") are rated on a 5-point scale (1 = *not at all/very slightly*, 5 = *extremely*), with scores averaged to get a total score reflecting higher levels of state negative affect. The I-PANAS-SF has demonstrated adequate psychometric properties in previous validation studies (Thompson, 2007).

Coping motives for eating palatable foods. The 5-item coping subscale from the revised 20-item Palatable Eating Motives Scale (PEMS; Boggiano, 2016) assessed eating palatable foods as a means of coping with negative emotions. The PEMS presents examples of palatable foods and asks participants to think about how often they have eaten these foods for the reason listed. Items such as "I consume these foods/drinks to forget my worries," and "I consume these foods/drinks to forget about my problems" are rated on a 5-point scale (1 = *never/almost never*, 5 = *almost always/always*) with scores averaged to reflect stronger motives for eating palatable foods to cope with negative emotions. The PEMS coping subscale has demonstrated good psychometric properties in previous research (Boggiano, 2016).

Preferences for palatable versus healthy foods. Preferences for eating palatable vs. healthy foods were assessed with a paired food image task. Participants were presented with pairs of images depicting either a healthy or palatable meal and the forced choice question "Which would you prefer to eat right now?" and the option to select the meal on the left or the right for each of the four paired image sets. The presentation of the healthy/palatable image pairs were randomised and each of the meal pairs were aligned with the participants' self-selected dietary preferences - vegetarian/vegan vs meat/pescatarian. The food choices were coded so that palatable choices are coded "1″ and healthy choices were coded as "0″. A sum of the palatable food choices across the four image pairs was used to create an index of palatable food preferences.

Results and discussion

The data analysis for this study was pre-registered on the Open Science Framework (OSF; https://osf.io/65akr). Data are available upon reasonable request on the OSF (https://osf.io/4 g3p7).

Preliminary analyses

Missing data. The proportion of missing data was 0.6%. To test whether there was a pattern to the missing data, we conducted the Little's MCAR test. The test was not significant, $\chi^2 = 861.07$, $df = 802$, $p = .073$, meaning that the data were missing at random. Accordingly, we used a linear interpolation to replace missing values.

Main analyses

Zero-order correlations. First, we examined the relations among chronic loneliness, negative affect, coping with negative emotions through eating palatable foods, and preferences for palatable over healthy food (Table 1). As expected, chronic loneliness was significantly and positively related to negative affect and coping with negative emotions through eating palatable foods. Additionally, coping with negative emotions through eating palatable foods was significantly and positively related to negative affect as well as preference for palatable over healthy foods. We also tested whether age was related to the main study variables to determine whether it was needed to be controlled for in the test of the indirect effects. Age was significantly and negatively related to negative affect, coping with negative emotions through eating palatable foods, and palatable food choice.

Tests of the indirect effects. Next, we tested the indirect effects of chronic loneliness on preferences for palatable over healthy food via negative affect (*self-regulation failure hypothesis*) and/or coping with negative emotions through eating palatable foods (*coping hypothesis*). We conducted a bootstrapped mediation analysis using 10,000 resamples, with two parallel mediators using PROCESS (Model 4; Hayes, 2013). As illustrated in Fig. 1, the direct effects from chronic loneliness to coping

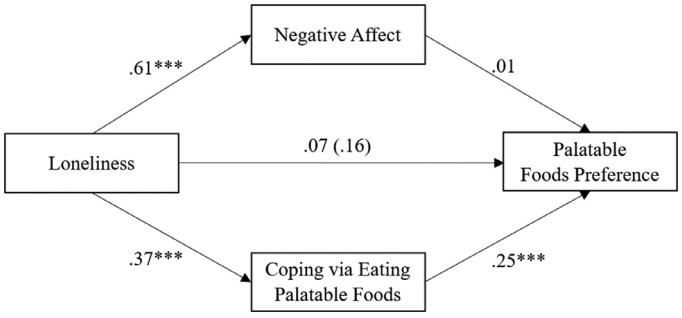

Fig. 1. Indirect effect of chronic loneliness on preference for palatable over healthy foods via negative affect and coping with negative emotions through eating palatable foods. Note. $^{***}p < .001$.

with negative emotions through eating palatable foods and from the latter to preferences for palatable over healthy foods were both significant. In support of the coping hypothesis, the indirect effect (denoted as *ab*) through coping motives was also significant, $ab = 0.0923$, $SE = 0.0324$, 95% CI = [0.0417, 0.1732] (Fig. 1). However, the analysis did not reveal support for the self-regulation failure hypothesis as the indirect effect of chronic loneliness on preferences for palatable foods via negative affect was not significant, $ab = 0.0011$, $SE = 0.0500$, 95% CI = [−0.0928, 0.0986]. The results remained the same when age was entered into the analysis as a covariate.

Together these findings support the proposition that chronic loneliness is linked to eating palatable foods due to coping motives, which in turn contributes to preferences for eating palatable versus healthy foods.

Study 2

The findings from Study 1 supported a coping hypothesis but not a self-regulation hypothesis for explaining why loneliness may be associated with preferences for palatable foods. Although the indirect effects through coping motives were significant, the direct effect of loneliness on palatable food preferences was not. In Study 2 we aimed to address whether this finding was due to the way palatable food preferences were assessed by using images of palatable versus healthy snacks matched to participants preferences for sweet or savoury snacks. Additionally, we expanded on the forced choice question about food preference by including preference ratings for each of the palatable and healthy snack options as an alternative way of examining food preferences. We also used a measure of general health behaviors that included eating and exercise to examine how loneliness was linked with general health behaviors, with the expectation that there would be a negative association. Lastly, we expanded on the correlational-dispositional links between loneliness and food preferences in Study 1 by also taking an experimental-situational approach to investigating the effects of loneliness on food choices in Study 2, with the aim of replicating the findings by inducing state loneliness.

Methods

Participants

After receiving ethical clearance, potential participants were recruited via notices placed on the University volunteers list, social media, and on websites that advertised online psychological research to take part in a study ostensibly about how self-perceptions relate to preferences for weight management behaviors. People who were 18 and currently engaged in weight maintenance behaviors (e.g., watching what they eat) were eligible to participate. Anyone who had been diagnosed with an eating disorder were not eligible to participate. Participants who complete the study were given an opportunity to enter a draw to win a £25 Amazon voucher.

We recruited 164 participants, from whom we excluded one participant who provided the same responses when completing the majority of the scales. The final sample consisted of 163 participants (125 women, 36 men, 2 other) aged between 18 and 74 years ($M = 29.85$, $SD = 11.93$; two participants did not provide their age), who were predominantly white (68.1%), with the majority (63%) having a preference for sweet snacks.

Materials

In addition to basic demographic questions about age, sex, ethnicity, and snacking preference (sweet vs. savoury), participants completed the following measures. Descriptives and reliability values for each scale appear in Table 2.

Chronic loneliness. The 20-item UCLA revised loneliness questionnaire (Russell et al., 1980) was used to assess chronic loneliness as in Study 1.

Coping motives for eating palatable foods. The 5-item coping subscale from the revised 20-item Palatable Eating Motives Scale (PEMS; Boggiano, 2016) was used to assess eating palatable foods as a means of coping with negative emotions as in Study 1.

Negative affect. For Study 2 we used a 10-item version of the Center for Epidemiological Studies Depression (CES–D) scale (Radloff, 1977) to assess negative affective states. The CES-D assesses the frequency of depressive symptoms over the past two weeks with the items being rated on a 4-point scale (i.e., "you felt depressed," "you could not get going"; 1 = *rarely or none of the time*, 4 = *most of or all of the time*). The 10-item version has demonstrated good reliability in previous research (Sirois et al., 2006).

General health behaviors. The *Wellness Behaviors Inventory* (WBI) (Sirois, 2001) is a 12-item measure that assesses how often common health-promoting behaviors (e.g., healthy eating, exercising) are performed in a week. Items such as "I eat healthy, well-balanced meals", and "I take time to relax" are rated on a 5-point scale (1 = *less than once a week or never*, 5 = *every day of the week*). Ten of the 12 items are

Table 2
Correlations among measured variables in study 2.

					Correlation with						
	Scale	α	*M*	*SD*	2	3	4	5	6	7	8
1	Chronic loneliness	.94	1.97	0.61	.66***	.26**	−0.27**	−0.10	.01	.09	−0.05
2	Depressive symptoms	.90	2.03	0.69	–	.51***	−0.38***	−0.02	−0.01	.06	−0.23**
3	Coping via eating palatable foods	.90	2.11	0.99		–	−0.23**	.15†	−0.25**	.21*	−0.20*
4	Health-promoting behaviors	.73	3.34	0.63			–	−0.10	.18*	−0.11	.16*
5	Palatable foods preference	–	5.03	2.00				–	.01	.14†	.07
6	Healthy foods preference	–	5.92	1.32					–	−0.54***	−0.05
7	Healthy vs. palatable foods preference	–	–	–						–	.02
8	Age	–	29.85	11.93							–

Note. † $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$. Correlations with preference for palatable over healthy foods are point-biserial (healthy foods = 1, palatable foods = 2).

used to calculate the total score for the WBI, with higher scores indicating more frequent practice of health-promoting behaviors. The WBI has demonstrated good psychometric properties in previous research (Sirois, 2007).

State loneliness. Changes in momentary feelings of loneliness were assessed with three items that served as a manipulation check for the loneliness manipulation. Participants rated the three statements "I feel lonely," "I feel isolated from others," and "I feel like I belong" on a 7-point Likert scale (1 = *not at all*; 7 = *very much*) before the loneliness manipulation ($\alpha = 0.84$) and after the loneliness manipulation ($\alpha = 85$).

Preferences for palatable and healthy foods. Participants preferences for healthy or palatable foods was assessed with a single item "how much do you like these snack foods?" rated on a 7-point scale (1 = *not at all likely*, 7 = *very likely*) presented after each snack image. Ratings for the palatable snacks were used to assess preferences for palatable foods, and the ratings for the healthy snacks were used to assess preferences for the healthy foods.

Preference for palatable over healthy foods. Preferences for palatable versus healthy foods was assessed with a forced choice question presented alongside a pair of snack images showing healthy options on one side, and palatable options on the other. Participants were asked "If you had to snack right now, which type of snack would you choose?" and and the option to select the meal on the left or the right for each of the four paired image sets. The presentation of the healthy/palatable snack image pairs were randomised and each of the snack pairs were aligned with the participants' self-selected snack preferences – sweet versus savoury. The food choices were coded so that palatable choices are coded "1″ and healthy choices were coded as "0″.

Procedure

After completing measures of chronic loneliness coping motives, negative affect, and general health behaviors, participants were randomised to a loneliness versus belongingness recall writing task based on instructions used in previous research (Cacioppo et al., 2006b). Those in the loneliness condition were instructed to "Please write about a time in which you felt isolated; you felt lonely; perhaps you felt like you just didn't belong—that you had no friends." Whereas those in the belongness condition were instructed to "Please write about a time in which you felt a sense of belonging; perhaps you were a member of a group; perhaps you had a best friend with whom you felt you could share anything." Following this, participants again completed the three items assessing state loneliness. Next, participants were presented with an image showing a set of palatable snacks (either sweet or savoury depending on their self-selected snack preference) and an image with a set of healthy snacks, and asked to rate their preferences. The presentation order of the palatable and healthy snack sets was randomised to reduce order effects. Next, they were presented with an image showing paired palatable and healthy snacks and asked to choose which they would like to eat. Lastly, all participants were provided with a mood neutralization task which consisted of the instructions for the belongness condition, and then were redirected to the study debrief and draw page.

Results and discussion

The data analysis for this study was pre-registered on the OSF (https://osf.io/h4fbs). Data are available upon request on the OSF (https://osf.io/4 g3p7).

Preliminary analyses

Missing data. The proportion of missing data was 4.0%. To test whether there was a pattern to the missing data, we conducted the Little's MCAR test. The test was not significant, $\chi^2 = 1022.42$, $df = 1001$, $p = .312$, meaning that the data were missing at random. Accordingly, we used a linear interpolation to replace missing values.

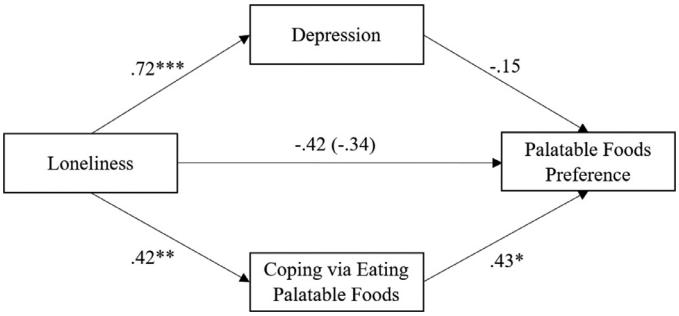

Fig. 2. Indirect effects of chronic loneliness on preference for palatable foods via depressive symptoms and coping with negative emotions through eating palatable foods.

Manipulation check. To test whether the loneliness manipulation was effective for increasing state loneliness, we conducted a 2 (manipulated loneliness: loneliness vs. belongingness) x 2 (time: before vs. after the manipulation) mixed Analysis of Variance (ANOVA) with levels of state loneliness as the dependent variable. This analysis revealed no main effects of the loneliness manipulation, $F(1, 125) = 0.04$, $p = .835$, $\eta^2 = 0.001$, or time, $F(1, 125) = 0.15$, $p = .697$, $\eta^2 = 0.001$, and the interaction between manipulated loneliness and time was not significant, $F(1, 125) = 0.92$, $p = .340$, $\eta^2 = 0.007$. Given these null findings for the loneliness manipulation, it was not possible to examine the proposed effects of state loneliness on food choices.

Main analyses

Zero-order correlations. First, we examined the associations among chronic loneliness, depressive symptoms, coping with negative emotions through eating palatable foods, practice of health-promoting behaviors, preferences for healthy and palatable foods, and preference for palatable over healthy foods (Table 2). Similar to the findings for Study 1, chronic loneliness was significantly and positively related to depressive symptoms, coping with negative emotions through eating palatable foods, and negatively related to engaging in health-promoting behaviors. Additionally, coping with negative emotions through eating palatable foods was significantly and positively related to depressive symptoms, preference for palatable foods, preference for palatable over healthy foods, and negatively related to engaging in health-promoting behaviors and preference for healthy foods. Age was also significantly and negatively related to depressive symptoms, coping with negative emotions through eating palatable foods, and positively associated with engaging in health-promoting behaviors.

Tests of the indirect effects. Next, we conceptually replicated the analyses conducted in Study 1 by testing the indirect effects of chronic loneliness on preference for palatable foods and preference for palatable over healthy foods via depressive symptoms and coping with negative emotions through eating palatable foods. Specifically, we conducted two separate bootstrapped mediational analyses (with 10,000 resamples) with two parallel mediators using PROCESS (Model 4; Hayes, 2013). Mirroring the findings from Study 1, the direct effects from chronic loneliness to coping with negative emotions through eating palatable foods and from the latter to preference for palatable foods were both significant (Fig. 2). The indirect effect through coping was also significant, $ab = 0.1831$, $SE = 0.1027$, 95% CI = [0.0338, 0.4680]. In contrast, the indirect effect of chronic loneliness on preference for palatable foods via depressive symptoms was not significant, $ab = -0.1046$, $SE = 0.2438$, 95% CI = [−0.5576, 0.4092]. The results remained essentially the same when controlling for age.

Regarding preference for palatable over healthy foods, the direct effects from chronic loneliness to coping with negative emotions through eating palatable foods and from the latter to preference for palatable

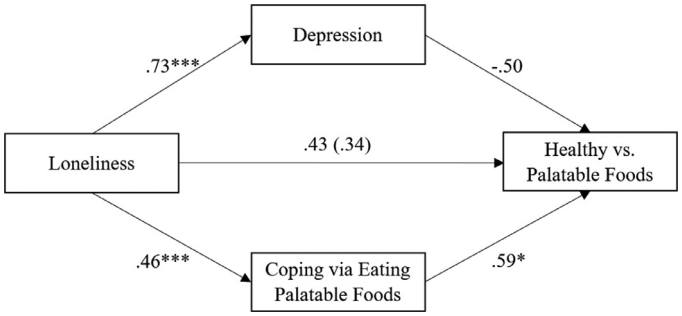

Fig. 3. Indirect effects of chronic loneliness on preference for palatable over healthy foods (healthy foods = 1, palatable foods = 2) via depressive symptoms and coping with negative emotions through eating palatable foods.

over healthy foods were both significant (Fig. 3). The indirect effect was also significant, $ab = 0.2738$, $SE = 0.1567$, 95% CI = [0.0441, 0.6665]. Here again the indirect effect of chronic loneliness on preference for palatable over healthy foods via depressive symptoms was not significant, $ab = -0.3654$, $SE = 0.3805$, 95% CI = [−1.1796, 0.3375], and the results remained the same when controlling for age.

Because the loneliness manipulation was not effective, it was not possible to test whether state loneliness had similar effects on coping motives and palatable food choices. Nonetheless, the findings from this study mirrored those from Study 1 and provide additional support for the proposition that chronic loneliness is associated with eating palatable foods due to coping motives, which in turn contributes to preferences for eating palatable versus healthy foods.

General discussion

The overarching aim of the current research was to examine the contributions of loneliness to a specific and important aspect of eating behavior, namely preferences for eating palatable foods. In addition, we sought to test two competing hypotheses that might explain the proposed links between loneliness and preferences for palatable foods, a *self-regulation failure hypothesis,* and a *coping hypothesis*. Across two studies, which used different measures of negative affect and different food preference options, we found consistent support for the role of coping with negative mood as a key motive linking loneliness to preferences for eating palatable foods. Although loneliness was associated with higher levels of negative affect in both studies, negative affect did not link loneliness to preferences for eating palatable foods in either study. Taken together, these findings suggest that when people feel lonely, they may use palatable foods to help them cope with the unpleasant feelings that accompany loneliness.

Our findings make several important contributions to our understanding of loneliness and its health implications. First, our findings highlight that loneliness may create risk for poor health through preferences for eating energy dense foods high in sugar, fat and salt, as a means of coping with the negative emotions associated with feeling lonely. Such foods can pose a significant risk to health due to their role in hedonic eating (Burgess et al., 2014), and the links between hedonic eating and obesity (Morris et al., 2015). Importantly, there is evidence that using palatable foods to cope with negative emotions in particular creates more risk for obesity than other motives for eating palatable foods. For example, in a sample of undergraduate students, only scores on the PEMS eating palatable foods to cope with negative emotions distinguished healthy weight from overweight students, and were highest amongst obese and severely obese students (Boggiano, 2016). PEMS coping scores were also associated with higher body mass index (BMI) in this study and others examining the PEMS (Burgess et al., 2014). Similarly, eating to cope was associated with corresponding weight gain during the pandemic (Mason et al., 2021), a time when social isolation and loneliness increased.

The current research also extends our understanding of the strategies that lonely people use to cope with the distress they experience. A systematic review of loneliness and coping strategies found that loneliness was associated with greater use of emotion-focused coping strategies such as avoidance, hopelessness, and emotive coping (Deckx et al., 2018). To the best of our knowledge, the current research is the to first document a link between loneliness and eating palatable foods as a means to cope with emotions, which can be considered another form of emotional coping. From this perspective, eating palatable foods becomes a means to and end, by offering the option to “feel good now” rather than endure the negative emotions associated with feeling lonely. However, the collateral damage to health from using this particular form of emotional coping makes it potentially more harmful than other forms of emotional coping, and therefore worth further investigation.

Despite the novelty of these findings, it is important to note that chronic loneliness was indirectly but not directly linked to preferences for palatable foods in both studies. Prior work has shown that it is possible to find a significant indirect effect if there is non-significant direct effect (Hayes, 2013; MacKinnon et al., 2000). Additionally, we obtained evidence for each path of the proposed model. Specifically, chronic loneliness was consistently associated with using palatable foods to cope with negative emotions, and negative emotions were in turn associated with preferences for palatable foods in the food preference tasks in both studies. Regardless, there are several possible explanations for the lack of significant direct effects. Viewing a food as palatable food involves making a positive hedonic evaluation about the sensory characteristics of the food (Yeomans, 1998). This evaluation is based on a number of factors including past memories of eating that food, as well as sensory cues, such as odor and visual presentation (McCrickerd and Forde, 2016). In the current research, participants were asked to report their preferences for foods shown in a visual format only, with no other sensory information. This may have limited their evaluation of the palatability of the foods presented, especially if these were foods for which they had little previous experience eating. This seems plausible if we consider that previous research in which participants were presented with actual palatable food in the form of cookies found that those who were induced to feel lonely ate more cookies compared to those who were not induced to feel lonely (Rotenberg and Flood, 1999). Research that replicates the current findings using real food rather than images is therefore needed to gain a more complete understanding of the impact of loneliness on palatable food choices.

The use of food images rather than real food choices also offers an alternative explanation for the lack of support for the self-regulation hypothesis in both studies. Rating preferences and regulating which of the two images of palatable foods participants would like to eat, with no opportunity to eat, is not qualitatively the same as actually exerting self-control to regulate behavior in real time. As well, controlling impulses regarding food choices is much more difficult in the presence of strong food cues that signal palatability, such as pleasant food odors (McCrickerd and Forde, 2016). It is possible that without a strong self-control challenge, there was little to self-regulate and therefore less chance that examine the hypothesised role of negative affect for disrupting self-regulation.

Limitations and strengths

The current findings need to be considered in the context of several limitations. As mentioned above, the food choice task used images rather than real food, which may have impacted the evaluations of the palatability of the food, and therefore the ratings of food preferences used in the analyses. In addition, the loneliness manipulation used in Study 2 was not effective, and therefore it is unclear whether the findings are applicable for momentary feelings of loneliness as well as for chronic loneliness. There is some evidence that momentary loneliness may im-

pact food choices (Rotenberg and Flood, 1999), and emotional eating (Mason et al., 2021). However, further research is needed to examine the impact of induced loneliness on palatable food preferences.

Although we found that age did not impact the overall findings in both studies, it is worth noting that the samples used for both studies were relatively young, with mean ages below 30. It is therefore unclear whether our conclusions would also hold for older adults, a segment of the population for which loneliness is prevalent (Chawla et al., 2021; Victor and Yang, 2012). Older adults face a number of social and physiological challenges that can reduce appetite and therefore their desire for eating palatable foods (Donini et al., 2003). Indeed, we found that age was negatively associated with using palatable foods to cope with negative emotions in Study 1 as well as negatively linked to palatable food choices and positively linked to practice of health-promoting behaviors in Study 2. Accordingly, our findings may not be generalizable to older adults.

Strengths of the current research include replicating the findings across two studies using different methods. The *self-regulation failure hypothesis* was tested using two different measures of negative affect across the two studies, general negative affect and depressive symptoms, with parallel results. We also used the same forced choice food preference task across both studies, but then supplemented this with a continuous measure of palatable food preferences in Study 2, which produced similar results for the tests of both the *coping hypothesis* and the *self-regulation failure hypothesis*. These slight changes increase confidence that the findings can be replicated across different research methods.

Conclusion

Overall, our findings make novel contributions to current understandings of the role of loneliness in health behaviors and coping. Across the two studies, chronic loneliness was associated with a greater tendency to use palatable foods to cope with negative emotions, which in turn was associated with greater preference for palatable over healthy foods. Further research is needed to validate our findings using real food rather than food images, and with more diverse samples with respect to age. Nonetheless, our research provides new insights for understanding the behavioural pathways and processes linking loneliness to poor health outcomes that can be useful for addressing the harmful health effects of this growing public health issue.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability statement

The data and materials for both studies are available on the Open Science Framework website, by reasonable request: https://osf.io/4g3p7.

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