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Distraction, the desire to eat and food intake: towards an expanded model of mindless eating

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Abstract

This study compared the impact of different forms of distraction on eating behaviour with a focus on the mechanisms behind this association and the link between the amount consumed and changes in the desire to eat. Participants (n=81) were randomly allocated to four conditions: driving, television viewing, social interaction or being alone in which they took part in a taste test. Measures of the desire to eat (ie. Hunger, fullness, motivation to eat) were assessed before and after the intervention. The results showed that those watching television consumed more than the social or driving conditions. Food intake was associated with a decreased desire to eat for those eating alone, but was unrelated to changes in the desire to eat for those driving. Watching television also created a decrease in the desire to eat commensurate with food intake whereas social eating resulted in the reverse relationship. The results are discussed in terms an expanded model of mindless eating and it is argued that eating more requires not only distraction away from the symptom of hunger but also sufficient cognitive capacity left to attend to the process of eating.

Key words: distraction; cognitive capacity; mindless eating; taste test; hunger

Although the literature indicates a role for biological factors in the regulation of food intake (eg. Pinel, 2011; Mercer and Speakman, 2001) much research highlights that the desire to eat and eating behaviour are influenced by a multitude of psychological factors (see Conner and Armitage, 2006; Ogden, 2010 for reviews). One area that has received much attention over the past few years is the impact of distraction and the ways in which factors such as television viewing, aspects of the food environment and social interaction influence how much food is consumed. These will now be considered.

In terms of the impact of television viewing, several studies indicate that food intake in the current meal is increased when distracted by watching television (Bellissimo, Pencharz, Thomas & Anderson, 2007; Temple et al 2007). Similarly, Higgs and Woodward (2009) showed an impact of television viewing on subsequent meals and reported that participants who ate lunch whilst watching television had less vivid memories of their lunch and consumed more in a subsequent snack tasting session compared to a control group. Furthermore, Blass et al (2006) found that although those watching television ate significantly more food than a control group the two groups had comparable ratings of appetite. Moray et al (2007) also concluded that estimates of food intake were less accurate if participants were watching television whilst eating. In a similar vein research indicates that many other factors may distract from eating including listening to a story (Bellisle and Dalix, 2001; Long et al, 2011), listening to music (Stroebele and de Castro, 2006), playing a computer game (Oldham-Cooper et al, 2011) and engaging in a word counting task (Boon et al, 2002).

Research has also explored the ways in which aspects of the food environment can distract an individual making it easier to overeat and harder to monitor how much is being consumed (Fisher, Rolls and Birch, 2003; Rozin, Dow, Moscovitch and Rajaram, 1998; Wansink, 2004). For example, a multitude of studies indicate that over eating can be

triggered by factors such as the ambience of the room, container size, plate size, variety of food and perceived time of day (Stroebele and de Castro, 2004; Wansink, Painter and Lee, 2006; Wansink, van Ittersum and Painter, 2006; Wansink and Park, 2001). In particular, research indicates that the environment distracts the individual and that not only do people make automatic decisions to eat without any conscious processing, they also deny that the environment has an impact of their food intake (Wansink, 2004; 2009; Wansink and Kim, 2005; Wansink and Sobal, 2007). This process has been termed ‘mindless eating’ and can be contrasted with ‘mindful’ eating when people are encouraged to self monitor and process what they eat (Wansink and Sobal, 2007).

Research has also addressed the impact of social influence on eating behaviour and several studies indicate that that people tend to eat more food in the presence of others or in groups rather than when eating alone (Berry, Beatty and Klesges, 1985; de Castro, 1991; de Castro & Brewer, 1992; Hirsch & Kramer, 1993; Patel & Schlundt, 2001; Redd & de Castro, 1992). In line with research on television viewing it has been argued that social influence is also a type of distraction, as attention is generally diverted away from the meal to concentrate on actions such as talking and interpreting information (Hetherington, Anderson, Norton & Newson, 2006). In contrast, however, it has been suggested that social influence functions via the expectations of the experience itself. For example Klesges et al (1984) argued that eating with others is regarded as a pleasant event, whereas eating alone is considered a response to overcoming hunger (Herman, Roth and Polivy, 2003). Accordingly, such expectations change food intake. Similarly, Feunekes, de Graaf & Van Stavern (1995) suggested that people predict that they will overeat in the presence of others which in turn becomes a self fulfilling prophecy. This could be as a result of expecting to be eating for a longer period of time when in the presence of others as shown in de Castro’s time-extension hypothesis (1990), theorising that the more people present during a meal; the longer the

duration of the meal and the greater the food intake (e.g. Bellisle, Dalix & de Castro, 1999; de Castro, Bellisle, Feunekes, Dalix & de Graaf, 1997; de Castro, Brewer, Elmore & Orozco, 1990).

Not all research, however, shows an increase in food intake in social situations and studies indicate that this effect is influenced by the relationships with the other people eating. For example, when the other person(s) present is a stranger, the social facilitation of eating tends to be weaker or even absent (de Castro, 1994; Clendenen, Polivy & Herman, 1994; Hetherington, Anderson, Norton & Newson, 2006; Salvy et al., 2006). This may be a result of impression management and the desire to be seen in a positive light in front of strangers (Leary & Kowalski, 1990; Tice et al, 1995). Mori, Chaiken & Pliner (1987), however, argued that impression management is just as likely to take place between familiar companions of the opposite sex, especially if they find each other desirable. Similarly, Wansink and Park (2000) reported that whereas women decrease their food intake as an attempt to appear more feminine, men consider overeating to be a sign of masculinity and power.

Research has also highlighted possible mechanisms for the impact of distraction on food intake with a particular focus on memory. For example, it has been argued that distraction divides an individual's selective attention away from the encoding of the meal and interrupts episodic memory formation (Chun & Turk-Browne, 2007; Ward & Mann, 2000; Boon, Stroebe, Schut & Ijnterna, 2002; Brunstrom & Mitchell, 2006; Stroebele & de Castro, 2006; Long, Meyer, Leung and Wallis, 2010; Moray, et al 2007). In line with this, Herman and Polivy expanded their boundary model of eating to include a role for memory and reported that when the amount consumed by participants was made salient by leaving the wrappers of the sweets nearby, participants were more aware of how much they had eaten and consequently ate less than those who couldn't see any wrappers (Polivy, Herman,

Hackett, and Kuleshnyk, 1986). In a similar vein, research indicates that reminding participants of recent meals makes the memories of these meals more apparent which in turn suppresses subsequent food intake (Higgs, 2002, 2005, 2008; Higgs, Williamson & Attwood, 2008). Research also shows that lacking a memory of meals or having impaired memory such as amnesia can increase food intake (Higgs, Williamson, Rotshtein & Humphreys, 2008; Rozin, Dow, Moscovitch and Rafaram, 1998).

Research has therefore explored the impact of distraction on food intake with a focus television viewing, the food environment and social interaction. Such studies, however, have tended to explore the impact of individual forms of cognitive distraction compared to a control condition of no distraction, rather than making comparisons across different manipulations of cognitive capacity. In line with this, the present experimental study aimed to compare across three different forms of distraction which varied in the extent to which they utilised an individual's cognitive capacity and to assess their relative impact on eating behaviour. In particular, the study focused on two common distractions, namely, television viewing and social interaction and compared them with the impact of driving as although research indicates that eating whilst driving increases the risk of a crash due to a decrease in eye contact, attention to the road and taking the participants' hand off the wheel (Stutts, 2001; Young et al., 2007), little is known about the reverse affect of driving on eating. Therefore these three forms of distraction were compared to a control condition of eating alone.

Some previous studies have also attempted to address the mechanisms behind the link between distraction and eating with a focus on memory. Although, providing some insights into the ways in which distraction may influence food intake the emphasis to date has been on distraction as a trigger to the onset of eating behaviour and food choice rather than eating as an ongoing behaviour. At its simplest, eating behaviour is a classic example of a negative feedback system as it is driven by factors such as hunger and a desire to eat which are in turn

modified and reduced once food has been consumed causing a sense of fullness or satiety (Blundell, 1979; Blundell and Burley, 1987). From this perspective, it is therefore hypothesised that not only does distraction trigger the onset of eating it distracts from the consequences of this eating, thus making changes in hunger and / or fullness harder to detect. The present study therefore explored the impact of distraction on the relationship between food intake and subsequent changes in hunger and the desire to eat. This finds reflection in the suggestion that as well as inhibiting memory, distraction may also inhibit our attention to signals of satiety which remains untested (Wansink, 2009). It is also parallel to the notion of hunger as a symptom which is perceived and modified through processes such as mood, attention and social influence (Roberts and Pennebaker, 1995; Ogden, 2007; 2010). Accordingly, it was predicted that distraction would result in increased eating behaviour and that different forms of distraction would have differing effects on the amount consumed. In addition, it was also predicted that distraction would disrupt the relationship between food intake and a reduction in the desire to eat as participants would be less able to monitor the impact of any food consumed on their perceptions of hunger. No specific predictions were made as to which condition would be the most distracting or whether the mechanisms linking distraction with changes in food intake would be consistent or different across the different forms of distraction being manipulated.

Method

Sample

Female participants (n=81) ranging in age from 18 to 40 years took part in the study. Their mean age was 22 years (SD=5.18), the majority were white (n=71 (87.7%)) and full time students (n=59 (72.8%)). Men were not included as there are clear gender differences in food intake in terms of quantity and food preferences relating to factors such as the impact of

emotional and restrained eating and the menstrual cycle which would have required gender to be an additional independent variable, thus requiring twice the sample size. Inclusion criteria were: female, aged over 18 and in possession of a full manual driving licence.

Design

The study used an experimental design with four independent conditions in which food was consumed: driving, watching television, social interaction and sitting alone. The dependant variables were the total mass of food consumed and the ratings of the participants' desire to eat (ie hunger, fullness and motivation to eat) before and after the intervention.

Pilot work

Initial pilot work with a small sample of 10 students at the University resulted in the choice of film for the television condition and snack food for the taste test. The American sitcom 'Friends' was selected as all students were familiar with it, it is highly popular and easy to watch for a short period of time. An episode was selected in which there was no mention of food. The snack food used was 'hula hoops' which are a crisp like food made from potatoes and circular in shape with a hole in the middle. They were selected as pilot work indicated that they were liked by all students and were easier to eat whilst driving than other snack foods as they can fit over the end of a finger.

Procedure

Favourable ethical approval was obtained from the University Faculty Ethics Committee. An opportunity sample of participants was recruited through emails and adverts to staff and students at a University in the South of England. After consenting, participants were randomised to one of the four conditions by retrieving a numbered piece of paper from a bag and either directed to the driving simulator room or to an empty room with a desk and

chair depending on their allocated condition. Participants were then asked to choose their flavour of snack food and to complete the baseline questionnaire. After completion, the questionnaire was collected and the experimenter read a short script about what would happen next. The experimenter then gave the participants a medium sized bowl (8cm in height and 13.5 in diameter) of snack food (100 grams) and the intervention commenced which lasted for 7 minutes for each condition. Participants then completed the follow up questionnaire and once the participant had left the room, the bowl of food was reweighed.

Measures

Baseline measures: Participants completed the following measures at baseline. Reliability was assessed where appropriate using Cronbach's alpha:

i) **Participant demographics;** age, ethnicity, employment, weight and height.

ii) **Desire to eat:** This was assessed using 5 point Likert scales ranging from 'strongly disagree' (1) to 'strongly agree' (5) in terms of a) hunger (3 items: 'hungry', 'I could eat now', 'a desire to eat' $\alpha=0.78$), b) fullness (3 items: 'full', 'I have a full stomach', 'I do not want to eat' $\alpha=0.81$) and c) motivation to eat (3 items: 'I have a drive to eat', 'I am thinking about food', 'I am looking forward to eating' $\alpha=0.85$). Aspects of the desire to eat and hunger are complex concepts and have been defined in different ways by different researchers (Blundell, 1979; Blundell and Burley, 1987). For example, some researchers have differentiated between the biological drive to eat (as hunger) and the psychological desire to eat (Blundell, Hill and Lawton, 1989). Other researchers have focused on the hunger that triggers a meal and the hunger that ensures that eating continues (eg. Van Itallie and Vanderweele, 1981). Given the subjective nature of the present study, in line with the definitions provided by Blundell et al (1989) participants rated their hunger in terms of their experiences of hunger and desire to eat, their motivation to eat in terms of the drive to find

food, and their fullness to reflect their experiences of haven eaten. The measures used were modified from previous research (eg. Ogden and Wardle, 1990).

Follow-up measures: After the intervention, participants completed the following measures:

i) **Desire to eat:** as at baseline (hunger ($\alpha=0.82$), fullness ($\alpha=0.82$) and motivation to eat ($\alpha=0.92$).

ii) **Weight concern:** This was assessed in terms of the restrained eating sub scale of the Dutch Eating Behaviour Questionnaire (Van Strien et al., 1986; $\alpha= 0.95$) and the Body Shape Questionnaire (Cooper et al, 1986 ($\alpha=0.96$). These were included as a means to profile participants as weight concern has been previously linked with overeating and disinhibition (eg. Ogden, 2010).

iii) **Food Intake:** This was measured by weighing the bowl of snack food before and after the intervention.

In addition, in order to justify the consumption of food participants completed a taste test (Ogden and Wardle 1990) and were asked to rate the snack food in terms of sweetness, saltiness, sourness and how much participants liked the taste using 100mm visual analogue rating scales ranging from 'Not at all' (1) to 'Very' (100).

Interventions

Participants were randomly allocated to one of four conditions; driving, television viewing, social interaction, or alone. They were read one of the following scripts by the researcher depending upon the condition.

1.Driving: *“You will be driving on a pre-determined route, please try to stick to 40mph avoiding pedestrians and crashing. We will give you some hula hoops for the duration of the*

experiment; you need to taste them as you will be asked to complete a taste test afterwards. Please feel free to eat as much as you like. The driving simulation will stop automatically after seven minutes”

The driving condition took place in a driving simulator which consists of the front half of a car surrounded by synchronised screens. When sitting in the car the experience is extremely realistic as the driver has to steer and utilise the pedals in a realistic way. For this study a basic training route was designed with very few obstacles which required the participant to concentrate on driving whilst still being able to eat. The car is a manual car which requires the participant to change gears although given the simplicity of the drive it is estimated that participants changed gear on average about 3 times in the seven minutes after they had got up to driving speed. The coordinator of the driving simulator was present in the room, but hidden behind the car to ensure the simulation went smoothly. After answering any queries the participant sat in the car and was handed a bowl of hula hoops to place on their lap to eat throughout the drive. The participant simulated a simple drive with minimal obstacles for 7 minutes.

2. Television: *“You will be watching an episode of FRIENDS. We will give you some hula hoops for the duration of the experiment; you need to taste them as you will be asked to complete a taste test afterwards. Please feel free to eat as much as you like. The episode will stop automatically after seven minutes.”*

The participant was sat at a table in front of a laptop. The experimenter gave the participant a bowl of hula hoops, started the DVD on the laptop and left the room for 7 minutes. The same FRIENDS episode was used for each participant (played from the beginning) and was edited to stop automatically after 7 minutes.

3.Social interaction: *“You will be sitting with one of the researchers talking about a range of topics for seven minutes. We will give you some hula hoops for the duration of the experiment; you need to taste them as you will be asked to complete a taste test afterwards. Please feel free to eat as much as you like. The session will end after seven minutes”*

The female researcher gave the participant a bowl of hula hoops, and then sat down at the table with the participant to discuss various topics together for 7 minutes, which was timed by the experimenter. The topics included; university (if they were a student), what they are doing/did for Christmas and New Year and popular TV programmes. The conversation was led by the researcher and where possible the researcher attempted to speak for about 50% of the time.

4.Alone: *“You will be sitting alone at a table. We will give you some hula hoops for the duration of the experiment; you need to taste them as you will be asked to complete a taste test afterwards. Please feel free to eat as much as you like. I will return after seven minutes.”*

The participant was seated at a table and given a bowl of hula hoops by the experimenter. The experimenter then left the room and returned after 7 minutes.

Data analysis

Data were analysed to describe participants’ demographics using descriptive statistics and to assess differences in demographics by condition using an ANOVA and chi-square. The impact of condition on changes in desire to eat was then assessed using repeated measures ANOVA and the impact on food intake was assessed using ANOVA. Associations between food intake and baseline ratings of desire to eat within conditions were assessed using correlation coefficients. Associations between food intake and changes in the desire to eat, within and between conditions, were assessed using correlation coefficients, unstandardised Beta coefficients and z scores.

Results

1. Participants' demographics

Participants' demographics by condition are shown in Table 1. The results showed that the majority of participants were full time students, white, with a mean age of 22 years. The four conditions were matched in terms of age, ethnicity, occupation, BMI, restrained eating and body dissatisfaction indicating that the randomisation procedure was effective.

-insert table 1 about here –

2. The impact of condition on changes in desire to eat and food intake

The impact of condition on changes in desire to eat and food intake are shown in Table 2.

-insert table 2 about here-

The results showed a significant main effect of time for hunger, fullness and motivation to eat indicating that regardless of condition participants reported a lower desire to eat after the intervention. The results showed no main effects of condition or time by condition interactions for any measures of the desire to eat. A main effect of condition was found for food intake. Post hoc tests showed that those in the television condition consumed more than those in the social ($p < 0.01$) and driving ($p < 0.05$) conditions. Differences between the television and alone condition were not significant ($p = 0.06$).

3. Associations between food intake and baseline desire to eat

The results for correlations between baseline hunger, fullness and motivation to eat and subsequent food intake are shown in Table 3.

-insert table 3 about here –

The results showed no significant correlations for any of the four conditions indicating that the amount consumed during the intervention was not related to participants' baseline levels of their desire to eat.

4. Associations between food intake and changes in desire to eat within and between conditions

Changes in ratings of desire to eat were computed (T2-T1) so that more negative scores reflected a decrease in ratings of hunger, fullness and the motivation to eat. Associations between food intake and changes in the desire to eat within each condition were then analysed using Pearson's correlation coefficients. Comparisons between conditions were then compared using the unstandardised beta coefficients and standard error scores to compute Z-scores (see Table 4).

-insert table 4 about here -

In terms of associations within condition the results showed no associations between changes in the desire to eat and the mass consumed for either the driving or social conditions indicating that the amount eaten was unrelated to a change in either hunger, fullness or the motivation to eat. For the television condition, however, greater intake of food was associated with a greater decrease in both hunger and the motivation to eat and for those in the alone condition a greater intake of food was associated with a greater increase in fullness and a greater decrease in the motivation to eat. It is important to note that whilst the correlations between changes in hunger, motivation to eat and food intake were negative for the driving, television and alone conditions they were positive for the social condition. Further, whilst the correlations for fullness and food intake were positive for the driving, television and alone conditions they were negative for the social condition. This indicates that whilst increased food intake was related to a decrease in the desire to eat in the driving,

television and alone conditions, it was associated with an increased desire to eat in the social condition.

The data were then analysed to assess differences in the associations between food intake and the desire to eat between conditions. For changes in hunger, the results showed significant differences between the social condition and both the driving ($p < 0.05$) and the television condition ($p < 0.05$). For changes in fullness, differences were found between the alone condition and both the driving ($p < 0.05$) and the social condition ($p < 0.05$). Finally, in terms of the motivation to eat, differences were found between social condition and both the television ($p < 0.05$) and alone ($p < 0.05$) conditions. This indicates that the positive association between the amount eaten and several of the ratings of the change in the desire to eat found in both the alone and television conditions was significant greater than several of the ratings of the desire to eat in the social and driving conditions. Accordingly, when alone or watching television eating more was associated with a decrease in the desire to eat and this association was greater than when either driving or being sociable. Further, in the social condition, eating more was associated with an increase in the desire to eat.

Discussion

The present study aimed to evaluate the impact of different forms of distraction on food intake and showed that those in the television condition consumed more food in the taste test than those in the driving or social conditions. This supports previous research which has highlighted how television viewing increases food intake (eg. Bellissimo, Pencharz, Thomas & Anderson, 2007; Temple et al 2007; Blass et al, 2006). The results also indicated that television viewing has a greater impact on food intake than two other forms of distraction, namely social interaction and driving.

The study also aimed to explore possible mechanisms for this relationship with a focus on changes in the desire to eat after eating. The results from this analysis produced complex results. First, the results indicated that food intake during all interventions, even the alone condition, was unrelated to baseline levels of hunger, fullness or participants' motivations to eat. This is in conflict with more biological models of eating behaviour with their emphasis on hunger and satiety but provides supports for the notion of mindless eating and the impact of external rather than internal factors on food intake (eg. Wansink, 2004; 2009). Further, it suggests that even when eating alone, factors other than initial hunger levels influence how much food is consumed. Next, the results showed that contrary to our predictions, increased food intake was associated with a reduction in some measures of the desire to eat not only for those eating alone but also for the television condition although this association was not apparent for either the driving or the social conditions. In addition, this association between the amount consumed and changes in the desire to eat was significantly different between the different conditions. In particular, for those in the social condition, eating more was associated with an increased desire to eat after the intervention; for those watching television or eating alone, eating more seemed to effectively switch off hunger and for those driving, eating and changes in the desire to eat remained unconnected.

Theories of the impact of distraction focus on the role of memory as an explanation and predict that external factors such as watching television, social interaction or driving distract the participant from their desire to eat and disrupt their memory of their food intake (Chun & Turk-Browne, 2007; Ward & Mann, 2000; Boon, Stroebe, Schut & Ijnterna, 2002; Brunstrom & Mitchell, 2006; Stroebele & de Castro, 2006; Long, Meyer, Leung and Wallis, 2010; Moray, et al 2007). The results from the present study indicate that distraction may also work by disrupting the link between food intake and subsequent reductions in hunger. Such a perspective not only finds reflection in a simple feedback model of eating behaviour

but is also parallel to the notion of hunger as a symptom that needs to be perceived and that can be modified through levels of attention (Blundell, 1979; Blundell and Burley, 1987; Roberts and Pennebaker, 1995; Ogden, 2007; 2010). Accordingly, distraction not only triggers the onset of eating but also disrupts an individual's ability to perceive the consequences of their behaviour and if hunger is conceptualised as a symptom, distraction reduces the perception of this symptom.

One way to conceptualise this is in terms of an expanded definition of 'mindless eating'. To date, Wansink and colleagues have used the term 'mindless eating' to describe the ways in which environmental factors trigger eating without conscious processing (eg. Sobal and Wansink, 2007; Wansink, 2004; 2009). Accordingly, the 'mindless' component refers to the lack of processing concerning the decisions to start eating. Perhaps, however, individuals also continue to eat 'mindlessly' as they fail to perceive the ways in which their desire to eat reduces after food intake. Therefore they are 'mindless' both in terms of the cues to eat and the cues to stop eating. The results from the present study provide some support for this hypothesis and illustrate both mindless and mindful eating. In particular, whilst those eating alone, who were not distracted, showed a reduction in their desire to eat in parallel to mindfully eating more, those in the driving condition, who were distracted, showed no association between ratings of their desire to eat and food intake suggestive of mindless eating. Contrary to prediction, however, those watching television seemed to show mindful rather than mindless eating and those in the social condition seemed more hungry the more they ate.

The results therefore indicate that distraction, in the form of watching television, resulted in increased food intake which is in line with previous research. The results also showed evidence of mindful eating for those eating alone and mindless eating for those in the driving condition which similarly supports research in the area of distraction and highlights

how distraction may work by disrupting the link between eating and changes in the desire to eat. But what remains unclear is why those in the television condition ate the most, yet appeared to eat mindfully, whilst those in the social condition ate less but showed the reverse association between the desire to eat and actual eating? One possible explanation lies in the multidimensional nature of distraction which will now be considered by addressing the mechanisms of each condition in turn.

It has been argued that once distracted from internal cues such as hunger and satiety by external factors an individual will eat mindlessly and that their food intake will not be encoded in ways that impact upon their desire to eat. This suggests that distraction is a unidimensional construct with only one target, namely hunger. Food intake itself, however, requires some degree of cognitive effort and if too distracted the participant will have insufficient cognitive capacity left to engage in eating behaviour. Therefore in order to eat and continue to eat, an individual needs to be distracted away from their hunger but still able to engage the cognitive capacity needed to eat. From this perspective there are two forms of distraction; distraction away from hunger and distraction away from eating. And in parallel there are two forms of attention; namely attention to hunger and attention to eating.

It is possible that this more complex model of distraction could help to explain the results found in the current study as follows. First, those in the alone condition could attend both to their hunger and to the process of eating resulting in moderate intake which in turn modified their desire to eat; they ate mindfully. In contrast, those driving were so distracted by the task from both their hunger and the process of eating that they consumed only a minimal amount which had no impact on their perceptions of hunger; they ate a small amount, mindlessly. Third, those watching television were distracted from their hunger but not distracted from eating which enabled them to consume the most whilst the television was on. Once the intervention had finished, however, their overconsumption was then recognised

and translated into a reduction in their hunger; they ate a large amount mindlessly but encoded this after the task. Finally, those in the social condition were distracted from eating by their interaction with the researcher and so unable to consume much during the task. Rather than being unaware of their hunger, however, this under consumption may have been more due to feelings of social embarrassment and stigma as in line with theories of social interaction eating alone whilst being watched by a stranger is an unfamiliar and uncomfortable behaviour (de Castro, 1994; Hetherington, Anderson, Norton & Newson, 2006; Salvy et al., 2006; Tice et al, 1995; Wansink and Park, 2000). Therefore, once the task had ended, the hunger they had felt during the task which had not been translated into eating due to social unease, resulted in a priming effect making them more hungry at the end. Those in the social condition were therefore mindful of their hunger but blocked from eating by social stigma.

There are however, some methodological issues that need to be considered. The first concerns the ecological validity of the different conditions given their laboratory basis and artificial nature. This is particularly the case for the social interaction condition whereby people were asked to eat whilst talking to someone who was not eating. This imbalance may explain the results for this condition and limits their generalisability to normal social situations. Second, the driving condition involved the participants to use their hands which may have limited their ability to eat. This increases the ecological validity of this condition but again may have influenced their food consumption. The complexity of the driving task, however, was low and the need for gear changes was minimal, thus enabling the participant to eat and drive if desired. Further, the snack food offered was 'hula hoops' which fit over the finger and are easier to eat when otherwise occupied. Finally, the desire to eat was assessed in terms of hunger, fullness and the motivation to eat and different patterns of responses were seen across these different measures. This may have been due to weaknesses

in the measures. However, it may also reflect that these three constructs are discrete and react differently to distraction. Further research is needed to explore these explanations.

To conclude, the present study aimed to evaluate the impact of distraction on food intake and to explore possible mechanisms for this association. The results showed that those watching television consumed more than those in the social or driving conditions. The results also showed that the key mechanism for this relates to the association between food eaten and subsequent changes in the desire to eat highlighting how hunger can be conceptualised as a symptom to be perceived and understood within an expanded model of both mindful and mindless eating. In particular, whereas eating alone resulted in mindful eating, those driving showed mindless eating as their food intake had no impact on their perceptions of hunger. The results however, were more complex than indicated by this unidimensional model of distraction and highlight how distraction should be understood as a multidimensional construct which influences the attention available not only for both perceiving the desire to eat but also engaging in the process of eating. In contrast to more biological models of food intake, hunger can therefore be conceptualised as a symptom to be perceived which is influenced by a number of psychological factors. One key factor is distraction which can take attention away from hunger thus breaking the link between the amount consumed and changes in the desire to eat. But distraction can also take attention away from the process of eating. Therefore in order to overeat an individual needs to be distracted away from their hunger but not away from the effort required in order to eat. Eating in the company of others may be hindered through the stigma of being watched particularly if these others are unfamiliar and / or not eating. Eating whilst driving may be mindless but is limited if the task of driving requires a degree of effort. Eating whilst watching television, however, may be the perfect recipe for overeating as there is no social

stigma, it prompts mindless eating whilst leaving sufficient cognitive capacity to still actually eat.

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Table 1: Participant demographics by condition (means / SDs / % / n)

	Driving (n=21)	Television (n=20)	Social (n=19)	Alone (n=21)	F / χ^2
Age	22.38 SD=4.93	22.90 SD=5.45	21.95 SD=5.57	21.90 SD=5.14	F=0.16 P=0.95
Ethnic.	W=16 (76.2%) B=0 (0%) A=5 (23.8%) O=0 (0%)	W=18 (90%) B=0 (0%) A=1 (5%) O=1 (5%)	W=17 (89.5%) B=0(0%) A=1 (5.3%) O=1 (5.3%)	W=20 (95.2%) B=1 (4.8%) A=0 (0%) O=0 (0%)	$\chi^2=13.45$ P=0.14
Occup.					
FT stud	19 (90.5%)	10 (50%)	14 (73.7%)	16 (76.2%)	$\chi^2=10.53$
Work	1 (4.8%)	9 (45%)	4 (21.1%)	5 (23.8%)	P=0.1
PT stud	1 (4.8%)	1 (5%)	1 (5.3%)	0 (0%)	
BMI	21.26 SD=2.39	22.69 SD=5.16	22.24 SD=5.19	22.56 SD=4.25	F=0.46 P=0.7
Rest. eating	2.67 SD=1.0	2.43 SD=0.94	2.45 SD=0.99	2.45 SD=0.78	F=0.32 P=0.8
Body diss.	2.22 SD=0.95	2.65 SD=0.99	2.47 SD=1.13	2.48 SD=0.84	F=0.65 P=0.6

Table 2: Impact of condition on the desire to eat and mass consumed (mean / SD)

	Driving (n=21)		Television (n=20)		Social (n=19)		Alone (n=21)		ME Time (F/p)	ME cond (F/p)	Tx Cond (F/p)
	T1	T2	T1	T2	T1	T2	T1	T2			
Hung	2.98 (0.8)	2.74 (1.1)	3.51 (0.9)	2.8 (0.9)	3.4 (1.1)	2.8 (1.3)	3.2 (0.8)	2.8 (0.8)	23.6 0.0001	0.5 0.7	1.1 0.4
Full	2.4 (0.9)	2.7 (1.2)	2.2 (0.9)	2.8 (0.8)	2.2 (1.0)	2.7 (1.2)	2.4 (0.8)	3.0 (0.7)	32.0 0.0001	0.5 0.7	0.6 0.6
Mot	2.9 (0.8)	2.7 (1.1)	3.5 (0.9)	2.8 (0.9)	3.3 (1.1)	2.9 (1.9)	3.1 (0.9)	2.5 (0.8)	19.2 0.0001	0.9 0.4	0.6 0.6
Mass Cons (g)	14.02 (10.34)		28.61 (24.44)		14.16 (12.33)		18.21 (20.9)		ME cond F=2.91 p=0.04		

Table 3: Associations between baseline desire to eat and mass eaten across conditions

	Driving (n=21)	Television (n=20)	Social (n=19)	Alone (n=21)
Hunger	r=0.27 p=0.23	r=0.32 p=0.17	r=0.37 p=0.12	r=0.17 r=0.46
Fullness	r=-0.04 p=0.87	r=-0.19 p=0.41	r=-0.37 p=0.12	r=-0.36 p=0.11
Motivation to eat	r=0.28 p=0.22	r=0.34 p=0.14	r=0.26 p=0.28	r=0.21 p=0.37

Table 4: Associations between mass consumed and changes in the desire to eat within and between conditions

	Driving (n=21)	Television (n=20)	Social (n=19)	Alone (n=21)	Z scores
Change in Hunger	r=0.37 β =-3.8 SE=2.2	r=-0.51* β =-11.87 SE=4.7	r=0.33 β =4.56 SE=3.17	r=-0.16 β =-5.25 SE=7.6	D-T=1.56 D-S=2.16* D-A=-0.18 T-S=2.89* T-A=0.74 S-A=-1.19
Change in Fullness	r=0.11 β =1.41 SE=2.99	r=0.36 β =8.91 SE=5.4	r=-0.09 β =-1.6 SE=4.5	r=0.47* β =16.7 SE=7.07	D-T=-1.21 D-S=0.56 D-A=-1.99* T-S=-1.49 T-A=0.88 S-A=-2.18*
Change in Motivation to eat	r=-0.26 β =-2.6 SE=2.2	r=-0.47* β =-12.5 SE=5.5	r=0.3 β =3.99 SE=3.06	r=-0.47* β =-9.3 SE=4.85	D-T=-1.67 D-S=-1.75 D-A=1.26 T-S=-2.62* T-A=-0.44 S-A=2.32*

*p<0.05