Identification of Psychological Correlates of Dietary Mis-Reporting under Laboratory and Free-Living Environments

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ABSTRACT

Errors inherent in self-reported measures of energy intake (EI) are substantial and well-documented, but correlates of mis-reporting remain unclear. Therefore, potential predictors of mis-reporting were examined. In Study One, 59 individuals (BMI=26.1±3.8kg/m^2, age=42.7±13.6yrs, females=29) completed a 14d stay in a residential feeding behaviour suite where eating behaviour was continuously monitored. In Study Two, 182 individuals (BMI=25.7±3.9kg/m^2, age=42.4±12.2yrs, females=96) completed two consecutive days in a residential feeding suite and five consecutive days at home. Mis-reporting was directly quantified by comparing covertly measured laboratory weighed intakes (LWI) to self-reported EI (weighed dietary record; WDR, 24-hr recall, 7-day diet history, food frequency questionnaire; FFQ). Personal (age, sex, %body fat) and psychological traits (personality, social desirability, body image, IQ, eating behaviour) were used as predictors of mis-reporting. In Study One, those with lower psychoticism (p=0.009), openness to experience (p=0.006) and higher agreeableness (p=0.038) reduced EI on days participants knew EI was being measured to a greater extent than on covert days. Isolated associations existed between personality traits (psychoticism, openness to experience), eating behaviour (emotional eating) and differences between the LWI and self-reported EIs, but these were inconsistent between dietary assessment techniques and typically became non-significant after accounting for multiplicity of comparisons. In Study Two, sex was associated with differences between LWI and the WDR (p=0.009), 24-hr recall (p=0.002) and diet history (p=0.050) in the laboratory, but not home environment. Personal and psychological correlates of mis-reporting identified displayed no clear pattern across studies or dietary assessment techniques, and had little utility in predicting mis-reporting.

1.0 INTRODUCTION

The relationship between energy and nutrient intake and disease prevalence is crucial in understanding disease aetiology at the individual and population level. However, quantifying true patterns of food intake in the free-living environment is severely limited by the under or over-reporting of energy and nutrient intakes using self-report techniques. This has led to suggestions that self-report dietary techniques are not only "useless" in elucidating diet-health relationships, but may actually distort the true nature of the relationships upon which nutritional health policies are based[1; 2]. Although this view has been refuted[3], errors inherent in self-reported intakes appear substantial[4]. Dietary mis-reporting with self-report techniques has long been recognised[5], but this has yet to lead to the development of techniques that i) detect the extent of mis-reporting in self-reported dietary data, ii) identify or predict those likely to mis-report using self-report techniques, and iii) correct for erroneous values in self-reported data.

Previous studies suggest that under-reporting is more prevalent in women[6; 7], older rather than younger adults[7], and those with higher BMIs[4; 8]. However, identification of consistent correlates of mis-reporting across different self-reported dietary measurement techniques (e.g. food frequency questionnaires, 24-hr dietary recalls, dietary records/diaries), study populations (e.g. sex, age, ethnicity, social class and educational level) or environments (e.g. laboratory vs free-living) has proved remarkably difficult. An array of psychological, personality and social characteristics have been suggested as potential correlates, including dietary restraint[9; 10], social desirability and approval[10; 11], social economic class and educational level[12; 13; 14]. However, purported correlates are often not consistent between studies and typically only explain a small proportion of the variance in under or over reporting[7; 15]. This failure to identify robust correlates of mis-reporting may reflect the fact that previous studies have not directly quantified mis-reporting (i.e. the discrepancy between what people actually eat and report eating), but rather, use indirect estimates of low or high energy reporting based on indices of energy balance (e.g. doubly labelled water[6; 10] or the Goldberg cut-offs[16]) or nitrogen balance (e.g. dietary to urinary nitrogen ratios[17]). Given the limitations associated with these approaches in identifying mis-reporting at the individual level[18; 19; 20], these indirect estimates may lack sufficient sensitivity to detect correlates of under or over reporting.

Identification and prediction of dietary mis-reporting is further complicated by the fact that mis-reporting is not a unitary phenomenon. Rather, it comprises of two separate but synchronous processes, termed the observation effect and the reporting effect[21], that summate to determine overall mis-reporting. Based on covert measures of food intake during a 14 day stay in residential metabolic facility, Stubbs et al.[21] were able to directly compare actual food intake to that self-reported by participants during their stay. Participants were shown to decrease their energy intake (EI) by 5% when asked to record their food intake, which was termed the observation effect. Self-reported EI was 5 to 21% lower than the actual intake, depending on the reporting method used (termed the reporting effect). However, potential correlates of the observation and reporting effects have yet to be examined in these data.

Therefore, the present paper examined the psychological correlates of mis-reporting in two separate studies in which objective and self-reported food intake was measured to directly quantify mis-reporting of EI under i) residential laboratory conditions in which energy balance and feeding behaviour were measured continuously for 14 days (Study One; *n* = 59)[21], and ii) combined residential (two days) and free-living (four days) conditions in which laboratory dietary intakes were compared to self-reported assessments made in the laboratory and home environments (Study Two; *n* = 182)[19]. This approach allowed mis-reporting to be directly quantified in a metabolic facility and under simulated conditions representative of the environments in which EI is often estimated in dietary survey studies using self-report techniques. These studies included commonly used self-report techniques (weighed dietary records, 24-hr recall, food frequency questionnaire and diet history), and the validly of these approaches has been discussed elsewhere[7] .

2.0 METHODS

Data from two separate studies are reported in which dietary mis-reporting was directly quantified by comparing covertly measured food intake to self-reported intakes using four commonly used methods (weighed dietary records, 24-hr recalls, 7-day diet history, food frequency questionnaire). In Study One, 59 participants (age = 42.7 ± 13.6 years; BMI = 26.1 ± 3.8 kg/m^2) completed a 14 day stay in a residential feeding behaviour suite during which food intake was recorded for 12 consecutive days following a two day maintenance period. In Study Two, 182 participants (age = 42.4 ± 12.2 years; BMI = 25.7 ± 3.9 kg/m^2) completed three consecutive days (one day maintenance and two days recording) in a residential feeding behaviour suite and five consecutive days (one day maintenance and four days recording) in their home environment in a randomised, and counter-balanced order. All data were collected at the Rowett Institute, University of Aberdeen, United Kingdom, and participants were weight stable (weight change of <2 kg in the previous three months), healthy, non-smokers, and not taking medication known to influence metabolism or appetite. The true purpose of each study was not explained to participants, who were informed that the studies examined the relationships between diet and lifestyle. Written informed consent was obtained prior to the start of each study. The studies were conducted according to the guidelines laid down in the Declaration of Helsinki, and all procedures involving human subjects/patients were approved by the Joint Ethical Committee of the Grampian Health Board and the University of Aberdeen.

2.1 STUDY ONE- Participants and Design

Fifty-nine participants (30 men and 29 women) were recruited, with participants stratified into three age categories (20-35 years, 36-50 years and 51-65 years) and two BMI categories (BMI 20-25 kg/m^2 and BMI >25 kg/m^2). Participant characteristics can be seen in Table 2. The overall aim of this study was to develop a gold standard protocol for the measurement of food intake against which common self-reported dietary intake methods could be evaluated. Primary outcomes from this study relating to the nature and extent of dietary mis-reporting have previously been reported[21]. The current novel analyses examined the personal and psychological correlates of this mis-reporting.

Figure 1 here

Figure 1 describes the experimental protocol, and a detailed description of the procedures used can be found elsewhere[21]. Participants completed a 14 day stay in a residential feeding behaviour suite (Human Nutrition Unit at the Rowett Institute of Nutrition and Health) during which energy balance and feeding behaviours were measured continuously. Resting metabolic rate (indirect calorimetry) was measured on a screening visit prior to the start of the study. On days 1-2, participants consumed a fixed diet designed to maintain energy balance, with EI estimated at 1.5 and 1.6 times resting metabolic rate for women and men, respectively. The proportion of energy contributed by fat, protein and carbohydrate to daily energy intake was 35%, 15% and 55%, respectively. Percentage body fat (skinfold thickness) was measured on day 3. On days 3-14, food intake was covertly measured by trained research staff using a laboratory weighed intake method (LWI) to establish actual energy and nutrient intake. Participants were unaware that their food intake was being measured in this fashion using covert LWI measures. Participants also self-reported their food intake using a weighed dietary record method (WDR) and 24-hr recall during two, 3-day overt feeding periods during days 3-14. On these overt feeding days, participants were aware that their food intake was being measured using these self-report techniques, but they remained blinded to the fact that their food intake was also being covertly measured using the LWI. As such, we refer to the days in which self-reported measures of intake were conducted as overt days to reflect the participants awareness that their food intake was being monitoring. The order of these overt feeding periods was randomized using a cross-over design. In total, six 24-hr recalls and six weighed dietary records were completed by participants over the 14-day period, while food intake was covertly measured for 12 days. A 7-day diet history was also conducted, between two-days and two-weeks, before the start of the study, and two food frequency questionnaires (FFQ) were completed. The first FFQ was completed on day 1 and related to the frequency of consumption of specific foods over the preceding 2 to 3 months. On day 15, the same FFQ was completed for a second time but pertained to their intake over the proceeding 14 days in the residential feeding suite (this is referred to as FFQ^2).

Participants were able to move freely around the unit and associated grounds (under supervision of a member of staff) and were free to leave the unit during the study (but were accompanied and observed by a member of staff at all times). During the 14-day periods, participants also completed a range of psychological questionnaires, and the specific timing of their completion can be found in Table 1.

2.2 STUDY TWO- Participants and Design

Participants (n = 182; 86 men and 96 women) were recruited to cover a range of age (25-60 years) and BMIs (19-30 kg/m^2) in a balanced design. Participant characteristics can be seen in Table 3. This study was designed in parallel with Study One, and aimed to extend this study by identifying the nature and extent of under-reporting in a larger sample of individuals under laboratory and home environments. The plausibility of the self-reported EI relative to the LWI in these data have previously been reported[(19)]. The current analyses are novel. The protocol for Study Two can be seen in Figure 1, and a detailed description of the procedures used can be found elsewhere[(19)]. In a randomised order, participants completed three consecutive days (one day maintenance and two days recording) in the Human Nutrition Unit, Rowett Institute of Nutrition and Health, five consecutive days (one day maintenance and four days recording) in their home environment. Percentage body fat (skinfold thickness) was measured on day 1 of the laboratory phase.

2.2.1 Laboratory phase

The laboratory phase consisted of two consecutive days (Friday and Saturday, or Sunday and Monday), in consecutive order, with one day's maintenance diet beforehand. On each day, EI was covertly measured by research staff using the LWI method. Participants also completed a WDR on each day, and a 24-hr dietary recall was performed on the morning of the subsequent day. Prior to the start of the study, participants also completed a FFQ and a 7-day diet history, as in Study One.

2.2.2 Home phase

The home study consisted of a one-day maintenance followed by four consecutive days consisting of two weekdays and two weekend days (days 1-4, Thursday to Sunday, or Saturday to Tuesday). During this time participants conducted daily WDR in their home environment (referred to as WDR-H), using the same method as the laboratory phase. No other measures of food intake were taken during this home phase. During the laboratory and home phases of Study Two participants also completed a range of psychological questionnaires, and the specific timing of their completion can be found in Table 1.

2.3 COMMON METHODOLOGICAL PROCEDURES

2.3.1 Resting Metabolic Rate

Resting metabolic rate was measured following an overnight fast (12-hr) using an indirect calorimetry device fitted with a ventilated hood (Deltatrac II, MBM-200, Datex Instrumentarium Corporation, Finland). Resting metabolic rate was calculated from minute-by-minute data using the mean of 15 minutes of stable measurements, with the first and last five minutes excluded. The equations of Elia and Livesey[22] were used to calculate resting metabolic rate. Details of calibration burns and repeatability testing have been described previously[23].

2.3.2 Anthropometry and Skinfold Thickness

Height was measured to the nearest 0.5 cm using a portable stadiometer (Holtain Ltd., Crymych, Dyfed, Wales), while body weight was measured to the nearest 0.01 kg after voiding (DIGI DS-410 CMS Weighing Equipment, London, UK). Skinfold thickness was also measured at standardized anatomic locations (biceps, triceps, subscapular and supra-iliac) using calibrated skinfold callipers (Holtain Ltd., Dyfed, Wales, UK), and the equations of Durnin & Womersley[24] were used to estimate percentage body fat from skinfold thickness.

2.3.3 MEASURES OF FOOD INTAKE

Laboratory Weighed Intake Method

During the laboratory phases of Study One and Study Two, each participant had access to their own individual kitchen, which consisted of a fridge, freezer and a cupboard containing pre-selected foods and beverages. Between two-days and two-weeks prior to the start of each study, a 7-day diet history was completed, and shopping receipts were collected. An inventory of foods and beverages they typically consumed was purchased. Participants then had *ad libitum* access to these foods and beverages during the laboratory phases of each study. If a participant reported that a food or beverage usually consumed in their habitual diet had been omitted, this item was subsequently purchased and made available. Participants were able to freely select what and when they wanted to eat (based on their own foods and beverage items), and meals were cooked by participants in their own kitchens. Access to these was restricted, with participants only having key access to his/her own kitchen. Participants were instructed to leave all food waste, peelings and packaging in special bins. Furthermore, any dishes/cooking utensils used were placed in a specific section of their kitchen following meal/snack consumption, and subjects were instructed not to wash any dishes/utensils.

On days in which the participants stayed in the residential feeding suite in Study One and Two, measures of daily food intake were made using the LWI method. Participants were unaware that their food intake was being measured in this fashion, and therefore we refer to these measures of food intake as covert. Each morning, a researcher entered the kitchen before the participants woke and re-weighed all the food items to the nearest 0.1 g (Soehnle model 820; Soehnle-Waagen GmbH or Ravencourt model 333; Ravencourt), and the weights of any left-overs, peelings and packaging found in their bins were also recorded. The laboratory-weighed intakes were then used to calculate 24-hr food intakes, with EI calculated using dietary analysis software (Diet 5, Robert Gorden University, Aberdeen). Nutritional information from manufacturers was added to the Diet 5 database for processed foods. Each individual kitchen contained a discrete unobtrusive video camera, while all parts of the unit were monitored via video cameras (aside from the bathroom facilities and private rooms; participants were not allowed to take food into these areas). Participants were informed that cameras were present for security purposes, although they were not made overtly aware of the camera in their larders, which resembled an infrared motion detector commonly used in burglar alarm systems. Video data were used to ensure participants were adhering to the study procedures.

Weighed Dietary Records

Participants were instructed to carry out weighed dietary records[25] on the overt phases of Study One and the laboratory phase of Study Two. Participants were asked to weigh and record all food and drinks consumed and any leftovers, in a food diary. Participants used digital portable weighing scales (Soehnle model 820), which were calibrated prior to use. Full written and verbal information on how to conduct a WDR was given at the beginning of the study and participants were trained in the use of the equipment.

Twenty-Four Hour Recalls

24-hr recalls were performed by trained member of staff based on the multiple pass method. Each recall was conducted on the day after participants completed a WDR during the overt phases of each study.

7-Day Diet History

Prior to taking part in each study participants completed a 7-day diet history with a trained member of staff. The diet history was based on the multiple pass method. Participants were asked to describe their usual food intake at different meal/snack occasions during the previous week, and were asked to use household measures when recalling food items. This information was also used to formulate a list of foods and beverages usually consumed by each participant, which were made available to them during the laboratory phases of each study. Each diet history was entered into a spreadsheet, and suitable portion sizes were used to convert the household food portion sizes into grams using the UK Food Standard Agency book on average portion sizes[26].

Food Frequency Questionnaire

The Aberdeen Food Frequency Questionnaire[27; 28], which is a 150-item semi-quantitative questionnaire, was used to assess the frequency of consumption of foods in the habitual diet of participants in both studies and mean daily energy and nutrient intakes calculated. Full written and verbal information on how to complete this questionnaire was provided.

2.3.4 Psychological Predictors

A range of common questionnaires to measure aspects of personality and eating behaviours hypothesised to be of potential relevance to biased responding of food intake were completed by participants in both studies to examine potential predictors of dietary mis-reporting[7; 15]. IQ was measured using the National Adult Reading Test (NART)[29], the Alice Heim 4 (AH4)[30] and the Raven Standard Progressive Matrices[31]. The NART is a single word, oral reading test in which participants read out 50 written words with irregular spellings graded in difficulty. The AH4 is a two-part test with multi-choice answers. Part 1 is a 65-item test with verbal or numerical bias that assesses mental arithmetic, vocabulary and reasoning by analogy, while Part 2 is a 65-item test with a diagrammatic bias. The Raven Standard Progressive Matrices tests problem solving ability using shapes and diagrams, and contains 60 problems requiring participants to determine the relationships between abstract shapes. To measure mood, the UWIST Mood Adjective Checklist[32] was used. This measures the average state of mood experienced by the participants during the present day, with 24 separate feelings rated on a scale of definitely to definitely not. Perceptions of body image were measured using the Body Image Questionnaire[33], with participants presented with a series of schematic silhouettes of different body sizes from which they selected the one most representing their own body shape. Personality was measured using two questionnaires; the Eysenck-100 (EPQR)[34] and the Neuroticism, Extraversion, Openness Personality Inventory-Revised (NEOPIR)[35]. The EPQR measures four personality traits (sociability, psychoticism, neuroticism and lie scale), with participants responding true/false to 100 statements. The NEOPIR consists of 100 questions to determine the big five personality traits; neuroticism, extraversion, openness, agreeableness and conscientiousness. Social desirability was measured using the Marlowe Crowne Social Desirability Scale[36], a 33-item questionnaire assesses whether or not respondents are concerned with social approval, and the Balanced Inventory of Desirable Responding (BIDR)[37], which is a 40 item questions that measure the tendency to give socially desirable responses on self-reports (each item is scored 1 to 7 on a true or false scale). Psychometric eating behaviours were assessed using the Dutch Eating Behaviour Questionnaire [DEBQ][38]). The DEBQ is a 33-item questionnaire that uses a 5-point Likert scale ranging from 1 (seldom) to 5 (very often) to assess three eating behaviour domains: restrained eating (10 items), emotional eating (13 items) and the external eating (10 items).

Table 1 here

2.5 Statistical Analyses

Data are reported as mean ± SD. Statistical analyses were performed using IBM SPSS (Chicago, Illinois, Version 25). Two-sided paired t-tests were used to examine differences in EI between the LWI method and self-report methods. Discrepancies between measured and reported EIs were displayed using Bland-Altman plots (mean bias and upper and lower 95% limits of agreement). In Study One, the effect of being observed on feeding behaviour (the observation effect) was quantified by comparing LWIs during covert and overt phases using two-sided paired t-tests. The difference between what people actually ate and what they reported eating (the reporting effect), was quantified by comparing the difference between the measured LWI during the overt days and the self-reported intakes using two-sided paired t-tests.

A two-stage approach was taken to the analyses of the potential correlates of mis-reporting. Firstly, we examined the associations between individual psychological traits and mis-reporting using separate multiple regression models (while controlling for age, sex and percentage body fat), and secondly, we included all of the individual predictors found to be significant in a subsequent stepwise regression model to examine the overall predictive ability of any significant predictors identified. Multiple linear regressions were used to examine if mis-reporting (i.e. the discrepancy between actual food intake and reported food intake) was associated with personal (age, sex and percentage body fat) and selected dimensions of personality and eating behaviour traits (personality, social desirability, body image, IQ, mood, and eating behaviours). To account for potential confounding, age, sex and percentage body fat (% BF) were included in all models. Including BMI rather than percentage body fat did not change any of the reported outcomes. Regression analyses are summarised in the Results Section, and individual model parameters are reported in the Supplementary Materials (Supplementary Tables S1-S24). Benjamini & Hochberg false discovery rate (FDR) adjusted q-values[39] were calculated using the regression coefficients in models where significant predictors were identified due to the multiplicity of comparisons presented (R Studio, Version 1.2.5042, RStudio, Inc.).

In Study One, to examine the predictors of the observation effect, differences between covert and overt LWIs were regressed against personal and psychological characteristics (Section 3.2.1). To examine for predictors of the reporting effect, differences between the LWI on overt days and each self-reported measure of intake were regressed against personal and psychological characteristics (Section 3.2.2). For the laboratory phase of Study Two, the discrepancy between the LWI and the self-reported intakes were regressed against personal and psychological characteristics. In the home phase of Study Two, the discrepancy between the WDR-H and the FFQ and diet history were regressed against personal and psychometric characteristics (Section 3.3.1). The WDR-H was not compared to the 24-hr recall performed during the laboratory phase as the timings of these measures differed. To examine the predictive ability of the correlates identified in Study One and Two, data common to both studies were combined, and stepwise regression was used in which all of the previously identified correlates were entered as predictors (probability of F; 0.05 entry and 0.10 removal). The differences between the LWI on overt days and each self-reported measure of intake were used as the outcome variables (Section 3.3.2).

3.0 RESULTS

Descriptive characteristics of participants in Study One and Study Two can be found in Tables 2 & 3.

Tables 2 & 3 here

3.1 Extent of Dietary Mis-Reporting

A summary of mean daily EI using measured and self-reported techniques can be found in Table 4, and Bland-Altman plots displaying the deviations between intake measures at the individual level can be found in Figure 2. When compared to the measured LWI, self-reported EI was -0.6 ± 1.9 MJ/day lower ($p < 0.001$) using the WDR (Study One = -0.6 ± 1.3 MJ/day, $p < 0.001$; Study Two = -0.6 ± 2.1 MJ/day, $p < 0.001$), -1.4 ± 2.3 MJ/day lower ($p < 0.01$) using the 24-hr recall (Study One = - 1.2 ± 1.5 MJ/day, $p < 0.001$; Study Two = -1.5 ± 2.4 MJ/day, $p < 0.001$), -2.4 ± 3.7 MJ/day lower ($p < 0.001$) using the 7-day diet history (Study One = -1.8 ± 2.4 MJ/day, $p < 0.001$; Study Two = -2.6 ± 4.0 MJ/day, $p < 0.001$), and -1.2 ± 4.2 MJ/day lower ($p < 0.001$) using the FFQ (Study One = -0.3 ± 3.6 MJ/day, $p = 0.492$; Study Two = -1.4 ± 4.4 MJ/day, $p < 0.001$).

Figure 2 here

Table 4 here

3.2 STUDY ONE OUTCOMES

EI during the overt phase was significantly lower than the covert phase (10.9 ± 2.7 vs 11.6 ± 2.9 MJ/d; $p < 0.001$). This discrepancy, termed the observation effect, reflects the effect of being observed on feeding behaviour. To quantify the difference between what people actually ate and what they reported eating, the measured LWI during the overt days were compared to self-reported intakes. This difference is referred to as the reporting effect. Compared to the measured LWI, self-reported intake was significantly lower using the WDR (-0.6 ± 1.3 MJ/d; $p < 0.001$), 24-hr recall (-1.2 ± 1.5 MJ/d; $p < 0.001$), 7-day diet history (-1.8 ± 2.4 MJ/d; $p < 0.001$), FFQ (-0.3 ± 3.6 MJ/d; $p = 0.492$) and FFQ^2 (i.e. intake over the 14 day residential period; -1.2 ± 2.6 MJ/d; $p < 0.001$).

3.2.1 Correlates of the Observation Effect

After controlling for age, sex and %BF, those with lower EPQR psychoticism ($\beta = 0.389$; $p = 0.009$) reduced energy intake on overt days to a greater extent as compared to covert days. However, the FDR correct p-value for EPQR psychoticism was non-significant ($q = 0.063$). Those with higher NEO PIR agreeableness ($\beta = -0.303$; $p = 0.038$) and lower NEO PIR openness to experience ($\beta = 0.440$; $p = 0.006$) also reduced EI on overt days to a greater extent as compared to covert days. While the association between NEO PIR openness to experience and the observation effect remained significant after FDR adjustment ($q = 0.048$), the NEO PIR agreeableness adjusted p-value was non-significant ($q = 0.152$). Age, sex, %BF, eating behaviour traits, body image, social desirability, IQ and mood were not associated with observation effect (Supplementary Tables S1 to S8).

3.2.2 Correlates of the Reporting Effect

Lower NART performance IQ was associated with greater underreporting of EI using the WDR as compared to the LWI after accounting for age, sex and % BF ($\beta = 4.072$; $p = 0.036$), but this did not remain significant after FDR adjustment ($q = 0.288$). Sex ($\beta = -0.564$; $p = 0.001$), % body fat ($\beta = -0.664$; $p = 0.001$) and DEBQ emotional eating ($\beta = -0.350$; $p = 0.044$) were associated with the discrepancy between the LWI and 24-hr recall. Males, those with greater %BF or emotional eating demonstrated greater underreporting of EI using the 24-hr recall as compared to the LWI. Sex ($q = 0.001$) and % body fat ($q = 0.001$) remained significant after FDR adjustment, but the FDR adjusted p-value for emotional eating was non-significant ($q = 0.088$). After accounting for age, sex and %BF, higher EPQR psychoticism ($\beta = -0.338$; $p = 0.024$) and NEO PIR openness to experience ($\beta = -0.335$; $p = 0.044$) were associated with greater underreporting using the diet history as compared to the LWI. However, the FDR adjusted p-value for EPQR psychoticism (q = 0.168) and NEO PIR openness to experience (q = 0.352) were non-significant. Males also demonstrated greater underreporting using the FFQ[2] as compared to the LWI (β = -0.447; p = 0.012), and this remained significant after FDR adjustment (q = 0.036). No other significant associations were found for personal characteristics, eating behaviour traits or personality traits, social desirability, body image, IQ or mood (Supplementary Tables S9 to S16).

3.3 STUDY TWO OUTCOMES

During the laboratory phase of Study Two, the self-reported WDR was 0.6 ± 2.1 MJ/day lower than the LWI ($t_{(181)}$ = 3.726, p < 0.001). In turn, the WDR in the home phase was 1.0 ± 2.9 MJ/day lower than the WDR during the laboratory phase ($t_{(180)}$ = 4.620, p < 0.001; Figure 3). This difference in the WDR between laboratory and home environments was associated with %BF (β = 0.274; p = 0.010). However, no further associations were seen between this difference and sex, age, eating behaviour, body image, personality, social desirability, IQ or mood.

Figure 3 here

3.3.1 Correlates of Mis-Reporting under Laboratory and Home Environments

Laboratory Phase

When the discrepancy between the measured LWI and the self-reported techniques was regressed against personal characteristics, sex was associated with the discrepancy between the LWI and WDR (β = -0.214; p = 0.029), 24-hr recall (β = -0.297; p = 0.002) and the 7-day diet history (β = -0.188; p = 0.050), with mis-reporting greater in men than women (Supplementary Tables S17 to S24). After FDR adjustment, the p-value for sex remained significant for the 24-hr recall (p = 0.006), but not for the WDR (p = 0.087) or the 7-day diet history (p = 0.150). Lower NEO PIR neuroticism (β = 0.186; p = 0.022), higher NEO PIR openness to experience (β = -0.218; p = 0.028) and higher BIDR self-deceptive enhancement (β = -0.161; p = 0.048) were associated with a greater underreporting using the 24-hr recall as compared to the LWI (after accounting for age, sex and %BF). However, NEO PIR neuroticism (q = 0.077), openness to experience (q = 0.077) and BIDR self-deceptive enhancement (q = 0.144) were not significant after FDR adjustment. Higher EPQR extraversion (β = -0.164; p = 0.032) was associated with greater underreporting using 7-day diet history as compared to the LWI, but this did not remain significant after FDR adjustment (q = 0.224). After accounting for age, sex and %BF, lower DEBQ external eating was associated with greater underreporting using the FFQ as compared to the LWI (β = 0.212; p = 0.028), but this was not significant after FDR adjustment (q = 0.168). IQ and mood were not associated with the discrepancy between the LWI and any of the self-reported techniques (Supplementary Tables S17 to S24).

Home Phase

In the home environment, lower body image (β = 0.223; p = 0.028), lower DEBQ external eating (β = 0.214; p = 0.030), higher emotional eating (β = -0.231; p = 0.024) and lower EPQR social desirability (β = 0.178; p = 0.024) were associated with greater underreporting using the FFQ as compared to the WDR-H. However, after FDR adjustment body image (q = 0.089), DEBQ external eating (q = 0.090), emotional eating (q = 0.090) and EPQR social desirability (q = 0.168) were not significant. No further associations were seen between personal characteristics, personality traits, eating behaviour, social desirability, IQ or the discrepancy between the WDR-H and the other self-report techniques (Supplementary Tables S17 to S24).

3.3.2 Combined Analyses of Study One and Study Two.

In order to examine the predictive ability of the correlates identified in Study One and Two, data common to both studies were combined (sex, %BF, body image, external eating, emotional eating, EPQR social desirability, psychoticism and extraversion, NEO PIR neuroticism, agreeableness and openness to experience, BIDR self-deceptive enhancement, NART performance IQ), and stepwise regression performed (probability of F; 0.05 entry and 0.10 removal). Sex was the only variable entered into the model when the discrepancy between the LWI and the WDR (β = -0.170; $F_{(1, 225)}$ = 6.670, adj-R^2 = 0.025, p = 0.010), 24-hr recall (β = -0.279; $F_{(1, 225)}$ = 18.841, adj-R^2 = 0.073, p < 0.001), and 7 day history (β = -0.217; $F_{(1, 224)}$ = 11.033, adj-R^2 = 0.043, p = 0.001) were examined. When the discrepancy between the LWI and FFQ was examined, %BF was the only variable entered into the model (β = 0.223; $F_{(1, 224)}$ = 11.717, adj-R^2 = 0.046, p = 0.001).

4.0 DISCUSSION

The present paper examined the psychological correlates of mis-reporting under laboratory and free-living conditions using two separate studies designed *a priori* to examine the nature and extent of dietary mis-reporting[19; 21]. The design of these studies allowed the extent of under or over-reporting to be directly quantified via comparisons between covertly measured food intake and that self-reported using a range of common dietary assessment techniques. These data were collected alongside a large amount of psychometric data under conditions more rigorous than typically possible in free-living studies. Despite these methodological strengths, there was little evidence of robust psychological correlates of mis-reporting. Sex and selected personality and eating behaviour traits were correlated with mis-reporting, but these associated were not consistent across studies or dietary assessment types, and explained little of the variance in mis-reporting (typically <5%). The lack of robust and consistent correlates suggests that personal or psychological characteristics have little utility in predicting the extent of mis-reporting, even when mis-reporting is directly quantified.

4.1 Effect of Measurement Technique and Study Environment on Energy Intake

When food intake was measured under laboratory conditions in which energy balance and feeding behaviour were measured continuously for 12 days (Study One), self-reported EI was 5-21% lower than measured intake depending on the self-report technique used. The extent of under-reporting was greater for the dietary recall and the FFQ as compared to the WDR method. While the mean bias using the FFQ was relatively small, examination at the individual level indicated significant under and over reporting (Figure 3). In Study Two where mis-reporting was measured under laboratory conditions and free-living environments, results revealed the same degree of mis-reporting in the laboratory phase as in Study One. However, relative to the laboratory, mis-reporting increased further in the home environment, with EI lower in the home environment than reported in the laboratory environment.

4.2 Correlates of the Observation and Reporting Effect (Study One)

While the mis-reporting of energy and nutrient intake using self-report techniques has long been documented[40], this has not led to *a priori* techniques that allow the identification of those likely to mis-report or the extent to which an individual will mis-report. A number of purported correlates of mis-reporting have previously been suggested, but these are inconsistent between studies and typically have little explanatory value[7; 10; 15]. This may in part reflect the use of proxy measures of mis-reporting (i.e. indices of energy requirements or expenditure to estimate the degree of low or high energy reporting with the assumption that individuals are in energy balance) rather than direct comparisons between 'true' and self-reported intake. To address this, mis-reporting was directly quantified in the present study and potential correlates were examined separately for the observation and reporting effect.

When the observation effect was examined, lower psychoticism and openness to experience and higher agreeableness were associated with a greater reduction in EI on days when participants knew food intake was being measured (i.e. overt vs. covert days). Age, sex and % BF, or any of the other psychological measures, were not correlated with the observation effect. Personality traits have previously been reported to correlate with dietary mis-reporting[7], but in the present study, the amount of variance in the observation effect explained by personality traits was small and of little predictive value after adjusting for potential confounders (<5%). Furthermore, these associations typically became non-significant after FDR adjustment. When the reporting effect was examined, sex was found to be associated with the discrepancy between the LWI and both the 24-hr recall and FFQ[2] (i.e. intake over the 14-day residential period), with males under-reporting to a greater extent than females. No associations were seen between sex and the WDR, 7-day diet history or FFQ. Isolated associations were also seen between the LWI and selected self-report methods, but there appeared to be no consistency between the self-reported measurement techniques. Furthermore, while some of the same personality traits were correlated with both the reporting and observation effect (e.g. psychoticism and openness to experience), it should be noted that the direction of these associations differed between mis-reporting states, and again, these associations often became non-significant after accounting for multiplicity of comparisons. The reported associations should therefore be interpreted with caution as isolated values occurring amongst multiple comparisons are likely of limited significance. Taken together, these data indicate that both the reporting and the observation effect are difficult to predict from the personal and psychological characteristics used in this study even under the controlled residential condition of Study One.

4.3 Correlates of Mis-Reporting under Different Study Environments (Study Two)

It was also interesting to note in Study Two EI using the WDR was lower in the home phase, with the EI:RMR in the home environment 1.58 vs 1.75 the laboratory environment (using the WDR as the reference values of EI). While this could be taken to suggest that mis-reporting was greater in the home environment, it should be noted that i) the WDR measured in the laboratory and home phases were measured at different time points, and, ii) 'true' intake was not measured in this phase so a comparison between true intake and self-reported intake cannot be made in the same way as Study One. While this limits direct comparison, it is possible that the residential nature of the laboratory phase, with fewer of the usual day-to-day distractions, may have increased the completeness of food recording during this phase of the study and limited mis-reporting of EI in the laboratory. It is also note Therefore, future studies should further examine the effect of the eating environment, as well as the dietary assessment tool, on the extent of mis-reporting. As was the case in Study One, sex was found to be associated with the degree of mis-reporting between the LWI and 24-hr recall, WDR and 7-day diet history in the laboratory environment, with males mis-reporting to a greater extent than females. Furthermore, several psychological traits, namely neuroticism, openness to experience, agreeableness, extroversion and external eating, were related to mis-reporting in the laboratory environment when EI was self-reported. Again however, caution must be taken when interpreting these isolated associations given the size and complexity of the dataset, and the multiplicity of comparisons. Indeed, these association often did not remain significant after FDR adjustment, the extent to which these psychometric traits predicted mis-reporting in the laboratory phase of Study Two was again extremely limited (typically <5% of the variance in mis-reporting), and the correlates of mis-reported differed between the laboratory and home environments as well as self-report measurement techniques.

It is interesting to note that in these data males mis-reported to a greater extent than females, while there was also an apparent lack of association between personal characteristics such as age and % body fat and mis-reporting. It has previously been reported that females and those with a higher BMI, as a proxy measure of body fat, are more likely to under-report. However, despite the wealth of studies examining both the extent, prevalence and correlates of mis-reporting using self-reported techniques, results remain inconsistent[7; 15]. For example, while some studies find that women under-report EI more often than men[41; 42; 43; 44], others have found under-reporting to be higher in males[45; 46] or there to be no association with sex[47]. It is also worth noting that due to their greater body size, energy requirements in men was ~20% higher than women. This was reflected in greater absolute EI in males, and therefore greater mis-reporting (in absolute terms) may in part reflect a body size effect. Numerous studies have reported an association between higher BMI and an increased likelihood of under-reporting when compared to estimated energy requirements, such as estimated RMR. However, RMR is often estimated using linear regression equations, which tend to over-estimate RMR at higher body weights. Over-estimating RMR will lower the ratio of reported energy intake to RMR, and result in subjects with higher BMIs being more likely to be incorrectly identified as under-reporters than are lean subjects.

The apparent lack of associations between personal and psychological traits and mis-reporting in the present study may also reflect the fact that participants in Study One and Study Two were stratified for age, sex and BMI. This is of particular importance as potential psychological correlates of mis-reporting (e.g. personality and eating behaviours traits) are known to covary with age, sex and body weight/composition. Age and BMI are also often used as independent predictors of mis-reporting, but in the populations concerned age and BMI almost always co-vary. Given the large amount of psychometric data collected as part of Study One and Two, these data suggest that mis-reporting behaviours do not appear to aggregate into discrete clusters amongst people. When such factors are considered alongside the marked heterogeneity in study design and populations used, and the methods used to assess both of dietary intake and misreporting and the significant methodological limitations inherent to these, it is not perhaps surprising previous findings are inconsistent.

4.4 Can Mis-Reporting be predicted based Personal or Psychological Characteristics?

Findings from the two studies presented here indicate that it is difficult to predict mis-reporting based on either personal characteristics or psychological traits. While some correlates of mis-reporting were seen, the strength of these associations was too low to enable reliable prediction. Indeed, when data were combined across studies, the only consistent predictor across the dietary assessment methods was sex, but only ~5% of the variance in the discrepancy between the LWI and the WDR, 24-hr recall or 7-day history was accounted for by sex. It may be that these variables truly contain no predictive value, or that their small effects are overwhelmed in these studies by random variation in food intake. When this is considered alongside the fact that mis-reporting is normally distributed, with virtually all participants exhibiting some degree of mis-reporting[21], mis-reporting as a phenomenon appears to be very difficult to predict at the individual level even when all of its components are precisely and accurately measured (which, in itself, is often very difficult under free-living conditions). Given the small amount of variance the personal and psychological traits accounted for in the present study, and the fact that associations differed between dietary assessment techniques, our interpretation is that it is not possible to use these traits to develop models that will predict with any certainty who will mis-report, and to what extent they will mis-report. It seems almost everyone exhibits mis-reporting to some degree, and the underlying personal, behavioural and psychological traits do not aggregate into discrete clusters amongst people, making them difficult to predict. While subject traits are often related to either low energy reporting or mis-reporting (e.g. sex and BMI), these relationships are often far too tenuous to use these traits to account for more than a few percent of the variance in mis-reporting. It should be noted that socioeconomic level, which has previously been shown to be associated with dietary mis-reporting[7], was not measured in-depth or included in the analysis of the present study.

4.5 Limitations

As compared to previous studies[7], the extent and magnitude of under reporting in the present study was smaller. This may reflect the design of the two studies, with the residential nature of the laboratory phases reducing the usual day-to-day distractions and increasing the completeness of food recording for example. Furthermore, in both studies the 24-hr recall was performed the day after the WDR. As the 24-hr recall method is memory based, it is possible that the WDR acted to prime participants and improve the accuracy of the subsequent 24-hr recall. The analyses of the present paper were also limited to discrepancies in the reporting of EI, with mis-reporting of specific nutrient intakes not considered here. While there is some evidence of macronutrient specific mis-reporting[7; 15; 41], and that some food groups tended to be under-reported to a greater extent than did others in Study One[48], the personal or psychological factors reported in the present data failed to predict mis-reporting of carbohydrate, fat and protein intake (data not reported). It should also be acknowledged that while the WDR and 24-hr recall techniques used in Study One and Two, and the FFQ[2] in Study One, provided direct self-assessment of EI on the same days in which food intake was covertly measured (LWIs), the 7-day diet histories and FFQ reflected a participant's habitual intake. FFQs are more commonly used in dietary surveys to quantify patterns of dietary intake rather than absolute energy or nutrient intakes. Thus, it is not perhaps surprising mis-reporting of EI relative to the LWIs was evident with these tools. During the laboratory phases of each study every effort was made to provide an environment in which participants habitual physical activity and (eating patterns) could be replicated. Participants were able to move freely around the unit and associated grounds (under supervision of a member of staff) and were free to leave the unit during the study (but were accompanied and observed by a member of staff at all times). Despite this, it is unlikely that physical activity and food intake reflected true free-living habitual patterns. While participants were in a slight positive energy balance in both studies, it is noted that in Study One total daily energy expenditure was measured using doubly labelled water[21] and the mean daily PAL was 1.69 x RMR. This is similar to those seen in modern Western populations when energy expenditure is measured using doubly labelled water under free-living conditions. By design, the home phase of Study Two was more representative of their habitual feeding environment, but as a result this phase was less controlled, and it is unknown whether illnesses or special events for example influenced the reported intakes.

4.6 Conclusions

While selected personal and psychological traits were associated with mis-reporting, these associations displayed no clear pattern across studies or dietary assessment technique and had little utility in predicting mis-reporting. Even when mis-reporting is directly quantified under robust experimental conditions (that exceed the level of control likely to be achieved in free-living studies), it appears difficult, if not impossible, to predict mis-reporting based on personal or psychological characteristics. It is therefore recommended that wherever possible, EI should be studied in the context of energy balance. Indeed, there is increasing focus on using intake-balance methods and mathematical models to estimate energy intake from energy expenditure and changes in stored energy. While not providing information on macro-nutrient intake, these approaches provide the only current objective quantitative framework in which to measure the impact of mis-reporting of EI, and avoids cross-validation of self-report techniques. It also offers a context in which new biomarkers of energy and nutrient balance can be developed, using metabolomic approaches, to further improve the measurement of energy and nutrient balance.

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Disclaimers

The authors declare no conflicts of interest.

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FIGURE LEGENDS

Figure 1: Schematic overview of Study One (Panel A) and Study Two (Panel B) design. MTD, maintenance diet. LWI, laboratory weighed intake. In Study One, covert measurement of food intake was made using the laboratory weighed intake method across all days, while participants self-reported food intake during overt phases only. Order of covert and overt phases was randomised. In Study Two, covert measures of food intake were made using the laboratory weighed intake and self-report methods during the laboratory phase. Food intake was measured using daily weighed dietary records in the home phase, and the order of the home and laboratory phases was randomised. LWI, laboratory weighed intake. WDR, weighed dietary record. FFQ, food frequency questionnaire. UWIST, UWIST Mood Adjective Checklist; IQ, intelligence quotient; NART, National Adult Reading Test; AH4, Alison Heim 4; Raven, Raven Standard Progressive Matrices; EPQR, Eysenck-100; NEOPIR, Neuroticism, Extraversion, Openness Personality Inventory-Revised; BIDR, Balanced Inventory of Desirable Responding.

Figure 2: Bland-Altman plots illustrating the difference between mean daily energy intake using the laboratory weighed intake method and the weighed dietary record method (a), 24-hr recall (b), 7-day diet history (c) and food frequency questionnaire (d) against the mean of the two measures. The dashed horizontal line represents the mean bias between the two methods, and the two doted horizontal lines represent the upper and lower 95% limits of agreement. LWI, laboratory weighed intake. WDR, weighed dietary record. FFQ, food frequency questionnaire.

Figure 3: Effect of the study environment on reported energy intake measured using the weighed dietary record under laboratory and home environments of Study Two (n = 181; men = 86, women = 96). Data are mean ± SD. *Significant difference (two-sided paired t-test) between energy intake measured using the weighed dietary record under laboratory and home environments ($p < 0.05$). WDR, weighed dietary record.

Table 1: Psychological questionnaires used in Study One and Two, and the specific day(s) of completion.

	Study One	**Study Two**
HOME PERIOD		
Mood		
- UWIST	-	2-5
LABORATORY PERIOD		
Mood		
- UWIST	3-14	2-3
IQ		
- NART	3	2
- AH4	4	2
- Ravens	3	3
Personality		
- Body image questionnaire	9	2
- EPQR	13	2
- NEO PIR	15	3
Social desirability		
- Marlowe Crowne Social Desirability Scale	7	2

- BIDR	7	3
Eating behaviour		
- Dutch eating Behaviour Questionnaire	1	1

UWIST, UWIST Mood Adjective Checklist; IQ, intelligence quotient; NART, National Adult Reading Test; AH4, Alison Heim 4; Raven, Raven Standard Progressive Matrices; EPQR, Eysenck-100; NEOPIR, Neuroticism, Extraversion, Openness Personality Inventory-Revised; BIDR, Balanced Inventory of Desirable Responding.

Table 2: Descriptive characteristics of subjects (Study One).

	Total Sample (n = 59)		**Men (n = 30)**		**Women (n = 29)**	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
Age, yrs	42.7	13.6	42.9	13.1	42.5	14.3
Height, m	1.71	0.1	1.76	0.1	1.65	0.1
BMI, kg/m^2	26.1	3.8	26.7	4.0	25.4	3.5
Weight, kg	75.9	14.3	82.7	14.5	68.9	10.3
Body fat, %	32.2[a]	7.0	28.4	6.2	36.2	5.4
RMR, MJ/d	6.56	1.23	7.20	1.17	5.90	0.91
Education Level (%)	42% secondary		33% secondary		52% secondary	
	58% tertiary		67% tertiary		48% tertiary	

RMR, resting metabolic rate. Note, % body fat estimated from skinfold thickness using the equations of Durnin & Womersley[24]. [a]n = 57.

Table 3: Descriptive characteristics of subjects (Study Two).

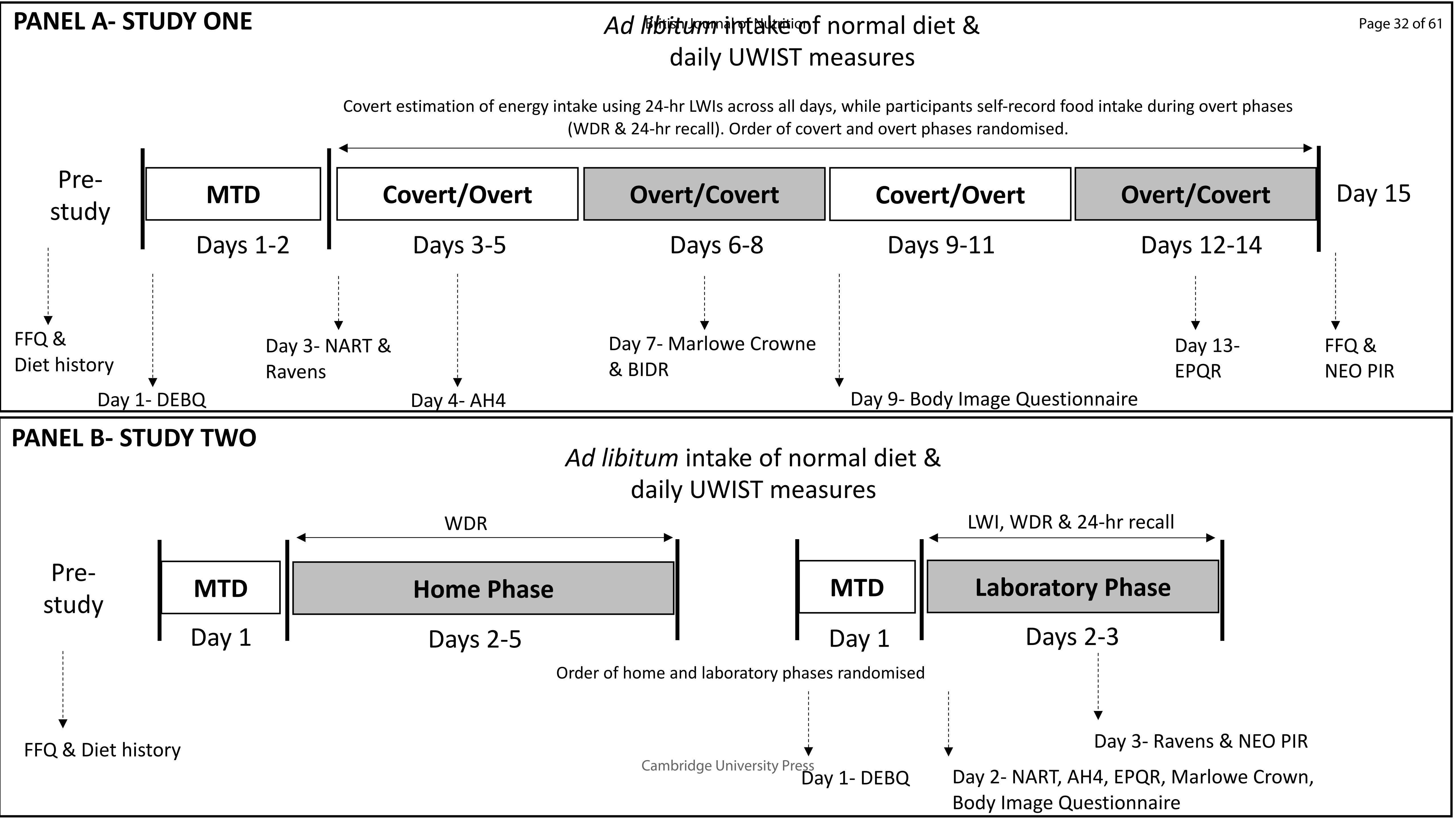
	Total Sample (n = 182)		Men (n = 86)		Women (n = 96)	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
Age, yrs	42.4	12.2	41.2	12.1	43.3	12.3
Height, m	1.70[a]	0.1	1.77[b]	0.1	1.63[c]	0.1
BMI, kg/m^2	25.7	3.9	26.1	3.7	25.4	4.0
Weight, kg	74.6	14.1	82.1	13.6	67.8	10.8
Body fat, %	30.2[a]	8.2	24.9[b]	7.0	34.8[c]	6.0
RMR, MJ/d	6498	121	7286	1184	5755	845
Education Level (%)	31% secondary		31% secondary		31% secondary	
	69% tertiary		69% tertiary		69% tertiary	

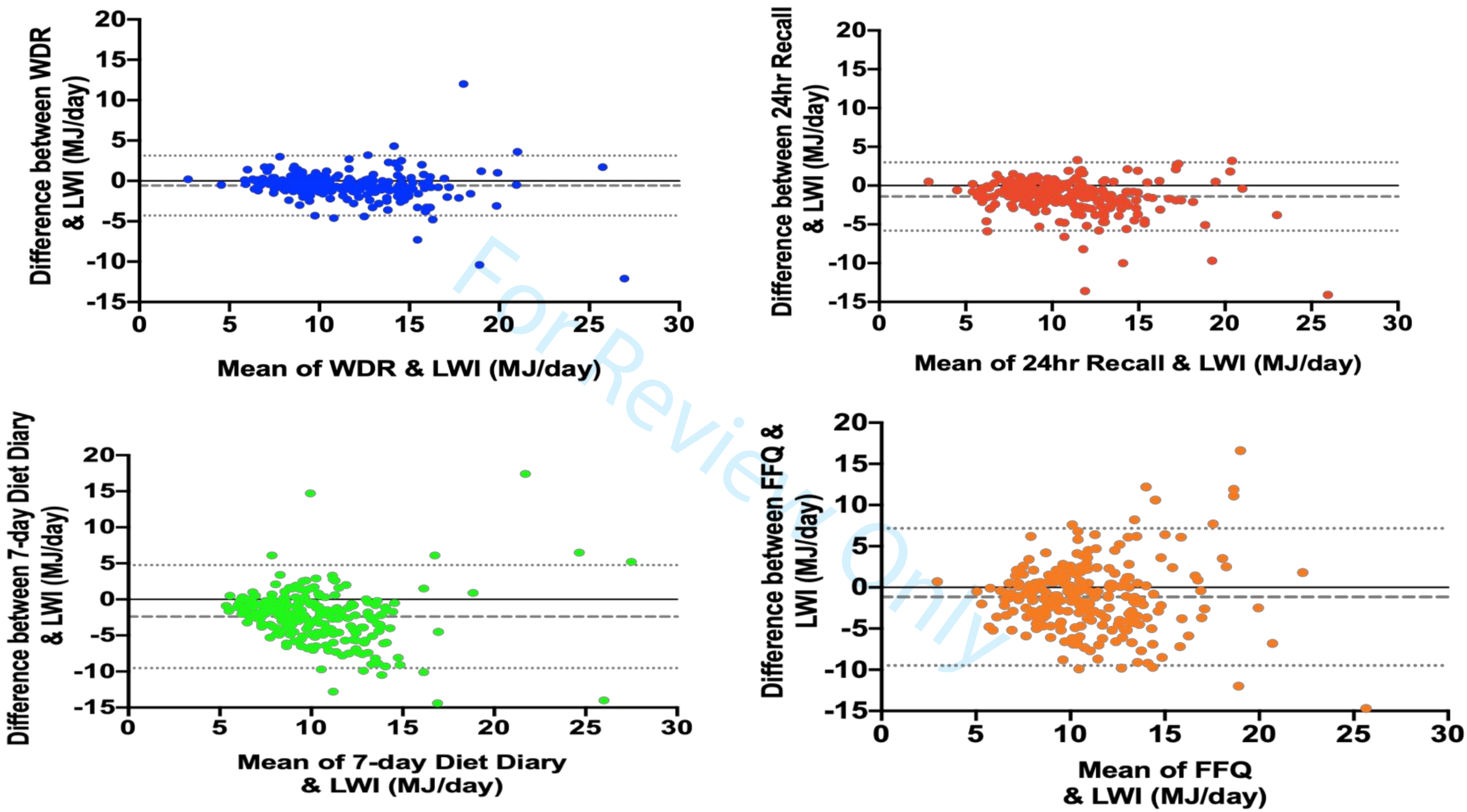
RMR, resting metabolic rate. Note, % body fat estimated from skinfold thickness. [a]n = 179. [b]n =84. [c]n = 95.

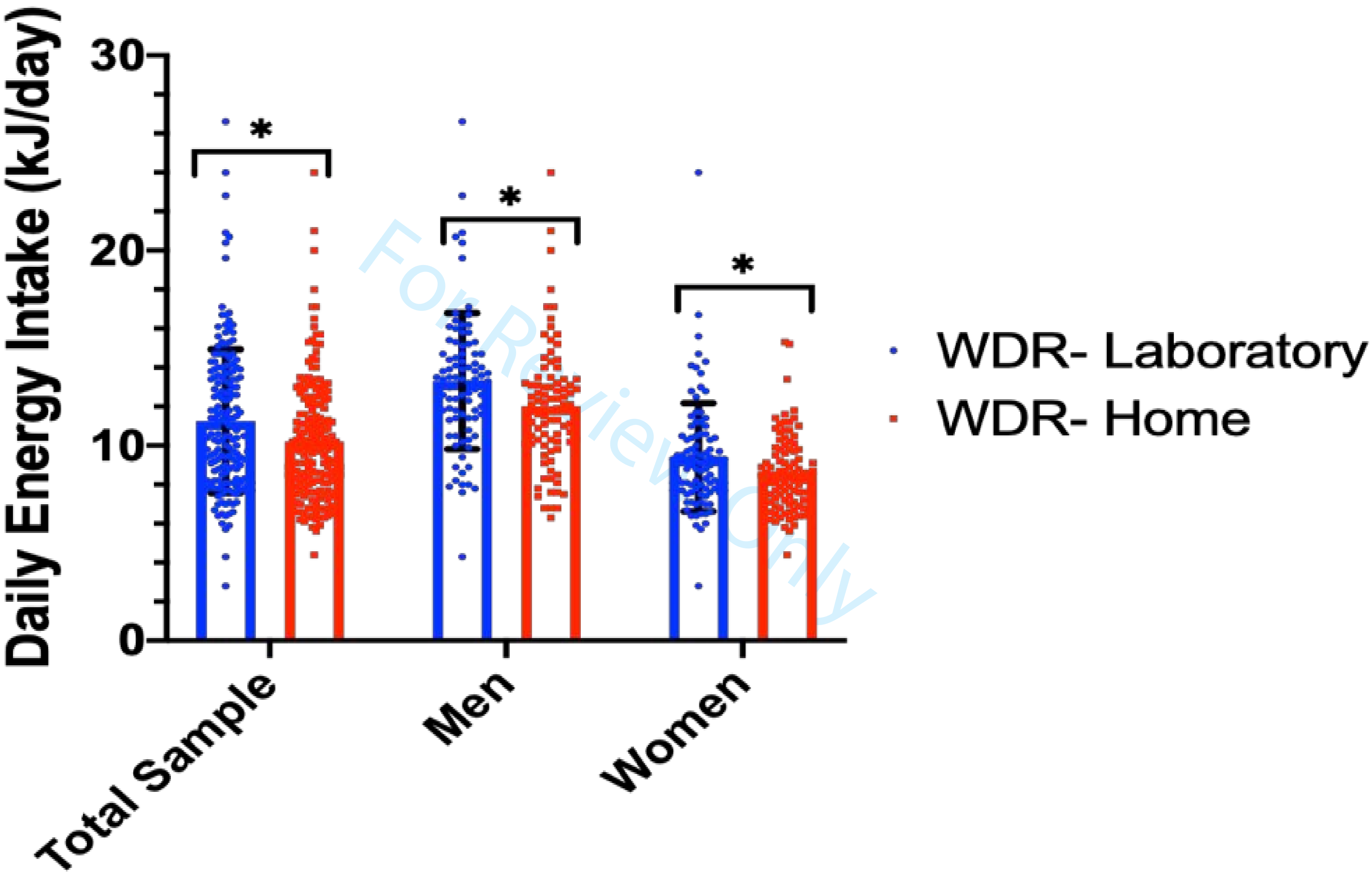
861 Table 4: Measured and self-reported mean daily energy intake values for Study One, Study Two and the total sample combined.

	Total Sample (n = 241)		**Study One (n = 59)**		**Study Two (n = 182)**	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
LWI overt phase (MJ/day)	11.6	3.8	10.9	2.7	11.8	4.1
Laboratory WDR (MJ/day)	11.0	3.5	10.3	2.6	11.2	3.7
Home WDR (MJ/day)	N/A	N/A	N/A	N/A	10.2	3.1
24-hr Recall (MJ/day)	10.2	3.3	9.7	2.3	10.3	3.6
7-day Diet history (MJ/day)	9.2[a]	3.5	9.1	3.3	9.2[c]	3.6
FFQ (MJ/day)	10.4[a]	3.9	10.6	4.0[b]	10.4	3.9

862 LWI, laboratory weighed intake. WDR, weighed dietary record. FFQ, food frequency questionnaire. N/A, measure not taken during this particular
863 experimental phase. [a]n= 240; [b]n = 58; [c]n = 181.


PANEL A- STUDY ONE
Ad libitum intake of normal diet & daily UWIST measures
Covert estimation of energy intake using 24-hr LWIs across all days, while participants self-record food intake during overt phases (WDR & 24-hr recall). Order of covert and overt phases randomised.
Pre-study
MTD
Covert/Overt
Overt/Covert
Covert/Overt
Overt/Covert
Day 15
Days 1-2
Days 3-5
Days 6-8
Days 9-11
Days 12-14
FFQ & Diet history
Day 1- DEBQ
Day 3- NART & Ravens
Day 4- AH4
Day 7- Marlowe Crowne & BIDR
Day 9- Body Image Questionnaire
Day 13- EPQR
FFQ & NEO PIR
PANEL B- STUDY TWO
Ad libitum intake of normal diet & daily UWIST measures
WDR
LWI, WDR & 24-hr recall
Pre-study
MTD
Home Phase
MTD
Laboratory Phase
Day 1
Days 2-5
Day 1
Days 2-3
Order of home and laboratory phases randomised
FFQ & Diet history
Day 3- Ravens & NEO PIR
Day 1- DEBQ
Day 2- NART, AH4, EPQR, Marlowe Crown, Body Image Questionnaire


Difference between WDR & LWI (MJ/day)
Mean of WDR & LWI (MJ/day)
Difference between 24hr Recall & LWI (MJ/day)
Mean of 24hr Recall & LWI (MJ/day)
Difference between 7-day Diet Diary & LWI (MJ/day)
Mean of 7-day Diet Diary & LWI (MJ/day)
Difference between FFQ & LWI (MJ/day)
Mean of FFQ & LWI (MJ/day)


Daily Energy Intake (kJ/day)
30
20
10
0
*
*
*
Total Sample
Men
Women
WDR- Laboratory
WDR- Home

SUPPLEMENTARY MATERIALS

STUDY ONE- OBSERVATION EFFECT

Table S1: Multiple regression between the observation effect (difference between overt and covert LWIs) and age, sex and % body fat in Study One participants.

	Co-E (MJ)	SE	P-Value
Age	0.008	0.017	0.631
Sex	0.558	0.456	0.256
% Body Fat	0.010	0.040	0.801

n = 57
$F_{(3, 53)} = 0.823$, $p = 0.487$; adj-$R^2 = -0.010$

Co-E: Co-efficient, SE: Standard Error, LWI: Laboratory Weighed Intakes

Table S2: Multiple regression between the observation effect (difference between overt and covert LWIs) and age, sex, % body fat and psychometric eating behaviour traits in Study One participants.

	Co-E (MJ)	SE	P-Value
Age	0.004	0.017	0.817
Sex	0.591	0.516	0.257
% Body Fat	0.014	0.040	0.736
Cognitive Restraint	0.283	0.265	0.290
Emotional Eating	0.077	0.255	0.764
External Eating	-0.798	0.472	0.097

n = 57
$F_{(6, 50)} = 1.080$, $p = 0.387$; adj-$R^2 = 0.009$

Co-E: Co-efficient, SE: Standard Error, LWI: Laboratory Weighed Intakes

Table S3: Multiple regression between the observation effect (difference between overt and covert LWIs) and age, sex, % body fat and body image in Study One participants.

	Co-E (MJ)	SE	P-Value
Age	0.007	0.017	0.696
Sex	0.579	0.492	0.244
% Body Fat	0.018	0.043	0.683
Body Image Score	-0.050	0.111	0.653

n = 57
$F_{(4, 52)} = 0.659$, $p = 0.623$; adj-$R^2 = -0.025$

Co-E: Co-efficient, SE: Standard Error, LWI: Laboratory Weighed Intakes

Table S4: Multiple regression between the observation effect (difference between overt and covert LWIs) and age, sex, % body fat and EPQR personality dimensions in Study One participants.

	Co-E (MJ)	SE	P-Value
Age	0.002	0.018	0.896
Sex	0.368	0.484	0.451
% Body Fat	0.029	0.040	0.468
Psychoticism	**0.167**	**0.061**	**0.009**
Extraversion	-0.045	0.034	0.192
Neuroticism	0.017	0.030	0.566
Social Desirability	0.028	0.054	0.601

n = 57
$F_{(7, 49)} = 1.662$, $p = 0.141$; adj-$R^2 = 0.076$
FDR adjusted q-values = 0.896, 0.701, 0.701, 0.063, 0.672, 0.701, 0.701

Co-E: Co-efficient, SE: Standard Error, LWI: Laboratory Weighed Intakes, FDR: false discovery rate (Benjamini & Hochberg, 1995).

Table S5: Multiple regression between the observation effect (difference between overt and covert LWIs) and age, sex, % body fat and NEO PIR personality dimensions in Study One participants.

	Co-E (MJ)	SE	P-Value
Age	0.006	0.016	0.736
Sex	0.391	0.500	0.438
% Body Fat	0.037	0.038	0.343
Neuroticism	0.005	0.008	0.551
Extraversion	-0.016	0.009	0.073
Openness to Experience	**0.026**	**0.009**	**0.006**
Agreeableness	**-0.021**	**0.010**	**0.038**
Conscientiousness	0.005	0.010	0.610

n = 55
$F_{(8, 46)} = 1.862$, $p = 0.090$; adj-$R^2 = 0.113$
FDR adjusted q-values = 0.736, 0.697, 0.686, 0.697, 0.195, **0.048**, 0.152, 0.697

Co-E: Co-efficient, SE: Standard Error, LWI: Laboratory Weighed Intakes, FDR: false discovery rate (Benjamini & Hochberg, 1995).

Table S6: Multiple regression between the observation effect (difference between overt and covert LWIs) and age, sex, % body fat and social desirability in Study One participants.

	Co-E (MJ)	SE	P-Value
Age	0.009	0.018	0.631
Sex	0.547	0.504	0.283
% Body Fat	0.009	0.041	0.827
Marl Crowne Score	-0.041	0.044	0.356
BIDR- Self-deceptive Enhancement	0.025	0.058	0.669
BIDR- Impression Management	-0.008	0.066	0.903

n = 56
$F_{(6, 49)} = 0.589$, $p = 0.738$; adj-$R^2 = -0.047$

Co-E: Co-efficient, SE: Standard Error, LWI: Laboratory Weighed Intakes

Table S7: Multiple regression between the observation effect (difference between overt and covert LWIs) and age, sex, % body fat and IQ in Study One participants.

	Co-E (MJ)	**SE**	**P-Value**
Age	0.019	0.022	0.402
Sex	0.674	0.516	0.197
% Body Fat	0.013	0.043	0.762
Ravens Score	-0.021	0.038	0.588
AH4 Score	0.017	0.016	0.293
NART- Full Scale IQ	-0.132	0.519	0.800
NART- Verbal IQ	-0.007	0.510	0.988
NART- Performance IQ	0.155	0.568	0.786

n = 56
$F_{(8, 47)} = 0.660$, $p = 0.724$; adj-$R^2 = -0.052$

Co-E: Co-efficient, SE: Standard Error, LWI: Laboratory Weighed Intakes

Table S8: Multiple regression between the observation effect (difference between overt and covert LWIs) and age, sex, % body fat and UWIST hedonic, tense and energetic scores in Study One participants.

	Co-E (MJ)	SE	P-Value
Age	0.023	0.021	0.298
Sex	0.329	0.526	0.535
% Body Fat	-0.013	0.045	0.772
Hedonic	-0.022	0.099	0.826
Tense	0.072	0.094	0.445
Energetic	0.049	0.066	0.458

n = 57
$F_{(6, 50)} = 1.939$, $p = 0.650$; adj-$R^2 = -0.033$

Co-E: Co-efficient, SE: Standard Error, LWI: Laboratory Weighed Intakes

SUPPLEMENTARY MATERIALS

STUDY ONE- REPORTING EFFECT

Table S9: Multiple regressions between the reporting effect (difference between overt LWI and self-reported intake method) and age, sex and % body fat in Study One participants.

Personal characteristics		Sex			Age			% Body Fat		
	Model Summary	Co-E (MJ)	SE	P-Value	Co-E (MJ)	SE	P-Value	Co-E (MJ)	SE	P -Value
WDR[a]	$F_{(3, 53)}$ = 0.998, p = 0.401, adj-R^2 = 0.000	-0.468	0.445	0.298	0.010	0.015	0.519	0.061	0.036	0.099
24hr Recall[a]	**$F_{(3, 53)}$ = 5.348, p = 0.003, adj-R^2 = 0.189**	**-1.629**	**0.463**	**0.001**	0.027	0.016	0.097	**-0.139**	**0.038**	**0.001**
7-day History[a]	$F_{(3, 53)}$ = 0.229, p = 0.876, adj-R^2 = -0.043	-0.370	0.864	0.670	-0.002	0.030	0.955	0.017	0.070	0.806
FFQ[b]	$F_{(3, 52)}$ = 0.071, p = 0.975, adj-R^2 = -0.053	-0.432	1.285	0.738	0.019	0.046	0.681	-0.030	0.107	0.780
FFQ^{2}[c]	$F_{(3, 51)}$ = 2.700, p = 0.055, adj-R^2 = 0.086	**-2.251**	**0.865**	**0.012**	0.057	0.031	0.071	-0.109	0.071	0.131

Co-E: Co-efficient, SE: Standard Error, LWI: Laboratory Weighed Intakes, WDR: Weighed Dietary Record, FFQ: Aberdeen Food Frequency Questionnaire (administered on day one), FFQ^2: Aberdeen Food Frequency Questionnaire (administered on day fifteen), FDR: false discovery rate (Benjamini & Hochberg, 1995).

[a]n = 57. [b]n = 56. [c]n = 55.

24hr Recall FDR adjusted q-values = **0.001,** 0.097, **0.001**

FFQ_2 FDR adjusted q-values = **0.036,** 0.107, 0.131

Table S10: Multiple regressions between the reporting effect (difference between LWI and self-reported intake method) and psychometric eating behaviour traits in Study One participants. Note, age, sex and percentage body fat were also included in all models reported but their coefficients are not reported below.

Eating Behavior Traits-DEBQ		Cognitive Restraint			Emotional Eating			External Eating		
	Model Summary	**Co-E (MJ)**	**SE**	**P-Value**	**Co-E (MJ)**	**SE**	**P-Value**	**Co-E (MJ)**	**SE**	**P-Value**
WDR[a]	$F_{(6, 50)} = 0.970$, $p = 0.455$, adj-$R^2 = -0.003$	-0.314	0.245	0.206	-0.042	0.236	0.861	0.556	0.437	0.210
24hr Recall[a]	$F_{(6, 50)} = 3.496$, $p = 0.006$, adj-$R^2 = 0.211$	-0.006	0.251	0.982	**-0.498**	**0.242**	**0.044**	0.751	0.448	0.100
7-day History[a]	$F_{(6, 50)} = 0.443$, $p = 0.847$, adj-$R^2 = -0.064$	-0.203	0.479	0.673	-0.409	0.462	0.295	1.175	0.856	0.176
FFQ[b]	$F_{(6, 49)} = 0.131$, $p = 0.992$, adj-$R^2 = -0.105$	0.319	0.726	0.663	0.315	0.698	0.654	-0.270	1.291	0.835
FFQ[2c]	$F_{(6, 48)} = 2.083$, $p = 0.073$, adj-$R^2 = 0.107$	0.485	0.468	0.305	0.583	0.450	0.201	-0.440	0.833	0.600

Co-E: Co-efficient, SE: Standard Error, LWI: Laboratory Weighed Intakes, WDR: Weighed Dietary Record, FFQ: Aberdeen Food Frequency Questionnaire – administered on day one, FFQ^2: Aberdeen Food Frequency Questionnaire – administered on day fifteen, FDR: false discovery rate (Benjamini & Hochberg, 1995).

[a]n = 57. [b]n = 56. [c]n = 55.

24hr Recall FDR adjusted q-values = 0.982, 0.088, 0.120

Table S11: Multiple regressions between the reporting effect (difference between LWI and self-reported intake method) and body image in Study One participants. Note, age, sex and percentage body fat were also included in all models reported but their coefficients are not reported below.

Body Image		**Body Image Score**		
	Model Summary	**Co-E (MJ)**	**SE**	**P-Value**
WDR[a]	$F_{(4, 52)} = 0.772$, $p = 0.549$, adj-$R^2 = -0.017$	-0.038	0.102	0.710
24hr Recall[a]	**$F_{(4, 52)} = 3.938$, $p = 0.007$, adj-$R^2 = 0.173$**	0.009	0.106	0.932
7-day History[a]	$F_{(4, 52)} = 0.689$, $p = 0.603$, adj-$R^2 = -0.023$	0.278	0.194	0.158
FFQ[b]	$F_{(4, 51)} = 0.225$, $p = 0.923$, adj-$R^2 = -0.060$	0.243	0.293	0.411
FFQ^2[c]	$F_{(4, 50)} = 0.051$, $p = 0.198$, adj-$R^2 = 0.069$	0.051	0.198	0.798

Co-E: Co-efficient, SE: Standard Error, LWI: Laboratory Weighed Intakes, WDR: Weighed Dietary Record, FFQ: Aberdeen Food Frequency Questionnaire – administered on day one, FFQ^2: Aberdeen Food Frequency Questionnaire – administered on day fifteen.

[a]n = 57. [b]n = 56.[c]n = 55.

Table S12: Multiple regressions between the reporting effect (difference between LWI and self-reported intake method) and EPQR personality dimensions in Study One participants. Note, age, sex and percentage body fat were also included in all models reported but their coefficients are not reported below.

Personality Traits-EPQR		**Psychoticism**			**Extraversion**			**Neuroticism**			**Social Desirability**		
	Model Summary	**Co-E (MJ)**	**SE**	**P-Value**	**Co-E (MJ)**	**SE**	**P-Value**	**Co-E (MJ)**	**SE**	**P-Value**	**Co-E (MJ)**	**SE**	**P -Value**
WDR[a]	$F_{7, 49}$ = 0.416, p = 0.888, adj-R^2 = -0.079	0.008	0.061	0.895	0.004	0.034	0.898	-0.003	0.030	0.911	0.012	0.054	0.823
24hr Recall[a]	**$F_{(7, 49)}$ = 3.443, p = 0.004, adj-R^2 = 0.234**	-0.113	0.059	0.062	-0.012	0.033	0.709	-0.044	0.029	0.138	0.009	0.052	0.857
7-day History[a]	$F_{(7, 49)}$ = 1.299, p = 0.271, adj-R^2 = 0.036	**-0.254**	**0.109**	**0.024**	0.088	0.061	0.156	-0.009	0.053	0.871	0.141	0.096	0.150
FFQ[b]	$F_{(7, 48)}$ = 0.102, p = 0.998, adj-R^2 = -0.129	0.029	0.175	0.869	0.008	0.098	0.934	0.046	0.085	0.592	0.081	0.155	0.605
FFQ[2c]	$F_{(7, 47)}$ = 1.673, p = 0.139, adj-R^2 = 0.080	-0.088	0.114	0.442	0.024	0.064	0.704	0.088	0.056	0.120	0.114	0.100	0.264

Co-E: Co-efficient, SE: Standard Error, LWI: Laboratory Weighed Intakes, WDR: Weighed Dietary Record, FFQ: Aberdeen Food Frequency Questionnaire – administered on day one, FFQ^2: Aberdeen Food Frequency Questionnaire – administered on day fifteen, FDR: false discovery rate (Benjamini & Hochberg, 1995).

[a]n = 57. [b]n = 56.[c]n = 55.

7-day History FDR adjusted q-values = 0.168, 0.364, 0.884, 0.364

Table S13: Multiple regressions between the reporting effect (difference between LWI and self-reported intake method) and NEO PIR personality dimensions in Study One participants. Note, age, sex and percentage body fat were also included in all models reported but their coefficients are not reported below.

Personality Traits- NEO PIR		**Neuroticism**			**Extraversion**			**Openness to Experience**			**Agreeableness**			**Conscientiousness**		
	Model Summary	**Co-E (MJ)**	**SE**	**P-Value**	**Co-E (MJ)**	**SE**	**P-Value**	**Co-E (MJ)**	**SE**	**P-Value**	**Co-E (MJ)**	**SE**	**P -Value**	**Co-E (MJ)**	**SE**	**P -Value**
WDR[a]	$F_{(8, 46)} = 1.018$, $p = 0.436$, adj-$R^2 = 0.003$	0.007	0.0081	0.407	-0.001	0.009	0.888	0.010	0.009	0.292	0.019	0.010	0.051	0.007	0.010	0.457
24hr Recall[a]	**$F_{(8, 46)} = 5.146$, $p = 0.003$, adj-$R^2 = 0.170$**	-0.002	0.008	0.786	0.000	0.009	0.966	-0.007	0.009	0.446	0.013	0.010	0.214	0.013	0.010	0.230
7-day History[a]	$F_{(8, 46)} = 1.007$, $p = 0.444$, adj-$R^2 = 0.001$	0.004	0.015	0.759	0.027	0.017	0.113	**-0.035**	**0.017**	**0.044**	0.012	0.018	0.502	0.014	0.01[a]	0.447
FFQ[b]	$F_{(8, 45)} = 0.243$, $p = 0.980$, adj-$R^2 = 0.041$	0.010	0.023	0.672	0.016	0.027	0.544	-0.012	0.027	0.664	0.029	0.029	0.322	-0.011	0.030	0.723
FFQ[2c]	$F_{(8, 44)} = 1.333$, $p = 0.253$, adj-$R^2 = 0.049$	0.021	0.015	0.182	0.004	0.018	0.802	0.014	0.018	0.450	-0.006	0.019	0.771	0.020	0.020	0.315

Co-E: Co-efficient, SE: Standard Error, LWI: Laboratory Weighed Intakes, WDR: Weighed Dietary Record, FFQ: Aberdeen Food Frequency Questionnaire – administered on day one, FFQ^2: Aberdeen Food Frequency Questionnaire – administered on day fifteen, FDR: false discovery rate (Benjamini & Hochberg, 1995).

[a]n = 55. [b]n = 54. [c]n = 53.

7-day History FDR adjusted q-values = 0.858, 0.452, 0.352, 0.858, 0.858

Table S14: Multiple regressions between the reporting effect (difference between LWI and self-reported intake method) and social desirability in Study One participants. Note, age, sex and percentage body fat were also included in all models reported but their coefficients are not reported below.

Social Desirability		Marl Crowne Score			BIDR- Self-deceptive Enhancement			BIDR- Impression Management		
	Model Summary	Co-E (MJ)	SE	P-Value	Co-E (MJ)	SE	P-Value	Co-E (MJ)	SE	P-Value
WDR[a]	$F_{(6, 49)} = 0.580$, $p = 0.745$, adj-$R^2 = -0.048$	0.029	0.040	0.469	-0.023	0.053	0.670	0.015	0.061	0.803
24hr Recall[a]	**$F_{(6, 49)} = 3.127$, $p = 0.011$, adj-$R^2 = 0.188$**	0.030	0.041	0.470	0.090	0.054	0.102	-0.057	0.062	0.361
7-day History[a]	$F_{(6, 49)} = 1.486$, $p = 0.202$, adj-$R^2 = 0.050$	0.113	0.073	0.119	0.191	0.096	0.051	-0.018	0.110	0.872
FFQ[b]	$F_{(6, 48)} = 0.112$, $p = 0.995$, adj-$R^2 = -0.109$	0.064	0.117	0.590	0.014	0.153	0.929	0.063	0.175	0.721
FFQ^{2}[c]	$F_{(6, 47)} = 1.213$, $p = 0.316$, adj-$R^2 = 0.024$	0.026	0.076	0.731	-0.002	0.099	0.987	0.007	0.115	0.952

BIDR: balanced Inventory of Desirable Responding, Co-E: Co-efficient, SE: Standard Error, LWI: Laboratory Weighed Intakes, WDR: Weighed Dietary Record, FFQ: Aberdeen Food Frequency Questionnaire – administered on day one, FFQ^2: Aberdeen Food Frequency Questionnaire – administered on day fifteen.

[a]n = 56. [b]n = 55. [c]n = 54.

Table S15: Multiple regressions between the reporting effect (difference between LWI and self-reported intake method) and IQ in Study One participants. Note, age, sex and percentage body fat were also included in all models reported but their coefficients are not reported below.

IQ		Ravens Score			AH4 Score			NART- Full Scale IQ			NART- Verbal IQ			NART- Performance IQ		
	Model Summary	**Co-E (MJ)**	**SE**	**P-Value**	**Co-E (MJ)**	**SE**	**P-Value**	**Co-E (MJ)**	**SE**	**P-Value**	**Co-E (MJ)**	**SE**	**P - Value**	**Co-E (MJ)**	**SE**	**P - Value**
WDR[a]	$F_{(8, 47)} = 1.656$, p = 0.135, adj-R^2 = 0.087	0.019	0.033	0.566	0.005	0.014	0.722	-0.579	0.451	0.205	-0.288	0.443	0.519	**1.067**	**0.494**	**0.036**
24hr Recall[a]	**$F_{(8, 47)} = 2.796$, p = 0.013, adj-R^2 = 0.207**	0.026	0.036	0.470	0.017	0.015	0.276	-0.104	0.494	0.833	0.451	0.485	0.357	-0.591	0.541	0.280
7-day History[a]	$F_{(8, 47)} = 0.512$, p = 0.841, adj-R^2 = -0.076	-0.091	0.069	0.192	0.022	0.029	0.455	0.631	0.942	0.506	0.433	0.925	0.643	-1.421	1.032	0.175
FFQ[b]	$F_{(8, 46)} = 0.845$, p = 0.569, adj-R^2 = -0.024	-0.057	0.098	0.561	-0.037	0.041	0.374	1.570	1.358	0.707	-0.499	1.318	0.707	-1.384	1.477	0.353
FFQ[2c]	**$F_{(8, 45)} = 2.164$, p = 0.049, adj-R^2 = 0.149**	-0.126	0.066	0.062	-0.004	0.028	0.898	0.838	0.909	0.362	-0.272	0.877	0.757	-0.731	1.007	0.472

NART: National Adult Reading Test, AH4: Alison Heim 4, Co-E: Co-efficient, SE: Standard Error, LWI: Laboratory Weighed Intakes, WDR: Weighed Dietary Record, FFQ: Aberdeen Food Frequency Questionnaire – administered on day one, FFQ^2: Aberdeen Food Frequency Questionnaire – administered on day fifteen.

[a]n = 56. [b]n = 55. [c]n = 54.

WDR FDR adjusted q-values = 0.722, 0.722, 0.722, 0.722, 0.288

Table S16: Multiple regressions between the reporting effect (difference between LWI and self-reported intake method) and UWIST hedonic, tense and energetic scores in Study One participants. Note, age, sex and percentage body fat were also included in all models reported but their coefficients are not reported below.

UWIST Mood		**Hedonic**			**Tense**			**Energetic**		
	Model Summary	**Co-E (MJ)**	**SE**	**P-Value**	**Co-E (MJ)**	**SE**	**P-Value**	**Co-E (MJ)**	**SE**	**P-Value**
WDR[a]	$F_{(6, 50)} = 1.132$, $p = 0.358$, adj-$R^2 = 0.014$	-0.110	0.089	0.222	0.040	0.084	0.639	-0.057	0.059	0.344
24hr Recall[a]	**$F_{6, 50)} = 2.990$, $p = 0.014$, adj-$R^2 = 0.176$**	0.001	0.094	0.993	-0.080	0.089	0.373	-0.072	0.063	0.257
7-day History[a]	$F_{(6, 50)} = 0.239$, $p = 0.961$, adj-$R^2 = -0.089$	-0.019	0.177	0.915	-0.098	0.168	0.564	0.027	0.118	0.818
FFQ[b]	$F_{(6, 50)} = 0.196$, $p = 0.976$, adj-$R^2 = -0.096$	-0.228	0.272	0.407	-0.248	0.257	0.340	-0.023	0.176	0.898
FFQ[2c]	$F_{(6, 48)} = 1.536$, $p = 0.187$, adj-$R^2 = -0.056$	-0.157	0.181	0.391	-0.149	0.172	0.390	0.073	0.118	0.540

Co-E: Co-efficient, SE: Standard Error, LWI: Laboratory Weighed Intakes, WDR: Weighed Dietary Record, FFQ: Aberdeen Food Frequency Questionnaire – administered on day one, FFQ[2]: Aberdeen Food Frequency Questionnaire – administered on day fifteen.

[a]n = 57. [b]n = 56. [c]n = 55.

SUPPLEMENTARY MATERIALS- STUDY TWO

Table S17: Multiple regressions of the discrepancy between the laboratory weighed intakes and other methods (outcome variable) and age, sex and % body fat for participants in Study Two.

			Sex			Age			% body fat		
Phase	**Method**	**Model Summary**	**Co-E (MJ)**	**SE**	**P-Value**	**Co-E (MJ)**	**SE**	**P-Value**	**Co-E (MJ)**	**SE**	**P-Value**
Laboratory Phase: LWI vs	**WDR**[a]	$F_{(3, 175)}$ = 2.205, p = 0.089, adj-R^2 = 0.020	**-0.885**	**0.401**	**0.029**	0.005	0.014	0.749	-0.011	0.027	0.670
	24hr Recall[a]	**$F_{(3, 175)}$ = 5.366, p = 0.001, adj-R^2 = 0.002**	**-1.456**	**0.463**	**0.002**	-0.006	0.017	0.724	-0.003	0.031	0.916
	7-day History[b]	**$F_{(3, 174)}$ = 4.048, p = 0.008, adj-R^2 = 0.049**	**-1.500**	**0.761**	**0.050**	-0.012	0.027	0.656	0.048	0.051	0.346
	FFQ[a]	**$F_{(3, 175)}$ = 3.956, p = 0.009, adj-R^2 = 0.047**	-1.240	0.846	0.145	0.003	0.030	0.930	0.075	0.057	0.187
Home Phase: WDR-H vs	**24hr Recall**[b]	$F_{(3, 174)}$ = 1.396, p = 0.246, adj-R^2 = 0.007	-1.084	0.633	0.089	0.019	0.023	0.396	0.084	0.043	0.052
	7-day History[c]	$F_{(3, 173)}$ = 1.059, p = 0.368, adj-R^2 = 0.001	-1.182	0.670	0.080	0.015	0.024	0.521	-0.049	0.045	0.284
	FFQ[b]	$F_{(3, 174)}$ = 1.195, p = 0.313, adj-R^2 = 0.003	-0.874	0.733	0.235	0.028	0.026	0.286	-0.007	0.050	0.889

Co-E: Co-efficients, SE: Standard Error, LWI: Laboratory Weighed Intakes, WDR: Weighed Dietary Record; WDR-H: WDR Home Phase; FFQ: Aberdeen Food Frequency Questionnaire – administered on day one, FDR: false discovery rate (Benjamini & Hochberg, 1995). [a]n = 179. [b]n = 178. [c]n = 177.

Laboratory Phase:

WDR FDR adjusted q-values = 0.749, 0.087, 0.749

24HR Recall FDR adjusted q-values = **0.006** 0.916 0.916

7-day History FDR adjusted q-values = 0.150 0.656 0.519

Table S18: Multiple regressions of the discrepancy between the criterion measure of food intake in the laboratory (LWI) and home environments (WDR) and the self-reported intake methods (outcome measures) and psychometric eating behaviour traits (predictors) in Study Two participants. Note, age, sex and percentage body fat were included in all models reported but their coefficients are not reported below.

			External Eating			Emotional Eating			Cognitive Restraint		
Phase	**Method**	**Model Summary**	**Co-E (MJ)**	**SE**	**P-Value**	**Co-E (MJ)**	**SE**	**P-Value**	**Co-E (MJ)**	**SE**	**P-Value**
Laboratory Phase: LWI vs	**WDR[a]**	$F_{(6, 172)} = 1.271$, $p = 0.273$, adj-$R^2 = 0.009$	-0.042	0.245	0.863	0.162	0.269	0.548	-0.232	0.247	0.347
	24hr Recall[a]	**$F_{(6, 172)} = 2.879$, $p = 0.011$, adj-$R^2 = 0.060$**	-0.111	0.283	0.694	0.199	0.311	0.523	-0.271	0.285	0.343
	7-day History[b]	$F_{(6, 171)} = 2.088$, $p = 0.057$, adj-$R^2 = 0.036$	-0.042	0.465	0.928	-0.311	0.513	0.545	0.024	0.470	0.959
	FFQ[a]	**$F_{(6, 172)} = 2.839$, $p = 0.012$, adj-$R^2 = 0.058$**	-0.541	0.510	0.291	**1.243**	**0.561**	**0.028**	-0.260	0.515	0.614
Home Phase: WDR-H vs	**24hr Recall[b]**	$F_{(6, 171)} = 1.173$, $p = 0.323$, adj-$R^2 = 0.006$	-0.584	0.385	0.131	0.009	0.422	0.982	0.039	0.389	0.921
	7-day History[c]	$F_{(6, 170)} = 1.107$, $p = 0.360$, adj-$R^2 = 0.004$	-0.433	0.407	0.289	-0.482	0.448	0.283	0.435	0.413	0.294
	FFQ[b]	$F_{(6, 171)} = 1.875$, $p = 0.088$, adj-$R^2 = 0.029$	**-1.001**	**0.440**	**0.030**	**1.055**	**0.482**	**0.024**	0.066	0.445	0.882

Co-E: Co-efficients, SE: Standard Error, LWI: Laboratory Weighed Intakes, WDR: Weighed Dietary Record; WDR-H: WDR Home Phase; FFQ: Aberdeen Food Frequency Questionnaire – administered on day one, FDR: false discovery rate (Benjamini & Hochberg, 1995).

[a]n = 179. [b]n = 178. [c]n = 177.

Laboratory Phase:

FFQ FDR adjusted q-values = 0.465, 0.168, 0.737

Home Phase:

FFQ FDR adjusted q-values = 0.090, 0.090, 0.999

Table S19: Multiple regressions of the discrepancy between the criterion measure of food intake in the laboratory (LWI) and home environments (WDR) and the self-reported intake methods (outcome measures) and body image (predictor) in Study Two participants. Note, age, sex and percentage body fat were included in all models reported but their coefficients are not reported below.

			Body Image Score		
Phase	**Method**	**Model Summary**	**Co-E (MJ)**	**SE**	**P-Value**
Laboratory Phase: LWI vs	**WDR**[a]	$F_{(4, 173)} = 2.370$, $p = 0.054$, adj-$R^2 = 0.030$	-0.171	0.107	0.112
	24hr Recall[a]	**$F_{(4, 173)} = 4.280$, $p = 0.003$, adj-$R^2 = 0.069$**	0.035	0.124	0.779
	7-day History[b]	$F_{(4, 172)} = 3.459$, $p = 0.010$, adj-$R^2 = 0.053$	-0.177	0.203	0.384
	FFQ[a]	**$F_{(4, 173)} = 4.757$, $p = 0.001$, adj-$R^2 = 0.078$**	0.221	0.213	0.301
Home Phase: WDR-H vs	**24hr Recall**[b]	$F_{(4, 172)} = 1.451$, $p = 0.219$, adj-$R^2 = 0.010$	0.218	0.169	0.199
	7-day History[c]	$F_{(6, 171)} = 0.804$, $p = 0.5254$, adj-$R^2 = -0.005$	0.018	0.180	0.919
	FFQ[b]	**$F_{(6, 172)} = 2.875$, $p = 0.024$, adj-$R^2 = 0.041$**	**0.405**	**0.183**	**0.028**

Co-E: Co-efficients, SE: Standard Error, LWI: Laboratory Weighed Intakes, WDR: Weighed Dietary Record; WDR-H: WDR Home Phase; FFQ: Aberdeen Food Frequency Questionnaire – administered on day one, FDR: false discovery rate (Benjamini & Hochberg, 1995).

[a]n = 178. [b]n = 177. [c]n = 176.

Home phase:

FFQ FDR adjusted q-values = 0.089

Table S20: Multiple regressions of the discrepancy between the criterion measure of food intake in the laboratory (LWI) and home environments (WDR) and the self-reported intake methods (outcome measures) and EPQR personality dimensions (predictors) in Study Two participants. Note, age, sex and percentage body fat were included in all models reported but their coefficients are not reported below.

			Psychoticism			Extraversion			Neuroticism			Social Desirability		
Phase	**Method**	**Model Summary**	**Co-E (MJ)**	**SE**	**P-Value**	**Co-E (MJ)**	**SE**	**P-Value**	**Co-E (MJ)**	**SE**	**P-Value**	**Co-E (MJ)**	**SE**	**P-Value**
Laboratory Phase: LWI vs	**WDR[a]**	$F_{(7, 170)} = 1.546$, p = 0.155, adj-R^2 = 0.021	-0.066	0.049	0.179	-0.003	0.031	0.932	0.044	0.031	0.157	0.024	0.042	0.561
	24hr Recall[a]	**$F_{(7, 170)} = 2.584$, p = 0.015, adj-R^2 = 0.099**	-0.028	0.057	0.624	-0.044	0.036	0.223	-0.004	0.036	0.902	-0.044	0.048	0.369
	7-day History[b]	**$F_{(7, 169)} = 2.679$, p = 0.012, adj-R^2 = 0.063**	-0.047	0.092	0.614	**-0.125**	**0.058**	**0.032**	0.052	0.058	0.364	-0.061	0.078	0.440
	FFQ[a]	**$F_{(7, 170)} = 2.629$, p = 0.013, adj-R^2 = 0.061**	-0.101	0.102	0.323	-0.057	0.064	0.377	0.041	0.664	0.521	0.145	0.087	0.097
Home Phase: WDR-H vs	**24hr Recall[b]**	$F_{(7, 169)} = 1.011$, p = 0.425, adj-R^2 = 0.000	0.114	0.077	0.141	0.003	0.048	0.945	-0.043	0.048	0.380	-0.019	0.066	0.775
	7-day History[c]	$F_{(7, 168)} = 1.069$, p = 0.386, adj-R^2 = 0.003	0.113	0.082	0.171	-0.084	0.051	0.105	0.028	0.051	0.582	-0.025	0.070	0.724
	FFQ[b]	$F_{(7, 169)} = 1.311$, p = 0.248, adj-R^2 = 0.012	0.044	0.089	0.621	-0.011	0.059	0.843	0.005	0.056	0.922	**0.172**	**0.076**	**0.024**

Co-E: Co-efficients, SE: Standard Error, LWI: Laboratory Weighed Intakes, WDR: Weighed Dietary Record; WDR-H: WDR Home Phase; FFQ: Aberdeen Food Frequency Questionnaire – administered on day one, FDR: false discovery rate (Benjamini & Hochberg, 1995).

[a]n = 178. [b]n = 177. [c]n = 176.

Laboratory phase:

7-day History FDR adjusted q-values = 0.628, 0.224, 0.628, 0.628

Home phase:

FFQ FDR adjusted q-values = 0.991 0.991, 0.991, 0.168

Table S21: Multiple regressions of the discrepancy between the criterion measure of food intake in the laboratory (LWI) and home environments (WDR) and the self-reported intake methods (outcome measures) and NEO PIR personality dimensions (predictors) in Study Two participants. Note, age, sex and percentage body fat were included in all models reported but their coefficients are not reported below.

			Neuroticism			**Extraversion**			**Openness to Experience**			**Agreeableness**			**Conscientiousness**		
Phase	**Method**	**Model Summary**	**Co-E (MJ)**	**SE**	**P-Value**	**Co-E (MJ)**	**SE**	**P-Value**	**Co-E (MJ)**	**SE**	**P-Value**	**Co-E (MJ)**	**SE**	**P-Value**	**Co-E (MJ)**	**SE**	**P-Value**
Laboratory Phase: LWI vs	**WDR[a]**	**$F_{(8, 169)} = 2.484$, $p = 0.014$, adj-$R^2 = 0.063$**	0.007	0.007	0.343	-0.010	0.009	0.275	-0.005	0.009	0.569	-0.018	0.009	0.051	-0.003	0.008	0.657
	24hr Recall[a]	**$F_{(8, 169)} = 3.379$, $p = 0.001$, adj-$R^2 = 0.097$**	**0.018**	**0.008**	**0.022**	0.007	0.010	0.485	**-0.022**	**0.010**	**0.029**	0.006	0.010	0.588	-0.002	0.009	0.858
	7-day History[b]	**$F_{(8, 168)} = 2.657$, $p = 0.009$, adj-$R^2 = 0.070$**	0.015	0.013	0.266	-0.028	0.017	0.101	0.005	0.017	0.753	0.017	0.017	0.326	-0.012	0.015	0.397
	FFQ[b]	**$F_{(8, 169)} = 2.849$, $p = 0.005$, adj-$R^2 = 0.077$**	0.011	0.014	0.410	-0.020	0.018	0.272	0.004	0.017	0.825	0.026	0.018	0.156	-0.006	0.015	0.684
Home Phase: WDR-H vs	**24hr Recall[b]**	$F_{(8, 168)} = 0.742$, $p = 0.654$, adj-$R^2 = -0.012$	0.004	0.011	0.752	0.016	0.015	0.288	-0.013	0.014	0.359	0.010	0.015	0.496	-0.004	0.013	0.739
	7-day History[c]	$F_{(8, 167)} = 1.232$, $p = 0.283$, adj-$R^2 = 0.010$	0.002	0.012	0.846	-0.025	0.015	0.099	0.020	0.015	0.172	0.017	0.015	0.263	-0.012	0.013	0.373
	FFQ[b]	$F_{(8, 168)} = 1.575$, $p = 0.136$, adj-$R^2 = 0.025$	-0.003	0.012	0.801	0.012	0.016	0.440	0.014	0.015	0.377	0.030	0.016	0.062	-0.008	0.013	0.531

Co-E: Co-efficients, SE: Standard Error, LWI: Laboratory Weighed Intakes, WDR: Weighed Dietary Record; WDR-H: WDR Home Phase; FFQ: Aberdeen Food Frequency Questionnaire – administered on day one. FDR: false discovery rate (Benjamini & Hochberg, 1995).

[a]n = 178. [b]n = 177. [c]n = 176.

Laboratory phase:

24hr Recall FDR adjusted q-values = 0.077, 0.885, 0.077, 0.885, 0.885

Table 22: Multiple regressions of the discrepancy between the criterion measure of food intake in the laboratory (LWI) and home environments (WDR) and the self-reported intake methods (outcome measures) and social desirability (predictors) in Study Two participants. Note, age, sex and percentage body fat were included in all models reported but their coefficients are not reported below.

			Marl Crowne Score			**BIDR- Self-deceptive Enhancement**			**BIDR- Impression Management**		
Phase	**Method**	**Model Summary**	**Co-E (MJ)**	**SE**	**P-Value**	**Co-E (MJ)**	**SE**	**P-Value**	**Co-E (MJ)**	**SE**	**P-Value**
Laboratory Phase: LWI vs	**WDR**[a]	$F_{(6, 170)} = 1.141$, $p = 0.341$, adj-$R^2 = 0.005$	0.025	0.036	0.490	-0.038	0.054	0.485	0.002	0.049	0.968
	24hr Recall[a]	**$F_{(6, 170)} = 3.353$, $p = 0.004$, adj-$R^2 = 0.074$**	0.041	0.041	0.313	**-0.123**	**0.062**	**0.048**	-0.008	0.056	0.890
	7-day History[b]	**$F_{(6, 169)} = 2.179$, $p = 0.047$, adj-$R^2 = 0.039$**	-0.044	0.068	0.515	-0.047	0.102	0.645	-0.041	0.093	0.661
	FFQ[a]	$F_{(6, 169)} = 1.849$, $p = 0.092$, adj-$R^2 = 0.028$	-0.025	0.075	0.743	0.005	0.113	0.965	0.057	0.103	0.581
Home Phase: WDR-H vs	**24hr Recall**[b]	$F_{(6, 169)} = 1.739$, $p = 0.115$, adj-$R^2 = 0.025$	0.072	0.054	0.188	-0.159	0.082	0.054	0.078	0.074	0.298
	7-day History[c]	$F_{(6, 168)} = 0.731$, $p = 0.625$, adj-$R^2 = -0.009$	-0.005	0.060	0.928	-0.084	0.090	0.352	0.043	0.082	0.599
	FFQ[b]	$F_{(6, 169)} = 1.162$, $p = 0.329$, adj-$R^2 = 0.040$	0.006	0.065	0.922	-0.031	0.098	0.749	0.142	0.089	0.111

Co-E: Co-efficients, SE: Standard Error, LWI: Laboratory Weighed Intakes, WDR: Weighed Dietary Record; WDR-H: WDR Home Phase; FFQ: Aberdeen Food Frequency Questionnaire – administered on day one. FDR: false discovery rate (Benjamini & Hochberg, 1995).

[a]n = 177. [b]n = 176. [c]n = 175.

Laboratory phase:

24hr Recall FDR adjusted q-values = 0.626, 0.144, 0.890

Table S23: Multiple regressions of the discrepancy between the criterion measure of food intake in the laboratory (LWI) and home environments (WDR) and the self-reported intake methods (outcome measures) and IQ (predictors) in Study Two participants. Note, age, sex and percentage body fat were included in all models reported but their coefficients are not reported below.

			Ravens Score			AH4 Score			NART- Full Scale IQ			NART- Verbal IQ			NART- Performance IQ		
Phase	**Method**	**Model Summary**	**Co-E (MJ)**	**SE**	**P-Value**	**Co-E (MJ)**	**SE**	**P-Value**	**Co-E (MJ)**	**SE**	**P-Value**	**Co-E (MJ)**	**SE**	**P-Value**	**Co-E (MJ)**	**SE**	**P-Value**
Laboratory Phase: LWI vs	**WDR[a]**	$F_{(8, 167)} = 1.501$, $p = 0.160$, adj-$R^2 = 0.022$	-0.025	0.040	0.539	-0.002	0.015	0.898	-0.462	0.395	0.245	0.265	0.367	0.471	0.176	0.403	0.664
	24hr Recall[a]	**$F_{(8, 167)} = 2.393$, $p = 0.018$, adj-$R^2 = 0.060$**	-0.049	0.047	0.303	0.019	0.017	0.273	-0.573	0.467	0.277	0.472	0.434	0.277	0.021	0.476	0.964
	7-day History[b]	$F_{(8, 166)} = 1.691$, $p = 0.104$, adj-$R^2 = 0.031$	0.021	0.077	0.784	-0.026	0.028	0.358	-0.488	0.760	0.521	-0.149	0.706	0.834	0.833	0.775	0.284
	FFQ[b]	**$F_{(8, 167)} = 2.124$, $p = 0.036$, adj-$R^2 = 0.049$**	-0.129	0.085	0.130	-0.002	0.031	0.940	0.376	0.835	0.653	-0.971	0.775	0.212	0.893	0.851	0.296
Home Phase: WDR-H vs	**24hr Recall[b]**	$F_{(8, 166)} = 0.979$, $p = 0.454$, adj-$R^2 = -0.001$	-0.062	0.063	0.330	0.034	0.023	0.140	-0.328	0.621	0.597	0.563	0.577	0.330	-0.396	0.633	0.533
	7-day History[c]	$F_{(8, 166)} = 0.979$, $p = 0.454$, adj-$R^2 = -0.001$	-0.062	0.063	0.330	0.034	0.023	0.140	-0.328	0.621	0.597	0.563	0.577	0.330	-0.396	0.633	0.533
	FFQ[b]	$F_{(8, 166)} = 1.317$, $p = 0.238$, adj-$R^2 = 0.014$	-0.141	0.074	0.057	0.012	0.027	0.643	0.629	0.726	0.387	-0.896	0.674	0.185	0.488	0.740	0.510

Co-E: Co-efficients, SE: Standard Error, LWI: Laboratory Weighed Intakes, WDR: Weighed Dietary Record; WDR-H: WDR Home Phase; FFQ: Aberdeen Food Frequency Questionnaire – administered on day one.

[a]n = 176. [b]n = 175. [c]n = 174.

Table S24: Multiple regressions of the discrepancy between the criterion measure of food intake in the laboratory (LWI) and home environments (WDR) and the self-reported intake methods (outcome measures) and UWIST hedonic, tense and energetic scores (predictors) in Study Two participants. Note, age, sex and percentage body fat were included in all models reported but their coefficients are not reported below.

			Hedonic			Tense			Energetic		
Phase	**Method**	**Model Summary**	**Co-E (MJ)**	**SE**	**P-Value**	**Co-E (MJ)**	**SE**	**P-Value**	**Co-E (MJ)**	**SE**	**P-Value**
Laboratory Phase: LWI vs	**WDR**[a]	$F_{(6, 171)} = 1.664$, $p = 0.133$, adj-$R^2 = 0.022$	-0.081	0.077	0.291	0.024	0.067	0.719	0.073	0.046	0.116
	24hr Recall[a]	$\mathbf{F_{(6, 171)} = 3.009}$, **p = 0.008, adj-**$\mathbf{R^2 = 0.064}$	0.065	0.089	0.469	0.082	0.077	0.288	0.010	0.053	0.846
	7-day History[b]	$\mathbf{F_{(6, 170)} = 2.410}$, **p = 0.029, adj-**$\mathbf{R^2 = 0.046}$	-0.006	0.147	0.965	0.147	0.127	0.247	0.079	0.088	0.366
	FFQ[a]	$F_{(6, 171)} = 1.930$, $p = 0.079$, adj-$R^2 = 0.031$	0.004	0.164	0.981	0.015	0.142	0.913	-0.011	0.098	0.912
Home Phase: WDR-H vs	**24hr Recall**[b]	$F_{(6, 170)} = 1.476$, $p = 0.189$, adj-$R^2 = 0.016$	**0.241**	**0.211**	**0.049**	0.134	0.105	0.204	-0.106	0.073	0.140
	7-day History[c]	$F_{(6, 169)} = 1.023$, $p = 0.412$, adj-$R^2 = 0.001$	0.141	0.130	0.278	0.170	0.122	0.132	-0.059	0.077	0.451
	FFQ[b]	$F_{(6, 170)} = 1.045$, $p = 0.398$, adj-$R^2 = 0.002$	0.174	0.142	0.221	0.062	0.123	0.617	-0.131	0.085	0.124

Co-E: Co-efficients, SE: Standard Error, LWI: Laboratory Weighed Intakes, WDR: Weighed Dietary Record; WDR-H: WDR Home Phase; FFQ: Aberdeen Food Frequency Questionnaire – administered on day one, FDR: false discovery rate (Benjamini & Hochberg, 1995).

[a]n = 178. [b]n = 177. [c]n = 176.

Home phase:

24hr Recall FDR adjusted q-values = 0.147, 0.245, 0.222