Larger portions make me eat more: Awareness of the external factors that influence food intake

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ABSTRACT

There is consistent evidence that the amount of food people consume can be influenced by external factors, such as food portion size or the amount of food others are eating. However research studies to date have suggested that people are generally unaware of the influence that these external factors have on food intake. In the present research we directly tested whether consumers are aware of how external factors can affect their food intake. In Study 1 we re-analysed data from a study in which an effect of portion size on food intake was observed and post-consumption, participants were asked whether they believed portion size had influenced their food intake. In Study 2 participants were asked to indicate whether several different external factors known to increase food intake would be likely to increase, decrease or have no effect on how much they would eat in hypothetical scenarios. In Study 1, a large proportion of participants (56%) believed that their food intake was influenced by portion size. In Study 2, a large proportion of participants accurately identified that external factors known to affect eating behaviour would be likely to increase their food intake: portion size (73%), social influence (40%), food variety (75%), and distraction (59%). Together these results suggest that consumers show awareness of the influence that external factors have on their food intake.

INTRODUCTION

The amount eaten during a meal is influenced by several factors. For example, pre-meal hunger predicts ad-libitum meal intake (Bellisle, Lucas, Amrani, & Lemagnen, 1984; Sadoul, Schuring, Mela, & Peters, 2014). Factors in the 'external' environment can also influence eating behaviour. There is consistent evidence that consumers eat more when meals contain a variety of different flavours (Raynor & Epstein, 2001; Remick, Polivy, & Pliner, 2009), when they are distracted during eating (Bellisle, Dalix, & Slama, 2004; Temple, Giacomelli, Kent, Roemmich, & Epstein, 2007), if they eat in the presence of someone who eats a large amount of food (Vartanian, Spanos, Herman, & Polivy, 2015) and when served larger portion sizes (French et al., 2014; Hollands et al., 2015; Zlatevska, Dubelaar, & Holden, 2014).

There is some evidence to suggest that people may be largely unaware of the influence that external factors have on their food intake (Spanos, Vartanian, Herman, & Polivy, 2014; Vartanian, Herman, & Wansink, 2008; Vartanian, Sokol, Herman, & Polivy, 2013). First, participants in laboratory studies appear relatively insensitive to the effects of eating different sized portions (e.g., Levitsky & Youn, 2004; Rolls et al., 2002) and may therefore not identify that they have over or undereaten due to external factors. In addition, when asked why they have eaten the amount of food consumed, participants in these laboratory studies often cite internal cues as the drivers for their food intake (e.g. hunger, satiety, taste) rather than external factors, such as the portion size (Cavanagh, Vartanian, Herman, & Polivy, 2014; Vartanian, Herman, & Wansink, 2008; Vartanian, Sokol, Herman, & Polivy, 2013; Vartanian, Spanos, Herman & Polivy, 2017). Using a different study design, Myers, Brunstrom,. Rogers & Holtzman (2019) also found that members of the Samburu tribe in Kenya who ate two separate sized portions of food on alternate days, had difficulties identifying on which day they had consumed the larger of the two portions.

However, several other studies suggest that consumers do show some awareness of external influences on food intake. Keenan, Childs, Hetherington, Rogers, & Brunstrom (2018) used a computerised version of 'a method of constant stimuli' to estimate how much participants intended to consume of three separate foods. After being served either a large or small portion of one of these foods and eating until comfortably full, participants were asked to indicate if they believed that had eaten less ore more than the amount they had earlier identified as their intended intake amount. Most participants could accurately identify if they had eaten less or more than their intended intake amount, indicating some level of awareness. Similarly, Robinson and Field (2015) analysed data from a study examining the influence that social norms have on food intake (Robinson, Sharps, Price, & Dallas, 2014). After eating, participants were asked whether they believed the amount they had consumed was socially influenced. In total, 34% of participants believed they had been influenced. Critically, these participants appeared to be correct: the amount of food consumed by participants who reported social influence, was affected by the amount eaten by other people. In contrast, for those reporting no social influence, there was no evidence that their food intake had been influenced by the amount others had eaten. Together, these findings indicate that participants in laboratory studies are to some extent aware of how much they consume when influenced by external factors.

A potential explanation for these contradictory results could lie in the different types of questions used to address awareness of external influences on food intake. Several of the studies showing that people unknowingly over-consume have asked participants how the amount they ate compared to their typical portion, as opposed to directly asking about awareness of having been influenced by an external factor. Several other studies have asked participants post-meal to select the reason for the amount of food they consumed from a list including internal cues (e.g. hunger) and external cues (e.g. portion size, social factors)

(Vartanian, Herman, & Wansink, 2008; Vartanian Sokol, Herman, & Polivy, 2013; Vartanian, Spanos, Herman & Polivy, 2017; Vartanian, Reily, Spanos, Herman, & Polivy; 2017). In general, factors such as taste or liking are selected as the most important influences on meal intake, whilst external factors like how much others ate, are rarely selected, when this method is adopted. In contrast, in Keenan, Childs, Hetherington, Rogers, & Brunstrom (2018) participants were directly asked if they were aware of having eaten more or less than their initial plan. Similarly, in Robinson & Field (2015) participants were directly asked whether the amount they ate was influenced by the information they saw about the number of cookies other participants had eaten and a sizeable proportion of participants reported having been influenced by the number of cookies other participants had eaten. However, it should be noted that participants in Myers, Brunstrom,. Rogers & Holtzman (2019) were asked a similar direct question about which day they believed they had consumed the larger portion but still struggled to answer correctly, raising uncertainty about whether it is the nature of the question asked

A further factor that may play a role in whether or not consumers report that their food intake has been influenced by external factors is social desirability. Vartanian, Reily, Spanos, McGuirk, Herman and Polivy (2017) concluded that consumers may acknowledge the influence of external cues on food intake under specific conditions. Namely, that consumers will report external influence for self-serving purposes; e.g. to justify over-eating. Moreover, Vartanian and colleagues report empirical data that supports this proposition; in one study participants who believed they had overeaten were more likely to acknowledge the influence of portion size than participants who believed they had not overeaten (Vartanian, Reily, Spanos, Herman & Polivy, 2017). Thus, although it is clear from these studies that consumers will sometimes report external influence on their food intake, whether or not

reports of awareness of influence are likely to be accurate (or merely self-serving) is questionable.

The present studies examined whether consumers are aware of the influence that external factors can have on food intake. In Study 1 we aimed to extend the finding of Keenan, Childs, Hetherington, Rogers, & Brunstrom (2018) by examining whether a sizeable proportion of participants in a laboratory study would report awareness of their food intake being influenced by portion size shortly after eating. Participants reports of influence using this method may be explained by participants using portion size 'as an excuse' for overeating. Thus, in Study 2 we examined whether participants appeared to be aware that external factors would influence their food intake when there would be no obvious self-serving purpose for reporting external influence. In Study 2, participants completed a survey on their beliefs about whether a variety of external factors (portion size, food variety, eating in the presence of someone who eats a large amount, being distracted while eating) would affect their food intake in hypothetical eating scenarios and if so, why. Across the two studies we predicted that when directly asked, a substantial proportion of participants would be aware that their food intake can be influenced by external factors.

STUDY 1

Overview

In Study 1 we reanalysed data from a previously published study (Robinson, te Raa, & Hardman, 2015) in which the effect that a larger (vs. smaller) portion size of ice cream had on ice cream intake was examined. Post-consumption, participants also reported on whether they believed the portion size had influenced their food intake. Because larger portion sizes are known to increase food intake, for the purpose of the present study our planned analysis

strategy made use of data from the large portion condition only[1] of Robinson, te Raa & Hardman (2015). We hypothesised that if consumers are aware of external influences on their food intake, a sizeable proportion should report that they were influenced by portion size. We also examined whether reports of being influenced by portion size were associated with the amount of food participants consumed. We hypothesised that if participant reports of being influenced were accurate, awareness should be most common among participants who ate large quantities when served a large portion of food.

Method

Original Study

For a detailed description of the method and results of the original study, see Robinson, te Raa, & Hardman (2015). In the original study 88 participants (44 male and 44 female) were recruited from the University of Liverpool and surrounding area in exchange for a small monetary reward. The main aim of the study was to examine whether pre-meal intentions (how much of a meal a person intends to eat) relate to actual meal intake. The study advertisement described the study as being about cognitive ability and mood in order to distract participants from the true aims of the study. Participants were informed that a lunch-time meal would be provided and they must have no history of any food allergies. The study was approved by the University's ethics board.

Procedure

Participants arrived for a lunchtime laboratory session and were seated in a cubicle alone. To corroborate the cover story of cognitive ability and mood participants first completed mood ratings, followed by a word search task that lasted 5 minutes. After this participants were served a standard sized sandwich and asked to indicate how much (as a percentage) of the

sandwich they intended to eat. After consuming the sandwich, participants were served either a smaller (approximately 75 grams, 62 kcals) or a larger portion of vanilla ice cream (approximately 175 grams, 145 kcals) in a bowl. Participants rated how much of the ice cream they intended to eat and were then told that they could eat as much or as little as they wanted. The bowl was weighed and re-weighed after consumption in order to calculate the amount eaten. After this, participants were provided with a final questionnaire which included questions about their experience during the study, including 'would you say that the amount of food you ate was influenced by the portion size of the food you were given?' with five response options: 'strongly disagree', 'disagree', 'unsure', 'agree', 'strongly agree'. Next, participants were asked to write down why they were (or were not) influenced. Participants then had their height and weight measured before being debriefed, reimbursed and thanked for their time.

Planned analysis (a-priori)

In order to characterise the numbers of participants reporting vs. not reporting being influenced by portion size, participants were first categorised as reporting they were influenced by portion size if they selected 'strongly agree' or 'agree' in response to the question asking them whether their food intake was influenced by portion size. Conversely, participants selecting 'strongly disagree' or 'disagree' were categorised as believing they had not been influenced. Participants who selected 'unsure' were categorised as being unsure. We planned to use a chi-square to examine whether the number of participants in each response category differed to chance expectation.

To examine whether participants reported being influenced by portion did eat more from a large portion size we planned linear regression analysis. Reporting of the influence of portion size on food intake was the dependent variable (continuous data). Ice cream intake (in

grams) was entered as a predictor variable and gender was also included as a predictor variable in the model because males consumed more than females in the original study.

Finally, for those participants that did report having been influenced, we examined the reasons why they believed they had been influenced. Two independent coders read participants' responses and identified any common explanations for the influence of portion size. Next, they independently coded each response to calculate the number of participants endorsing any of the commonly endorsed explanations. If there were any inconsistencies in coding, the two coders reached agreement on discussion.

Results

Participant Characteristics

The study sample size was determined by the number of participants that participated in the original experiment. Three of the 44 participants who were served the large portion of ice cream did not answer the question about the influence of portion size, resulting in a final sample of 41 participants (21 males, 20 females). The sample had a mean age of 33.2 years (SD = 12.2), and mean BMI of 25.6 kg/m^2 (SD = 4.3).

Reports of being influenced by portion size

Of the 41 participants, 56.1% (23/41) believed they had been influenced, 14.6% (6/41) were unsure, and 29.2% (12/41) did not believe they had been influenced by portion size. A chi-square test was significant (χ^2 (2) = 10.88, p = .004) indicating that the proportion of participants reporting influence, no influence or uncertainty about having been influenced significantly differed to chance expectation.

Relationship between food intake and reporting of having been influenced by portion size

Of the 175 grams of ice cream served, mean ice cream consumption was 102.7 grams (SD = 51.3). The overall regression model was significant (Adjusted R^2 = .12, p = .037). As predicted, participants who reported being aware that the size of the portion had influenced their intake, tended to eat more than those who reported no influence (standardised B = .43, p = .035). Gender did not significantly predict reports of having been influenced by portion size (standardised B = .05, p = .81). The unadjusted association between reports of being influenced by portion size and ice cream intake was r = .40, p = .010.

Explanations for why participants were influenced by portion size

One common theme was identified in participants' responses for why they were influenced by portion size; multiple participants reported that they were used to 'plate clearing' or trying to 'eat everything' served. When coding the presence of this explanation in each participant's response, the two independent coders had good inter-rater reliability (96.2% agreement) and agreed on the inconsistencies through discussion. In total, 34.8% (8/23) of participants endorsed this explanation for why their food intake had been influenced by portion size.

Discussion

In Study 1 we found that after being served a large portion of ice cream, a sizeable proportion of participants (56%) reported that they believed the amount they ate had been influenced by portion size. Moreover, participants who ate the most ice cream from the large portion were more likely to report having been influenced. In addition, when asked to explain why they thought their food intake had been influenced by portion size, a number of participants reported that this was because they wanted to try and clear their plate when eating. Thus, Study 1 provides evidence that consumers may be aware of how an external factor like portion size can increase their food intake. However, in this study participants reported on

having been influenced shortly after eating. It is plausible that participants' reports may have been in part caused by motivated reasoning, as opposed to 'genuine' awareness. For example, some participants may have believed they had overeaten, and could have attributed their intake to the portion size they were provided with to alleviate feelings of guilt (Vartanian, Reily, Spanos, Herman, & Polivy, 2017). A second potential issue with the method adopted in the present study is that participants were asked prior to eating how much they intended to eat and this may have influenced subsequent post-consumption responses about having been influenced by portion size. We addressed these concerns in Study 2 by examining participants' awareness of external influences on food intake when asked about how much they thought they would be likely to eat in future hypothetical eating scenarios. In Study 2, as well as examining awareness of the influence of portion size, we also examined awareness of a range of other external influences on food intake.

STUDY 2

Overview

In a recent study Vartanian, Reily, Spanos, McGuirk, Herman, & Polivy (2017) asked participants to predict how much they and others would consume when eating in the presence of someone else or when served a larger portion. They were asked to imagine how these external cues might influence intake on their own, or in conjunction with internal cues (e.g. hunger, taste). Participant predictions were influenced by both internal (e.g., taste, hunger) and external factors (portion size / social influence). In the present study we asked participants directly about the potential influence of external factors on food intake and extended these findings by surveying participants on a wider number of external factors that have been empirically shown to increase food intake; portion size (Rolls, Roe, Kral, Meengs, & Wall, 2004) social influence (Robinson, Tobias, Shaw, Freeman, & Higgs, 2011) food

variety (Rolls, Vanduijvenvoorde, & Rolls, 1984) and distraction whilst eating (Robinson et al., 2013).

Participants were asked whether they believed that the presence of that factor would affect their food intake, in what way the external factor would affect their food intake and why. In addition, to gauge whether participants were confident in their responses, we asked participants to report how certain they felt about each response. We also included a 'dummy' external factor that would be unlikely to have any meaningful effect on food intake (being sat at a square vs. round table), as this would allow us to further examine whether participants awareness is accurate; i.e. if participants are genuinely aware when reporting on the influence of external factors that influence their food intake, we hypothesised that very few participants should report that the 'dummy' external factor would affect their food intake.

In addition, we examined individual differences. Previous research has shown that individuals are more likely to acknowledge social influences on their own intake if they report being responsive to social cues (Spanos Vartanian, Herman, & Polivy, 2014). Here, we reasoned that if reports of awareness of external influence on food intake are accurate, then consumers who are influenced by external factors when normally eating should be most likely to identify that their food intake would be influenced in the eating scenarios. Thus, we also included self-report trait measures of external eating in Study 2. However, we were aware of a number of recent studies questioning the validity of self-report trait measures of eating behaviour and whether they accurately characterise what people actually do, as opposed to their beliefs about how they behave (Adriaanse, Prinsen, de Witt Huberts, de Ridder, & Evers, 2016; Evers, de Ridder, & Adriaanse, 2009). Thus, we tentatively predicted that higher scores on trait measures of external eating behaviour would be associated with participants being more likely to report external influences on food intake.

Method

Participants

Participants were recruited from the student and staff population of the University of Liverpool. Participation was incentivized by entering participants into a small cash prize draw. The study was advertised as being about opinions towards eating behaviours and specified that participants were required to be 18 or older and not currently taking any medication which may influence their appetite. To ensure more than adequate statistical power in all our planned analyses ($f = 0.25$, $p < .05$, 80% power) we aimed to recruit a minimum of 100 participants during a data collection period of 8 weeks. One hundred and fifty eight participants started the survey, but 20 participants did not complete the survey. The final sample consisted of 138 participants; 103 were female and 35 male, with a mean age of 37.4 (SD = 12.6) and a mean BMI of 24.95 (SD = 4.44) kg/m^2. The study was approved by the University of Liverpool's Institute of Psychology, Health and Society research ethics board.

Questionnaire

After providing electronic informed consent, participants were shown (in a random order) five dining scenarios on separate pages of the online survey. For each scenario (see section *'Eating scenarios'*), participants read a brief summary of the scenario, and were then presented (in fixed order) with four response options on the same page: the external factor would make them consume more, the external factor would make them consume less, the external factor would have no influence on amount consumed, and unsure. Participants were then asked how certain they were about their response about whether they would be influenced, on a 5-point scale ranging from 'very uncertain' to 'very certain'. Next,

participants were asked to explain why they believed they would (would not) be influenced by the external factor. After this, participants were asked to provide demographics, including self-reported weight and height (to calculate BMI). To measure self-reported trait responsiveness to external vs. internal cues when eating, participants then completed the 'external eating' scale of the Dutch Eating Behaviour Questionnaire (van Strien, Frijters, Bergers, & Defares, 1986), the 'uncontrolled eating' subscale from the revised three Factor Eating Questionnaire (Karlsson, Sjöström, & Sullivan, 2000) and the 'reliance on internal hunger/satiety' questions from the Intuitive Eating Scale (Tylka, 2006). Finally, debriefing information was provided and participants were thanked for their time.

Eating scenarios

For the portion size scenario participants were asked: 'Imagine you are dining out at a restaurant. You order a meal and when the waiter brings over your order, the portion size of the meal is very large. Do you think that being served a very large portion would affect how much you eat?', response options: 'Yes, I would eat more if served a larger portion, as opposed to a smaller portion', 'Yes, I would eat less if served a larger portion, as opposed to a smaller portion', 'No, being served a larger portion would have no effect on how much I eat', 'I am unsure whether a large portion would have any effect on how much I eat'. For the social influence scenario participants were asked 'Imagine you are eating with a friend and they select and consume a very large amount of food. Do you think a friend eating a large amount would affect how much you eat?' For the variety scenario participants were asked 'Imagine that you are at a friend's house for a buffet. If there was a wide variety of different food items on option at the buffet, do you think this would affect how much you would eat?' For the distraction scenario participants were asked 'Do you think you would eat more if you were snacking whilst watching TV, compared to snacking with no distraction?' Finally, for

the table shape 'dummy' scenario, participants were asked 'Imagine you are eating at a restaurant and you are seated at a square table rather than a round table; do you think this would influence how much you eat?' For the wording of the individual response options for each of the scenarios see *supplementary material.*

Planned analysis (a-priori)

For participants' reports of external influence in each eating scenario, we planned to use a chi-square test to determine whether the number of participants in each response category ('not influenced', 'influenced to eat more', 'influenced to eat less', 'unsure') differed to chance expectation. To determine whether participants were certain or uncertain about how their food intake would (not) be influenced, we conducted a one sample t-test comparing the certainty ratings for each scenario with a test value of 3 (equal to the midpoint of the scale). To examine whether the individual difference measures were associated with accurate reporting of external influence, we correlated (Pearson's r) trait external eating with the total number of times a participant reported that their food intake would be increased by either portion size, social influence, food variety and/or distraction whilst eating (resulting in a 5 point scale from 0-4). Finally, two independent coders read participants' responses and identified any common explanations for each of the external factors. If any common explanations were identified, the two coders independently coded each response for the presence of the identified theme.

Results

Reporting of influence of external factors

We found consistent evidence that participants believed their intake would be influenced by external factors, and that larger portion sizes (73% of participants), social influence (40%),

food variety (75%) and distraction (59%) would cause them to increase their food intake. On average, participants reported that 2.5 of the four external factors (SD = 1.1) would increase their food intake and 97.1% (134/138) of participants reported that their food intake would be increased by one or more of the four external factors. Conversely, when asked about a 'dummy' external factor that should not affect food intake (table shape), very few participants (5%) believed this would affect their food intake. Participants who did not report that an external factor would increase their food intake, tended to report that they would be unaffected or were unsure, rather than reporting that the external factor would decrease their intake. See Table 1.

Certainty

Participants' ratings of their certainty in their report of each external factor's influence were significantly greater than the midpoint of the scale indicating that participants tended to be certain about their responses. See Table 2.

Table 1: Frequencies of participants reporting influence of external factors on food intake

	Beliefs about external influence on food intake				
	Would not affect	*Uncertain*	*Would decrease*	*Would increase*	*Chi-square test results*
Portion size	25 (18.1%)	5 (3.6%)	7 (5.1%)	101 (73.2%)	χ^2 (3) = 177.94, p <.001
Social influence	60 (43.5%)	17 (12.3%)	6 (4.3%)	55 (39.9%)	χ^2 (3) = 63.45, p <.001
Food variety	20 (14.5%)	6 (4.3%)	8 (5.8%)	104 (75.4%)	χ^2 (3) = 190.00, p <.001
Distraction	35 (25.4%)	17 (12.3%)	5 (3.6%)	81 (58.7%)	χ^2 (3) = 96.78, p <.001
Table shape	86 (62.3%)	45 (32.6%)	4 (2.9%)	3 (2.2%)	χ^2 (3) = 135.80, p <.001

Values denote number of participants (percentages in parentheses)

Table 2: Participants' certainty of the influence of external factors on their food intake

	N	*Certainty* [a]	*One sample t-test results*
Portion size	138	4.09 (.74)	$t(137) = 17.26$, $p < .001$
Social influence	138	3.69 (.90)	$t(137) = 9.00$, $p < .001$
Food variety	138	3.96 (.84)	$t(137) = 13.47$, $p < .001$
Distraction	138	3.93 (.73)	$t(137) = 14.90$, $p < .001$

[a] denotes mean score on 1 (very uncertain) to 5 (very certain) response scale. SDs in brackets

Trait external eating

The three trait measures of external eating (the external eating subscale from the Dutch Eating Behaviour Questionnaire; the uncontrolled eating subscale from the Three Factor Eating Questionnaire; the reliance on internal hunger/satiety questions from the Intuitive Eating Scale) were correlated and principal component analysis indicated that they loaded onto a single factor. Thus, we z-scored each of the three scale scores and summed these to produce a single composite measure of external eating, whereby a high score denoted higher trait external (as opposed to internal) eating. The number of scenarios in which participants believed their food intake would be increased by an external factor was significantly correlated with trait external eating ($r = .48$, $p < .001$). This relationship remained significant when accounting for participant BMI and gender in follow up linear regression models ($p < .05$).

Explanations for why external factors would influence food intake

Initial agreement between two coders was high for each of the scenarios (> 90%). The most common theme for why participants believed they would eat more when served larger portion sizes was the desire to plate clear 39% (39/101), e.g. 'I would want to clear my plate'. The most common theme for why an eating partner consuming a large amount of food would increase food intake was because of social norms; 44% (24/55), e.g. 'makes it seem more

acceptable to eat more if everyone else is'. For the variety scenario participants tended to report that variety would increase their food intake because of enjoyment of trying different food items; 65% (68/104), e.g. 'I like to taste lots of different things'. Finally, the most common theme for why participants believed they would eat more when watching television was because they believed they would be distracted and lose track of how much they had eaten; 49% (40/81), e.g. 'not really thinking about how much I have eaten as distracted'.

GENERAL DISCUSSION

In two studies we examined whether consumers are aware of the external factors that influence their food intake. In Study 1 we re-analysed data from a previous study (Robinson, te Raa, & Hardman, 2015) in which participants served a large portion consumed significantly more food than those served a standard portion and participants were also asked to report whether they believed portion size had influenced their intake. A sizeable number of participants served the large portion of ice cream (59%) believed that their food intake had been influenced by portion size, whereas a minority of participants did not believe they had been influenced. Participants who ate the most from the large portion of food were most likely to report that they had been influenced. A limitation of Study 1 was that awareness of the influence of portion size was measured retrospectively. We addressed this limitation in Study 2 by asking participants to indicate whether external factors that have been shown empirically to increase food intake (e.g. portion size, social influence, food variety, distraction) would be likely to affect how much they would eat in hypothetical eating scenarios. Large numbers of participants reported that they would be influenced by external factors known to affect food intake and participants tended to correctly believe that these external factors would increase their food intake.

In Study 2 we also examined whether trait self-report measures of external eating were associated with the degree to which participants reported awareness that their food intake would be influenced by external factors. We found that participants who scored highly on trait 'external' eating behaviour measures were more likely to identify that portion size, social influence, food variety and distraction would affect their food intake. This finding could be interpreted as evidence that consumers show genuine awareness of when external factors will increase their food intake, because we would expect that awareness should be most common among those that are regularly externally influenced when eating. However, it has been argued that self-report trait eating behaviour questionnaires measure beliefs about behaviour, rather than how people actually behave (Evers et al., 2009; Evers et al., 2011). Thus, the correlation we observed may in part be caused by the trait measures of external eating and the hypothetical external eating scenarios used in Study 2 both measuring the same underlying construct or 'belief'. Thus, this correlational finding should be interpreted cautiously.

Previous Research

Previous research has suggested that consumers are unaware of the external or environmental factors that influence their food intake (e.g., Vartanian, Herman & Wansink, 2008; Vartanian, Sokol, Herman, & Polivy, 2013). Here we found that a sizeable proportion of participants reported being aware of the influence of external factors on their food intake. One possible explanation for this difference could be the methods used to assess awareness of external influences. In the present study and in Keenan, Childs, Hetherington, Rogers & Brunstrom (2018) and Robinson and Field (2015), participants were asked directly about the influence of a specific external factor. Other studies have often involved asking participants how their intake compared to their typical intake (e.g. Vartanian, Herman & Wansink, 2008). As

identified by Vartanian, Reily, Spanos, Herman and Polivy (2017) responses to this measure might be influenced by social desirability, with participants acknowledging the influence of external cues when they are motivated to do so; for example, as a way of justifying overconsumption. Asking a direct question might reduce the presence of this form of bias. Another factor that might explain why past studies have found participants to be unaware of the influence of external factors on their intake is that many have focused on social influence (Vartanian Herman & Wansink, 2008; Vartanian, Sokol, Herman, & Polivy., 2013; Spanos, Vartanian, Herman, & Polivy., 2014; 2015). In Study 2 we found that although participants tended to report awareness of external influences on food intake, this was less pronounced when reporting on social influence. For example, 73% of participants reported that they would be influenced by portion size when eating, whereas this number was 40% for social influence. One explanation of this finding is that people feel embarrassed to report that they would conform to the actions of others, so may wish to deny social influence. This explanation is consistent with the findings of Spanos et al (2015): participants thought it was more socially acceptable to eat more in response to larger portions than because of social influence. However, it is also plausible that the extent to which participants report they would be and/or were influenced by different external factors may reflect how powerful these different external factors are in shaping food intake. For example, there may be a subset of people whose food intake is not strongly socially influenced and this results in fewer people identifying that social influence affects their food intake (Robinson & Field, 2015). Indeed, there is evidence that personality traits relating to social approval predict whether a person is likely to be susceptible to social influence on eating and drinking behaviour (Caudill & Kong, 2001; Litt, Stock, & Lewis, 2012; Robinson et al., 2011). Further work to understand the factors that determine whether consumers accurately report on the external factors that influence their food intake would be informative.

Implications

The results of the present studies indicate that consumers are likely to be aware of the types of external factors that cause them to eat more, so this casts doubt on whether intervention approaches that aim to educate consumers about external influences on food intake will reduce over-eating. This observation is in line with studies showing that educating consumers about the influence of external factors on eating behaviour (such as social influence and portion size) does not reduce the effect that these factors subsequently have on food intake (Bevelander, Engels, Anschütz, & Wansink, 2013; Cavanagh, Vartanian, Herman, & Polivy, 2014). If consumers are aware that external factors like large food portion sizes increase their food intake but still eat more in response to these external cues, the most powerful approach to reducing over-eating is likely to be one that targets the external factor directly. For example, rather than reminding consumers about the influence that large portion sizes of commercially available food products can have on food intake, we suggest that the most effective intervention approach will be to reduce the size of commercially available food portion sizes.

Strengths and Limitations

A strength of the present research was that we addressed our research question using two methodological approaches (laboratory and survey data) and findings were consistent across both studies. Although other research has examined awareness after a meal (Robinson & Field, 2015; Keenan et al., 2018), we did not measure awareness during a meal. It could be argued that measurement of awareness during a meal would provide even stronger evidence for or against consumer awareness of the external factors that influence food intake. However, taking such measurements during a meal may affect intra-meal eating behaviour

and also make it difficult to determine whether it is the external factor being manipulated or mere measurement of awareness. In the present study we predominantly asked about external factors likely to increase food intake and it would therefore be valuable to examine whether a similar pattern of results is observed for factors likely to decrease food intake. It is also possible that media coverage could have influenced how individuals responded to the hypothetical scenarios used in the present study. If any participants were conscientious readers of health news, they may have been exposed to stories highlighting how external factors influence intake. Likewise, socially desirable responding or 'demand characteristics' are potential issues with survey research and although our results suggest that people report that they believe their food intake would be influenced by external factors in the present study we did not validate these reports. However, nearly all participants reported that they would not be influenced by an external factor that we know would be very unlikely to affect food intake and this indicates validity of participant reports from this study. Likewise, when asked why they would be influenced by specific external factors, participants often provided reasons that are consistent with the mechanisms of action thought to explain why these factors are likely to affect food intake (e.g. TV viewing causing overeating via distraction), which suggests participants reports may reflect accurate awareness.

Conclusions

Across two studies, we find evidence that consumers show awareness of the influence that external factors have on their food intake.

NOTES

[1] In this paper we focused on the relationship between food intake and awareness of the influence of portion size for participants in the large portion size condition from Robinson, te

Raa & Hardman (2015) due to practical considerations concerning statistical power. For a detailed justification and descriptive statistics of data from the standard portion size condition, please see *Online Supplementary Materials*.

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