

# Food healthiness versus tastiness

Citation for published version (APA):

Mergelsberg, E. L. P., MacLeod, C., Mullan, B., Rudaizky, D., Allom, V., Houben, K., & Lipp, O. V. (2019). Food healthiness versus tastiness: Contrasting their impact on more and less successful healthy shoppers within a virtual food shopping task. *Appetite*, 133, 405-413. <https://doi.org/10.1016/j.appet.2018.11.029>

## Document status and date:

Published: 01/02/2019

## DOI:

[10.1016/j.appet.2018.11.029](https://doi.org/10.1016/j.appet.2018.11.029)

## Document Version:

Publisher's PDF, also known as Version of record

## Document license:

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## Food healthiness versus tastiness: Contrasting their impact on more and less successful healthy shoppers within a virtual food shopping task

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### ARTICLE INFO

#### Keywords:

Intention-behaviour gap  
Food shopping behaviour  
Intention  
Food selection  
Health  
Taste  
AAT

### ABSTRACT

A virtual shopping task was employed to illuminate why women who intend to shop healthily are differentially successful in doing so. Female undergraduates ( $N = 68$ ) performed a modified approach and avoidance task that employed food items differing in healthiness and tastiness, and yielded relative speed to select and reject food items in a stylised supermarket. Participants categorised a food item either in terms of healthiness or tastiness, then pulled (selected) or pushed (rejected) the item using a joystick. Participants showed faster selection of tasty food after categorisation in terms of tastiness, irrespective of the food's healthiness. However, after categorisation in terms of healthiness, only more successful healthy food shoppers showed faster selection of healthy items regardless of tastiness. Less successful healthy food shoppers showed this effect only for tasty food, and displayed faster rejection of food items not considered tasty, regardless of their assessed healthiness. Thus, when participants who reported the greatest gap between their shopping intention and shopping behaviour were judging the healthiness of food items, their speed to select and reject items continued to be influenced by tastiness. This suggests that reducing incidental processing of food tastiness may reduce the intention-behaviour gap in healthy food shopping.

## 2. Introduction

### 2.1. The intention-behaviour gap in food shopping

Even for people with a high intention to shop for healthy foods, the food that ends up in shopping trolleys does not always fulfil this intention. Although several theories propose that one of the best predictors of an individual's behaviour should be their intention to engage in that behaviour (Ajzen, 1991; Locke & Latham, 1990; Schwarzer, 2008; Schwarzer et al., 2003; Sniehotka, Presseau, & Araujo-Soares, 2014), previous research has shown that intention only moderately predicts behaviour (Kothe, Sainsbury, Smith, & Mullan, 2015; McEachan, Conner, Taylor, & Lawton, 2011; Sheeran, 2002). Studies have attempted to explain why behaviour does not always follow from intentions by examining variables that may moderate the relationship between intention and behaviour (i.e., the intention-behaviour gap; Hamilton, Bonham, Bishara, Kroon, & Schwarzer, 2017; Kothe et al.,

2015; Mullan, Allom, Brogan, Kothe, & Todd, 2014; Sheeran, 2002; Vasiljevic, Ng, Griffin, Sutton, & Marteau, 2016). Most explanations offered by past literature in the domain of food shopping behaviour are predominantly couched in terms of external factors like shopping environment and policy (Orth, Wirtz, & McKinney, 2016; Story, Kaphingst, Robinson-O'Brien, & Glanz, 2008), discounts (Waterlander, Steenhuis, de Boer, Schuit, & Seidell, 2013), or food packaging (Miller et al., 2015; Thorndike, Riis, Sonnenberg, & Levy, 2014). While person-related factors have only been sparsely explored when addressing the intention-behaviour gap in food shopping behaviour, they have been shown to be important in predicting other food-related behaviours. These person-related factors are self-control (Friese & Hofmann, 2009; Kleiman, Trope, & Amodio, 2016; Mullan et al., 2014; van Koningsbruggen, Stroebe, Papias, & Aarts, 2011), hunger (Castellanos et al., 2009; Mogg, Bradley, Hyare, & Lee, 1998), motivation (Nasir & Karakaya, 2014; Turner, Skubisz, Pandya, Silverman, & Austin, 2014), self-efficacy (Turner et al., 2014), habit (Allom & Mullan, 2012; Mullan

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<https://doi.org/10.1016/j.appet.2018.11.029>

Received 9 July 2018; Received in revised form 28 October 2018; Accepted 28 November 2018

Available online 02 December 2018

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et al., 2016), and individual differences in automatic behavioural tendencies (Kemps & Tiggemann, 2015; Wudarzewski, 2014).

Of particular relevance to the present research is prior work that has considered the influence of conflicting intentions, such as the intention to eat healthily and the intention to eat food that tastes good. It has been suggested that a gap between prior intention and actual behaviour may arise because people weight competing intentions differently prior to, and concurrently with, their behavioural decision-making (Liberman & Trope, 1998). Consistent with this intention-evaluation account, Wudarzewski (2014) found that the psychological constructs of liking, defined as ‘the hedonic impact or pleasure’ and wanting, defined as ‘motivation that promotes approach toward and consumption of rewards’ exerted differing and independent impacts on the intention to exercise in the future, and on the decision to actually exercise in the present. A similar approach to investigating the intention-behaviour gap in the context of healthy food shopping behaviour is currently lacking.

## 2.2. The interference of taste on behavioural tendencies to select healthy foods

The current study was based on the intention-evaluation approach, according to which intentions are evaluated differently when we plan to shop for food, compared to when we actually shop for food. When individuals with a high intention to shop healthily plan their food shopping, healthiness is the most important factor that drives the decisions as to what items to put on their shopping list. However, at the supermarket, healthiness is not the only salient aspect of food that influences the decision to buy food - the taste of the food has also been shown to be an important motivator when buying food (Furst, Connors, Bisogni, Sobal, & Falk, 1996). In general, people are reluctant to compromise on taste when deciding to purchase a food item. Verbeke (2006) showed that individuals were willing to compromise on taste only if they had a health focus at the moment of food purchase.

The current research sought to examine the basis of inter-individual differences in the intention-behaviour gap by investigating automatic behavioural approach and avoidance tendencies for differing food items when engaging in simulated shopping at a virtual supermarket. The behavioural approach and avoidance tendencies of interest are the subtle, automatic, and implicit inclinations that reflect relative speed to either select or reject target food items. We proposed that food shopping behaviour can be explained by variation in such speed to select or reject food items that differ in healthiness and tastiness, which is moderated to the degree to which the intention to shop healthily drives healthy shopping behaviour. According to the intention-evaluation approach, the intention-behaviour gap in unsuccessful healthy shoppers, reflects the fact that their intention to shop healthily may be overshadowed by the heightened behavioural tendency to select food items that taste good during shopping; whereas in successful healthy shoppers, their intention to shop healthily is less compromised by such heightened behavioural tendency to select tasty food items during shopping.

We developed a new simulated food shopping task based on the approach and avoidance task (Rinck & Becker, 2007) to assess the behavioural tendencies to quicker select and reject food items differing in healthiness and tastiness. In this task, behavioural tendencies are revealed by the relative speed with which participants can pull a food item towards themselves when instructed to do so (thereby depositing it in a virtual shopping trolley) and can push it away from themselves when instructed to do so (thereby returning it to the virtual shelf). Faster pulling than pushing an item indicates a tendency to make a selection response to the item, whereas slower pulling than pushing an item indicates a tendency to make a rejection response to the item. The items used in the task were images of food that differed in healthiness and tastiness. In order to assess the impact of having people evaluate a food item's healthiness or tastiness on such measures of speed to select

or reject this item in the simulated shopping task, participants were required to categorise each food item in terms of either its healthiness or tastiness, immediately before being instructed to pull (select) or push (reject) the item. As the study was designed to investigate the basis of variability in the intention-behaviour gap among people intending to shop healthily, only participants with an intention to shop healthily were included. Furthermore, previous research had found differences between men and women in the decision-making processes involving food (e.g., Havermans, Giesen, Houben, & Jansen, 2011), therefore, we limited the sample to female participants who do their own food shopping.

Our first general hypothesis (Hypothesis 1) was that all participants would be faster to select (compared to reject) food items that are healthy and tasty and faster to reject (compared to select) food items that are unhealthy and not-tasty. Our second set of hypotheses concerned the impact of requiring participants to classify food in terms of its tastiness, before executing their selection/rejection response, and we distinguish three possibilities. We expected that, across participants, the initial classification of items in terms of their tastiness would lead participants to be relatively faster to select (compared to reject) food items classed as tasty, and to be relatively faster to reject (compared to select), food items classed as not-tasty (Hypothesis 2a), but we also propose two possible differences in this effect that may distinguish less successful healthy shoppers from more successful healthy shoppers. One possibility is that the former participants will show this effect to a greater extent than the latter, indicating an increased tendency for classification based on tastiness to influence their readiness to execute selection and rejection responses (Hypothesis 2b). An alternative possibility is that for the more successful healthy shoppers, this effect will be moderated by the healthiness of food items, such that it is less evident on healthy food items, which are characterised by facilitated selection regardless of whether they have just been classified tasty or not-tasty (Hypothesis 2c). Our third set of hypotheses concern the impact of requiring participants to classify food in terms of healthiness, before executing their selection/rejection response, and again we distinguish three possibilities. We expected that initial classification of items in terms of their healthiness would result in faster selection (compared to rejection) of food items classed as healthy, and in faster rejection (compared to selection) of food items classed as unhealthy (Hypothesis 3a), and again we propose two possible differences in this effect that may distinguish less successful healthy shoppers from more successful healthy shoppers. One possibility is that the former participants will show this effect to a lesser degree than the latter, indicating a reduced tendency for classification based on healthiness to influence their speed to execute selection and rejection responses (Hypothesis 3b). An alternative possibility is that, for the less successful healthy shoppers, this effect will be moderated by the tastiness of food items, such that it is less evident on tasty items, which are characterised by facilitated selection responses regardless of whether they have just been classified healthy or unhealthy (Hypothesis 3c).

## 3. Methods

### 3.1. Participants

One hundred and thirteen undergraduate female students (69 self-identified as Caucasian, 26 as Asian, 8 as African and 10 as other) were recruited via the university participation pool. Because we were specifically interested in why women with an intention to shop healthily sometimes fail to do so, we only recruited women with an intention to shop healthily. Other inclusion criteria for this study were: a) participants were responsible for their own food purchases, b) no special dietary requirements, and c) no current or past eating disorders. Participants signed up via a web based system and were granted course credit for their participation. We excluded eight participants who did not meet inclusion criteria. As will be explained in the relevant sections,

we subsequently excluded twenty-five participants who failed to categorise at least one food item in each of the four possible food categories (these participants categorised all healthy and not-tasty foods as healthy and tasty), and twelve participants who made more than 35% of errors on the food shopping task. The final sample consisted of sixty-eight participants with an age between 17 and 46 years ( $M = 21.7$ ,  $SD = 5.87$ ). A sensitivity analysis in G\*Power ( $I = 0.80$ ,  $\alpha = 0.05$ ; Faul, Erdfelder, Lang, & Buchner, 2007) suggested that 68 participants was sufficient to detect a small-to-medium effect of  $f = 0.41$  in an ANCOVA. Measurements.

### 3.2. Intention inclusion criteria

In order to include only women who had an intention to shop healthily we measured intention as the mean across four items on 7-point Likert scales ranging from 'strongly disagree' (1) to 'strongly agree' (7) (Ajzen, 1991). An example item was: 'I intend to make healthy choices at the supermarket'. The items demonstrated good reliability with a Cronbach's alpha of  $\alpha = 0.81$ . Participants who scored above 4.5 on the scale were included. The distribution was normal according to the Shapiro-Wilk test of Normality,  $W(68) = 0.848$ ,  $p = .007$ . After visually inspecting the distribution, it was concluded that the scores were negatively skewed.

### 3.3. Healthy shopping success-score

Success at healthy food shopping was assessed by having participants answer the question: "When you are finished grocery shopping, what proportion of items in your trolley actually is healthy?" using on a Visual Analogue scale (VAS) ranging from 0% to 100%. Success scores ranged from 52 to 100 ( $M = 73.9$ ,  $SD = 10.3$ , median = 72.5) and were normally distributed according to the Shapiro-Wilk test of Normality,  $W(68) = 0.979$ ,  $p = .312$ . We calculated z-standardised mean success scores as advised by Schneider, Avivi-Reich, and Mozuraitis (2015) before entering the Success-score as a continuous predictor in the ANCOVA. Follow-up analyses dichotomised participants into two groups (low vs high healthy shopping success) based on a median split. Table 1 shows the mean and standard deviation of healthy shopping success per

**Table 1**  
Self-reported measures per success group.

	Low success group $n = 35$	High success group $n = 33$
Healthy Shopping Intention <sup>∞</sup>	5.90(.400)	6.27(.541)
Healthy Shopping Success***	65.7(5.21)	82.6(6.53)
Hunger score	43.1(25.0)	35.9(26.8)
Weight-loss diet: Yes ( $n$ )	4	1
No ( $n$ )	31	32
BMI <sup>∞</sup>	22.9(6.09)	22.6(4.11)
Self-control	4.60(.474)	4.71(.497)
Automaticity* <sup>∞</sup>	4.72(1.01)	5.51(1.04)
Motivation*	3.69(4.46)	6.37(4.85)
Self-efficacy* <sup>∞</sup>	6.12(.660)	6.47(.477)

Note: Mean (Standard Deviation) of self-report measures for participants classed as low or high in healthy shopping success (median-split). Hunger score was derived from 2 items on a VAS from 0 to 100; Self-control was measured with the 13-item Brief Self-Control scale (Tangney, Baumeister, & Boone, 2004; 5-point Likert scale); Automaticity was measured with the 4-item sub-scale of the Self-Reported Habit Index (Gardner, Abraham, Lally, & de Bruijn, 2012; 7-point Likert scale); Motivation was measured with the 8 item Perceived Locus of Causality scale (Ryan & Deci, 2000; 4-point Likert scale), scores are weighted per regulation type (external regulation  $\times (-2)$  + introjection  $\times (-1)$  + identified  $\times (1)$  + intrinsic motivation  $\times (2)$ ) and can range from  $-18$  (externally motivated) to  $18$  (internally motivated); Self-efficacy was measured with a 6 item measure based on Ajzen (1991; 7-point Likert scale). Significant differences between groups are indicated with \* ( $p < .050$ ) or \*\*\* ( $p < .001$ ); Non-normality is indicated with <sup>∞</sup> (Shapiro-Wilk,  $p < .050$ ).

group.

### 3.4. Person-related factors

Other person related factors that may affect behavioural approach and avoidance tendencies in food shopping were measured, these were mean levels of hunger, BMI, dieting status, self-control, automaticity, motivation and self-efficacy. Table 1 shows descriptive statistics of all self-report measures. Further preliminary analyses included them as z-standardised continuous covariates, but none of the variables did contribute to the model above and beyond shopping success and are not reported further.

### 3.5. Stimulus materials and apparatus

Sixty-four food items from a local supermarket website were selected as stimuli in the food shopping task and sixteen were only used in the practice trials. These items were selected from a larger set with the aim of maximising the prospect that participants would judge at least some items to belong to one of the four categories: 1) healthy/tasty food items (e.g., strawberries; H/T), 2) healthy/not-tasty food items (e.g., celery; H/NT), 3) unhealthy/tasty food items (e.g., ice cream; UH/T), and 4) unhealthy/not-tasty food items (e.g., canned meat; UH/NT). Selection was based on ratings of healthiness and tastiness for each item by a panel of researchers and by participants in a pilot study. Photos depicting the food items were cropped to 500 by 500 pixels and their background was removed using Adobe Photoshop CC.

The computer task was presented on a 21-inch screen, with high resolution (1920–1080 pixels). The headphones used were Logitech USB headset h540 and responses were made with a Logitech type Attack 3 joystick and a keyboard.

### 3.6. Food Shopping Task

In order to simulate food shopping behaviour in the lab, we modified an approach and avoidance task (Rinck & Becker, 2007) to measure participants' relative speed to select and reject food items differing in healthiness and tastiness in a computerised supermarket environment. The background displayed on the computer monitor during the food shopping task showed supermarket shelves, with a shopping trolley in the bottom centre shown from the perspective of the shopper. Participants were instructed to make a series of decisions about various grocery items from the supermarket. Each trial started with the presentation of one food item in the middle of the screen, together with delivery of the single word 'healthy' or 'tasty' through headphones. Participants had to decide whether the presented item could be considered to be in the top 50%, in terms of its health or taste characteristics, out of all the products they possibly could imagine in a supermarket. Participants answered the question with their non-dominant hand pressing the left arrow key for 'no' and the right arrow key for 'yes' on a QWERTY keyboard. Immediately after this response, the food item was framed by a rectangle presented either in portrait or landscape. The rectangle acted as a cue for the participant to select the item by pulling the joystick towards them or to reject it by pushing the joystick away. The joystick was operated with the dominant hand and the orientation of the rectangle determined the action. The match of action to orientation was counterbalanced across participants. When a food item was selected, it increased in size and was placed in the shopping trolley. When an item was rejected, it decreased in size and was placed back on the background shelves. Fig. 1 displays the background of the food shopping task and Fig. 2 shows the flow of two exemplar trials schematically.

In total, there were 384 trials. Forty-eight food items were presented eight times, four times with the initial categorisation task requiring the participant to judge whether or not the food item was healthy, and four times with this task requiring them to judge whether or not the food



Fig. 1. Exemplar screen background of the food shopping task.

item was tasty. Three equally distributed self-timed breaks were included in the task.

3.7. Procedure

The procedure was approved by the Curtin University Human Research Ethics Committee. All participants were invited to a laboratory session where they were reminded that participation was entirely voluntary and that they could withdraw at any time without penalty. Each participant was welcomed and after verbally confirming that she had met all the requirements, the researcher invited her into a cubicle where a computer with headphones and a joystick was installed. The researcher explained that the study consisted of two parts. The first part was to fill in the questionnaires, which took approximately 10 min to complete and the second was to complete the food shopping task, which took about 45 min. After finishing the questionnaires, the researcher explained the food shopping task and instructed the participant to complete sixteen practice trials. Before the main experiment was

started, the experimenter made sure that the participant felt confident at performing the task. If she did not ( $n = 3$ ), more practice trials were offered. At the end of the experiment the participant was debriefed, thanked for participation and awarded course credits. The total procedure took approximately 1 h.

3.8. Design and data preparation

The study used an experimental within-participants design, with four independent variables varying on two levels (categorisation decision required [health vs taste]; judged healthiness of item [healthy vs unhealthy]; judged tastiness of the item [tasty vs not-tasty]; and joystick movement required [push vs pull]). The z-standardised scores of healthy shopping success were included as continuous covariates in the analysis. Each trial of the food shopping task started with a request to categorise a food item's healthiness or tastiness; the questions 'Healthy?' or 'Tasty?' were answered four times for every food item. The analysis of the time taken to categorise the food items can be found in

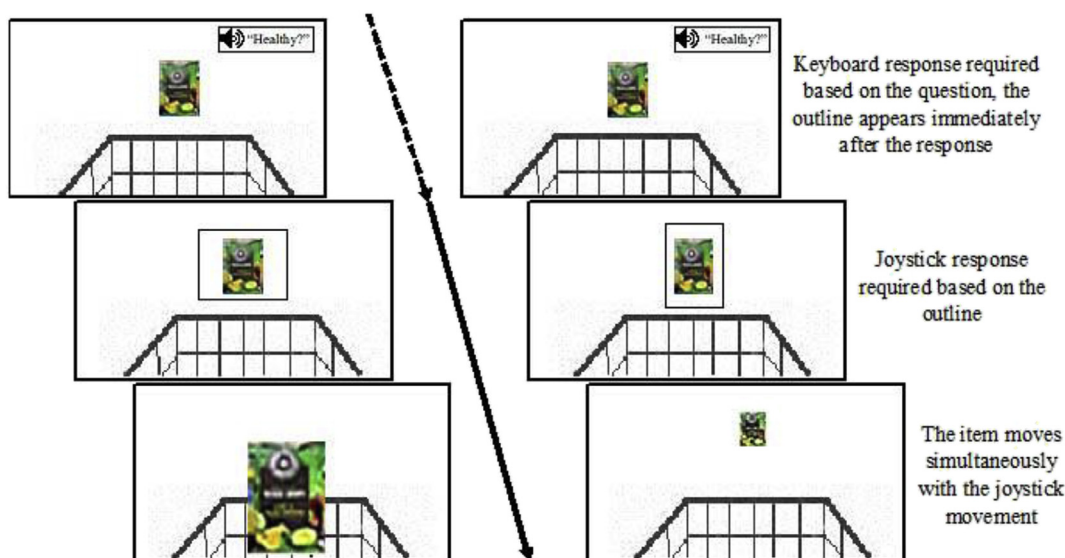


Fig. 2. A Schematic Representation of the Food Shopping Task. Two trial examples are given, the audio-question depicted in the top panels was not visible for the participant. The dotted arrow represents the time required for the categorisation task; the solid arrow represents the time needed to make the joystick movement (no inter-trial intervals). The left side represents an exemplar selection trial where participants were instructed to pull the joystick; the right side represents an exemplar rejection trial where participants were instructed to push the joystick.

**Table 2**  
Mean (Standard Deviation) of Trials on which Food Items were Allocated to Each Category.

	Low success group		High success group	
	(n = 35)		(n = 33)	
	M(SD)	Range	M(SD)	Range
Healthy/Tasty	17.0(3.58)	9–23	17.5(3.51)	8–24
Healthy/Not Tasty	4.09(2.66)	1–11	3.45(2.62)	1–11
Unhealthy/Tasty	12.1(3.97)	4–20	10.3(5.11)	1–25
Unhealthy/Not Tasty	10.9(4.21)	1–20	12.9(5.51)	1–23
No Category	3.91(4.15)	0–19	3.79(3.88)	0–17

Note: The categorisation of participants into the ‘Low success’ and ‘High success’ groups was based on a median-split on a self-report measure; the groups did not significantly differ on the average number of trials that food items were categorised per category (all  $p > .097$ ).

the supplemental material as well as on <https://osf.io/rnb3t/>. A preliminary analysis revealed that participants’ judgments of health and taste differed from those obtained from the experts and in the pilot study. Thus, food items were re-categorised according to the individual participant’s health and taste judgements before extracting the data. Items were included if they were categorised as healthy/unhealthy or tasty/not-tasty on three or four of the four possible occasions. Items were discarded if classified inconsistently, e.g., twice as healthy and twice as unhealthy or twice as tasty and twice as not-tasty. Thus, a food item category could contain different items and different numbers of items across participants. The number of food items included per category is displayed in Table 2. This reassignment of food items to food categories yielded empty categories for 25 participants, that is, no food items were categorised as healthy/not-tasty. These participants were excluded from the final sample. Compared to those included, they had a higher intention to shop healthily, the mean differences was 0.233,  $t(91) = 2.01$ ,  $p = .047$ , 95%CI(0.003, 0.463),  $d = 0.48$ . However, the proportion of low ( $n = 9$ ) and high ( $n = 16$ ) successful shoppers among those 25 participants deleted from the sample was similar to those included in the sample,  $X^2(2) = 1.14$ ,  $p = .566$ ,  $\phi = 0.104$ . Similarly, they did not differ from those included in other self-reported measures of BMI, hunger, automaticity, self-efficacy, motivation or self-control, all  $p > .091$ .

Participants were also excluded if they made a joystick movement error on more than 35% of trials. A joystick movement error involved either making a joystick movement opposite to that instructed (direction error), or moving the joystick before the rectangle signalling the required movement had appeared (pre-cue movement error). Twelve participants made such errors on more than 35% of trials and so were excluded. On average, the remaining 68 participants committed pre-cue movement errors on 0.75% and direction errors on 4.63% of the trials. Response times from error trials were discarded. Thus, all analyses were based on correct responses and errors were not analysed given their low prevalence. To minimise the potential impact of outliers, the bias score measure employed in the analyses was computed using median response latencies exhibited by each participant in each experimental condition. Specifically, this bias score expressed the extent to which the participant was faster to pull the joystick (thereby selecting the item) than to push the joystick (thereby rejecting the item) for each category of food item. Thus, a positive bias score would result from faster selection than rejection of the item (thereby indicating heightened speed to select the item), whereas a negative bias score would result from faster rejection than selection of the item (thereby heightened speed to reject the item).

### 3.9. Statistical analysis

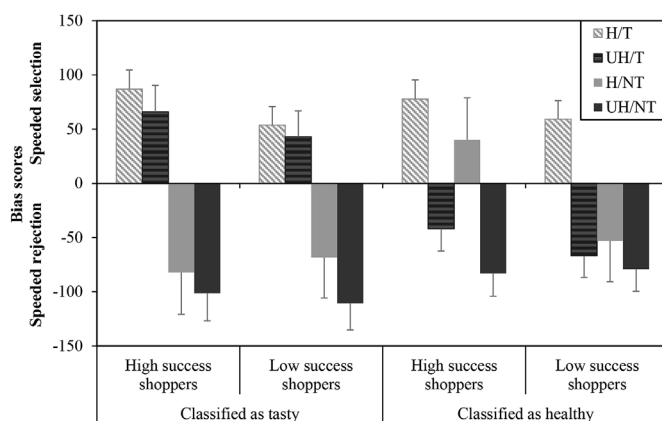
IBM SPSS Statistic software version 23 was used to conduct the

analyses. Bias scores, reflecting the reaction time scores to pull the joystick (i.e. select the item) relative to pushing the joystick (i.e. rejecting the item), were subjected to a  $2 \times 2 \times 2$  (Categorisation Decision Required [healthy vs tasty]  $\times$  (Tastiness [tasty vs not-tasty])  $\times$  (Healthiness [healthy vs unhealthy]) repeated measures Analysis of Covariance (ANCOVA), with the standardised score of Healthy Shopping Success as a continuous covariate. Follow-up analyses were to be carried out provided that the 4-way interaction with the covariate of Healthy Shopping Success was significant. This will be done by dichotomising participants into high and low success healthy shoppers on the basis of a median split carried out on Healthy Shopping Success scores.

## 4. Results

The ANCOVA yielded significant main effects of Tastiness,  $F(1,66) = 57.3$ ,  $p < .001$ ,  $\eta^2 = 0.465$ , and Healthiness,  $F(1,66) = 21.6$ ,  $p < .001$ ,  $\eta^2 = 0.247$ . Additionally, significant two-way interactions were found between Categorisation Decision Required and Tastiness,  $F(1,66) = 14.1$ ,  $p < .001$ ,  $\eta^2 = 0.176$ , between Categorisation Decision Required and Healthiness,  $F(1,66) = 9.32$ ,  $p = .003$ ,  $\eta^2 = 0.124$ , and between Categorisation Decision Required and Healthy Shopping Success,  $F(1,66) = 4.00$ ,  $p = .050$ ,  $\eta^2 = 0.057$ . However, all these effects were subsumed within a significant four-way interaction involving Categorisation Decision Required, Healthiness, Tastiness and Healthy Shopping Success,  $F(1,66) = 6.29$ ,  $p = .015$ ,  $\eta^2 = 0.087$ . Hence, understanding the relationship between these factors requires examination of this higher order interaction. The nature of this relationship is conveyed in Fig. 3, which, for illustrative purposes, dichotomises participants into high and low success healthy shoppers on the basis of a median split carried out on Healthy Shopping Success scores.

As can be seen, high success and low success shoppers displayed similar patterns of bias scores when they had just categorised the target food item in terms of its tastiness. Specifically, following such categorisation both sets of participants demonstrated faster selection (compared to rejection) of the items they had just classified as tasty, and faster rejection (compared to selection) of the items they had just classified as not-tasty. This pattern of results was evident in both groups of participants, regardless of whether (in other trials) they classified this food item as healthy or as unhealthy. Thus, when separate  $2 \times 2$  ANOVAs were performed on bias scores calculated from trials that commenced with categorisation based on tastiness, considering the factors Tastiness (tasty vs not-tasty) and Healthiness (healthy vs



**Fig. 3.** Bias Scores, reflecting speeded selection and rejection of food items as a function of food category, categorisation decision required and healthy shopping success (error bars are standard errors of the mean; H/T: healthy/tasty foods; H/NT: healthy/not-tasty foods; UH/T: unhealthy/tasty foods; UH/NT: unhealthy/not-tasty foods).

unhealthy), these yielded only a main effect of Tastiness for both high success and low success shoppers ( $F(1,32) = 20.51$ ,  $p < .001$ ,  $\eta^2 = 0.391$ , and  $F(1,34) = 35.24$ ,  $p < .001$ ,  $\eta^2 = 0.509$ , respectively).

However, high success and low success shoppers differed from each other in their bias score patterns when they had just classified target food items in terms of healthiness. High success shoppers demonstrated faster selection (compared to rejection) of the items they had just classified as healthy, and faster rejection (compared to selection) of the items they had just classified as unhealthy, and this pattern was evident regardless of whether (in other trials) they classified this food item as tasty or not-tasty. Thus, for these high success shoppers, a  $2 \times 2$  ANOVA performed on bias scores following categorisation based on healthiness, which considered the factors Tastiness (tasty vs not-tasty) and Healthiness (healthy vs unhealthy), yielded only a main effect of Healthiness. In contrast, low success shoppers demonstrated this pattern only for food they (in other trials) considered to be tasty, and the above described  $2 \times 2$  ANOVA conducted on these participants' bias scores, following categorisation based on healthiness, revealed a Healthiness  $\times$  Tastiness interaction,  $F(1,34) = 13.37$ ,  $p = .001$ ,  $\eta^2 = 0.282$ . For tasty food items, low success shoppers demonstrated faster selection (compared to rejection) when they had just classified them as healthy, and faster rejection (compared to selection) when they had just classified them as unhealthy. However, for not-tasty food items these low success shoppers demonstrated faster rejection (compared to selection) regardless of whether they had just classified food items as healthy or as unhealthy.

Importantly, the different behavioural tendencies of each group in the healthy, not tasty category were based on effects within-subject in each group, not on between group differences. To assess whether the groups differed, independent samples t-tests on the bias scores were conducted. These revealed no significant differences between groups when asked to categorise the items on tastiness, all  $t > 1.35$ ,  $p > .181$ . Based on Fig. 3, a difference between the bias scores for the healthy, not-tasty items was expected when asked to categorise food items on healthiness. There was a 93 ms difference between the two groups, and those in the high success group showed a tendency to approach healthy/not-tasty items ( $M = 40.2$ ,  $SD = 277$ ), compared to the low success group, who showed a tendency to avoid healthy/not-tasty items ( $M = -53.1$ ,  $SD = 154$ ). Likely due to the large variance and small number of items in this category (see Table 2) this difference did not reach significance,  $t(66) = 1.73$ ,  $p = .088$ ,  $95\%CI(-201, 14.3)$ ,  $d = 0.42$ . All other bias scores were not close to significance, all  $t > 0.868$ ,  $p > .389$ . Nevertheless, it seems that for low success shoppers, focussing on the healthiness of healthy food they considered not to be tasty did not facilitate the selection of this food (as would have been evidenced by faster selection compared to rejection), whereas for high successful shoppers focussing on the healthiness of healthy food facilitated the selection of this food even when it was considered not to be tasty.

## 5. Discussion

This study was designed to investigate the basis of the intention-behaviour gap that involves failure to successfully implement the intention to shop healthily, by assessing the factors that facilitate the selection and rejection of food items in a new virtual shopping task. We manipulated whether participants focussed on either the health or the taste of the food items by requiring that the food item was categorised on the basis of one or the other dimension, before a selection or rejection response to the item was executed. We measured relative speed to execute these alternative responses. Supporting Hypothesis 1, the results showed a relatively faster selection, rather than rejection of food items that were healthy and tasty (e.g., strawberries), and a relatively faster rejection, rather than selection of food items that were unhealthy and not-tasty (e.g., canned meat), when data were averaged across

participants and conditions. This confirms that our virtual shopping task was sensitive to reflect participants' tendencies to select or reject food items for which the dimensions taste and health are consistent.

Consistent with Hypothesis 2a, when participants had just categorised food items in terms of tastiness, they demonstrated relative faster selection, rather than rejection of items they had classified as tasty, and relative faster rejection, rather than selection of items they had classified as not being tasty. Contrary to Hypothesis 2b, this effect was demonstrated to an equivalent degree by participants who reported high and low levels of success in fulfilling their intention to shop healthily. Hypothesis 2b predicted that this tendency to display faster selection of tasty items and faster selection of not-tasty items, following a classification decision focussed on a food items tastiness, may be more evident for participants who reported being less successful in fulfilling their healthy food shopping intentions. This was not the case. Moreover, for both sets of participants, relatively faster selection, rather than rejection of items just classified as tasty, and relative faster rejection, rather than selection of items they had just classified as not being tasty, was equally evident regardless of whether the participant considered the food to be healthy or unhealthy. Therefore, there was no support for Hypothesis 2c, according to which more successful healthy shoppers may demonstrate less evidence of this effect for items they considered to be unhealthy.

There was some support for Hypothesis 3a, which predicted that following a categorisation decision based on a food item's healthiness, participants would demonstrate relative faster selection, rather than rejection of items they had just classified as healthy, and relative faster rejection, rather than selection of items they had just classified as being unhealthy. However, this pattern of results was not equivalent for participants who reported high and low levels of success in fulfilling their healthy shopping intentions. It was not the case that, as predicted by Hypothesis 3b, this effect was simply exaggerated in those who reported to be more successful in healthy shopping. Rather, consistent with Hypothesis 3c, in those who reported to be highly successful healthy shoppers this difference was unaffected by whether they considered the food to be tasty or not-tasty, whereas in those who reported to be less successfully healthy shoppers it was eliminated in when the food was considered not to be tasty. Therefore, this adaptive facilitation of the selection response for food just categorised as healthy was shown by those who reported to be more successfully healthy food shoppers regardless of whether or not they considered the food to be tasty, but was restricted in those who reported to be less successful healthy food shoppers only to foods that they considered to be tasty. Although there was a significant differences of behavioural tendencies within group in regards to healthy/not-tasty food items, the direct comparison between groups on healthy/not-tasty food items resulted in a marginal effect. The analysis may be underpowered given that the healthy/not-tasty category often consisted of a small number of items. Future research utilising this task can increase the power of the food shopping task by asking participants to provide items for each category.

A particular strength of this study was the use of a new virtual and personalised food shopping task, adapted from the established approach and avoidance task that utilised a virtual supermarket environment. The sensitivity of this new task was confirmed by the observed general facilitation of the selection response for healthy and tasty items, and general facilitation of the rejection response for unhealthy items and items not considered tasty. The categorisation judgement manipulation, employed within the task to render salient either the healthiness or tastiness of the food item, also appears to have worked successfully, as indicated by the heightened facilitation of selection responses to tasty food and rejection responses to not-tasty food immediately following their categorisation in terms of tastiness, and the heightened facilitation of selection responses to healthy food and rejection responses to unhealthy food immediately following their categorisation in terms of healthiness. Moreover, the task showed sensitivity to individual differences, by revealing that people who reported

to be less successful in fulfilling their healthy shopping intentions showed different patterns of results compared to those who reported to be more successful healthy shoppers, by showing no speeding of selection responses for food items just classified as healthy, unless they also considered these food items to be tasty. We suggest that this task could readily be adapted by future investigators, to reveal how approach and avoidance tendencies towards different types of target stimuli are affected both by the manner in which these stimuli have just been explicitly classified, and also by alternative stimulus dimensions not rendered focal by the categorisation required at the commencement of a trial.

Another strength of the study was that all participants reported an intention to shop healthily, but they differed in terms of their reported success in doing so. Therefore, these findings illuminate factors that may contribute to the gap that sometimes exists between healthy shopping intentions and actual shopping behaviour. Our findings suggest that the probability of an intention-behaviour gap concerning healthy food shopping may be influenced by the particular way in which food items are categorised during shopping, as such categorising an item in terms of healthiness or in terms of tastiness can serve to facilitate either a selection or rejection responses to the same item. In the present study, selection responses were facilitated for tasty food items and rejection responses facilitated for food items considered not-tasty, when these items had just been explicitly categorised in terms of their tastiness, and the healthiness of the food items had no impact on relative speed of these alternative responses under this categorisation condition. In contrast, selection responses were facilitated for healthy food and rejection responses facilitated for unhealthy food, when these items had just been categorised in terms of their healthiness. For the successful healthy shoppers, the tastiness of the food items had no impact on the relative speed to make these alternative responses under this categorisation condition. This pattern of results is in line with the intention-evaluation approach, which holds that individuals weigh different characteristics of certain foods differently at the time one's intentions are evaluated and at the time when the intended behaviour is acted out (Lieberman & Trope, 1998; Wudarczycki, 2014). While the present participants all reported an intention to shop healthily, when the task required them to classify the food items only in terms of their healthiness the pattern of relative faster selection and rejection of items revealed that the less successful healthy shoppers continued to be affected by the tastiness of the food, whereas this was not the case for those who reported to be more successful in healthy shopping, at least after categorisation of healthiness. Additionally, participants who were excluded because they did not allocate items to one of the four categories had significantly higher intentions to shop healthily compared to those who were included. Interestingly, the main reason for exclusion was a failure to categorise any items designed to be healthy/not-tasty as such. Rather, excluded participants (mis-) categorised these items as healthy/tasty. It would be interesting for future research to investigate the relationship between intentions to shop healthily and attributions of taste to healthy foods.

Overall, it was found that taste is a more important motivator than expected when assessing the relative speed to select and reject food items at the supermarket. Not everyone selected healthy food items as quickly if the items were also categorised as not-tasty, even when the individuals' focus was directed to the health aspect of the item. These results are not in line with Verbeke (2006), who showed that all individuals were willing to compromise on taste if they had a strong health focus at the moment of food purchase, or other studies, which found that when healthy eating intentions were primed, the automatic selective attention bias towards tasty food was eliminated and individuals were more likely to act on their healthy intentions (e.g., Papies, Potjes, Keesman, Schwinghammer, & Van Koningsbruggen, 2014; Papies, Stroebe, & Aarts, 2008; van Koningsbruggen et al., 2011). The main difference between previous studies and the current study seems that we used a more direct and objective method to assess food

shopping behaviour. Verbeke (2006) used a qualitative approach, whereas, Papies et al. (2008), van Koningsbruggen et al. (2011) and Sellahewa and Mullan (2015) used cue-dependent strategies where food words (e.g., dieting) served as cues in different lexical tasks (e.g., word completion or lexical decision task). Our focus manipulation used an auditory cue that required the participants to directly evaluate the healthiness or tastiness of a food item that they then had to select or reject in a supermarket environment. Furthermore, these food items were classed as healthy or tasty based on the individual's evaluations and not on a-priori defined categories. Therefore, we argue that our method, while still artificial, provided a more ecologically valid simulation of food shopping behaviour.

A second difference between previous studies and the current study is that previous studies sampled restrained eaters (Papies et al., 2008; van Koningsbruggen et al., 2011) or overweight and obese individuals (Papies et al., 2014). Our sample comprised women with a high intention to shop healthily without an intention to lose weight. Furthermore, previous studies did not measure if participants were successful or not in achieving their health related goals. Even though our study measured this with self-report, which is prone to demand-characteristics, our results indicated that there is an important difference in food shopping tendencies in those who report to be successful or not. These methodological differences may explain why the current study showed that not everybody was able to make the shift between having health, instead of taste, as their most important motivator to shop for food after categorising on health. In contrast to previous studies, which concluded that everyone was able to make the shift towards health as the most important motivator to shop healthily, women in the current study, who reported to be unsuccessful in carrying out their healthy shopping intentions, were not able to do so.

We recommend that future research focuses on investigating ways to increase healthy food shopping success for those who are unable to maintain their focus on the health of a food item. A recent study of Demos et al. (2017) showed that preferences for healthy over tasty food are malleable, as their behavioural weight loss program significantly changed how obese people selected food. Participants selected more often the healthy and not-tasty food items and less often the unhealthy and tasty food items, however, they did not reach the same level as healthy weight people. Nevertheless, these promising results combined with cue-dependence literature (e.g., Papies, et al., 2014; Papies et al., 2008; van Koningsbruggen et al., 2011; Sellahewa & Mullan, 2015; Verbeke, 2006) and the results of our study open up an avenue for further research to investigate ways to train a preference for health over taste when deciding what food to buy. Specifically, future research should further investigate the most effective and feasible way to train a stronger health focus taking into account the adherence, acceptability, and personalisation of such training (Forman et al., 2017). Such training should aim to change the bias for healthy and not-tasty food items from reject to select, resulting in improved success when shopping for healthy food.

The present study also has some limitations. The sample was restricted to undergraduate female students and so it remains to be seen whether the findings will generalise to other cohorts. Most participants had a healthy BMI and it is possible that factors influencing success in fulfilling healthy food shopping intentions may differ in people with unhealthy BMIs. Also, our measure of success in fulfilling healthy shopping intentions was based on retrospective self-report, and it would be prudent for future research to assess this using detailed diary records or food shopping receipts, and, where possible, third party input. However, there still may be error utilising these methods, considering that these may not be fully representative of natural shopping behaviour either. For instance, keeping a diary often changes behaviour and a grocery list can be prone to selection bias (e.g., a receipt from a fruit and vegetable delivery). Lastly, 21% of our sample needed to be excluded as these participants did not allocate food items in every category. Future research utilising this task can minimise the number of



participants who require exclusion by asking participants to provide items for each category, which will also increase the power as discussed before. Despite these limitations, however, we believe the present findings provide a solid foundation for future research and we hope that the novel assessment approach we have developed and deployed in this study will be of interest, and also of practical value, to other investigators working in this field.

## 6. Conclusion

This study tested hypotheses concerning the basis of inter-individual variation in the intention-behaviour gap across people intending to shop healthily, by assessing how the healthiness and tastiness of food items influenced their speed to select and reject such items in a virtual shopping task, as revealed by relative speed to pull these items into their virtual shopping trolley and to push them back onto the virtual supermarket shelf. We found that categorising food items in terms of their tastiness served to facilitate selection responses to tasty items, and rejection responses to items considered not to be tasty irrespective of item health. We also found that categorising food items in terms of their healthiness served to speed selection responses to healthy items, and rejection responses to unhealthy items. Perhaps of greatest importance, we found that for people who reported low success in fulfilling their healthy shopping intentions, this facilitation of selection responses to healthy foods, following classification of food healthiness, was restricted only to foods that these participants considered to be tasty. In contrast, people who reported that they more commonly succeeded in fulfilling their healthy shopping intentions demonstrated facilitation of selection responses to healthy foods, following classification of food healthiness, regardless of the food's tastiness. This suggests that interventions designed to reduce the degree to which people incidentally classify food tastiness, when actively endeavouring to classify food in terms of its healthiness, may help to close the intention-behaviour gap shown by those who intend to shop healthily but who commonly fail to do so.

## Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

## Declarations of interest

None.

## Acknowledgement

We thank Miss Monique Ablas from the University of Amsterdam for assistance with developing the food shopping task.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.appet.2018.11.029>.

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