Does labelling a food as ‘light’ vs. ‘filling’ influence intake and sensory-specific satiation?

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Abstract

Although several studies have investigated the influence of nutrition labelling on food intake, the effect of labels indicating a food’s satiating power on food intake and sensory-specific satiation (SSS) is poorly understood. We investigated whether providing information about the satiating power of a meal affects intake and SSS. Participants (19 men and 18 women) consumed the same test meal of pasta salad ad libitum on two occasions, once described as ‘light’ and once as ‘filling’. SSS was determined as the change in liking of the flavor and desire to eat the test meal before and after consumption, compared to seven uneaten foods. As hypothesized, intake increased by a mean (±SD) of 31 ± 59 g and 42 ± 81 kcal when the meal was labelled ‘light’ as opposed to ‘filling’ (p < 0.01). After eating, ratings for both liking and desire to eat decreased significantly more for the test meal than for the uneaten control foods (p < 0.001), demonstrating SSS. These relative changes in liking and desire to eat did not differ between the label conditions, despite differences in intake. Furthermore, accounting for amount consumed, the magnitude of SSS did not differ between the label conditions, which suggests that it did not explain the effect of the labels on intake. This study shows that labels indicating the satiating power of a meal can affect intake, warranting caution in the use of such labels on products intended to reduce intake.

Keywords: Sensory-specific satiation; Labels; Food labels; Expected satiation; Food intake; Sensory-specific satiation; Sensory-specific satiation

1. Introduction

Food labelling has received much attention in the past decades, with many studies investigating the effects of nutrition labelling (e.g., energy, protein-, or fat-content) on food intake. These studies have reported mixed findings (see e.g., Bowen et al., 2003; Brown et al., 2018; Oostenbach et al., 2019; Roefs & Jansen, 2004). For example, McCann et al. (2013) found that fat/energy content labelling affected intake of a lunch meal, while Ebner et al. (2013) failed to find an effect of providing information about fat and energy content on intake of M&M’s in undergraduate women. As nutritional knowledge might not be as ubiquitous as presumed (see e.g., Andrews et al., 2009; Breck et al., 2014), nutrition labels might not necessarily affect participant’s beliefs about the food and, hence, intake. The effect of food labels denoting the satiating properties of a food have been less studied (see e.g., Chambers et al., 2015; Yeomans, 2015). Such labels could affect food intake, since expected satiation has been found to influence appetite ratings and food intake (see e.g., Forde et al., 2015; Brunstrom, 2014; Wilkinson et al., 2012; but see Guillotreau et al., 2018). Therefore, this study aimed to investigate whether labelling a meal as ‘filling’ or ‘light’ could affect beliefs about satiation and thereby affect intake of that meal. Additionally, we explored the effects of such labelling on the magnitude of sensory-specific satiation (SSS, commonly called sensory-specific satiety, is a relative decline in pleasantness of a food during consumption; Rolls et al., 1981) experienced after eating the meal, as this mechanism might play a role in the effect of satiation labels on intake.

SSS has been shown to play a role in eating cessation and the consumption of a varied diet (Rolls, 2018). Indeed, presenting a different food after consumption of a specific food leads to greater intake as compared to presenting the same food item again (Rolls et al., 1981). SSS is a basic mechanism (relying on sensory exposure) that has been demonstrated even in individuals with amnesia (Higgs et al., 2008),

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suggesting that it does not depend on cognitive processing. However, the fact that SSS can occur in the absence of memory of the eating episode does not necessarily mean that it is insensitive to cognitive cues such as food labelling. Results of a study by Rolls et al. (1992) suggest that SSS may be influenced by cognitive processes. In that study, participants with anorexia nervosa with bulimic features and participants with bulimia nervosa were given either a high-energy salad or a low-energy salad as a preload, or no preload, after which they consumed a self-selected lunch. The participants with anorexia nervosa only showed SSS (measured by desire to eat) after consumption of the high-energy salad. In comparison, the participants with bulimia nervosa only demonstrated SSS after consumption of the low-energy salad. Thus, SSS appeared to be influenced by perceptions based on food properties (i.e., energy content) which differed by eating disorder psychopathology. It remains unclear whether cognitive factors related to food properties (e.g., beliefs concerning taste intensity, texture, or satiating capacity) could influence SSS in individuals without a diagnosed eating disorder. Miller et al. (2000) failed to find an effect of nutrition information (fat and energy content) on SSS for potato chips in healthy subjects, but the effect of information about the satiating value of a food on SSS has not been studied yet.

Here, we aimed to investigate whether labels indicating the satiating power of a food can influence food intake and SSS. Participants were led to believe that they would consume two similar meals with different satiating capacities: a ‘light’ and a ‘filling’ meal. We hypothesized that meal intake would increase when the meal was presented as less satiating (‘light’) compared to more satiating (‘filling’). We additionally hypothesized that the cognitive effects of the satiation labels would influence SSS. Since SSS is an important factor in meal termination, we expected that participants would experience a similar relative decline in pleasantness for both meal varieties, despite differences in ad libitum intake. In other words, we expected participants to be able to consume a greater amount of food for a similar hedonic change when the meal was labelled as ‘light’. The results of this study provide novel insights into the effects of satiation labels on food consumption and satiation.

2. Methods

All study procedures were approved by the Ethics Review Committee Inner City faculties of Maastricht University (ERCIC_164_10_12_2019) and the hypotheses were preregistered on The Open Science Framework (OSF) (https://osf.io/n9a3p). Supplemental materials of the study can be found on OSF (https://osf.io/rf5vu/).

2.1. Design

In a randomized crossover design with repeated measures, participants attended two laboratory sessions during which they were asked to consume a pasta salad as lunch (ad libitum). The sessions were separated by a washout period of at least two weeks and were scheduled during typical lunch hours (between 11:00 a.m. and 2:30 p.m.). In each session the pasta salad was labelled as either a ‘light’ or a ‘filling’ meal. The label was intended to influence participant’s beliefs about the satiating power of the meal. The order of the label conditions was counterbalanced across the sessions. Intake of the pasta salad was measured by subtracting the post-meal weight (leftovers) from the served weight.

To measure the magnitude of SSS, participants evaluated the pasta salad and seven control foods before and after eating the pasta salad. Participants indicated their liking of the flavor of the foods and their desire to eat the foods, from this point referred to as ‘liking’ and ‘desire to eat’. Pre-meal liking and desire to eat ratings were subtracted from post-meal ratings for the eaten food (pasta salad) and for the control foods, resulting in change scores for both the pasta salad and each control food. A mean change score for the control foods was calculated, which was then compared to the change score for the pasta salad (determining SSS).

2.2. Participants

To estimate the minimum number of participants needed in the study, a sample size calculation was performed using G*Power 3.1 (Faul et al., 2007) for a one-tailed dependent samples t-test, using an α rejection criterion of 0.05 and 0.80 (1-β) power to detect a medium effect (d = 0.5). This calculation indicated a minimum required sample size of 27 participants. We managed to recruit and test 37 participants.

Participants in this experiment were recruited via convenience sampling (e.g., posters and advertisements). The study was presented as a taste test in which we were investigating two pasta salads. Adult men and women aged between 18 and 65 years old were eligible for participation. The age limit of 65 years was chosen due to study results indicating that the sense of taste declines with age (Methven et al., 2012), and that SSS is not as pronounced in older adults as in younger adults (Rolls & McDermott, 1991). Participants were not eligible for the study if they: were currently adhering to a weight-loss or weight-gain diet, had physical or mental health conditions that might affect eating behavior (e.g., a history of cancer, gastrointestinal illness, celiac disease, dental surgery within the last three months, chronic obstructive pulmonary disease (COPD), diabetes, and eating disorders), chemosensory dysfunction, difficulties with swallowing/eating, hypersensitivity or allergies to the food products used in the study or dislike of the food items, were vegan, or were pregnant or breastfeeding.

Participants were screened prior to enrollment to ensure they met the inclusion criteria. Prior to the screening, participants were informed about the procedure of the experiment and indicated consent. Participants who were eligible were given further information about the procedure of the study and food items they would be expected to consume, but they were not informed of the aim or hypotheses of the study until after data collection was completed. Table 1 displays participant characteristics for the entire sample and for males and females separately.

2.3. Foods

The test meal (pasta salad, served at room temperature) consisted of (cooked) mini penne, pesto, snack tomatoes, oregano, and basil. Table 2 provides the approximate weights and corresponding macronutrient content of the test meal (pasta salad) recipe prepared for one participant. The control foods used in the SSS tests were: grape, raw carrot, grain crisp, sweet popcorn, fruit yogurt, chocolate chip cookie, and Tuc (salty

Table 1
Participant characteristics.

|                     | Men (N = 19) | Women (N = 18) | Total (N = 37) |
|---------------------|-------------|----------------|---------------|
| **Age (years)**     | Mean (SD)   | Range          | Mean (SD)     | Range          | Mean (SD)     | Range          |
|                     | 44 (13.4)   | 19–64          | 35.3 (12.4)   | 18–55          | 39.7 (13.5)   | 18–64          |
| **BMI (kg/m²)**     | 26.2 (5.2)  | 19.6–40        | 23.8 (3.4)    | 18.3–32        | 25 (4.5)      | 18.3–40        |
| **Health concern**  | 83 (14)     | 59–100         | 84 (13)       | 60–100         | 83 (13)       | 59–100         |
| **Restraint score** | 2.5 (0.7)   | 1.6–4.2        | 2.5 (0.6)     | 1.7–3.6        | 2.5 (0.6)     | 1.6–4.2        |

* How important is your health for you?*, VAS score ranging from 0 [not at all important] to 100 [extremely important].

* Dutch Eating Behaviour Questionnaire (van Strien et al., 1986). Range of possible values: 1–5.
Table 2
Nutritional content (kcal, fat, carbohydrate, and protein) of the test meal (pasta salad) recipe, prepared for one participant.

| Test meal recipe for 1 participant (728 g) | Kcal | Fat (g) | CHO (g) | Protein (g) |
|------------------------------------------|------|---------|---------|-------------|
| 200 g (raw) mini penne (≈ 500 g cooked)  | 706  | 2.6     | 142     | 26          |
| (Grand'Italia Mini penne tradizionali)   |      |         |         |             |
| 167 g snack tomatoes (AH)                | 51.8 | 1.3     | 6.7     | 1.5         |
| Snoepgroenten tomaat                     |      |         |         |             |
| 50 g pesto (Grand'Italia Pesto Rosso)    | 230.4| 21.6    | 5       | 3.5         |
| 0.5 g oregano (Verstegen oregano)        | 1.8  | 0.1     | 0.2     | 0.1         |
| 0.5 g basil (Verstegen basilicum)        | 1.2  | 0       | 0.1     | 0.1         |
| Nutritional values test meal recipe      | 991.2| 25.6    | 154     | 31.2        |
| Nutritional values test meal per 100 g   | 136.2| 3.5     | 21.2    | 4.3         |

* Nutritional values derived from the Dutch Food Composition Table (NEVO-online, version 2019/6.0; Rijksinstituut voor Volksgezondheid en Milieu (RIVM), 2019).

2.4. Procedure

Participants were instructed to eat breakfast as usual and not to eat (or drink energy-containing beverages) during the 3 h prior to their scheduled laboratory session. At the start of both sessions, participants were instructed to read an information sheet informing them of the meal they would consume during that session (either the light or filling version of the test meal). This information sheet remained present on the participant’s table during the entire session. The ‘light meal’ was presented using the manipulation text: ‘The pasta salad you are going to consume as lunch today is a light version of a pasta salad that we have developed in our lab. The recipe of this dish has been developed specifically to make this a light meal that does not fill you up quickly. Unfortunately, we cannot reveal the exact recipe (ingredients, processing and preparation) of the dish yet.’ The manipulation text used for the ‘filling meal’ was: ‘The pasta salad you are going to consume as lunch today is a filling version of a pasta salad that we have developed in our lab. The recipe of this dish has been developed specifically to make this a meal that fills you up quickly. Unfortunately, we cannot reveal the exact recipe (ingredients, processing and preparation) of the dish yet.’ Participants were requested not to engage in any activities that could distract them from the instructed tasks, such as using their phone or reading a book. After having read the information sheet, participants were asked at what time they last ate to check whether they adhered to the instructions. Next, participants tasted and evaluated a sample of the test meal (presented with the label of that session) and the seven control foods (SSS pre-test). They were instructed to taste the food items one by one and rate how much they liked the food right now?’, and how much calories (kcal) do you think this meal contains per 100 g?’. The participants also indicated post-meal hunger and fullness using a VAS, before tasting and rating the eight food samples again for the SSS post-test. The procedures of both SSS tests were identical.

At the end of the second session, participants completed a questionnaire to assess demographic and eating behavior characteristics including age, sex, health concerns (‘How important is your health for you?’), VAS ranging from 0 [not at all healthy] to 100 [extremely healthy]), and the restraint scale of the Dutch Eating Behaviour Questionnaire (DEBQ; van Strien et al., 1986). The participants were also asked to indicate whether they noticed any differences between the meals (and if yes, what they noticed), whether they preferred any of the meals (and if yes, which one), how they thought the meals were different, and what they thought we were investigating in the experiment. After completing this questionnaire, participants’ height and weight were measured to calculate their BMI (body mass index). Lastly, participants were compensated for their participation with a €10 gift voucher.

2.5. Statistical analysis

All analyses were performed in R using the RStudio® software package (RStudioTeam, 2021) and the packages ‘reshape’, ‘reshape2’, ‘ggplot2’, ‘ggpubr’, ‘dplyr’, ‘pastercs’, ‘psych’, ‘ez’, ‘gmodels’, and ‘nlme’. Effect sizes (Cohen’s d, η²p, and η²G) were calculated using the spreadsheet provided by Lakens (2013). The anonymized data and R scripts are available on OSF (https://osf.io/rf5vu/). The data for the main (intake and SSS) analyses were first screened for error outliers (e. g., due to potentially incorrect data entry), interesting outliers (e.g., unexpected extreme values not due to error), and influential outliers (Aguinis et al., 2013). Influential outliers (outside mean ± 3 SD range) were winsorized (clipping the outlier to match the value of the next highest or lowest data point).

Directional tests were used for preregistered directional hypotheses, while two-tailed tests were used for exploratory analyses. To test the hypothesized effect of the satiation information (label) on consumption (weight and energy), the amount of food eaten was calculated by subtracting the post-meal weight (leftovers) from the initial weight of the test meal. Differences between the experimental conditions were then analyzed using a one-tailed dependent samples t-test (‘light meal’ vs ‘filling meal’). We explored whether the order of the sessions or participant sex influenced these results with mixed design ANOVA’s. Furthermore, the influence of BMI, health concerns, and restraint was explored with multilevel linear models. The effect of the label (denoting satiating power) on SSS (both in terms of liking and desire to eat) was analyzed using a three-way repeated measures ANOVA with label (‘light’ vs. ‘filling’), food (eaten vs. control foods), and timepoint (pre- vs. post-meal) as factors. Liking and desire to eat ratings were incorporated as dependent variable.

We used two-tailed dependent samples t-tests to explore whether there were any perceived differences between the meals in caloric...
content (per 100 g), calories consumed, and healthiness. Further, we explored whether there were any differences in change in hunger and fullness between the meals with two-tailed dependent samples t-tests. Changes in hunger and fullness were calculated by subtracting the pre-meal ratings from the post-meal ratings. Lastly, we explored whether participants noticed any differences between the meals, how they rated the meals from the post-meal ratings. Lastly, we explored whether participants noticed any differences between the meals, how they thought the meals were altered, and whether they preferred any of the meals. Results are considered significant at \( p < 0.05 \). Performing all main (intake and SSS) analyses without participants who were aware of the study rationale (N = 9), smokers (N = 2) or plate clearers (N = 7 for the filling meal and N = 11 for the light meal), or all of these participants together (N = 16) did not alter the findings, therefore results of the entire sample are reported.

3. Results

3.1. Test meal intake

Participants consumed a greater weight of food (M\text{light} = 344.6, SD\text{light} = 144.4, M\text{filling} = 313.5, SD\text{filling} = 126.6) and more energy (M\text{light} = 469.3, SD\text{light} = 196.6, M\text{filling} = 427, SD\text{filling} = 172.4) when presented with the ‘light’ compared to the ‘filling’ pasta salad (t(36) = −3.18, \( p < 0.01 \), Cohen’s \( d_g = 0.51 \)) (Fig. 1). Several participants consumed the entire 500 g of pasta they received and one participant consumed an additional serving. These participants are considered plate clearers (N = 7 for the filling meal and N = 11 for the light meal). Results were similar when the plate clearers were removed from the analyses (t(25) = −2.02, \( p < 0.05 \), Cohen’s \( d_g = 0.40 \)).

We explored whether the order of the sessions or individual differences influenced the effect of the labels on intake. The order of the sessions did not have an influence on the results (both grams and kcal) (main effect session order: \( F_{(1, 35)} = 0.003, p = 0.96 \); interaction: \( F_{(1, 35)} = 0.81, p = 0.37 \)). There was a main effect of sex on intake (\( F_{(1, 35)} = 6.41, p < 0.05, \eta^2_p = 0.15 \)), but no interaction between sex and label (\( F_{(1, 35)} = 2.92, p = 0.10 \)). Males consumed more than females in both label conditions (see supplemental Figure S1 for intake by sex). We did not find significant main effects of BMI, restraint, or health concerns on intake, nor did they interact with the labels to influence intake (all \( ps > 0.05 \)).

3.2. Sensory-specific satiation

The three-way ANOVA (food x timepoint x label) showed significant main effects and an interaction of food (pasta salad vs. control foods) and timepoint (pre- vs. post-meal) on liking ratings (main effect food: \( F_{(1, 36)} = 57.85, p < 0.001, \eta^2_G = 0.24 \); main effect timepoint: \( F_{(1, 36)} = 56.30, p < 0.001, \eta^2_G = 0.14 \); food x timepoint interaction: \( F_{(1, 36)} = 32.49, p < 0.001, \eta^2_G = 0.07 \)). No main effect of label, a food x label, label x timepoint, or three-way interaction was present (all \( ps > 0.05 \). Fig. 2 shows that the decrease in liking was mainly specific to the test meal (pasta salad), signifying SSS. A post-hoc (one-tailed) dependent samples t-test was conducted on change scores for liking ratings of the pasta salad and control foods (data collapsed across label conditions), which showed that liking ratings declined significantly more for the pasta salad (M = −21, SD = 18) than for the control foods (M = −4, SD = 6), \( t_{(36)} = −5.83, p < 0.001, \) Cohen’s \( d_g = −0.96 \).

Repeating the three-way ANOVA for the desire to eat ratings (which also indicate SSS) showed the same pattern; that is, a significant main effect of food (\( F_{(1, 36)} = 38.32, p < 0.001, \eta^2_G = 0.19 \)) and timepoint (\( F_{(1, 36)} = 170.37, p < 0.001, \eta^2_G = 0.48 \)), and a significant food x timepoint interaction (\( F_{(1, 36)} = 113.83, p < 0.001, \eta^2_G = 0.20 \)). No other effects were found (all \( ps > 0.05 \)). The desire to eat ratings declined significantly more for the pasta salad than for the control foods (M\text{pasta} = −46, SD\text{pasta} = 20, M\text{control} = −15, SD\text{control} = 14, \( t_{(36)} = −10.26, p < 0.001, \) Cohen’s \( d_g = −1.69 \)). See Fig. 3 for desire to eat ratings of the pasta salad and control foods.

Presenting the pasta salad as ‘light’ promoted greater food intake compared to the ‘filling’ meal, for a similar magnitude of SSS (decline in ratings of liking and desire to eat the pasta salad relative to the control foods). This suggests that the labels affected the magnitude of SSS, since equal SSS was reached in both label conditions, while intake of the pasta salad was significantly increased when accompanied by the ‘light’ label.

![Fig. 1. Intake of the pasta salad in both grams and kcal. Mean ± 1SD. Small dots represent individual participants. Intake was significantly increased with the ‘light’ label (\( p < 0.01 \)). After removal of the ‘outlier’ who consumed a second serving, the same results were obtained.](image1)

![Fig. 2. Liking ratings for pasta salad and control foods, pre-meal and post-meal, separated by label condition. Mean ± 1SD. Small dots represent individual participants.](image2)
3.2.1. Exploratory analysis
We explored (not preregistered) the effect of the labels on SSS per grams eaten to investigate whether the labels affected the development of SSS. In this analysis we compared the change in liking and desire to eat the pasta salad and the (mean of the) seven control foods divided by the grams of food ingested (i.e., a change score corrected for grams of food ingested) between the label conditions. A two-way repeated measures ANOVA including food (pasta vs. control foods) and label (filling vs. light) as factors and liking as dependent variable showed only a significant main effect of food (main effect food: $F_{(1, 36)} = 26.46, p < 0.001, \eta^2 = 0.17$; main effect label: $F_{(1, 36)} = 0.36, p = 0.55$; interaction: $F_{(1, 36)} = 0.73, p = 0.40$). Thus, SSS per gram (in terms of liking) did not differ significantly between the labels. For the change in desire to eat the pasta salad as opposed to the control foods, repeating the two-way ANOVA, this time with 'desire to eat' as dependent variable, also revealed only a main effect of food (main effect food: $F_{(1, 36)} = 81.15, p < 0.001, \eta^2 = 0.31$; main effect label: $F_{(1, 36)} = 0.42, p = 0.52$; interaction: $F_{(1, 36)} = 2.39, p = 0.13$). The change in liking and desire to eat per gram of food eaten was stronger for the pasta salad than for the control foods, but was not affected significantly by the labels. See Fig. 4 for change scores per gram both for liking and desire to eat, separated by label.

3.3. Secondary analyses and manipulation check
To check possible influences on the main results of pre-meal hunger and fullness, water consumption during the meal, and pre-test liking and desire to eat ratings of the test meal, we conducted separate dependent samples t-tests comparing the label conditions. No differences were found in pre-meal hunger ratings ($t_{(36)} = 1.16, p = 0.25$), pre-meal fullness ratings ($t_{(36)} = -0.11, p = 0.91$) (see Table 3 for means and SDs), and in water consumption during the meal between the label conditions (M$_{light} = 144.1$, SD$_{light} = 105.6$, M$_{filling} = 131.2$, SD$_{filling} = 90.6$, $t_{(36)} = -0.99, p = 0.33$). There were also no differences between pre-test liking ($t_{(36)} = -0.66, p = 0.51$), and desire to eat ($t_{(36)} = -1.13, p = 0.27$) ratings of the filling and light pasta salad (see supplemental Tables S3 and S4 for means and SDs). To get some sense of the effectiveness of our manipulation in influencing beliefs about the satiating power of the meal we compared scores for the question ‘How filling did you find this pasta salad?’ with a one-tailed dependent samples t-test. We found that, despite eating more of the ‘light’ labelled pasta salad, participants rated the ‘light’ pasta salad (M = 60, SD = 18.1) as less filling than the ‘filling’ pasta salad (M = 72.3, SD = 17.3), $t_{(36)} = -2.85, p < 0.01$, which suggests that our label manipulation effectively influenced participants’ beliefs.

3.4. Exploratory analyses
Participants did not estimate the energy density to be different...
between the light (M = 173.4, SD = 101.3) and filling (M = 179.4, SD = 118.4) pasta salad (t(36) = 0.41, p = 0.68). The estimated calories consumed of the light (M = 512.2, SD = 389.3) and filling (M = 483.4, SD = 262.9) pasta salads also did not differ (t(36) = -0.66, p = 0.51). Several participants indicated, however, that they found it extremely difficult to estimate the energy density of a meal. Analysis of the participants’ answers on the question ‘How healthy do you think this pasta salad is?’ showed that the light and filling pasta salad were perceived as equally healthy (M<sub>light</sub> = 55.5, SD<sub>light</sub> = 22.4, M<sub>filling</sub> = 52, SD<sub>filling</sub> = 19.8), t(36) = 1.61, p = 0.12.

The analysis of changes in hunger and fullness from pre-to-post-meal showed that no differences were present in decline in hunger (t(36) = 0.05, p = 0.96), and increase in fullness (t(36) = -1.77, p = 0.09), between the label conditions. When plate clearers were removed from the sample, a significant difference in change in fullness was present (t(26) = -2.12, p = 0.04); fullness increased significantly more after consumption of the ‘filling’ pasta salad opposed to the ‘light’ pasta salad. In other words, without the plate clearers, fullness increased more at the ‘filling’ meal while less was eaten.

Lastly, we analyzed participants’ perceived differences between the pasta salads. Half of the participants (N = 18) indicated that they noticed differences between the meals. Of the participants who noticed differences, the answers on the question ‘Please explain the difference you have noticed between the two pasta salads’ mostly denoted differences in satiation/how much they could eat from the pasta salads, the taste, and, to a lesser extent, the dryness of the pasta salads. On the question ‘In what way, do you think, were the pasta salads different?’ participants mostly commented that they thought the dough of the pasta was different. The second most prevalent comment was that they did not think the salads were different, and the third and fourth most prevalent comments were that there were differences in the dressing/herbs that were used, and that there were more or fewer tomatoes in the salad. An equal number of participants indicated a preference for the light and filling pasta salad (N = 7 for both salads), while 23 participants indicated no preference.

4. Discussion

In this study, we investigated the influence of labels denoting the satiating power of a meal on intake. The results show that, as hypothesized, intake of the test meal (pasta salad) was larger when it was labelled as a ‘light’ meal than when it was labelled as ‘filling’. Equal changes in hunger for both label conditions and a more pronounced increase in fullness in the ‘filling’ condition (sample without plate clearers) suggest that the label manipulation affected subjective satiation. Within the context of a difference in intake, similar SSS in both conditions also suggests that the labels affected the amount participants could consume for a particular hedonic change. However, when the change scores for liking and desire to eat were corrected for the amount consumed (which can be expected to correlate with sensory exposure), no effect of the labels was present. Thus, in this study SSS did not explain the effect of the labels on food intake.

While studies investigating the effects of nutrition labels on food intake have reported mixed findings (see e.g., Oostenbach et al., 2019), the present study demonstrates that labels specifically informing consumers of the satiating capacity of a food can affect consumption. The effect of our labels denoting satiation power on food intake extends earlier findings showing that expected satiation affects portion-size selection and food intake (see e.g., Wilkinson et al., 2012). It should be noted, though, that we did not measure expected satiation of the test meal directly, and therefore, we can only indirectly infer that our labels affected expected satiation.

Our finding that SSS (in terms of liking and desire to eat) did not differ between the label conditions despite differences in intake is in line with results of Zuraikat et al. (2018), who found that participants consumed more when served larger portions for a similar change in how much of that food they would like to eat. Perhaps serving a larger portion or manipulating beliefs about satiating power with labels affects the anticipated consumption amount, which in turn affects the development of SSS. Thus, our results, and the effect of portion size on SSS (Zuraikat et al., 2018), suggest that SSS is flexible and can be influenced by other internal or external factors. The results of this study additionally showed that expectations about satiating qualities of a meal did not affect SSS per gram of food eaten. It should be noted that the absence of an effect of the satiation labels on SSS when corrected for amount eaten might be due to the relatively small difference in intake of the meal. Perhaps the self-report measure (VAS) of ‘liking’ and ‘desire to eat’ is simply not sensitive enough to detect any differences in SSS in light of an (approximately) 10% difference in intake. Furthermore, we cannot rule out the possibility that the labels affected meal duration, bite size, and time in between bites, since these were not measured in this study.

A limitation of our study design is the absence of a control (no label) condition in which participants were not provided with any information about the meal. Due to this study design, the results do not provide evidence as to whether the filling label decreased intake or the light label increased consumption relative to a ‘control’ situation (or both). Future research should determine the effects of a label denoting satiating power on intake as opposed to the absence of such information by adding a (no label) control condition. Furthermore, since this study was performed in a lab setting, replication is warranted in a more ecologically valid meal situation. Secondly, the three occasions on which participants were not offered more food after clearing the plate might have led to a slight underestimation of the portion consumed and the change in rating of the ‘filling’ test meal. A third limitation of this study is its short-term nature (food intake was only measured for a single test meal). Therefore, we cannot rule out the possibility that participants might have compensated for variations in energy intake in subsequent meals. However, in general, individuals do not tend to compensate energy intake across several meals (see e.g., Levitsky et al., 2019). Additionally, the effect of labels may be moderated by prior knowledge (e.g., satiety expectations) of the product, implying that a label denoting the satiating power of a product might be more influential for an unknown product than for a (highly) familiar product (see e.g., Brunstrom et al., 2008; Brunstrom et al., 2011; Hovard & Yeomans, 2015).

This is one of the first studies to investigate the effect of information about the satiating value of a food on intake, and, additionally we explored the effect of providing such information on SSS. In sum, this study shows that intake can be influenced by presenting information about the satiating power of a food or meal. This may be relevant for situations in which one would want to promote intake, such as maintaining adequate energy intake in vulnerable patient populations or in older persons. Additionally, the study results warrant caution in the use of labels (possibly denoting satiating power) for products intended to decrease energy intake or support weight loss (e.g., light products), as the use of a ‘light’ label could induce overeating.

Ethical statement

All study procedures were approved by the Ethics Review Committee Inner City faculties (ERCIC) of Maastricht University (ERCIC_164_10_12_2019). All participants in the study gave informed consent before taking part in the study.

Author contributions

The authors’ contributions were as follows: AEMH-H, BJR, PMC and RCH designed the research; AEMH-H conducted the experiment; AEMH-H analyzed the data and wrote the manuscript in consultation with RCH, BJR, PMC, and CN; all authors read and approved the submitted manuscript.
Declaration of competing interest

The authors have no conflicts of interest to declare.

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