Predicting meat consumption from concurrent, automatic appraisals: introducing nuance to product appraisals.

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Abstract

Research into the relationship between automatic product appraisals and consumer behaviour has largely been limited to measuring generic product evaluations (i.e., positive vs. negative). Especially in the context of meat consumption, this approach seems inadequate, as conflicting evaluative product dimensions may play a role in the preference for a plant-based vs. a meat-based diet (e.g., sustainability vs. taste vs. healthiness). We discuss the limitations of this approach and provide a novel tool that can measure automatic appraisals of several stimulus dimensions simultaneously. Using this tool, we register automatic appraisals (health, taste, price, sustainability, ethicality) of meat and vegetarian stimuli, and compare automatic and explicit appraisals in relation to a range of outcome measures, including self-reported likelihood of purchase and reducing meat consumption, willingness to pay, self-reported frequency of meat consumption, and Body Mass Index. Our findings suggest that the measured automatic appraisals represent unique constructs and vary in the degree to which they inform behaviour. Further, variation in the prediction of the outcome variables suggests that the appraisals captured by the explicit and automatic measures differed. Demonstrating unique contributions of the individual automatic appraisals has crucial implications for future research to understand and improve existing behavioural models.

Key words: Automaticity; Vegetarianism; Meat Eating; Sustainability; Implicit Measures, Product Appraisals

1.0. Introduction

1.1. Meat consumption

Meat consumption is an important feature of western society rooted in traditions, social purposes, and cultural identity (Chiles & Fitzgerald, 2018; Macdiarmid, Douglas, & Campbell, 2016; Rosenfeld, Rothgerber, & Janet Tomiyama, 2020; Rothgerber, 2013). However, increasing meat consumption is placing an ever-growing strain on finite resources and is linked to adverse environmental, social, and health consequences. Immoderate meat consumption promotes coronary heart disease, Type2 diabetes, and heightens risk of obesity (Aune, Ursin, & Veierød, 2009; Micha, Michas, & Mozaffarian, 2012; Tilman & Clark, 2014; Wang & Beydoun, 2009). Moreover, in 2015, the World Health Organisation's International Agency for Research on Cancer classified processed meat as carcinogenic to humans (IARC, 2015). A meta-analysis of studies investigating cardiovascular disease mortality and cancer incidences found that vegetarians had a 29% lower ischemic heart disease mortality and 18% lower cancer incidences than non-vegetarians (Huang et al., 2012). In 2013, the Food and Agriculture Organization of the United Nations reported that meat production caused 14.5% of all human induced greenhouse gas emissions worldwide (Gerber, et al., 2013). Agricultural livestock production is closely linked to water and air pollution, land degradation, as well as declines in biodiversity and global climate (Bellarby et al., 2013, Leip et al., 2015). In fact, meat and dairy products represent the highest environmental burden in a life cycle assessment of typical European foods (Notarnicola, Tassielli, Renzulli, Castellani, & Sala, 2017). As meat production is expected to continue its rapid rise, so will the adverse consequences associated with it (Alexandratos & Bruinsma, 2012).

It follows that a dietary shift away from animal proteins and towards more sustainable protein sources is a necessary step for achieving sustainable food production (Aiking, 2014; DEFRA, 2013; Garnett, 2011; Notarnicola, Tassielli, Renzulli, Castellani, & Sala, 2017; Sabaté & Soret, 2014). However, consumers have shown reluctant to change their behaviour accordingly (Lea, Crawford, & Worsley, 2006; Graça, Calheiros, & Oliveira, 2015; Macdiarmid, Douglas, & Campbell, 2016; Vanhonacker, Van Loo, Gellynck, & Verbeke, 2013).

1.2. Automatic appraisals and consumption behaviour

In fact, even ethically and environmentally informed consumers often fail to adhere to meat-free diets despite awareness of the related environmental, health, and/or ethical issues. For instance, Schröder and McEachern (2004) examined the attitudes and behaviour of thirty meat-eating participants in semi-structured interviews and found that the expressed attitudes towards animal welfare were largely discrepant with the respondent's reported consumption behaviour. Although participants expressed concern about the detrimental effects industrial animal farming practices have on animal welfare, they did not report acting in line with these views, and there was little willingness to pay a premium for organic food production (Schröder and McEachern, 2004). Similarly, in a qualitative study exploring the meat-eating habits of environmental-studies students, Šedová, Slovák and Ježková (2016) found that all of their respondents expressed viewing the consumption of meat as problematic, and recognised the negative impact on animal welfare and environmental issues, but consumed meat nonetheless. Moreover, although all but one of their participants expressed a preference for meat from organic sources, only one participant declared consistent behaviour with this preference (Šedová et al., 2016). In the same vein, Stubbs, Scott, and Duarte (2018) argued that meat consumption is subject to an intention-behaviour gap, whereby consumers intend to act in line with their ethical convictions but fail to take according action.

Of particular interest to the current research is how the measurement of automatic appraisals may help understand such discrepancies. Automatic appraisals can be characterised as fast, unintentional, uncontrollable, and/or unconscious evaluative processes (Moors & De Houwer, 2006), which can play a profound role in guiding consumption decisions (Bargh, 2002). Indeed, there is ample evidence supporting this claim. For example, automatic but not explicit appraisals predicted choice of environmentally friendly goody bags (Beattie & Sale, 2011). Moreover, automatic appraisals predicted consumer's fruit and chocolate purchases in an online shopping task (Prestwich, Hurling, & Baker, 2011), influenced participant's snack choices (Spruyt, Hermans, De Houwer, Vandekerckhove, & Eelen, 2007), predicted alcohol and nicotine consumption (Payne, Govorun, & Arbuckle, 2008; Spruyt et al., 2015), and were related to food approach biases in obese individuals (Kemps & Tiggeman, 2014). Although multiple scholars have measured automatic appraisals and behaviours in meat-eaters and vegetarians (e.g., Barnes-Holmes, Murtagh, Barnes-Holmes, & Stewart, 2010; Cliceri, Spinelli, Dinnella, Prescott, & Monteleone, 2018; De Houwer & De Bruycker, 2007), existing evidence concerning the role of automatic appraisals in meat-eating behaviours remains inconclusive.

1.3. Measuring automatic stimulus appraisals at the attribute level

A possible reason for those inconclusive findings might be the use of unidimensional measures of automatic appraisals. When consumers evaluate a product, they can do so on multiple feature dimensions. For example, one may evaluate the price, quality, or aesthetics of a product. Research assessing automatic (product) appraisals, however, has almost exclusively focused on generic or isolated attribute dimensions. This is at least in part due to methodological limitations as there is no validated measure of automatic evaluative processes that allows the assessment of several stimulus features simultaneously.

For example, the most commonly used automatic measure, the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998), is a speeded categorisation task that assesses the association strength between concepts and evaluative attributes. The IAT commonly consists of several blocks in which participants first categorise target stimuli (e.g., 'bacon' or 'tomato') according to one of two related target concepts (e.g., 'meat'/'vegetables') followed by categorising valanced words (e.g., 'joy' or 'hate') according to opposite ends of an attribute dimension (e.g., 'positive'/'negative'). Next, these tasks are combined whereby one target concept and one attribute (e.g., 'meat/positive' and 'vegetables/negative') are assigned the same response key. Finally, the concept-attribute pairings are reversed (e.g., 'meat/negative' and 'vegetables/positive') and the task repeated. Following this procedure, response latencies are assumed to reveal the strength with which a participant associates the presented concepts. For example, individuals who show faster mean reaction times on trials combining 'meat/negative' than 'meat/positive' are theorised to hold relatively more negative appraisals towards meat. Due to the nature of this procedure, each IAT can measure associations between only one attribute dimension and two (related) concepts. Assessing appraisals in terms of several stimulus dimensions at once would thus require a series of IATs to be carried out, one for each dimension. Considering that a standard seven-block IAT usually consists of 200 trials (e.g., as described in Greenwald, Nosek, and Banaji, 2003), it is apparent that the number of individual appraisals that can be assessed with such a series is limited to the extent that the multiplication of trials in this repetitive procedure would be impractical, time consuming, and prone to practice effects.

This single-attribute approach has several caveats. First, investigating evaluative processing of an isolated stimulus dimension while excluding all other dimensions is not an accurate reflection of evaluative situations that consumers encounter in real life. Products are multi-dimensional stimuli that allow and require assessment of a variety of attributes.

Consequently, insights gathered from investigating singular attributes are likely to prove inaccurate. Second, the standard procedure of the commonly used IAT assesses stimulus associations in terms of the broad evaluative categories 'positive' and 'negative'. This approach, however, offers little nuance. For instance, an individual might hold positive automatic associations of meat with taste and price, but negative associations of meat with health, sustainability, and ethicality. It is then impossible to infer which evaluations informed an overall positive or negative automatic evaluation when measuring only broad evaluative categories (see also De Houwer et al., 2015).

Indeed, findings by Trendel and Werle (2016) lend support to this notion. Participants completed a series of IATs assessing appraisals towards chocolate and apples. This included a standard evaluative IAT (positive/negative), a taste IAT, and a health IAT. Across two studies, the results suggested that taste and health associations were distinct constructs and that the overall appraisal measured by the evaluative IAT was largely independently driven by the two evaluations (Trendel & Werle, 2016). More importantly, participant's actual food choice was predicted only by the taste evaluations, but not by the health or general evaluations. In other words, although there was a significant effect of taste, this was not reflected in the relationship between the generic appraisal and choice. These findings demonstrate the importance of introducing nuance, as assessing a summary evaluation only would have inadvertently led to false conclusions about the relationship between automatic appraisals and food choice.

Finally, another important limitation of reducing stimuli evaluations to a singular attribute lies in the great variability between the goals that motivate individuals. As the degree of attention that is assigned to certain features of a stimulus is goal-driven (Corbetta & Shulman, 2002; Hopfinger, Buonocore & Mangun, 2000; Mazzietti, Sellem & Koenig, 2014; Yantis, 2000), it can be inferred that depending on their goals, consumers may direct their attention to varying attribute features of a product. Importantly, recent research consistently finds that automatic appraisals are crucially dependent on such top-down attentional control (e.g., Everaert, Spruyt, & De Houwer, 2016; Spruyt, Tibboel, De Schryver, & De Houwer, 2018; Vanaelst, Spruyt, Everaert, & De Houwer, 2016). In other words, the more attention is assigned to one stimulus attribute, the higher is the likelihood it will be processed under automaticity conditions (Everaert, Spruyt, & De Houwer, 2013; Spruyt, De Houwer, Everaert, & Hermans, 2012; Spruyt & Tibboel, 2015; Spruyt, Tibboel, De Schryver, & De Houwer, 2018).

This observation holds critical implications for the validity of existing measures of automatic appraisals and highlights the caveats of single-attribute approaches. If automatic

appraisals depend on top-down attentional control, then the extent of selective attention required to process a certain stimulus feature under automaticity conditions will likely differ between individuals. In other words, the success of someone who would like to adapt a vegetarian diet due to environmental concerns may depend on the likelihood that 'sustainability' evaluations of meat are activated under automaticity conditions. As personal goals and motivations are highly individual, it follows that this variability needs to be taken into account to improve prediction of consumer behaviour.

In line with this discussion, our first aim is to advance this theory and provide the means to register nuanced automatic appraisals in order to examine whether automatic appraisals on several different dimensions represent distinct constructs, and inform outcome variables to varying degrees. As existing measures of automatic appraisals do not facilitate the testing of several simultaneous automatic appraisals, we register automatic appraisals with the Implicit Attribute Classification Task (hereinafter 'IMPACT'; Spruyt & Altenburg, 2019), an adaptation of the Extrinsic Relational Simon Task (Spruyt & De Houwer, 2017) and the propositional evaluation procedure (PEP, Wiswede, Koranyi, Muller, Langner, & Rothermund, 2013).

On each trial of the IMPACT, participants are presented with a box (centrally) containing a target stimulus (e.g., 'MEAT') situated above an attribute (e.g., 'TASTY' or 'SUSTAINABLE'). Based on a task cue that appears after a short time, participants indicate either their perceived congruence of the target-attribute pair (i.e., induction trials, task cue: '???') or perform a non-evaluative key press task (i.e., measurement trials, task cues: 'YES', 'NO'). Perceived incongruence and the cue 'NO' are indicated by pressing the 'E'-key, whereas perceived congruence and the cue 'YES' are indicated by pressing the 'I'-key. As demonstrated by Spruyt and De Houwer (2017), participants are faster to respond during non-evaluative trials if the (task-irrelevant) conceptual relationship between stimuli is compatible with the relational meaning of the required response. In other words, although task-irrelevant, the perceived compatibility of target-attribute pairs will hinder or facilitate response time in non-evaluative trials. Based on this interference effect, one can then infer automatic appraisals triggered by a stimulus. The format of the target-attribute compounds allows the simultaneous assessment of multiple attribute dimensions activated by the targets. A near-universal associations paradigm similar to that used in initial IAT testing (Greenwald, McGhee, & Schwartz, 1998) demonstrated that the IMPACT indeed successfully registered automatic associations (Spruyt & Altenburg, 2019). Using the IMPACT, we assessed participant's automatic appraisals of meat and vegetarian targets on five attribute dimensions (health, taste, price, sustainability, and

ethicality). In line with the discussed literature, we expect appraisals of the individual attribute dimensions to represent distinct constructs (hypothesis 1a), and that these individual attributes inform behaviour to varying degrees (hypothesis 1b).

Moreover, we aim to demonstrate that the automatic appraisals recorded with the IMPACT differ from explicit appraisals, which are evaluations that require cognitive resources, deliberation, and/or careful consideration of existing information (Kahneman, 2011, Samson & Voyer, 2012), and can commonly be verbalised by the individual. To do so, we measure explicit and automatic appraisals in vegetarians and meat-eaters, and investigate their relationship with a range of outcome measures, including self-reported likelihood of purchase, self-reported likelihood to reduce meat consumption, willingness to pay (hereinafter 'WTP'), self-reported frequency of meat consumption, and Body Mass Index (hereinafter: BMI). Meat consumption has been consistently associated with heightened BMI and obesity, and BMI can therefore, to some degree, provide an approximation of meat intake (e.g., Dabbagh-Moghadam et al., 2017; Grosso et al., 2017; Vergnaud et al., 2010; Wang & Beydoun, 2009; You & Henneberg, 2016). For instance, in a large scale meta-analysis ($N = 113{,}477$), Rouhani, Salehi-Abargouei, Surkan, and Azadbakht (2014) concluded that increased consumption of red and processed meats was directly linked to increased BMI. We expect the differences between the explicitly reported appraisals and the automatic appraisals registered with the IMPACT to be reflected in their predictive validity of the outcome measures. As such, to the degree that estimating the likelihood of engaging in future behaviour requires careful contemplation and reflective processing, we expect that the explicit appraisals more strongly correlate with self-reported likelihood of purchase, self-reported likelihood to reduce meat consumption, willingness to pay compared to the automatic appraisals (hypothesis 2a). In contrast, automatic processes have been shown to inform behaviours that are commonly guided by impulses, such as dietary choices (Friese, Hofmann & Wänke, 2008). Consequently, we expect that automatic appraisals more strongly correlate with self-reported frequency of meat consumption and BMI compared to explicit appraisals (hypothesis 2b).

2.0. Method

2.1. Ethics Statement

Participants gave informed consent prior to participation. The Ethics Committee of the Faculty of Psychology and Educational Sciences of Ghent University approved this research.

2.2. Participants

Two hundred sixty Dutch-speaking participants were recruited online through postings on social media during April 2020. Using a sampling heuristic (Siddiqui, 2013), we aimed for a minimum of twenty respondents per predictor (five predictor dimensions x two modes (explicit/automatic)). Seventeen participants were omitted as willingness to pay indications did not show an increasing value between the lowest price point (priced too low to be of high quality) and the highest price point (priced too expensively for purchase). Additionally, one participant was excluded due to high error rates (41%) in the automatic measure and another thirty-three participants were omitted as they did not complete all tasks. A final sample of N = 209 was retained for analysis (80 men, 129 women, M_{Age} = 26.21, $Range_{Age}$ = 18-68).

2.3. Materials and Procedure

The study consisted of a measure of automatic appraisals and several explicit questionnaires. All tests were administered online but participation on mobile devices was not possible. Participants first encountered a consent form detailing the purpose and approximate duration of the study, as well as information on how to exit the survey might they wish to do so. To connect datasets across platforms, a 7-digit unique ID was randomly generated and automatically passed forward through the different testing platforms by URL query strings. After providing informed consent, participants were redirected to complete the automatic measure.

Implicit Attribute Classification Task (IMPACT). The IMPACT was built using PsychoPy3 software (Peirce et al., 2019) and administered via the PsychoPy launching platform Pavlovia.org. All stimuli were presented in Dutch in white capital writing on a black background but are below discussed in English. On each trial, participants were presented with a rectangular box situated centrally on the screen containing randomised pairings of a target stimulus above an attribute word.

The target stimuli consisted of four meat items and four vegetarian items. Meat items were chosen to encompass the main meat categories red meat, poultry, and pork. These stimuli

consisted of ‘steak’, ‘chicken’, ‘bacon’, and ‘sausage’. Similarly, vegetarian items were selected to comprise the main vegetarian protein alternatives beans, seeds, and wheat gluten. Specifically, these items were ‘tofu’, ‘quinoa’, ‘falafel’, and ‘seitan’. The ten attribute words consisted of opposing extremes of the five attribute dimensions healthiness (healthy-unhealthy), sustainability (sustainable-unsustainable), price (cheap-expensive), taste (tasty-yucky), and ethicality (ethical-unethical). These dimensions were chosen based on their role in informing meat and vegetarian dietary preferences (e.g., see Apostolidis & McLeay, 2016; Piazza et al., 2015; Verbeke, Pérez-Cueto, Barcellos, Krystallis, & Grunert, 2010).

The stimuli were presented for 1500ms, after which they disappeared and one of three task cues (‘???’, ‘YES’, or ‘NO’) was presented below the box until a response was registered. Participants were instructed to perform one of two tasks according to this cue. If the cue ‘???’ appeared (80 trials, or 33%), participants performed an evaluative task in which they indicated their perceived congruence of the target-attribute relationship. This was done by pressing the ‘E’-key for perceived mismatches or the ‘I’-key for perceived matches. There was no false or correct response for these trials. If the cues ‘YES’ or ‘NO’ appeared (80 trials each), participants performed a non-evaluative task in which they pressed a key corresponding to the cue regardless of their perceived target-attribute relationship. This was done by pressing the ‘E’-key if the cue ‘NO’ appeared and the ‘I’-key if the cue ‘YES’ appeared. If the response was incorrect, a red X appeared underneath the task cue until a correct response was registered. The next trial always started after an inter-stimulus interval that varied randomly between 500ms and 1500ms after a correct key press was registered. As participants cannot anticipate which task cue will appear in each trial, the evaluative induction task is used to promote semantic processing across all trials (Spruyt & De Houwer, 2017). Despite the fact that the target-attribute compounds are task-irrelevant during the non-evaluative trials, semantic processing of the word pairs is expected to facilitate or hinder responses that are compatible or incompatible, respectively, with the perceived target-attribute relationship (Spruyt & De Houwer, 2017). In other words, if the participant believes the target-attribute pairing ‘BACON – ETHICAL’ is not true, however, the task cue ‘YES’ appears, it is expected that the incongruence between the participant’s own believe and the required key press will hinder the response and prolong response latency. The complete measure consisted of six practice trials followed by 240 experimental trials presented as one block with no notable difference between the practice and experimental trials. Practice trials consisted of six target-attribute pairings with each task cue appearing at least once. These trials were identical to the experimental trials with the exception that the inter-stimulus interval

between trials was always set to 1500ms. During the experimental trials each possible target (8) x attribute (10) x task cue (3) combination was presented once.

Upon concluding the IMPACT, participants were redirected to the second part of the study. All items were generated and displayed using Qualtrics Software, Version April 2020 (Qualtrics, Provo, UT).

Explicit ratings. Participants rated each target stimulus across the five attribute dimensions used in the IMPACT by indicating their agreement with statements such as '*I think TOFU is sustainable*' on a 7-point Likert scale (1 = Extremely disagree, 7 = Extremely agree).

Willingness to Pay. Participants were presented with two images advertising near-identical looking beef and vegetarian oven croquettes. Both images featured two prepared croquettes displayed on a wooden board. From the images alone, the croquettes could not be identified as vegetarian or meat products. The words '*Oven Croquette Beef*' or '*Vegetarian Oven Croquette*' were featured above the image to identify the product. These two croquettes were chosen due to their visual similarity, while allowing for the key differentiation to be the meat-versus plant-based nature of the product. The images were presented in randomised order together with near-identical descriptions highlighting whether it was a meat or vegetarian product. Based on the price sensitivity meter by Van Westendorp (1976) participants were then asked across four questions to indicate a price point at which they would consider the product (1) priced so low that they would not think it could be of high quality, (2) priced as a bargain, (3) priced expensively (4) priced too expensively for them to consider a purchase.

Diet. Participants indicated one of four options (vegan, vegetarian, flexitarian, meat eater) to describe their overall diet, as well as answering an item inquiring frequency of their meat consumption.

Likelihood of reducing meat consumption. If participants reported a meat-inclusive diet, they were asked to indicate the likelihood that they would reduce their meat consumption within the next week and within the next year. Reponses were indicated on a slider scale ranging from 0 to 100%.

Familiarity. As the meat and vegetarian targets differed in the degree to which they are staple foods in a typical Belgian diet (e.g., 'Chicken' versus 'Seitan'), participants were asked to indicate their familiarity with each target on a 7-point Likert scale (1 = Extremely unfamiliar, 7 = Extremely familiar).

Likelihood of Purchase. Participants once again encountered the product images of the oven croquettes in randomised order and responded to the question '*If you saw this product in the supermarket shelf, how high would the chance be that you buy it?*'. Responses were recorded on a slider scale ranging from 0 to 100%.

Importance. Participants were asked to indicate on a 7-point Likert scale (1 = Not at all important, 7 = Very important) how important a range of topics and product features are to them. These items included global warming and animal cruelty, as well as healthiness, price, and taste of food products. These data were collected for the purpose of exploratory analyses and are not further discussed here.

Demographics. Lastly, participants encountered a demographic questionnaire inquiring their gender, age, and occupational status, as well as their height and weight in order to calculate their BMI.

2.4. Data Preparation

The study used a correlational design including automatic and explicit appraisals as predictor variables, and likelihood of purchase, likelihood to reduce meat consumption, WTP, frequency of meat consumption, and BMI as criterion variables. Familiarity with the target stimuli, diet, and gender were included as co-variates. Analysis was conducted using R version 3.6.1 (R Core Team, 2019) in the RStudio environment version 1.2.5019 (RStudio Team, 2019) and IBM SPSS Statistic for Windows, Version 26.

IMPACT scores. The evaluative induction trials do not allow for measurement of automatic appraisals and were consequently excluded from analysis alongside the practice trials. In addition, trials with response latencies shorter than 300ms or longer than 5000ms were discarded. Lastly, data sets exceeding an error rate of 37.5% were omitted from analysis. Otherwise, facilitation scores were computed in line with the D4 IAT scoring algorithm described by Greenwald, Nosek, and Banaji (2003). For each participant, the D-scores were calculated for each combination of target category (meat/vegetarian) and the five attribute dimensions (health, sustainability, price, taste, and ethicality) from the trials pertaining only to the relevant target category. For example, to achieve a score for the health perceptions of meat items, the mean response latencies of 'healthy' meat-target trials (i.e., trials featuring the attribute 'healthy' and the cue 'YES', or the attribute 'unhealthy and the cue 'NO') were subtracted from the mean response latencies of 'unhealthy' meat-target trials (i.e., trials featuring the attribute 'unhealthy' and the cue 'YES', or the attribute 'healthy' and the cue

'NO') and divided by the standard deviation of latencies across all meat-target health trials. Following Greenwald, Nosek, and Banaji (2003), error trials were replaced with the mean response latency of correct responses plus a penalty of 600ms. Following this procedure, positive scores suggest the targets were perceived as healthier.

Corresponding D-scores were calculated in the same way for each combination of attribute dimension and target category. Thus, ten D-scores were calculated for each participant, indicating their appraisal of meat and vegetarian targets on each of the five dimensions. Positive scores indicated that the targets were perceived as healthier for the health dimension, more sustainable for the sustainability dimension, more expensive for the price dimension, tastier for the taste dimension, and more ethical for the ethicality dimension. These target-segregated scores were used to compare appraisals between the target categories. As the dimensions are relative, difference scores were calculated for any further analysis to reduce the number of variables entered in the statistical models. These scores were calculated by subtracting the vegetarian-target scores from the meat-target scores on each attribute dimension. This resulted in five automatic appraisal scores for health, sustainability, price, taste, and ethicality, whereby positive scores suggest a tendency towards the meat products on the corresponding attribute. For example, a positive health difference score would indicate that the participant perceived meat targets to be healthier than the vegetarian targets.

Explicit rating scores. For each participant, explicit rating scores were computed as the sum of meat-item ratings on each attribute dimension and as the sum of vegetarian-item ratings on each attribute dimension. For example, to achieve an explicit score for perceived healthiness of meat items, the healthiness ratings of all meat targets were summed. This resulted in ten scores whereby higher scores indicated that the targets were perceived as healthier for the health dimension, more sustainable for the sustainability dimension, more expensive for the price dimension, tastier for the taste dimension, and more ethical for the ethicality dimension. These target-segregated scores were used for comparison of appraisals between the target categories. Again, as the dimensions are relative, difference scores were computed for any further analysis in the same way as for the automatic appraisals. This resulted in five explicit appraisals of health, sustainability, price, taste, and ethicality. Again, positive scores suggest a tendency towards the meat products on the corresponding attribute.

Willingness to Pay. Overall WTP difference scores were computed by subtracting the sum of all price points for the vegetarian product from the sum of all price points for the meat product. Following this procedure, a positive score suggests higher WTP for the meat product.

Familiarity. Overall familiarity difference scores were computed by subtracting the sum of all familiarity ratings for vegetarian items from the sum of all familiarity ratings for meat items. Following this procedure, a higher score indicated higher familiarity with the meat items.

Likelihood of Purchase. In line with the predictor variables, difference scores for the likelihood of purchase of meat and vegetarian oven croquettes were computed as the likelihood to purchase the meat croquette minus the likelihood to purchase the vegetarian croquette. Following this procedure, positive scores indicate higher likelihood to buy the meat croquette.

BMI. BMI scores were computed following the standard formula weight (kg) divided by height (m) squared.

The variables diet, frequency of meat consumption, and likelihood of reducing meat consumption did not require further processing.

2.5. Analyses

Reliability. Cronbach's alphas for the explicit appraisals of vegetarian items were α_{Health} = .69, $\alpha_{Sustainability}$ = .83, α_{Price} = .69, α_{Taste} = .71, and $\alpha_{Ethicality}$ = .82. For the explicit appraisals of meat items, Cronbach's alphas were α_{Health} = .78, $\alpha_{Sustainability}$ = .88, α_{Price} = .63, α_{Taste} = .81, and $\alpha_{Ethicality}$ = .93. To estimate reliability of the IMPACT measure, procedures described by Heider, Spruyt, and De Houwer (2015), and Heider, Spruyt, and De Houwer (2018) were followed. For each participant, the dataset is split in half randomly. Next, a D-score is computed for each half and the two scores are correlated. This process is repeated a hundred times. Finally, the correlations are averaged to provide a measure of reliability. In contrast with the explicit measure, reliability scores were calculated for each attribute dimension collapsed across target category, as splitting the data across attribute dimensions and the target categories resulted in too few observations per half. This computation resulted in spearman-brown corrected mean split-half correlations of Rsb_{Health} = .20, $Rsb_{Sustainability}$ = .10, Rsb_{Price} = .16, Rsb_{Taste} = .26, and $Rsb_{Ethicality}$ = .24. These relatively low estimates of reliability will be addressed in the discussion.

Stimulus evaluations. To compare evaluations of meat and vegetarian target stimuli, a 2 (target category: meat vs vegetarian) X 5 (attribute dimension: health, sustainability, price, taste, ethicality) repeated measures ANOVA was performed for each the explicit and the automatic appraisals. Where necessary, a Greenhouse-Geisser correction was applied to correct for violations of sphericity. To compare differences between the attribute dimensions at the

automatic level we ran pairwise comparisons of the difference scores (meat targets-vegetarian targets). Finally, bivariate correlations of the automatic appraisals were used to assess whether the attribute dimensions were distinct constructs (hypothesis 1a).

Predictions of the outcome variables. Regression models were used to assess whether explicit ratings more strongly correlated with self-reported likelihood of purchase, self-reported likelihood to reduce meat consumption, and willingness to pay compared to automatic appraisals (hypothesis 2a), and whether automatic appraisals more strongly correlated with self-reported frequency of meat consumption and BMIas compared to explicit ratings (hypothesis 2b). Moreover, the results of these analyses were assessed to infer whether automatic appraisals informed behaviour to differing degrees (hypothesis 1b). An initial inspection of the data revealed that most explicit measures tended to correlate with most automatic measures. Accordingly, to handle multicollinearity, hierarchical forward stepwise regression models were fitted on each of the outcome variables. In Step 1 of the models, we controlled for diet (coded as a binary variable), target familiarity, and gender[1], as the role of gender in meat-eating behaviours is well acknowledged and familiarity ratings of meat (M = 24.96, SD = 4.20) and vegetarian targets (M = 13.84, SD = 5.88) significantly differed, $t(208) = 19.45$, $p < .001$. Explicit ratings were entered at Step 2, followed by automatic appraisals in Step 3. Where necessary, scores were transformed using square root transformations to correct for violations of the linearity assumption.

3.0. Results

3.1. Stimulus Evaluations.

In a first step to compare the appraisals of the meat and vegetarian targets, and assess whether appraisals of the individual attribute dimensions represent distinct constructs (hypothesis 1a), we assessed whether participants perceived the meat and vegetarian target stimuli to differ significantly. Both explicit and automatic appraisals of the stimuli varied as a function of target category and attribute dimension (Table 1). Vegetarian targets were perceived to be healthier, more sustainable, more expensive, and more ethical than meat targets. However, meat targets were rated as tastier than the vegetarian targets. A 2 (target category) x 5 (attribute dimension) ANOVA showed that for explicit ratings, the main effect of target category, $F(1, 208) = 192.61$, $p < .001$; $\eta p^2 = .48$, the main effect of attribute dimension, $F(3.03, 629.4) =$

[1] All analyses controlled for these three factors. However, since they were not directly related to the specified hypotheses, we do not report the results for diet, familiarity, or gender. In instances where these variables had significant effects, the other variables significantly improved the models.

72.11, $p < .001$; $\eta p^2 = .26$, and the interaction effect, $F(2.72, 565.5) = 290.74$, $p < .001$; $\eta p^2 = .58$, were all significant. Planned comparisons showed that, at the explicit level, participants perceived the meat stimuli to differ significantly from the vegetarian stimuli on all attribute dimensions (Table 1). A similar analysis of the automatic appraisals revealed a main effect of target category, $F(1, 207) = 7.41$, $p = .004$; $\eta p^2 = .04$, the main effect of attribute dimensions, $F(4, 749.76) = 10.01$, $p < .001$; $\eta p^2 = .05$, and the interaction effect, $F(4, 791.23) = 12.91$, $p < .001$; $\eta p^2 = .06$. Planned comparisons showed that, at the automatic level, participants perceived the meat stimuli to differ significantly from the vegetarian stimuli on all attribute dimensions except for price (Table 1).

Table 1. Mean, standard deviations, and t-test significance of meat and vegetarian target stimuli across the five assessed attribute dimensions.

	Target				
	Meat		Vegetarian		
Attribute	*Mean*	*SD*	*Mean*	*SD*	*P*
	Automatic Appraisals				
Health	0.06	0.83	0.25	0.52	.007
Sustainability	-0.09	0.89	0.20	0.80	<.001
Price	-0.07	0.78	0.06	0.84	.077
Taste	0.48	0.85	0.15	0.86	<.001
Ethicality	-0.09	0.77	0.22	0.71	<.001
	Explicit Appraisals				
Health	14.51	4.04	20.90	3.22	<.001
Sustainability	11.57	4.91	20.56	4.11	<.001
Price	14.79	3.55	18.11	3.74	<.001
Taste	22.45	4.88	16.55	4.46	<.001
Ethicality	12.05	5.57	21.22	3.81	<.001

To further assess hypothesis 1a and the relationship of the attribute dimensions, we ran bivariate correlations between the difference scores of automatic appraisals across the dimensions (see Table 2). The results showed significant relationships between the health and sustainability dimension, between the health and ethicality dimension, and between the ethicality and sustainability dimension. Although these correlations were significant, the shared variance was low, ranging from 2.6% for health and ethicality, over 3.6% for health and sustainability, to 7.3% for ethicality and sustainability. The price and taste dimensions did not significantly correlate with each other or any other dimensions. These results suggest that the dimensions were indeed distinct.

Table 2. Pearson correlations of automatic appraisals by dimension.

	Health	Sustainability	Price	Taste
Health	-			
Sustainability	.19**			
Price	-.04	-.03		
Taste	.09	.09	.13	
Ethicality	.16*	.27*	.02	.09

* Significant at the .05 level (2-tailed). ** Significant at the .01 level (2-tailed).

3.2. Predictions of the outcome variables.

To assess whether explicit ratings more strongly correlated with self-reported likelihood of purchase, self-reported likelihood to reduce meat consumption, and willingness to pay as compared to automatic appraisals (hypothesis 2a), and whether automatic appraisals more strongly correlated with self-reported frequency of meat consumption and BMI as compared to explicit ratings (hypothesis 2b) the below regression analyses were conducted as described in detail in section *2.5. Analyses*.

3.2.1. Self-reported Likelihood of Purchase.

Likelihood of purchase of the croquettes was positively and significantly predicted by explicit ratings of taste, $\beta = .42$, $sr = .26$, $p < .001$, and explicit ratings of ethicality, $\beta = .11$, $sr = .10$, $p < .001$. The model was statistically significant, $F(1, 202) = 44.22$, $p < .048$; $R^2 = .52$. The tastier and more ethical participants rated meat targets on the explicit scale, the more likely they were to buy the meat croquettes, as opposed to the vegetarian croquettes. This effect was mainly driven by the explicit taste ratings, $R^2\text{-}change = .08$. Explicit ethicality ratings explained only a small amount of variance $R^2\text{-}change = .01$. None of the automatic appraisals predicted likelihood of purchase.

3.2.2. Self-reported Likelihood of Reducing Meat Consumption.

As only meat eaters answered this question (n = 195), non-meat eaters (n = 14) were excluded from these analyses.

Within the next week. Explicit ratings of taste, $\beta = -.24$, $sr = -.19$, $p = .005$, and price, $\beta = .17$, $sr = .17$, $p = .011$, significantly predicted likelihood of reducing meat consumption within the next week, $F(1, 189) = 12.18$, $p < .001$, $R^2 = .21$. The less tasty and the more pricey participants considered meat at the explicit level, the more likely they were to reduce meat

consumption within the next week. None of the automatic appraisals predicted likelihood of reducing meat consumption within the next week.

Within the next year. Explicit ratings of health, β = -.23, *sr* = -.21, *p* = .001, and taste, β = -.24, *sr* = -.17, *p* = .006, and automatic appraisals of price, β = .14, *sr* = .13, *p* = .033, predicted likelihood of reducing meat consumption within the next year, $F(1, 188) = 14.35$, $p < .001$; $R^2 = .28$. The less healthy and tasty participants explicitly considered meat, the likelier they were to reduce meat consumption within the next year. Additionally, the more expensive meat was perceived to be at the automatic level, the higher was likelihood. Although significant, the added predictive value of the automatic appraisals was limited, R^2*-change* = .02.

3.2.3. Willingness to Pay.

Only explicit ethicality ratings, β = .26, *sr* = .26, $p < .001$, significantly predicted WTP, $F(1, 206) = 15.08$, $p < .001$; $R^2 = .07$. The more ethical participants rated meat to be, the more they were willing to pay for the meat product. None of the automatic appraisals predicted WTP.

3.2.4. Self-reported Frequency of Meat Consumption.

Again, non-meat eaters were excluded from this analysis. Explicit ratings of ethicality, β = .18, *sr* = .17, *p* = .003, price, β = -.14, *sr* = -.14, *p* = .019, and taste, β = .18, *sr* = .13, *p* = .020, significantly predicted frequency of meat consumption, $F(1, 189) = 29.15$, $p < .001$, $R^2 = .38$. The higher participants explicitly rated meat as ethical and tasty, the higher was their reported frequency of meat consumption. The more expensive participants explicitly rated meat, the lower the reported frequency of meat consumption. None of the automatic appraisals predicted self-reported frequency of meat consumption.

3.2.5. BMI.

Only automatic appraisals of the health dimensions, β = .20, *sr* = .19, *p* = .005, was a significant predictor of BMI, $F(1, 206) = 8.02$, $p = .005$, $R^2 = .04$. This suggests that the more participants perceived meat to be healthy at the automatic level, the higher was their BMI. None of the explicit ratings predicted BMI.

4.0. Discussion

In light of the adverse consequences associated with meat consumption, the necessity of moving towards more sustainable and meat-free diets is evident. Yet, even consumers that express awareness of the ethical, environmental, and health-related caveats of meat consumption often do not adhere to meat-free diets. Past research shows that automatic appraisals play a role in food behaviours (e.g., Prestwich et al., 2011; Spruyt et al., 2007). However, evidence concerning the exact role of automatic appraisals in meat-eating behaviours remains inconclusive. We suggest that one reason for this equivocal evidence might be the use of unidimensional approaches to measuring automatic appraisals. In line with hypothesis 1a, we found that automatic appraisals differed significantly across attribute dimensions and target categories. For instance, perceived taste of meat items was much higher than perceived ethicality of meat items, whereas we found the reversed pattern for vegetarian items. Although automatic appraisals of sustainability, health, and ethicality were significantly related, these findings seem unsurprising considering the close conceptual relatedness of these attributes. Indeed, it might be argued that health and ethicality are inextricably linked with the fundamental principles of sustainability. Importantly, despite the significance of the correlations, the constructs shared little variance with each other (2.6% - 7.3%). Moreover, automatic appraisals of price and taste did not significantly relate to any other dimension. These results suggest that the measured automatic appraisals did indeed represent distinct dimensions.

Moreover, in line with hypothesis 1b, the results demonstrate that individual automatic appraisals informed the outcome variables to varying degrees. If there was no conceptual difference between the appraisal dimensions, one would expect to see the appraisals of each attribute dimensions to inform the outcome homogenously. However, some attribute dimensions were predictive above and beyond others and differed between outcome variables. For example, automatic appraisals of health, but not the other dimensions predicted BMI, and although automatic health appraisals predicted BMI, they were not a significant predictor of any other outcome variable. In the same vein, although automatic appraisals of the health dimension were relevant to BMI, it was automatic appraisals of the price dimension that significantly added to the prediction of self-reported likelihood of reducing meat consumption within the next year.

The results in support of hypothesis 1a and 1b provide evidence for the notion that automatic stimulus evaluations should indeed be investigated as a composite of multiple individual appraisals, rather than an indistinct conflation thereof. Yet, in the existing literature of automatic appraisals, conclusions are predominantly drawn from exactly such conflated, generic evaluations. This approach, however, does not allow to identify unique contributions of the individual appraisals. It is therefore impossible to conclusively infer to what degree the knowledge about the relationship between automatic appraisals and behaviours obtained by these studies is indeed accurate. Moreover, the findings align with research by Trendel and Werle (2016), who found that automatic health and taste appraisals were distinct constructs, and that these constructs informed choice between two products to varying degrees. In their study, automatic appraisals of taste but not health predicted the choice between apples and chocolate. More specifically, Trendel and Werle distinguish between automatic hedonic ('affective') and automatic utilitarian ('cognitive') reactions to food items whereby taste was defined as a hedonic appraisal, and health was defined as a utilitarian appraisal. They further examined the role of cognitive resources and trait impulsivity, and concluded that affective appraisals (e.g., taste) are the main driver of food choice if cognitive resources are limited, especially in consumers high in impulsivity. These findings provide a useful heuristic for predicting choice between two items that clearly differ in terms of their hedonic properties. The question arises, however, what appraisals may drive choice if a product is high on more than one hedonic quality, or when predicting product choice between two items of the same product category that do not differ on their hedonic qualities. Our results demonstrate that these are indeed questions worth asking, as we find distinct differences between individual automatic appraisals that surpass a distinction between utilitarian and hedonic appraisals.

Secondly, we found that explicit appraisals informed self-reported likelihood of purchase, self-reported likelihood of reducing meat consumption, and WTP. Although automatic price appraisals significantly improved predictions of self-reported likelihood of reducing meat consumption within the next year, incremental validity was low. These findings are in line with hypothesis 2a which postulates that explicit appraisals would correlate more strongly with these outcome variables compared to automatic appraisals, since estimating the likelihood of engaging in future behaviour requires careful contemplation and reflective processing. In contrast, we expected that automatic appraisals would more strongly correlate with self-reported frequency of meat consumption as well as BMI compared to explicit appraisals (hypothesis 2b), as automatic processes have been shown to inform behaviours that

are commonly guided by impulses, such as dietary choices (Friese, Hofmann & Wänke, 2008). The findings concerning hypothesis 2b, however, were mixed. Explicit appraisals but not automatic appraisals informed self-reported frequency of meat consumption. This finding is inconsistent with hypothesis 2b, which theorised that automatic appraisals would more strongly correlate with self-reported frequency of meat consumption, rather than explicit evaluations. In support, however, automatic appraisals but not explicit appraisals were a significant predictor of BMI. One possible explanation for this discrepancy lies within the operationalisation of behaviour. Frequency of meat consumption was measured based on retrospective self-reports. Such self-reports of consumption, however, have shown prone to recall-error (Seitzinger, Tataryn, Osgood, & Waldner, 2019) and might not have accurately reflected actual behaviour. On the other hand, research has consistently shown positive associations between meat consumption and BMI (e.g., Dabbagh-Moghadam et al., 2017; Grosso et al., 2017; Vergnaud et al., 2010; Wang & Beydoun, 2009; You & Henneberg, 2016). Due to this strong association of meat consumption with BMI and obesity, the BMI can provide an indirect approximation of meat consumption. These findings highlight that further work is needed to identify the specific types of outcome where utilising the IMPACT can provide true added value to understanding and predicting behaviour.

Although conclusions should be drawn with caution, the relationship between automatic appraisals and BMI provides some support for the role of automatic over explicit appraisals in the prediction of behaviours commonly guided by impulses (e.g., dietary choices; Friese, Hofmann & Wänke, 2008). Further studies may take into account and improve upon the limitations proposed by the operationalisation of the behaviour measures in the present study to further explore this effect. Specifically, the aim should be to define the behavioural measures purely in terms of objectively observable behaviours to avoid potential confounding effects, such as bias-effects in self-report measures. Importantly, however, the overall pattern of the results suggests that the appraisals recorded with the automatic and explicit measures differed. In the same vein as we argued for hypothesis 1b, automatic and explicit appraisals should be expected to inform all outcomes homogeneously if there were no differences between the measures. That is not the case here, as the appraisals recorded with the explicit and automatic measure varied in their predictive validity of the outcome variables.

The conclusions drawn from the present research have to be considered within the limitations of its methodology. Although we demonstrate that automatic stimulus appraisals consist of various distinct attribute evaluations with varying influence, no generalised appraisal

such as ‘positive’ or ‘negative’ towards meat and vegetarian products was tested. Consequently, although this research demonstrates potential benefits of a multiple-attribute approach to automatic appraisals, more research is required to quantify this added value. Future investigations measuring both, an overall affective appraisal (e.g., ‘positive/negative’) and attribute specific appraisals (i.e., different stimulus features) at the automatic level have the potential to provide some insights[2]. Direct comparisons of the relationships between generic automatic stimulus appraisals and behaviour, and attribute-specific automatic stimulus appraisals and behaviour further have the potential to establish whether or not conclusions drawn from generic affective appraisals are reliable or must be reconsidered. Additionally, while we theoretically established the need for the IMPACT in this study, we have not yet carried out a formal comparison of the IMPACT and other established automatic measures. In the context of the current study such a comparison would have been logistically implausible, as it would require participants to complete five IATs in a row, complemented with an IMPACT. Such a set up would not only be extremely difficult to counterbalance in order to address carry-over effects, but would also promote fatigue and boredom in the respondents. A comparison between a one-dimensional IMPACT and other measures would be informative nonetheless and can be done in the future. Additionally, while a comparison between measures is of course fundamental to ascertain whether one method comparably outperforms the other, the aim of our research is not to establish methodological superiority of our measure but to demonstrate the importance of assessing automatic product appraisals at the attribute level.

Secondly, while the oven croquettes as outcome stimuli allowed for careful matching of the meat and vegetarian products on visual similarity, they may not allow generalisation of the conclusions we can draw about factors that underpin decisions regarding all meat and vegetarian products. Establishing whether our findings as to what best predicts willingness to pay and the (self-reported) likelihood of purchasing plant- or meat-based products do indeed generalise to other products requires further work. It is worth noting, however, that we do not see the purpose of this study in establishing absolute claims about the prediction of these outcome variables, but in demonstrating that automatic appraisals of meat and vegetarian products on different dimensions can be simultaneously assessed, that these dimensions can be

[2] Although it would have been possible in the present study to compute an overall attitude from the individually measured appraisals to use for such a comparison, we decided against this approach as a composite score of the selected attribute appraisals cannot take into account the influence of appraisals towards stimulus features that were not measured, and is therefore not equivalent to a measure of a generic attitude.

measured as distinct constructs, and that appraisals on these different dimensions relate to the outcome variables to varying degrees.

Lastly, it is important to note that the internal consistency of the IMPACT was quite low. Despite extensive pretesting (Spruyt & Altenburg, 2019) and despite the fact that the underlying principles of the IMPACT were firmly established in prior studies (Spruyt & De Houwer, 2017; Wiswede et al., 2013), internal consistency estimates ranged between .16 for the price dimension and .26 for the taste dimension. While most implicit measures suffer from this limitation (e.g., Bosson, Swann & Pennebaker, 2000; Teige, Schnabel, Banse & Asendorpf, 2004; Gawronski & De Houwer, 2014; Meissner et al., 2019), it is clearly necessary to look for ways to improve the reliability of the IMPACT. An obvious way to achieve this goal would be to increase the number of observations for each combination of a target and an attribute dimension (now limited to just 16 trials). Irrespectively, the observation that the IMPACT scores were (a) mutually related in a meaningful manner and (b) related to the BMI over and above explicit measures, clearly shows the validity and added value of the IMPACT.

Obtaining a nuanced understanding of the automatic appraisals associated with behaviour can crucially contribute to the understanding and improvement of existing behavioural models. Such understanding is not only relevant to theory, but also has important practical implications for marketers of sustainable products, such as meat substitutes. In this research, we demonstrate the relevance for research of automatic product appraisals to investigate stimuli as the sum of its unique attribute appraisals and provide a promising tool for doing so.

Conflicts of interest.

There is no conflict of interest for any of the authors.

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Author Contributions.

Daria Altenburg and Adriaan Spruyt contributed to the design of the study and undertook the statistical analyses. Daria Altenburg managed the literature searches and wrote the first draft of the manuscript. All authors contributed to and have approved the final manuscript.

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