Effects of Simple Verbal Instructions on Eating Rate, Fullness, Meal Enjoyment and Meal Satisfaction

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Abstract

Laboratory studies have highlighted that eating slowly can increase satiety and might be an effective strategy in weight control. However, it was noted that slow eating can be less desirable in real life. Therefore, this study investigated the effects of simple verbal instructions on eating rate, fullness, meal enjoyment and satisfaction. It was predicted that instructing people to eat slowly and 'savour' a food would decrease eating speed and provide more fullness compared to control group. In addition, savouring a food would increase meal enjoyment and satisfaction. Firstly, baseline measures (hunger, fullness, thirst,) were collected from 100 healthy volunteers. Following this, they were allocated to one of three experimental conditions and instructed to eat a 431.03 kcal fixed lunch meal. Then, post-meal measures (hunger, fullness, meal enjoyment and satisfaction) were collected. Results demonstrates that participants in slow eating condition markedly decrease their eating rate compared to participants in usual and savour conditions. On the other hand, there was no significant differences in fullness, meal enjoyment and meal satisfaction across conditions. This study indicates that eating speed can be altered by simple instructions rather than complicated methods, however reduction in eating speed may not increase fullness, enjoyment and satisfaction.

Keywords: verbal instruction, eating speed, fullness, satisfaction, enjoyment

Author's Declaration

I declare that the work in this dissertation was carried out in accordance with the requirements of the University's Regulations and Code of Practice for Taught Postgraduate Programmes and that it has not been submitted for any other academic award. Except where indicated by specific reference in the text, this work is my own work. Work done in collaboration with, or with the assistance of others, is indicated as such. I have identified all material in this dissertation which is not my own work through appropriate referencing and acknowledgement. Where I have quoted from the work of others, I have included the source in the references/bibliography. Any views expressed in the dissertation are those of the author.

Student Number: 1703470 *DATE: 09.09.2018*

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Obesity has been recognised as a serious public health issue in many countries, and the prevalence of overweightness and obesity has risen three-fold in the last twenty years (James, Rigby & Leach, 2004). Predictions for this obesity trend seem to be even more concerning, indicating that 80% of Americans are at risk of being overweight and obese within 15 years (Wang, Beydoun, Liang, Caballero & Kumanyika, 2008). Today, the obesity epidemic is one of the urgent issues which needs to be dealt with in countries experiencing its adverse effects on health and the economy. Health professionals have stressed that obesity elevates many diseases; for example, diabetes, cardiovascular diseases and different forms of cancer (Wang, McPherson, Marsh, Gortmaker & Brown, 2011). Furthermore, it causes a significant economic burden in the health care system. It is stated that overweightness and obesity treatment cost £5.1 billion to the National Health Service (NHS) in the UK between the years 2006 and 2007 (Scarborough et al., 2011).

Obesity is often identified as an excessive increase in body fat (Wyatt, Winters & Dubbert, 2006). To determine the degree of obesity, academic and health investigators have used a well-known indicator, the Body Mass Index (BMI; in kg/m^2), which is based on a simple calculation where weight (kg) is divided by the square of the height (m^2). According to the World Health Organisation (WHO) annual report (2000), a BMI value of 25 or more is characterised as overweight, and a BMI of 30 or more is classified as obese.

Eating behaviour has been suggested to be complicated, as it involves biological, physiological, economic, social and cognitive components (Rogers, 1999). Therefore, although the causal factors in obesity have been discussed for several decades, it has been shown that they are not straightforward.

For Mela and Rogers (1998), genetics is an important contributor to obesity, since family studies have shown that genetic disposition could make a person more susceptible to

developing obesity. Further, this idea has gained strength after twin studies demonstrated that eating behaviour, specifically eating rate, might be a heritable behaviour, increasing the possibility of being obese (Llewellyn, van Jaarsveld, Boniface, Carnell & Wardle, 2008).

Environmental variables (such as food availability, portion size, food advertisements, and high fat diets) have also been pointed out as strong contributors to obesity. The term 'toxic environment' (Rogers, 1999) is probably a good way to draw attention to environment as one of the causal factors in weight gain. This idea states that our modern world offers high energy density foods (high in fat and low in water) with lower costs, which might affect our decisions about what to choose to eat. Although eating behaviour in humans is voluntary (Mela & Rogers, 1998), there are many environmental cues that might direct people to consume more or eat unhealthily by influencing our 'choosing' (decision making) action (Levitsky & Pacanowski, 2012). In such an environment, it would not be surprising to face an imbalance in energy intake and energy expenditure that might end with overweightness and obesity. On the other hand, it has been claimed that the toxic environment notion is probably insufficient in explaining obesity on its own, as it attributes a great role to appetite regulation making a person vulnerable to obesity (Rogers & Brunstrom, 2016).

For Blundell et al. (2010), appetite "refers specifically to qualitative aspects of eating, sensory aspects or responsiveness to environmental stimulation which can be contrasted with the homeostatic view based on eating in response to physiological stimuli, energy deficit etc." (p. 252). Here, it would be useful briefly to mention homeostatic and non-homeostatic systems for further understanding. Homeostatic control of eating is an essential part of being alive, which is derived from biological factors (hunger, or fullness) (Berridge, 1996), and is operated by the central nervous system, particularly the hypothalamus, which plays a crucial role in the regulation of food intake (Farr, Li & Mantzoros, 2016).

Nevertheless, it has been suggested that there are equally powerful determinants (reward, memory, attention and cognitive control systems) for energy intake. Otherwise, if energy intake was only managed by the homeostatic system, nobody would be overweight or obese (Saper, Chou & Elmquist, 2002). For example, in one study, the functional magnetic resonance imagining technique (fMRI) indicated that increased activation in brain regions related to the attentional and reward systems (parietal and occipital cortices) might highlight that obese people are more prone to food cues and have difficulties losing weight or maintaining healthy weight after treatment (Murdaugh, Cox, Cook & Weller, 2012). In another study, Parigi et al. (2002) demonstrated that eating behaviour (hunger and satiation) is not shaped by the hypothalamus alone (i.e. not only the homeostatic system), since it receives many inputs from other systems such as the prefrontal cortex (inhibition in inappropriate behaviour) and limbic/paralimbic areas (known as emotion regulation areas). Hence, the functional connectivity of the brain appears to point out a more sophisticated system.

In this context, non-homeostatic eating (the hedonic system) has been underlined as an important moderator in food intake, leading to overconsumption or underconsumption without biological requirements (Corwin & Hajnal, 2005). The hedonic system (also called the reward system) consists of two separate components: 'liking'- a pleasant taste experience of food in the mouth (Rogers & Hardman, 2015); and 'wanting'- motivation to eat food at any time. It is assumed that eating behaviour is operated by wanting components of a food reward system in overweight and obese people. This suggestion is based on the idea that obese people might eat more to compensate for this sense of reward, since they might not get pleasure from eating as opposed to the common belief that 'obese people like eating so they eat more' (Mela, 2006).

Recent studies have supported the view of interaction between homeostatic and non-homeostatic eating, rather than interpreting them as opposite systems (Rogers & Hardman, 2015) in appetite regulation and energy intake, but it is still unclear how liking and wanting contribute to this process (Finlayson, King & Blundell, 2007).

Taken together, an increasing amount of evidence has stated that external motives play a significant role in energy intake and appetite regulation, and as they are modifiable they may help to reduce the risk of obesity (Hill & Peters, 1998). However, it appears that control over only simple nutritional decisions may not be enough to achieve this aim, implying that a reduction in eating speed could be an alternative strategy to control weight gain (Hamilton-Shield et al., 2014).

Eating speed is one of the well-researched areas in the microstructure of eating, along with oral processing (i.e. bite size and chewing) (Hogenkamp & Schiöth, 2013). The association between eating rate and weight control was initially proposed by Ferster, Nurnberger and Levitt (as cited in Bray, 1996). The authors suggested that obese people could benefit from eating slowly in order to lose weight. This point of view has led researchers to examine the importance of eating rate to weight gain. In 1984, Hill and McCutcheon observed that obese people ate faster compared to lean people, after the factors of controlling hunger and preference of food are taken into account.

Furthermore, eating a fixed meal at a faster rate was found to be associated with reduced fullness (Ferriday et al., 2016), and fast eating was highlighted as a powerful determinant of excess body weight (Okhuma et al., 2015). These findings might be explained by a positive correlation between fast eating and excessive energy intake (Viskaal-van Dongen, Kok & de Graaf, 2011), and might address the high risk of obesity (Hill & McCutcheon, 1984).

Although Spiegel (2000) claimed that eating rate manipulation is ineffective in obesity treatment, many authors have suggested that eating slowly might be an effective intervention to weight control, since it helps to limit excessive consumption and provides satiety (Stuart, 1996; Zandian, Loakimidis, Bergh, Brodin & Södersten, 2009). It was claimed that slow eating might increase satiety (Zhu, Hsu & Hollis, 2013). In one study, Kokkinos et al. (2010) found that eating slowly (a five minute meal vs. a 30 minute meal) resulted in a marked increase in the anorexigenic hormones peptide YY (PYY) and glucagon-like peptide (GLP)-1, indicating that eating speed may lead to hormonal changes in order to increase satiety. In another study, Angelopoulos et al. (2014) found that participants with type 2 diabetes mellitus (T2DM) reported more fullness and less hunger when they ate at a moderately slower pace.

In this respect, new technological devices have been developed to modify eating rate in order to examine the effectiveness of eating slowly in relation to weight control. These tools were designed to give feedback to users regarding their eating speed, and remind them to eat at a slower pace. For example, new assistive technologies such as the HAPIfork/10sFork (Slow Control, Paris, France) and Mandolean® (previously Mandometer®, Mikrodidakt AB, Lund, Sweden) have been developed to assist with the reduction in eating rate to prevent excessive consumption. Despite their popularity, their effectiveness is not without controversy. Firstly, Hermans et al. (2017) claimed that although assistive technologies (in this study the 10sFork) might be promising in leading individuals to take smaller bites each time during a meal, changes in their eating habits do not certainly result in changes in satiation. In addition, Hamilton-Shield et al. (2014) argued that these tools, such as Mandolean®, are not effective in terms of slowing down the eating speed of obese children.

Secondly, these technological devices seem to be not available in public health care settings (e.g. the NHS). Hence, clinicians tend to rely on verbal instructions to slow down eating in practice. From this point of view, it has been argued that verbal instructions are an effective way to reduce hunger and promote satiety (Andrade, Kresge, Teixeira, Baptista & Melanson, 2012). It was also demonstrated that instructing participants verbally to chew more reduced subsequent energy intake (Smit, Kemsley, Tapp & Henry, 2011).

Despite the beneficial effects of slow eating, previous studies have demonstrated that when eating rate is manipulated by quite detailed instructions (e.g. chew for 30 seconds, or use a teaspoon to eat your food), participants have reported unpleasantness and low mood (Higgs & Jones, 2013). In another study, increase in chewing resulted in slower eating and reduced appetite (Zhu et al., 2013). Moreover, participants taking longer pauses during eating reported less meal satisfaction (Yeomans, Gray, Mitchell & True, 1997). On the other hand, eating rapidly was also reported to lead to a slight reduction in pleasantness due to shorter oral exposure to the food (Rogers & Hardman, 2015). Furthermore, Stuart (1996) highlighted that eating faster minimises food enjoyment. Therefore, it can be hypothesised that 'savouring' might be a key area to increasing food enjoyment, fullness and meal satisfaction, while decreasing eating rate.

In this context, savouring needs to be defined. Cambridge Dictionary defines savouring as "enjoying food or an experience slowly, to enjoy it as much as possible" ("savour", n.d.). In another English dictionary, Collins identifies savouring as "to eat or drink slowly to taste its full flavour and to enjoy it properly" ("savour", n.d.). According to the author's knowledge, 'savouring' has not been investigated by manipulating it with verbal instructions in a nutritional context. Instead of savouring, the concept of 'mindfulness' has been researched widely. Although there is an overlap between mindfulness and savouring in the wider thinking, they are distinct notions, since savouring focuses on promoting positivity

and it has a narrower perspective compared to mindfulness, which emphasises paying attention to the moment (positive or negative), and is a wider concept (Kiken, Lundberg & Fredrickson, 2017).

Based on the above, the aim of this study is to investigate the effects of simple verbal instructions ('eating as usual', 'slow eating', or savouring) on eating rate, fullness, meal enjoyment and meal satisfaction. The hypotheses are: (i) verbal instructions in the slow and savour conditions will decrease participants' eating rate (Eating rate: usual > slow = savour); (ii) participants in the slow and savour conditions will report more fullness compared to the usual condition (Fullness: Slow = savour > usual); (iii) meal enjoyment will be the greatest in the savour condition and the least in the slow condition (Meal enjoyment: Savour> usual > slow); and (iv) verbal instruction in the savour condition will increase meal satisfaction compared to the slow and usual conditions (Meal satisfaction: Savour > slow > usual).

Method

Participants

To determine sample size, an a priori power analysis was done based on data from a previous study conducted by Ferriday et al. (2015) in Nutrition and Behaviour Unit (NBU) laboratory. This paper was chosen as the current study design is similar to this study, in which the authors measured the changes in pre-lunch and post-lunch appetite in slow vs. faster eating conditions. The effect size in this study was large ($\eta_p^2 = 0.149$), using Cohen's (1988) criteria. Based on this, the power analysis indicated that 60 participants across three groups had 80% power for detecting a large effect size when applying a 0.05 criterion of statistical significance. However, the study could not be powered based on the savour condition, as it has never been done before. Since the effect size associated with the savour instruction was unknown, it was decided to be conservative, and the research recruited more participants than the calculated number to allow for possible drop-outs during the study.

Therefore, 100 healthy adults (34 men and 66 women) aged 18 to 70 from the population of Bristol (UK) were recruited via an online database of volunteers belonging to the NBU. Participants were excluded if they were: i) vegan; ii) not fluent in English; iii) allergic or intolerant to any food; iv) trying to lose weight; v) smoking more than five cigarettes a day; or vi) taking any medication that might influence appetite (with the exception of oral contraceptive pills).

All of the participants were reimbursed £5 (Sterling) for their participation. For this study, ethical approval was granted by University of Bristol Faculty of Science Human Research Ethics Committee (study approval code: 10051865761).

Test Meal

Before the main test meal, the participants were presented with two taster portions, consisting of a cheese and tomato sandwich (8 g) and a cookies and cream white chocolate wafer biscuit (8 g). The taster portions were offered to measure the participants' liking and desire to eat responses to the test meal. Following this, the participants were presented with a fixed portion of the main test meal, consisting of one cheese and tomato sandwich and one cookies and cream white chocolate wafer biscuit, which were cut equally into two pieces (the food was same in the tasting process, and was sourced from Sainsbury's, UK). The participants under all three conditions (usual, slow and savour) ate the same lunch. Table 1 demonstrates the nutritional information of the test meal. This meal was chosen since the sandwich is one of the most popular lunch meals in the UK. The test meal was prepared in the NBU research kitchen before the test sessions. The participants were instructed to finish their meal to prevent any possible variation in food intake. They were also offered a glass (250ml) of tap water alongside the meal. Only one participant was provided with a second glass of water. Water intake was recorded.

Table 1
Nutritional Value of the Test Meal

Ingredient	Weight (g)	kcal	Protein	Fat	Sat.	Carbs	Sugars	Fibre	Salt
Kingsmill no Crusts Soft Medium Sliced White Bread	44.05	100	3.4	0.8	0.2	19.4	1.4	1.2	0.44
British Mild Cheddar Cheese Slices	36	150	12.2	12.6	7.8	0.18	0.18	0.00	0.64
Classic Round Tomatoes	15.00	3.00	0.11	0.08	0.02	0.47	0.47	0.15	0.00
Anchor Spreadable	10.50	73.08	0.03	8.09	3.26	0.03	0.03	0.00	0.12
Cookies and Cream KitKat	20.7	104.95	1.58	5.26	2.98	12.61	10.24	0.29	0.05
TOTAL	126.25	431.03	17.32	26.83	14.26	32.69	12.3	1.64	1.25

Design

This study used a single-blind, between-subjects design, with verbal instructions (usual eating, slow eating and savouring) as the between-subjects factor. The dependent variables included eating rate, fullness, meal enjoyment and meal satisfaction. The participants were randomly allocated to three equal-sized groups, with the constraint that there would be equal numbers of men and women in each group. The three groups differed, as each group received different verbal instructions linked to their condition. Condition 1 was the ‘usual eating’ (control) group, where the participants were instructed to eat at their normal pace. The instruction for this condition was, ‘Make sure to eat as you would usually eat. It is important for this study that you eat at your normal pace.’ In Condition 2, ‘slow eating’, the participants were asked to eat slowly. For this condition, the instruction was, ‘Make sure to eat more slowly than you would usually eat. Take smaller bites and make sure to pause for longer between each mouthful.’ Condition 3 was the ‘savouring’ group, where the participants were instructed, ‘Make sure to make the most of your meal. Be a

gourmet: focus on how the food tastes and savour every mouthful'.

Materials

A 100mm horizontal visual analogue scale was used for all baseline and post-meal measurements. The left-hand end of the scale was anchored 'NOT AT ALL' (0), and the right-hand end of the scale was anchored 'EXTREMELY' (100). The participants rated their fullness, hunger and thirst before and immediately after eating the test meal. The following questions were presented on the computer screen: 'How FULL does your stomach feel RIGHT NOW?'; 'How HUNGRY do you feel RIGHT NOW?'; and 'How THIRSTY do you feel RIGHT NOW?'.

To measure the participants' liking and desire to eat responses, they were asked to rate their liking by responding to the request, 'Please rate how pleasant this food tasted in your mouth RIGHT NOW' (Rogers and Hardman, 2015). For the desire to eat rating, the instruction was, 'Now look at remaining food on the plates in front of you. How strong is your desire to eat, that is to taste, chew and swallow, the rest of this food RIGHT NOW?'.

Meal duration was recorded automatically by a special code developed in the laboratory for this study. Immediately after eating the test meal, the participants were asked to rate their meal enjoyment and meal satisfaction.

To rate their meal enjoyment, the instruction was, 'From the first bite to the last, how much did you ENJOY EATING your meal (sandwich and chocolate wafer biscuit) today?' Meal satisfaction was also evaluated by asking, 'Overall, how SATISFAYING did you find your meal today?'; the anchor points were 'NOT AT ALL' and 'EXTREMELY'.

All VAS-based measurements were stored in a computer data file that was created for this purpose. The instructions for appetite ratings and post-meal measures were randomised to reduce demand awareness. At the end of the study, the participants were asked an open-

ended question, which was, “In your opinion, what was the purpose of this study?” to test their demand awareness.

Finally, they were asked, “How would you describe your usual rate of eating?” based on previous studies (Petty, Melanson & Greene, 2013), to evaluate the self-reported eating rate. They rated their self-reported eating rate on a 5-point qualitative scale consisting of ‘Very slow’, ‘Relatively slow’, ‘Medium’, ‘Relatively fast’ and ‘Very fast’.

Real-time video recordings were used to assess the oral processing behaviours of the participants, which had been used previously in the laboratory (Ferriday et al., 2016). Participants were informed that they would be recorded during the experiments before taking part in the study. For this study, a Logitech C270 webcam was used and positioned at the top of the monitor. To prevent any disruption, the webcam light was disabled, and participants were unable to see themselves during filming.

Procedure

An online advertisement for the study (Appendix A) was placed on the NBU web page and the University of Bristol Experimental Psychology website for participant recruitment. The participants were told that the purpose of the study was to investigate ‘How people eat and appreciate different sandwiches’, to reduce demand awareness. All of the participants were provided with an information sheet (Appendix B), outlining the general requirements of the research. They were advised to read all of the information before taking part in this study, and were reminded that they were free to withdraw at any time. They were reminded to be prepared to consume bread, cheese, butter and tomatoes. They were also reminded to abstain from eating and drinking for three hours before the test session, except for water. The participants were given the researcher’s e-mail address to indicate their interest in the study. People who were willing to participate were provided with a link (via doodle) to specify their available time slots.

Test sessions were scheduled from Tuesday to Friday between 11:30 and 14:00 in the NBU (11:30-12:00, 12:10-12:40, 12:50-13:20, and 13:30-14:00). Each test session lasted for approximately 30 minutes.

On the test day, two participants under the same condition were taken to a quiet test room. They sat at tables where the prepared test meal was presented. They were placed apart from each other to prevent any interactions and distractions. Figure 1 shows the experimental set-up and the meal as served.

They were instructed to read the information sheet again, and fill out written consent (Appendix C) and video consent (Appendix D) forms before the test session started. The participants were reminded that they had the right to withdraw from the experiment at any point. Following this, they were reminded how to use the computerised VAS scale. They were not allowed to read or do anything else during the experiment.

The participants were initially asked to rate the time since they last ate. Then, they completed the baseline appetite (hunger, fullness and thirst) ratings. After completing the baseline appetite ratings, they were instructed to taste a small piece of cheese and tomato sandwich, and immediately after tasting, they were asked to rate their liking for it. Following this, they were instructed to taste a small piece of KitKat and rate their liking for that. The order of tasting and rating was the same for all participants. Then, the participants were asked to complete a desire to eat scale. As specified in the design section, the participants were instructed (eat slowly, eat as usual, or savour), linked to their condition. To assess meal duration for each participant, we asked them to press ‘ENTER’ when they were ready to start eating, and press the ‘F’ key when they had finished eating. They were instructed to drink as much of the water as they would like. Once the participants had finished eating, they were presented with appetite ratings randomly to rate their post-meal hunger, fullness and thirst. For these ratings, the same questions as had been used in the baseline ratings were used.

Additionally, they were asked to rate their meal enjoyment and meal satisfaction. After all of the computer-based ratings were finished, the participants' typical eating rate and demand awareness were measured. At the end of the test session, the participants' weight and height were measured for BMI calculation purposes. The participants were thanked and given £5 (Sterling) reimbursement for their participation. All of the participants were sent a debriefing sheet (Appendix E) after the testing was finished.

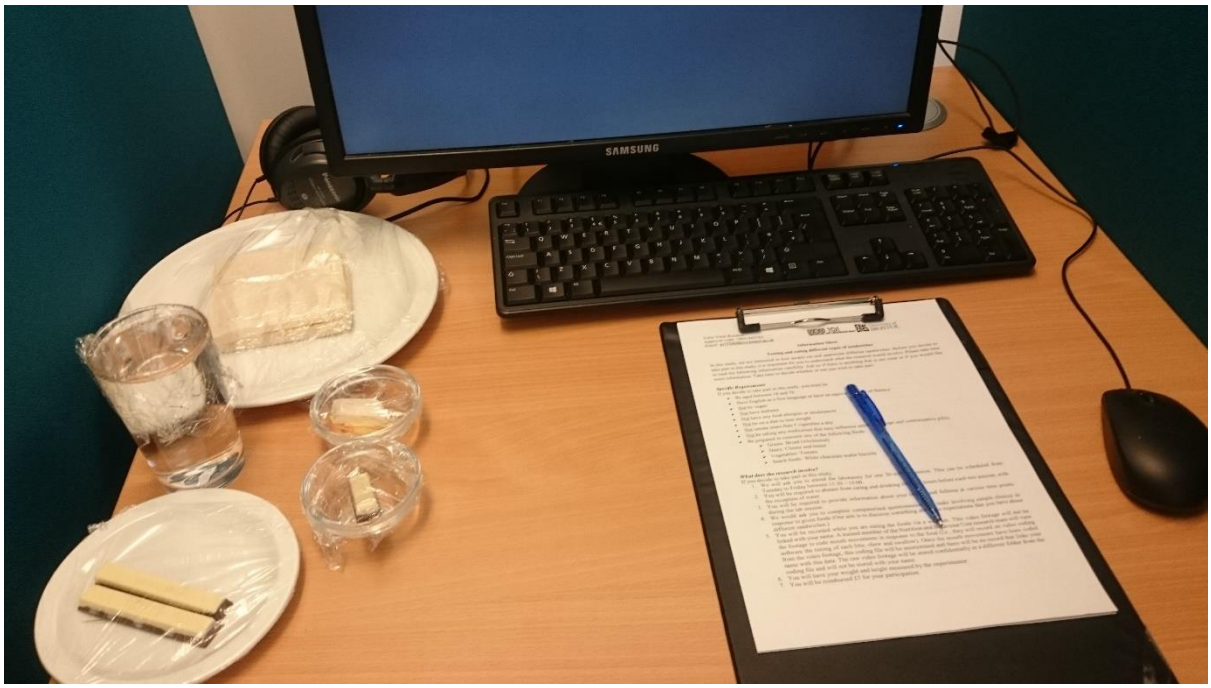

Figure 1. Experimental set-up and meal as served.

Data Management and Data Analysis

A copy of the anonymised computer was transferred from the researcher's encrypted USB drive to the secure NBU server once a week. All paper data and written consent forms were kept separately in a locked cabinet in the NBU.

To analyse the data, in the first instance, all the data were concatenated in an excel spreadsheet and then transferred to IBM SPSS statistics version 24 (IBM, New York, USA). Then, the raw data was converted to *z- scores* to screen outliers. Scores falling outside *-3.29* and *3.29 z-scores* (99.9% of a normal distribution) were treated as missing data. All data were analysed by using a critical p-value of $< .05$. Three participants were excluded from the study

since they did not meet the eligibility criteria of the study (they did not finish the offered meal). In total, the remaining 97 participants (32 male, 65 female) were included in the analysis. In the eating rate analysis, one more participant was excluded due to extreme data. For the eating rate analysis alone, the data of 96 participants were analysed. Due to experimenter error, the participants' age information was not collected. Therefore, the subjects mean age was estimated based on video recordings. The baseline measures (time since last eating, hunger, fullness, and thirst) and the participants' characteristics (weight and BMI) were analysed with a one-way ANOVA between-subjects design to determine differences across the conditions. Here, it should be noted that time since last eating was collected in hours, and for the analysis it was converted to minutes.

To investigate the differences in the self-reported eating rate, initially the participants' eating rates were classified into three categories, and they were renamed as 'slow', 'medium' or 'fast' eaters based on two previous studies (Ferriday et al., 2015; Petty et al., 2013), in order to see the typical eating pace differences across the three conditions (usual, slow and savour). Data was analysed with a Chi-Square test.

In order to analyse liking, firstly, composite liking scores were created based on a specific formula (80% of the cheese and tomato sandwich liking score + 20% of the KitKat liking score). The percentages in this formula were based on the contributions of the cheese and tomato sandwich (105.5 g) and the KitKat (20.7 g) to the test meal. After this arrangement, the composite liking scores and desire to eat scores were analysed with a one-way ANOVA to determine whether there were differences in the liking and desire to eat scores across the three conditions. Any 'change' in desire to eat could not be calculated, since it was not measured after the participants had consumed the test meal.

To evaluate the effectiveness of verbal instructions on eating rate (kcal/s), the amount of consumed meal (431.03 kcal) was divided by the recorded meal duration (s) for each

participant. Following this, a one-way ANOVA between-subjects analysis was applied to investigate the differences in eating rate between the conditions. Bonferroni's corrected post hoc test was used to understand the pairwise comparisons.

To analyse the effects of simple verbal instructions on fullness, firstly, the baseline fullness scores were subtracted from the post meal fullness scores to determine 'change' in fullness. Then, a one-way ANOVA between-subjects analysis was applied.

A one-way between-subjects variance analysis was also used to explore differences in post-meal enjoyment and meal satisfaction across the conditions.

Finally, Pearson's correlation (r) analysis was conducted to investigate the relationship between the taster ratings (composite liking and desire to eat) and the post-meal measures (meal satisfaction, meal enjoyment, change in fullness and change in hunger). In order to report effect sizes, widely accepted r values were used, which are 0.10, 0.30 and 0.50, interpreted as a small, medium and large respectively (Cohen, 1992).

Results

In terms of gender, all three conditions were balanced. The estimated mean age of the participants was 30 years. Table 2 shows the means and standard deviations of baseline ratings (time since last eating, hunger, fullness, and thirst) and the participants' characteristics (weight and BMI), in the usual, slow and savour conditions separately. The participants did not differ significantly in their baseline measures in terms of appetite ratings and characteristics. In addition, analysis of the self-reported eating ratings has revealed that there were an unequal number of fast, medium and slow eaters across the conditions, however they did not differ significantly.

The participants' average combined liking score was 68.42 (*SD* = 15.96), and the average desire to eat score was 67.76 (*SD* = 20.75). Analysis of variance showed that there

was no significant difference in the composite liking scores (F (2, 94) = 2.16, p = .12) or the desire to eat scores (F (2, 94) = 0.11, p = .90) across the conditions.

Table 2
Mean (± SD) Scores of Baseline Measures Across Conditions

	Usual eating (n= 32)	Slow eating (n=33)	Savouring (n=32)	F (94)	p
Time since last eating (min)	413.44 (329.3)	334.0 (263.6)	359.44 (305.5)	0.59	.56
Hunger (mm)	65.53 (22.53)	70.12 (17.26)	67.06 (17.35)	0.48	.62
Fullness (mm)	23.28 (19.27)	23.73 (20.32)	24.28 (16.19)	0.02	.98
Thirst (mm)	57.44 (25.33)	58.21 (20.26)	54.16 (22.11)	0.29	.75
Weight (kg)	63.98 (12.04)	67.76 (14.99)	67.18 (14.06)	0.71	.50
BMI (kg/m^2)	22.54 (2.92)	23.72 (3.51)	23.57 (3.99)	1.09	.34
Self-reported eating rate	16 fast/ 10 medium/ 6 slow	17 fast/ 6 medium 10 slow	15 fast/ 8 medium 9 slow	X^2= 2.14	.71

The one-way ANOVA analysis revealed a significant main effect of verbal instructions on meal duration (F (2, 93) = 24.66, p < .001, η_p^2 = 0.35). The average meal duration in the usual eating condition was 388.87 s (SD =100.70 s), in the savour condition it was 411.12 s (SD =116.52 s), whereas in the slow condition the average meal duration was 679.47 s (SD = 278.09 s), indicating that meal duration was approximately 4.5 minutes longer in the slow condition compared to the savour condition, and 4.8 minutes longer in the slow condition compared to the usual condition. This created an average eating rate of 1.18 s (SD = 0.29 s) in the usual condition, 1.13 s (SD = 0.34 s) in the savour condition, and 0.74s (SD = 0.31 s) in the slow eating condition. The post hoc test showed that there were significant differences in the usual vs. slow and savour vs. slow conditions. This analysis was repeated with the desire to eat scores included as a covariate, since it was found to be a strong predictor of food intake (Rogers & Hardman, 2015). However, the results did not change.

Analysis of variance indicated that verbal instructions did not cause any significant difference in self-reported fullness across the conditions (F (2, 94) = 0.35 p = .70). Water intake also did not differ between the groups (F (2, 93) = 0.16, p = 0. 85). The one-way

ANOVA showed that the participants' meal enjoyment did not differ across the groups (F (2, 94) = 0.04 p = .96). There was also no significant difference across the conditions in terms of post-meal satisfaction (F (2, 94) = 0.10 p = .91).

A correlation analysis was used to determine the relationships between the taster (composite liking and desire to eat) and post-meal ratings (meal enjoyment, meal satisfaction, change in fullness and change in hunger scores). Table 3 summarises the inter-relationships between these measures. The Pearson correlation coefficient and *p* values were provided. As seen in Table 3, meal enjoyment was significantly correlated to meal satisfaction (r = 0.79), desire to eat (r = 0. 54) and liking (r = 0. 51). In addition, meal satisfaction was strongly correlated to liking (r = 0.61) and desire to eat (r = 0.48). There was a strong positive correlation between liking and desire to eat (r = 0.50). There was a significant negative correlation between change in fullness and change in hunger (r = - 0.44).

Table 3
Inter-Relationships (Pearson's r) Between Self-Reported Taster and Post-Meal Measures

	Composite Liking (mm)	Desire to eat (mm)	Meal enjoyment (mm)	Meal satisfaction (mm)	Change in Fullness (mm)	Change in hunger (mm)
Composite Liking (mm)	-					
Desire to eat (mm)	.50**	-				
Meal enjoyment (mm)	.51**	.54**	-			
Meal satisfaction (mm)	.61**	.48**	.79**	-		
Change in fullness (mm)	.19	.14	.21*	.27**	-	
Change in hunger (mm)	-.14	-.23*	-.09	-.26*	-.44**	-

*p < 0.05; **p < 0.01.
All values are rounded to one decimal.

According to the open-ended question about the purpose of the study, the participants believed the cover story (eating and rating different types of sandwiches). Only 10% of the participants made close estimations, indicating that the "study was about fullness, and food enjoyment after receiving instructions". However, nearly 90% of the subjects suggested alternative ideas; for example, "the aim of the study was comparing savoury and sweet foods", or "this study explored the effects of food size on fullness and hunger".

Discussion

The aim of this study was to examine three different verbal instructions given before eating a fixed portion of a meal (specifically, instructing people to either eat slowly, eat at usual pace, or to savour the food), to understand whether they affect (1) eating rate, (2) fullness, (3) post-meal enjoyment and (4) post-meal satisfaction, across the conditions.

In the first hypothesis, it was predicted that the verbal instructions in the slow and savour conditions would decrease the participants' eating pace compared to the usual (control) condition. Consistent with previous research (Andrade et al., 2012; Shah et al., 2014), the participants in the slow condition significantly reduced their eating speed after receiving instruction ('eat slowly'). As stated above, in previous literature researchers have tended to use more complex instructions (eating with a spoon vs a fork, or instructing how to chew) to slow down eating speed (Bolhuis & Keast, 2016; Smit et al., 2011). Here, this study showed that even simple verbal instructions can be an effective way to achieve a reduction in eating pace. This could be elaborated as a promising outcome, and might be useful in clinical practice for obesity treatment.

When it comes to the comparison between the savour and the usual condition, whereas previously it was concluded that savouring decreased eating speed (Areni & Black, 2015), the results indicate that there was no meaningful difference between the savour group

and the control group. There might be some reasons that could explain why the verbal instruction in the savour condition could not reduce eating rate.

Firstly, it is assumed that 'savouring' the food might have been a new concept for some of the participants. This possibility might be convincing when it is considered that the participants come from different cultures, and cultural eating habits might have a significant influence on people's eating actions. For example, it was argued that there was a significant difference between French people and American people in terms of their eating habits, stressing that while French people spend a longer time eating and they focus on the food, Americans spend significantly less time. Hence, French people tend to experience savouring food as a part of their eating habits, whereas American people have a tendency to consume a meal quickly (Rozin, Kabnick, Pete, Fischler & Shields, 2003).

Secondly, in this study, the verbal instructions disappeared from the computer screen when the participants started eating. Presumably, this could have made them forget the verbal instruction in the savour condition. As stated above, this term was estimated to be new for some participants, and when the instruction was not on the screen during eating, the participants could forget them easily compared to more familiar instructions. In addition, it is also possible that participants may not have paid attention to these unfamiliar instructions. However, there is no evidence to support this assumption. Therefore, further studies might examine the differences between keeping and leaving instructions on the screen in order to reach a clear result. Furthermore, new studies could train participants to savour a food as a part of the testing process, to enhance their knowledge of savouring before the experiment.

The second hypothesis estimated that the verbal instructions that directed the participants either to eat slowly or to savour the meal would provide more fullness compared to the participants under the habitual eating condition. Here, cognitive factors, specifically memory was also stated as an important factor in satiety, claiming that chewing for a long

period of time can help to improve food memory and increase the attention given to the sensory characteristics of food (Higgs & Jones, 2013). However, surprisingly the participants who ate slowly did not report more fullness compared to the participants in habitual eating condition. Hence, this result is not compatible with previous studies, in which eating slowly was found to increase satiety compared to eating at a faster speed (Ferriday et al., 2015; Robinson et al., 2014).

One possible explanation could be regarding the usage of visual analogue scales. It was claimed that even though VAS have been used commonly and are the best appetite rating systems available to researchers, they might be insensitive to distinguishing differences in fullness (Raben, Tagliabue & Astrup, 1995). In addition, it was highlighted that if the participants were less able to use the computerised appetite rating systems, the reliability and quality of the data collection would decrease (Stubbs et al., 2000). In the current study, after a few test sessions, it was observed that some participants spent a long time figuring out how to use the electronic VAS. Therefore, unexpected results from the slow condition regarding satiety might be related to the participants' inability or unwillingness to use the VAS measurement.

Satiety here refers to a significant reduction in hunger that inhibits further energy intake and is related to fullness after finishing a meal, whereas satiation leads to stopping eating and is related to meal size (Blundell et al., 2010). This difference is important, since the interest of this study is in satiety rather than satiation, as the participants were instructed to eat all of the test meal. On the other hand, the current study did not examine further energy intake; therefore, it is unknown whether eating slowly reduces prospective energy intake.

Regarding Hypothesis 3, the forecast of this study was that reported enjoyment would be greatest in the savour condition and least in the slow condition. However, the results indicate that there was no difference between the conditions. This result is inconsistent with a

previous study, in which it was claimed that savouring helps to increase present enjoyment and sustain it for a long time, since it requires the participant to focus on the sensory aspects of food (Bryant, 2003).

Finally, in Hypothesis 4, it was suggested that meal satisfaction would be greatest in the savour condition, followed by the slow and usual eating conditions. Contrary to this assumption, verbal manipulation did not result in any significant differences between the three conditions. Meal satisfaction can be considered as an overall response to having eaten a meal (Piqueras-Fiszman & Jaeger, 2015). In their study, Haugaard and Lähteenmäki (2017) pointed out the possible contributors to satisfaction: sensory experience of food; physiological outcome after eating; social interaction; and an environment that establishes meal satisfaction. In addition, it was added that when participants' meal related goals are met, meal satisfaction increases. In this regard, Rogers and Hardman (2015) recognised desire to eat and meal enjoyment as important components for energy intake and food reward. This study also shows that meal satisfaction has a strong positive association with desire to eat ($r = 0.48$) and meal enjoyment ($r = 0.79$). Further studies should examine this association more closely. Especially, meal enjoyment appears to be a marked component in meal satisfaction, yet a regression analysis is needed to confirm it as a strong predictor in meal satisfaction.

Strengths and Limitations of the Study

This study has several strengths. Firstly, as stated in the introduction, savouring in a nutritional context was not manipulated previously by using only simple verbal instructions. Previous studies have generally tended to direct a subject to savour food by manipulating portion size (Rozin et al., 2003; Galak, Kruger & Loewenstein, 2013). Hence, this study can be considered the first to use this method. Secondly, the current study shows that eating speed can be decreased by using simple verbal instructions rather than specific and complicated methods. This could be a potential factor in obesity treatment. In addition, this study sample

consists of a wide range of people from different ages from the population of Bristol. What's more, a priori analysis was conducted to increase the strength of the sample size. Therefore, the generalisability of the results seems to be logical. On the other hand, even though this study was well-designed, there are still some limitations which should be noted.

Firstly, in the recruitment process, age information was not collected, and the average mean age was calculated based on estimations by using the video recordings. Thus, the average mean age could be unreliable.

Secondly, although gender balance was established across the conditions, this study consists of more female participants than male participants. In this respect, gender could be a significant variable, as eating behaviour may change between male and female participants. In this context, Hill and McCutcheon (1984) concluded that gender could be a significant contributor, since they determined a variation in bite size and bite speed between genders, and added that this contribution was not related to body size effects. In addition, Martin et al. (2007) found that eating slowly was an effective way to reduce men's food intake but not women's. Overall, further studies should examine gender in eating rate studies.

Another issue with this study is pertaining to researcher effect. This experiment has a single-blinded design that might create experimenter effect; however, to eliminate this, the instructions were standardised, and they were presented on a computer.

Although the participants were not provided with detailed instructions to establish a natural environment, the experiment was still conducted in a laboratory setting, implying that eating rate might be different in real-life settings compared to laboratory settings (Petty et al., 2013). What's more, social interaction may also have an influence on eating behaviour (Higgs, 2015). In this study, the participants were taken to a quiet test room; however, the use of video recordings and being with two strangers (one researcher and one other participant) might have affected their eating behaviour, and directed their attention to others rather than

the instructions or the experiment itself. On the other hand, creating an 'isolated' environment is nearly impossible, and might not reflect reality.

One last limitation of this study could be related to video recording analysis. Although it was indicated previously in the study protocol that oral processing data (bites, chews and swallows) would be coded if significant differences in eating rate were observed, the video recordings were not analysed, since this study found verbal instructions to be effective in the slow condition compared to the control group, but not for the savour vs. control conditions. Hogenkamp and Schiöth (2013) noted that the microstructure of eating behaviour consists of different components such as bite size, chewing, eating rate and texture of food, indicating they should be examined together. Nevertheless, the current study did not analyse bite size or pauses between bites, suggesting that it is unknown whether a reduction in the eating rate in the slow condition is generated from bite size or pauses between bites, or both. In this respect, further studies should seek the microstructure of eating and interactions between these elements.

Overall, this study shows that eating slowly can be implemented by simple instructions, which seems to be practical in real-life settings and can be useful in the treatment of obesity. However, slow eating did not result in an increase in fullness, and this is inconsistent with previous research. This study also indicates that savouring food could be examined in further studies, as it would be a potential driver to promote meal enjoyment, satisfaction and fullness by reducing eating speed.

References

Andrade, A. M., Kresge, D. L., Teixeira, P. J., Baptista, F., & Melanson, K. J. (2012). Does eating slowly influence appetite and energy intake when water intake is controlled? *International Journal of Behavioral Nutrition and Physical Activity*. https://doi.org/10.1186/1479-5868-9-135

Angelopoulos, T., Kokkinos, A., Liaskos, C., Tentolouris, N., Alexiadou, K., Miras, A. D., … le Roux, C. W. (2014). The effect of slow spaced eating on hunger and satiety in overweight and obese patients with type 2 diabetes mellitus. *BMJ Open Diabetes Research & Care*, *2*(1), e000013. https://doi.org/10.1136/bmjdrc-2013-000013

Areni, C. S., & Black, I. (2015). Consumers' responses to small portions: Signaling increases savoring and satiation. *Psychology & Marketing*, *32*(5), 532-543. https://doi.org/10.1002/mar.20798

Berridge, K. C. (1996). Food reward – brain structures of wanting and liking. *Neuroscience and Biobehavioral Reviews*, *20*(1), 1–25. Retrieved from https://pdfs.semanticscholar.org/ca2d/fa235e42c55be066ba7edffa7bc19b6f50c9.pdf

Blundell, J., De Graaf, C., Hulshof, T., Jebb, S., Livingstone, B., Lluch, A., … Westerterp, M. (2010). Appetite control: Methodological aspects of the evaluation of foods. *Obesity Reviews*, *11*(3), 251–270. https://doi.org/10.1111/j.1467-789X.2010.00714.x

Bolhuis, D. P., & Keast, R. S. J. (2016). Assessment of eating rate and food intake in spoon versus fork users in a laboratory setting. *Food Quality and Preference*, *49*, 66–69. https://doi.org/10.1016/j.foodqual.2015.11.015

Bray, G. A. (1996). Eat slowly--from laboratory to clinic; behavioral control of eating. *Obesity Research*, *4*(4), 397–400. https://doi.org/10.1002/j.1550-8528.1996.tb00248.x

Bryant, F. B. (2003). Savoring Beliefs Inventory (SBI): A scale for measuring beliefs about savouring. *Journal of Mental Health*, *12*(2), 175–196. https://doi.org/10.1080/0963823031000103489

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences*. *Routledge Academic*. https://doi.org/10.2307/2529115

Cohen, J. (1992). A power primer. *Psychol. Bull.* 112(1), 155–159. http://dx.doi.org/10.1037/0033-2909.112.1.155.

Corwin, R. L., & Hajnal, A. (2005). Too much of a good thing: Neurobiology of non-homeostatic eating and drug abuse. *Physiology and Behavior*, *86*(1–2), 5–8. https://doi.org/10.1016/j.physbeh.2005.06.021

Farr, O. M., Li, C. S. R., & Mantzoros, C. S. (2016). Central nervous system regulation of eating: Insights from human brain imaging. *Metabolism: Clinical and Experimental*, *65*(5), 699–713. https://doi.org/10.1016/j.metabol.2016.02.002

Ferriday, D., Bosworth, M. L., Godinot, N., Martin, N., Forde, C. G., Van Den Heuvel, E., … Brunstrom, J. M. (2016). Variation in the oral processing of everyday meals is associated with fullness and meal size; A potential nudge to reduce energy intake? *Nutrients*, *8*(5), 1–28. https://doi.org/10.3390/nu8050315

Ferriday, D., Bosworth, M. L., Lai, S., Godinot, N., Martin, N., Martin, A. A., … Brunstrom, J. M. (2015). Effects of eating rate on satiety: A role for episodic memory? *Physiology and Behavior*, *152*, 389–396. https://doi.org/10.1016/j.physbeh.2015.06.038

Finlayson, G., King, N., & Blundell, J. E. (2007). Liking vs. wanting food: Importance for human appetite control and weight regulation. *Neuroscience and Biobehavioral Reviews*, *31*(7), 987–1002. https://doi.org/10.1016/j.neubiorev.2007.03.004

Galak, J., Kruger, J., & Loewenstein, G. (2013). Slow Down! Insensitivity to Rate of Consumption Leads to Avoidable Satiation. *Journal of Consumer Research*, *39*(5), 993–1009. https://doi.org/10.1086/666597

Hamilton-Shield, J., Goodred, J., Powell, L., Thorn, J., Banks, J., Hollinghurst, S., … Sharp, D. (2014). Changing eating behaviours to treat childhood obesity in the community using Mandolean: The Community Mandolean randomised controlled trial (ComMando) - A pilot study. *Health Technology Assessment*. https://doi.org/10.3310/hta18470

Haugaard, P., & Lähteenmäki, L. (2017). Consumer satisfaction with real life meal experiences: An interview study. *Journal of Foodservice Business Research*, *20*(4), 371–393. https://doi.org/10.1080/15378020.2016.1215757

Hermans, R. C. J., Hermsen, S., Robinson, E., Higgs, S., Mars, M., & Frost, J. H. (2017). The effect of real-time vibrotactile feedback delivered through an augmented fork on eating rate, satiation, and food intake. *Appetite*. https://doi.org/10.1016/j.appet.2017.02.014

Higgs, S., & Jones, A. (2013). Prolonged chewing at lunch decreases later snack intake. *Appetite*, *62*, 91–95. https://doi.org/10.1016/j.appet.2012.11.019

Higgs, S. (2015). Social norms and their influence on eating behaviours. *Appetite*, *86*, 38–44. https://doi.org/10.1016/j.appet.2014.10.021

Hill, J. O., & Peters, J. C. (1998). Environmental Contributions to the Obesity Epidemic. *Science 280*(5368), 1371-1374. 10.1126/science.280.5368.1371

Hill, S. W., & McCutcheon, N. B. (1984). Contributions of obesity, gender, hunger, food preference, and body size to bite size, bite speed, and rate of eating. *Appetite*, *5*(2), 73–83. https://doi.org/10.1016/S0195-6663(84)80026-4

Hogenkamp, P. S., & Schiöth, H. B. (2013). Effect of oral processing behaviour on food intake

and satiety. *Trends in Food Science and Technology*, *34*(1), 67–75. https://doi.org/10.1016/j.tifs.2013.08.010

James, P. T., Rigby, N., & Leach, R. (2004). The obesity epidemic, metabolic syndrome and future prevention strategies. *European Journal of Preventive Cardiology*, *11*(1), 3–8. https://doi.org/10.1097/01.hjr.0000114707.27531.48

Kiken, L. G., Lundberg, K. B., & Fredrickson, B. L. (2017). Being Present and Enjoying It: Dispositional Mindfulness and Savoring the Moment Are Distinct, Interactive Predictors of Positive Emotions and Psychological Health. *Mindfulness*. https://doi.org/10.1007/s12671-017-0704-3

Kirsz, K., & Zieba, D. A. (2011). Ghrelin-mediated appetite regulation in the central nervous system. *Peptides*, *32*(11), 2256–2264. https://doi.org/10.1016/j.peptides.2011.04.010

Kokkinos, A., Le Roux, C. W., Alexiadou, K., Tentolouris, N., Vincent, R. P., Kyriaki, D., … Katsilambros, N. (2010). Eating slowly increases the postprandial response of the anorexigenic gut hormones, peptide YY and glucagon-like peptide-1. *Journal of Clinical Endocrinology and Metabolism*, *95*(1), 333–337. https://doi.org/10.1210/jc.2009-1018

Levitsky, D. A., & Pacanowski, C. R. (2012). Free will and the obesity epidemic. *Public Health Nutrition*, *15*(1), 126–141. https://doi.org/10.1017/S1368980011002187

Llewellyn, C. H., Van Jaarsveld, C. H. M., Boniface, D., Carnell, S., & Wardle, J. (2008). Eating rate is a heritable phenotype related to weight in children. *American Journal of Clinical Nutrition*, *88*(6), 1560–1566. https://doi.org/10.3945/ajcn.2008.26175

Martin, C. K., Anton, S. D., Walden, H., Arnett, C., Greenway, F. L., & Williamson, D. A. (2007). Slower eating rate reduces the food intake of men, but not women: Implications for behavioral weight control. *Behaviour Research and Therapy*, *45*(10), 2349–2359.

https://doi.org/10.1016/j.brat.2007.03.016

Mela, D. J., & Rogers, P. J. (1998). *Food, Eating and Obesity: The Psychobiological Basis of Appetite and Weight Control*. London: Chapman & Hall.

Mela, D. J. (2006). Eating for pleasure or just wanting to eat? Reconsidering sensory hedonic responses as a driver of obesity. *Appetite*, *47*(1), 10–17. https://doi.org/10.1016/j.appet.2006.02.006

Murdaugh, D. L., Cox, J. E., Cook, E. W., & Weller, R. E. (2012). FMRI reactivity to high-calorie food pictures predicts short- and long-term outcome in a weight-loss program. *NeuroImage*, *59*(3), 2709–2721. https://doi.org/10.1016/j.neuroimage.2011.10.071

Ohkuma, T., Hirakawa, Y., Nakamura, U., Kiyohara, Y., Kitazono, T., & Ninomiya, T. (2015). Association between eating rate and obesity: A systematic review and meta-analysis. *International Journal of Obesity*. https://doi.org/10.1038/ijo.2015.96

Parigi, A. Del, Gautier, J., Chen, K., Salbe, A. D., Ravussin, E., Reiman, E., & Tataranni, P. A. (n.d.). Neuroimaging and Obesity: Mapping the Brain Responses to Hunger and Satiation in Humans Using Positron Emission Tomography.

Petty, A. J., Melanson, K. J., & Greene, G. W. (2013). Self-reported eating rate aligns with laboratory measured eating rate but not with free-living meals. *Appetite*, *63*, 36–41. https://doi.org/10.1016/j.appet.2012.12.014

Piqueras-Fiszman, B., & Jaeger, S. R. (2015). What makes meals 'memorable'? A consumer-centric exploration. *Food Research International*, *76*, 233–242. https://doi.org/10.1016/j.foodres.2014.11.005

Raben, A., Tagliabue, A., & Astrup, A. (1995). The reproducibility of subjective appetite scores. *British Journal of Nutrition*, *73*(4), 517–530.

https://doi.org/10.1079/BJN19950056

Robinson, E., Almiron-Roig, E., Rutters, F., De Graaf, C., Forde, C. G., Smith, C. T., … Jebb, S. A. (2014). A systematic review and meta-analysis examining the effect of eating rate on energy intake and hunger. *American Journal of Clinical Nutrition*. https://doi.org/10.3945/ajcn.113.081745

Rogers, P. J. (1999). Joint Symposium with the British Dietetic Association on ' Implementing dietary change ; theory and practice ' Session 3 . Changing eating habits Eating habits and appetite control : a psychobiological perspective. *Proceedings of the Nutrition Society*, *4*(July 1998), 58–67.

Rogers, P. J., & Brunstrom, J. M. (2016). Appetite and energy balancing. *Physiology and Behavior*, *164*, 465–471. https://doi.org/10.1016/j.physbeh.2016.03.038

Rogers, P. J., & Hardman, C. A. (2015). Food reward. What it is and how to measure it. *Appetite*, *90*, 1–15. https://doi.org/10.1016/j.appet.2015.02.032

Rozin, P., Kabnick, K., Pete, E., Fischler, C., & Shields, C. (2003). The ecology of eating: smaller portion sizes in France than in the United States help explain the French paradox. *Psychological science*, *14*(5), 450-454. https://doi.org/10.1111/1467-9280.02452

Saper, C. B., Chou, T. C., Elmquist, J. K., & Homeostasis, W. (2002). The Need to Feed : Homeostatic and Hedonic Control of Eating Leptin : A Peripheral Signal Regulating Body. *October*, *36*, 199–211.

Savour. (n.d.). In *Cambridge online dictionary*. Retrieved from https://dictionary.cambridge.org/dictionary/english/savour

Savour. (n.d.). In *Collins online dictionary*. Retrieved from

https://www.collinsdictionary.com/dictionary/english/savour

Scarborough, P., Bhatnagar, P., Wickramasinghe, K. K., Allender, S., Foster, C., & Rayner, M. (2011). The economic burden of ill health due to diet, physical inactivity, smoking, alcohol and obesity in the UK: An update to 2006-07 NHS costs. *Journal of Public Health*. https://doi.org/10.1093/pubmed/fdr033

Shah, M., Copeland, J., Dart, L., Adams-Huet, B., James, A., & Rhea, D. (2014). Slower eating speed lowers energy intake in normal-weight but not overweight/obese subjects. *Journal of the Academy of Nutrition and Dietetics*, *114*(3), 393–402. https://doi.org/10.1016/j.jand.2013.11.002

Smit, H. J., Kemsley, E. K., Tapp, H. S., & Henry, C. J. K. (2011). Does prolonged chewing reduce food intake? Fletcherism revisited. *Appetite*. https://doi.org/10.1016/j.appet.2011.02.003

Spiegel, T. A. (2000). Rate of intake, bites, and chews - The interpretation of lean-obese differences. *Neuroscience and Biobehavioral Reviews*, *24*(2), 229–237. https://doi.org/10.1016/S0149-7634(99)00076-7

Stuart, R. B. (1996). Behavioral control of overeating. 1967. *Obesity Research*, *4*(4), 411–7. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/8822767

Stubbs, R. J., Hughes, D. A., Johnstone, A. M., Rowley, E., Reid, C., Elia, M., … Blundell, J. E. (2000). The use of visual analogue scales to assess motivation to eat in human subjects: a review of their reliability and validity with an evaluation of new hand-held computerized systems for temporal tracking of appetite ratings. *British Journal of Nutrition*, *84*(4), 405-415. https://doi.org/10.1017/S0007114500001719

Viskaal-van Dongen, M., Kok, F. J., & de Graaf, C. (2011). Eating rate of commonly consumed

foods promotes food and energy intake. *Appetite*. https://doi.org/10.1016/j.appet.2010.11.141

Wang, Y., Beydoun, M. A., Liang, L., Caballero, B., & Kumanyika, S. K. (2008). Will all Americans become overweight or obese? Estimating the progression and cost of the US obesity epidemic. *Obesity*, *16*(10), 2323–2330. https://doi.org/10.1038/oby.2008.351

Wang, Y.C., McPherson, K., Marsh, T., Gortmaker, S. L., & Brown, M. (2011). Obesity 2 Health and economic burden of the projected obesity trends in the USA and the UK. *The Lancet* 378(9793), 815-825. https://doi.org/10.1016/S0140-6736(11)60814-3

World Health Organisation. (2000). *Obesity : Preventing and Managing the Global Epidemic* (No. 894). World Health Organisation. Retrieved from http://www.who.int/nutrition/publications/obesity/WHO_TRS_894/en/

Wyatt, S. B., Winters, K. P., & Dubbert, P. M. (2006). *Overweight and Obesity: Prevalence, Consequences, and Causes of a Growing Public Health Problem* (Vol. 331). Retrieved from http://www.

Yeomans, M. R., Gray, R. W., Mitchell, C. J., & True, S. (1997). Independent effects of palatability and within-meal pauses on intake and appetite ratings in human volunteers. *Appetite*, *29*(1), 61–76. https://doi.org/10.1006/appe.1997.0092

Zandian, M., Ioakimidis, I., Bergh, C., Brodin, U., & Södersten, P. (2009). Decelerated and linear eaters: Effect of eating rate on food intake and satiety. *Physiology and Behavior*. https://doi.org/10.1016/j.physbeh.2008.10.011

Zhu, Y., Hsu, W. H., & Hollis, J. H. (2013). Increasing the number of masticatory cycles is associated with reduced appetite and altered postprandial plasma concentrations of gut hormones, insulin and glucose. *British Journal of Nutrition*, *110*(2), 384–390.

https://doi.org/10.1017/S0007114512005053

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Appendices

Appendix A – Advertisement

The Sandwich Study

We are currently looking for male and female participants to take part in our study, investigating how people eat and appreciate different sandwiches.
You will be asked to attend **one 30minute** test session in our Nutrition and Behaviour lab and fill out various ratings assessing the sandwich.
You will be provided **a sandwich** for lunch **and £5** for your time.
Eligibility criteria;
To take part **you must:**

- Be aged between 18 and 70
- Have English as a first language or have an equivalent level of fluency
- Not be vegan
- Not have diabetes
- Not have any food allergies or intolerances
- Not be on a diet to lose weight
- Not smoke more than 5 cigarettes a day
- Not be taking any medication that may influence appetite (except oral contraceptive pills)
- Be prepared to consume any of the following foods:
    - Grains: bread (wholemeal)
    - Dairy: Cheese and butter
    - Vegetables: tomato

You will be required to abstain from eating and drinking for three hours before test session, with the exception of water.

You will be recorded while you are eating the foods via a webcam. This video footage will not be linked with your name. A trained member of the Nutrition and Behaviour Unit research team will view the footage to code mouth movements in response to the food (i.e.,

they will record on video coding software the timing of each bite, chew and swallow). Once these mouth movements have been coded from the raw video footage, this coding file will be anonymised and there will be no record that links your name with this data. The raw video footage will be stored confidentially in a different folder from the coding file and will not be stored with your name.

This study has been approved by the University of Bristol, Faculty of Science Human Research Ethics Committee (10051865761)

If you are interested in taking part in this study, or would like further information please email: yv17549@my.bristol.ac.uk

Appendix B – Information Sheet

Yeliz Vural Karakas
Approval code: 10051865761
Email: yv17549@my.bristol.ac.uk

Information Sheet

Testing and rating different types of sandwiches

In this study, we are interested in how people eat and appreciate different sandwiches. Before you decide to take part in this study, it is important for you to understand what the research would involve. Please take time to read the following information carefully. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

Specific Requirements

If you decide to take part in this study, you must be

- Be aged between 18 and 70
- Have English as a first language or have an equivalent level of fluency
- Not be vegan
- Not have diabetes
- Not have any food allergies or intolerances
- Not be on a diet to lose weight
- Not smoke more than 5 cigarettes a day
- Not be taking any medication that may influence appetite (except oral contraceptive pills)
- Be prepared to consume any of the following foods:
    - Grains: Bread (wholemeal)

- Dairy: Cheese and butter
- Vegetables: Tomato
- Snack foods: White chocolate wafer biscuits

What does the research involve?

If you decide to take part in this study:

1. We will ask you to attend the laboratory for one 30-minute session. This can be scheduled from Tuesday to Friday between 11:30 – 14:00.
2. You will be required to abstain from eating and drinking for three hours before each test session, with the exception of water.
3. You will be required to provide information about your hunger and fullness at various time points during the lab session.
4. We would ask you to complete computerised questionnaires and tasks involving simple choices in response to given foods (Our aim is to discover something about the expectations that you have about different sandwiches.)
5. You will be recorded while you are eating the foods via a webcam. This video footage will not be linked with your name. A trained member of the Nutrition and Behaviour Unit research team will view the footage to code mouth movements in response to the food (i.e., they will record on video coding software the timing of each bite, chew and swallow). Once the mouth movements have been coded from the video footage, this coding file will be anonymised and there will be no record that links your name with this data. The raw video footage will be stored confidentially in a different folder from the coding file and will not be stored with your name.
6. You will have your weight and height measured by the experimenter.
7. You will be reimbursed £5 for your participation.

Your data

All data collected in this study will be kept confidential and will be anonymised on completion of the study. The only exception is the raw video footage, which it is not possible to anonymise. This will be kept confidential (see section below). There will be no record that links the data collected from you with personal data from which you could be identified (i.e. the signed consent form). Upon completion of the experiment, we ask you to give consent to include your data in further analyses. You are free to withdraw your data from the study at that point. Once you have given final consent, we cannot withdraw your data at a later stage because of the anonymised nature of the study.

At the end of the study, your anonymised data will be made "Open Access". This means that data are made available, free of charge, to anyone interested in the research, or who wishes to conduct their own analysis of the data. We will therefore have no control over how these data are used. Open access of research data and findings is considered best scientific practice and is a requirement of many funding bodies and scientific journals. As a large proportion of research is publicly funded, the outcomes of the research should be made publicly available. Sharing data helps to maximise the impact of investment through wider use, and encourages new avenues of research.

What will happen to my video footage?

The video footage recorded in this study will be stored in accordance with the guidelines set out by the Data Protection Act (1998). Your original video footage will be kept confidential in a folder on a secure server. This folder is only accessible by senior members of the Nutrition and Behaviour Unit research team. Videos will never be stored linked with your name and will only be shown to bona fide researchers or third parties for scientific purposes only. Permission will be required for anyone to view these videos from a senior member of the Nutrition and Behaviour Unit research team.

Who funds this research?

This research is funded by University of Bristol Nutrition and Behaviour Unit.

Who has reviewed this study?

This research has been reviewed by an independent group of people called a Research Ethics Committee to protect your safety, rights, well-being and dignity. This study has received approval from the University of Bristol, Faculty of Science Ethics Committee.

General notes

Your participation in the study is entirely voluntary. If you do decide to take part you will be required to sign a consent form but you are still able to withdraw at any time during the study, without giving a reason. If you have any questions at any time about the study, please do not hesitate to contact the researcher at yv17549@my.bristol.ac.uk

Debrief

Once we have completed testing all participants, you will be contacted by email and fully debriefed.

If you have a question or concern about any aspect of this study, you should ask to speak to the researcher who will do their best to answer your questions (xxxx). If you are unhappy and wish to complain formally you can do this through the Faculty of Science Human Research Ethics Committee, via Liam McKervey, Research Ethics Coordinator (Liam.McKervey@bristol.ac.uk, 0117 928 7841).

Appendix C – Consent Form

School of Experimental Psychology
Yeliz Vural Karakas
Email: yv17549@my.bristol.ac.uk

University of BRISTOL

Ethical approval code: 10051865761

CONSENT FORM: Testing and rating different sandwiches

Please answer the following questions to the best of your knowledge

	YES	NO
DO YOU CONFIRM THAT YOU:		
• have not eaten or drunk anything (except water) in the last 3 hours?	□	□
• fulfil all of the criteria outlined on the information sheet? (Please ask the experimenter if any of these are unclear)	□	□
HAVE YOU:		
• been given information explaining about the study?	□	□
• had an opportunity to ask questions and discuss this study?	□	□
• received satisfactory answers to all questions you asked?	□	□
• received enough information about the study for you to make a decision about your participation?	□	□
DO YOU UNDERSTAND: that you are free to withdraw from the study and free to withdraw your data prior to final consent		
• at any time?	□	□
• without having to give a reason for withdrawing?	□	□

I hereby fully and freely consent to my participation in this study

I understand the nature and purpose of the procedures involved in this study. These have been communicated to me on the information sheet accompanying this form.
I understand and acknowledge that the investigation is designed to promote scientific knowledge and that the University of Bristol will use the data I provide for no purpose other than research.
I understand that the data I provide will be kept **confidential**, and that on completion of the study my data will be **anonymised** by removing all links between my name or other identifying information and my study data. This will be done by 30th August 2018 and before any presentation or publication of my data.
I understand that after the study will be made "open data". I understand that this means the anonymised data will be publicly available and may be used for purposes not related to this study, and it will not be possible to identify me from these data.

Participant's signature: _____ Date: _____

Name in BLOCK Letters: _____

Final consent
Having participated in this study

I agree to the University of Bristol keeping and processing the data I have provided during the course of this study. I understand that these data will be used only for the purpose(s) set out in the information sheet, and my consent is conditional upon the University complying with its duties and obligations under the Data Protection Act.

Participant's signature: _____ Date: _____

Name in BLOCK Letters: _____

If you have a question or concern about any aspect of this study, you should ask to speak to the researchers who will do their best to answer your questions (yv17549@my.bristol.ac.uk).

If you are unhappy and wish to complain formally you can do this through the Faculty of Science Human Research Ethics Committee, via Liam McKervey, Research Ethics Coordinator (Liam.McKervey@bristol.ac.uk, 0117 928 7841).

Appendix D – Video Consent Form

School of Experimental Psychology
Nutrition and Behaviour Unit
yv17549@my.bristol.ac.uk

University of BRISTOL

APPENDIX D - VIDEO FOOTAGE CONSENT FORM

DO YOU UNDERSTAND;	**YES**	**NO**
1. That video recordings will be made while you are eating via a webcam?	□	□
2. That these video recordings will not be linked with your name?	□	□
3. That these video recordings will be stored on a secure server?	□	□
4. That these video recordings will only be shown to bona fide researchers or third parties for scientific purposes only and that permission will be required for anyone to view these videos from a senior member of the Nutrition and Behaviour Unit research team?	□	□
5. That these video recordings will not be stored with your study data?	□	□

Video footage consent

I hereby consent to the University, its successors, licensees, or assignees, taking and storing footage of myself provided the above conditions are met.
I understand and acknowledge that the investigation is designed to promote scientific knowledge and that the University of Bristol will use the data I provide for no purpose other than research.
I understand that the video footage I provide will be kept **confidential**, on a secure server and will not be linked with my name or study data.
I agree to the University of Bristol keeping and processing the data I have provided during the course of this study. I understand that these data will only be used for the purpose(s) set out in the information sheet, and my consent is conditional upon the University complying with its duties and obligations under the Data Protection Act.

Participant's signature: _____

Date: _____

Name in BLOCK Letters: _____

If you have any concerns related to your participation in this study please direct them to the Faculty of Science Human Research Ethics Committee via Liam McKervey (Liam.McKervey@bristol.ac.uk, 0117 928 9089).

Appendix E – Debriefing

Ethical approval code: 10051865761

Debriefing Sheet:

Tasting and rating different sandwiches

Obesity is a major concern of our modern world. According to Organisation for Economic Co-operation and Development (OECD) report (2017), one in two adults and one in six children are overweight and/or obese in OECD countries. Therefore, policy makers and health professionals have attempted to suggest new strategies to reduce overconsumption which is found to be closely associated with obesity.

One strategy to reduce excessive food intake is to decreasing eating rate to increase fullness. Many researchers have investigated the relation between slow vs fast eating and following energy intake. They have pointed out the effectiveness of slow eating in fullness. Many assistive technologies have been developed to monitor daily consumption by giving feedback to users about their eating pace. However, these tools are not accessible in everyday life even for clinicians working in the NHS. Although reducing eating rate might increase satiety, it is limited to laboratory studies and mostly not appropriate for real life settings.

Manipulation of eating rate is not easy. In many studies, eating rate has been manipulated via detailed instructions (e.g., chew every mouth 30s or…) which resulted in less desire to consume food. It is more likely that individuals tend to leave learned behaviours if they are less desirable. In other words, slowing down while eating might be temporary if it causes less enjoyment. In this context, we assumed that 'savouring' can be a key area to increase food enjoyment while decreasing eating rate in real life. According to Cambridge dictionary, savouring can be defined as 'enjoying food or an experience slowly, to enjoy it as much as possible.

In the present study, we compared the effect of verbal instructions ('usual eating', 'slow down', 'savouring') on fullness, eating rate, meal satisfaction and food enjoyment. Participants who were informed to eat at their usual rate was the 'control' of this study. In other two conditions, participants instructed to eat slowly and savouring the food while eating. The aim of this study was presented as 'tasting and rating a range of sandwiches' was a deception. This deception was necessary as we wanted to see differences between groups. We hypothesised that people in the 'savouring' condition report more fullness and enjoyment compared to other groups.

The other measures we took, for example on your hunger and on your liking and desire to eat the foods, provided additional information on how verbal instructions associated with eating rate affected your appetite.

Thank you for taking part in our study – we hope that you found it interesting.

If you have any specific questions about this study, please ask the experimenters, or contact yv17549@my.bristol.ac.uk